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

www.exeloncorp.com

SVP-19-091

December 20, 2019

Regional Administrator, Region III
U. S. Nuclear Regulatory Commission
2443 Warrenville Road, Suite 210
Lisle, IL 60532-4352

Quad Cities Nuclear Power Station, Units 1 and 2
Renewed Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: National Pollutant Discharge Elimination System (NPDES) Permit No. IL0005037
Application to Renew

Pursuant to Appendix B, Section 2.2 (Reporting Related to the NPDES Permits and State Certifications) of the Renewed Facility Operating Licenses for Quad Cities Nuclear Power Station, enclosed is the current NPDES Permit renewal request for the Station. The Permit renewal was recently requested from the Illinois Environmental Protection Agency, with a transmittal date of December 12, 2019.

Should you have any questions concerning this letter, please contact Rachel Luebbe at (309) 227-2813.

Respectfully,

Kenneth S. Ohr
Site Vice President
Quad Cities Nuclear Power Station

Enclosure: Application to Renew NPDES Permit No. IL0005037

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station

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

www.exeloncorp.com

SVP-19-087

December 12, 2019

Certified Mail

Darin LeCrone
Manager, Industrial Unit, Permit Section
Division of Water Pollution Control
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

Subject: Quad Cities Nuclear Generating Station Application to Renew NPDES Permit No. IL0005037

In accordance with the requirements of Title 35 of the Illinois Administrative Code, Subtitle C, Chapter I - Pollution Control Board, Section 309.104 and the requirements of 40 CFR 122.21, Exelon Generation Company, LLC, Quad Cities Generating Station ("Quad Cities Station" or the "Station") hereby submits two copies of Consolidated Permit Application Forms 1, 2C, and 2F with associated attachments for the renewal of Quad Cities Station NPDES Permit No. IL0005037.

Pursuant to Quad Cities Station's NPDES permit renewal application for its current NPDES permit, submitted December 9, 2014, Quad Cities Station requested, and IEPA granted a waiver from sampling for several Form 2C, Table-A pollutants. The Station is requesting that IEPA issue a similar waiver for its renewed permit. The waiver requests are included with Form 2C, attached to this letter. Additionally, this renewal application does not provide pollutants categorized as GC/MS Fraction Compounds for any outfalls, as requested by Quad Cities Station in a correspondence to the IEPA on October 8, 2019.

Pollutant levels for all permit-required parameters were derived from Station data reported on Discharge Monitoring Reports (DMRs) submitted for the January 2018 through December 2018 time period. In most cases, one analysis was conducted for all other pollutant parameters identified on Form 2C. Long-term flow averages requested on Form 2C, Table-A were derived by averaging the monthly flow averages reported on the DMRs for each outfall. Mass load values were derived using long-term average flows. Discharges from Outfall A02 (Radwaste Treatment System Blowdown) have been infrequent since 2015 with two discharges in 2015, zero discharges in 2016 and 2017, twelve discharges in 2018 (May, June, and July) and no discharges to date in 2019.

As per NPDES permit IL0005037 Special Condition 7.D., Quad Cities Station is submitting a study of white crappie, black crappie, and sauger populations in Pool 14 of the Mississippi River as Attachment 6. Copies of the study were submitted to Illinois DNR and Iowa DNR on December 11, 2019 under separate cover letters.

Per Special Condition 7.E. "*the permittee must assess the impact on aquatic life when the Station uses more than 219 excursion hours in any twelve-month period. The permittee must conduct this study the first time that more than 219 excursion hours are used in a twelve-month period. The results of this study must be made available to Illinois EPA, Illinois DNR, and Iowa DNR when the permittee applies for renewal of its NPDES permit*". Quad Cities Station has not exceeded the 219 hours in any twelve-month period since the new permit was issued in 2015. Quad Cities Station has used a total of 39.25 total excursion hours since the permit went into effect on July 20, 2015. Accordingly, a Special Condition 7.E. study is not included with this renewal application.

Per Special Condition 18.A. any applicable material and submissions required to demonstrate compliance with the Section 316(b) Cooling Water Intake Structure Existing Facilities Rule shall be submitted no later than 4 years from the effective date of July 20, 2015. The required 316(b) reports were submitted to the IEPA on June 17, 2019.

As per Special Condition 21, Quad Cities Station is requesting a continuation of the 316(a) alternative limits granted by the IPCB on September 18, 2014 PCB 14-123 (Thermal Demonstration) and included in existing NPDES Permit IL0005037 issued July 20, 2015. The supporting documentation for continuation of the 316(a) alternative limits are included as Attachment 7.

With regard to stormwater requirements and Form 2F, stormwater from impervious surfaces (parking lots, concrete surfaces, rocked ditches, roof drains) is routed to either the Unit-1 or Unit-2 Oil/Water Separators. Runoff from parking lots and ditches on north side of station are routed to storm sewer and into Unit-2 Oil/Water Separator. Runoff from parking lots and ditches on south side of station are routed to storm sewer and into Unit-1 Oil/Water Separator. Unit-1 and Unit-2 Oil/Water Separators discharge through Outfall 001/002 Open Cycle Diffusers. Per Special Condition 15., 'the effluent limitations in this permit constitute BAT/BCT for stormwater which is treated in the existing treatment facilities". Analytical data supplied on Form 2F Tables A, B, & C were obtained from Outfall 001/002 and copied over from Form 2C.

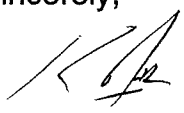
Finally, Attachment 1 to this letter sets forth changes to the Station's current NPDES Permit that the Station is proposing for the renewed application.

Included with application Forms 1, 2C, and 2F are several Attachments as follows:

- Attachment 1, Requested Permit Changes. The requests are bulleted under each outfall number for clarity.
- Attachment 2, Area Topographic Map and Site Area Map as requested in Form 1, Section 7.
- Attachment 3, Schematic of Water Flow NPDES IL0005037 as requested in Form 2C Section 2.
- Attachment 4, Quad Cities Generating Station Site Drainage Map as requested in Form 2F Section 3.
- Attachment 5, Copy of a correspondence to your office dated October 8, 2019 requesting the waiver of GC/MS Fraction Compounds.
- Attachment 6, Analysis of Crappie and Sauger Populations in Pool 14.
- Attachment 7, Continuation of 316(a) Alternative Thermal Limits and Supporting Documentation.
- Attachment 8, Listing of Water Treatment Additives that have the potential of being discharged by way of the various outfalls with associated Safety Data Sheets (SDSs)

Please contact Mark Stuhlman at (309) 227-2765 if you have any questions regarding this application.

Sincerely,



Kenneth Ohr
Site Vice President
Quad Cities Generating Station

Forms and Attachments:
EPA Form 1
EPA Form 2C
EPA Form 2F
Attachment 1: Requested Permit Changes
Attachment 2: Area Topographic Map and Site Area Map
Attachment 3: Schematic of Water Flow NPDES IL0005037
Attachment 4: Quad Cities Generating Station Site Drainage Map
Attachment 5: Copy of Letter Requesting Waiver
Attachment 6: Analysis of Crappie and Sauger Populations in Pool 14
Attachment 7: Continuation of 316(a) Alternative Thermal Limits and Supporting Documentation
Attachment 8: List of Water Treatment Additives and SDS Sheets

KO/MS

CC: Mark Stuhlman
Letterbook
Mark Liska, IEPA Permitting

Exelon Generation

EXELON GENERATION COMPANY, LLC
EVIDENCE OF AUTHORITY TO SIGN ENVIRONMENTAL PERMITS AND OTHER ENVIRONMENTAL RELATED DOCUMENTS

The undersigned certifies that he has been appointed an officer of the Exelon Generation Company, LLC and is authorized to act as a corporate representative for the purposes of signing and/or authorizing others to act as corporate representatives for the purpose of signing environmental permit applications, permit required reports, and other representations regarding environmental requirements, including but not limited to those made to Pollution Control Boards, the Illinois Environmental Protection Agency, the Maryland Department of the Environment, the New York Department of Environmental Conservation, the Pennsylvania Department of Environmental Protection, the United States Army Corps of Engineers, and the United States Environmental Protection Agency. Based on the authority vested in me as an Exelon Generation Company, LLC Officer, I hereby authorize and appoint the individuals, listed on Attachment #1, to act as corporate representative for the purpose of signing environmental permit applications, permit required reports, and other representations regarding environmental requirements, including but not limited to those made to the above listed agencies:

Signed: _____ Date: 11/10/19

Bryan C. Hanson
Senior Vice President Exelon Generation
Chief Nuclear Officer Exelon Nuclear

CC: Exelon Corporate Secretary
Exelon Generation Company Secretary

Exelon Generation

ATTACHMENT #1
Exelon Generation Company, LLC
Authorized Signatory List

Location	Authorized Individuals	Title
Exelon Generation	George Gellrich	Vice President, Fleet Support
	Zigmund Karpa	Director, Environmental Programs
	Scott Sklenar	Manager, Environmental Programs
	Roland Beem	Manager, Environmental Programs
Braidwood Station	Marri Marchionda-Palmer	Site Vice President
	John Keenan	Plant Manager
Byron Station	Mark Kanavos	Site Vice President
	Harris Welt	Plant Manager
Calvert Cliffs	Mark Flaherty	Site Vice President
	Thomas Haaf	Plant Manager
Clinton Power Station	Thomas Chalmers	Site Vice President
	John Kowalski	Plant Manager
Dresden Station	Peter Karaba, Jr.	Site Vice President
	Jeffery Stovall	Plant Manager
Fire Training Academy	Kostas Dovas	Vice President Training
Fitzpatrick Station	Joseph Pacher	Site Vice President
	Timothy Peter	Plant Manager
Ginna Station	Paul Swift	Site Vice President
	James (Daren) Blankenship	Plant Manager
LaSalle Station	John Washko	Site Vice President
	Phillip Hansett	Plant Manager
Limerick Generating Station	Frank Sturniolo	Site Vice President
	Martin Bonifanti	Plant Manager
Nine Mile Point Station	Peter Orphanos	Site Vice President
	Todd Tierney	Plant Manager
Peach Bottom APS	Patrick Navin	Site Vice President
	Matthew Herr	Plant Manager
Quad Cities Station	Kenneth S. Ohr	Site Vice President
	Patrick Boyle	Plant Manager
Three Mile Island	Trevor Orth	Site Decommissioning Director
Zion Station	Anthony Orawiec	Decommissioning Plant Manager

October 23, 2019

Attachment 1
Requested Permit Changes
Page 1 of 1

Requested Modifications/Corrections:

Exelon requests the following modifications to the renewed NPDES permit for Quad Cities Station.

(1) <u>Request deletion of Outfall 003 Sanitary Waste Treatment Plant.</u>

a. As approved by IEPA with issuance of Construction/Operating permit 2015-IA-59877 on June 15, 2015, Quad Cities Station constructed a sanitary sewer connection tributary to the Village of Cordova STP. Construction of the sewer extension was completed in the Spring of 2016. The Station began sending sanitary waste to Village of Cordova in June 2016. Quad Cities Station onsite Sewage Treatment Plant was shutdown June of 2016 and is no longer in operation.
b. Delete associated Special Condition 13 - *The maximum daily fecal coliform count shall not exceed 400 per 100 ml.*

(2) <u>Request that Oil and Grease be eliminated from the monitoring requirements for Outfall A02—Radwaste Treatment System Blowdown</u>.

a. Approximately 95% of the water discharged from the radwaste treatment system is processed water that has failed limits for reuse in high quality water systems. This processed water has been filtered to remove solids, then sent through resin to reduce amount of the radioactivity. The remainder of the water is from the laundry sample tank that consists primarily of water from washing masks and personal clothing that has become radioactively contaminated which has been filtered to remove solids. As previously noted, discharge from Outfall A02 occurs very infrequently (twenty-one discharges over last 10 years). Quad Cities Station Outfall A02 has had one Oil and Grease measurement >LLD of 1.4 ppm over past 10 years. The one analysis >LLD was 3.0 ppm in May of 2018.
b. Analysis of Oil and grease using the N-Hexane Method 1664A on radioactive contaminated samples has the potential to create a mixed waste (hazardous waste which is radioactive). Elimination of requirement to perform oil and grease on radwaste blowdown will eliminate the potential to create a mixed waste during analysis.

   Based on the history of compliance, Quad Cities Station requests that the oil and grease sampling/analysis requirement is removed.

(3) We request that the Agency review Quad Cities excellent compliance record and follow through with any other appropriate monitoring parameter and/or frequency reductions as deemed appropriate

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110041007111	IL0005037	Quad Cities Generating Station	

Form 1 NPDES

U.S. Environmental Protection Agency
Application for NPDES Permit to Discharge Wastewater

GENERAL INFORMATION

SECTION 1. ACTIVITIES REQUIRING AN NPDES PERMIT (40 CFR 122.21(f) and (f)(1))

Activities Requiring an NPDES Permit

1.1 Applicants *Not Required* to Submit Form 1

1.1.1	Is the facility a new or existing **publicly owned treatment works?** If yes, STOP. Do NOT complete Form 1. Complete Form 2A. ☑ No	1.1.2	Is the facility a new or existing **treatment works treating domestic sewage?** If yes, STOP. Do NOT complete Form 1. Complete Form 2S. ☑ No

1.2 Applicants *Required* to Submit Form 1

1.2.1	Is the facility a **concentrated animal feeding operation** or a **concentrated aquatic animal production facility?** ☐ Yes → Complete Form 1 ***and*** Form 2B. ☑ No	1.2.2	Is the facility an **existing** manufacturing, commercial, mining, or silvicultural **facility** that **is currently discharging process wastewater?** ☑ Yes → Complete Form 1 ***and*** Form 2C. ☐ No
1.2.3	Is the facility a **new** manufacturing, commercial, mining, or silvicultural **facility** that has **not yet commenced to discharge?** ☐ Yes → Complete Form 1 ***and*** Form 2D. ☑ No	1.2.4	Is the facility a **new or existing** manufacturing, commercial, mining, or silvicultural **facility** that **discharges only nonprocess wastewater?** ☐ Yes → Complete Form 1 ***and*** Form 2E. ☑ No
1.2.5	Is the facility a **new or existing facility** whose discharge is composed entirely of **stormwater associated with industrial activity** or whose discharge is composed of **both stormwater and non-stormwater?** ☑ Yes → Complete Form 1 ***and*** Form 2F unless exempted by 40 CFR 122.26(b)(14)(x) or (b)(15). ☐ No		

SECTION 2. NAME, MAILING ADDRESS, AND LOCATION (40 CFR 122.21(f)(2))

Name, Mailing Address, and Location

2.1 Facility Name

Quad Cities Generating Station

2.2 EPA Identification Number

110041007111

2.3 Facility Contact

Name (first and last)	Title	Phone number
Mark Stuhlman	Principle Environmental Specialist	(309) 227-2765

Email address
mark.stuhlman@exeloncorp.com

2.4 Facility Mailing Address

Street or P.O. box
22710 206th Avenue North

City or town	State	ZIP code
Cordova	Illinois	61242

Name, Mailing Address, and Location Continued

2.5 **Facility Location**

Street, route number, or other specific identifier
22710 206th Avenue North

County name	County code (if known)	
Rock Island		
City or town	**State**	**ZIP code**
Cordova	Illinois	61242

SECTION 3. SIC AND NAICS CODES (40 CFR 122.21(f)(3))

SIC and NAICS Codes

3.1

SIC Code(s)	Description (optional)
4911	Electric Power Generation by Nuclear Fuels

3.2

NAICS Code(s)	Description (optional)
221113	Nuclear Electric Power Generation

SECTION 4. OPERATOR INFORMATION (40 CFR 122.21(f)(4))

Operator Information

4.1 **Name of Operator**

Exelon Generation Company, LLC

4.2 Is the name you listed in Item 4.1 also the owner?

☑ Yes ☐ No

4.3 **Operator Status**

☐ Public—federal ☐ Public—state ☐ Other public (specify)_____
☑ Private ☐ Other (specify) _____

4.4 **Phone Number of Operator**

(309) 227-3600

Operator Information Continued

4.5 **Operator Address**

Street or P.O. Box
4300 Winfield Road

City or town	State	ZIP code
Warrenville	Illinois	60555

Email address of operator
kenneth.ohr@exeloncorp.com

SECTION 5. INDIAN LAND (40 CFR 122.21(f)(5))

Indian Land

5.1 Is the facility located on Indian Land?

☐ Yes ☑ No

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110041007111	IL0005037	Quad Cities Generating Station	

SECTION 6. EXISTING ENVIRONMENTAL PERMITS (40 CFR 122.21(f)(6))

Existing Environmental Permits

6.1 **Existing Environmental Permits** (check all that apply and print or type the corresponding permit number for each)

☑ NPDES (discharges to surface water) IL0005037	☑ RCRA (hazardous wastes) ILD060862810	☐ UIC (underground injection of fluids)
☐ PSD (air emissions)	☐ Nonattainment program (CAA)	☐ NESHAPs (CAA)
☐ Ocean dumping (MPRSA)	☑ Dredge or fill (CWA Section 404) CEMVR-OD-P-2016-1115	☑ Other (specify) FESOP - IL000161807AAB

SECTION 7. MAP (40 CFR 122.21(f)(7))

Map

7.1 Have you attached a topographic map containing all required information to this application? (See instructions for specific requirements.)

☑ Yes ☐ No ☐ CAFO—Not Applicable (See requirements in Form 2B.)

SECTION 8. NATURE OF BUSINESS (40 CFR 122.21(f)(8))

Nature of Business

8.1 Describe the nature of your business.

Generation of Electric Power by Nuclear Fuels

SECTION 9. COOLING WATER INTAKE STRUCTURES (40 CFR 122.21(f)(9))

Cooling Water Intake Structures

9.1 Does your facility use cooling water?

☑ Yes ☐ No → SKIP to Item 10.1.

9.2 Identify the source of cooling water. (Note that facilities that use a cooling water intake structure as described at 40 CFR 125, Subparts I and J may have additional application requirements at 40 CFR 122.21(r). Consult with your NPDES permitting authority to determine what specific information needs to be submitted and when.)

Mississippi River

SECTION 10. VARIANCE REQUESTS (40 CFR 122.21(f)(10))

Variance Requests

10.1 Do you intend to request or renew one or more of the variances authorized at 40 CFR 122.21(m)? (Check all that apply. Consult with your NPDES permitting authority to determine what information needs to be submitted and when.)

- ☐ Fundamentally different factors (CWA Section 301(n))
- ☐ Non-conventional pollutants (CWA Section 301(c) and (g))
- ☐ Not applicable
- ☐ Water quality related effluent limitations (CWA Section 302(b)(2))
- ☑ Thermal discharges (CWA Section 316(a))

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110041007111	IL0005037	Quad Cities Generating Station	

SECTION 11. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(a) and (d))

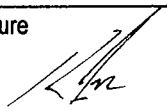
Checklist and Certification Statement

11.1 In Column 1 below, mark the sections of Form 1 that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing to alert the permitting authority. Note that not all applicants are required to provide attachments.

Column 1	Column 2
☑ Section 1: Activities Requiring an NPDES Permit	☐ w/ attachments
☑ Section 2: Name, Mailing Address, and Location	☐ w/ attachments
☑ Section 3: SIC Codes	☐ w/ attachments
☑ Section 4: Operator Information	☐ w/ attachments
☐ Section 5: Indian Land	☐ w/ attachments
☑ Section 6: Existing Environmental Permits	☑ w/ attachments
☑ Section 7: Map	☑ w/ topographic map ☐ w/ additional attachments
☑ Section 8: Nature of Business	☐ w/ attachments
☑ Section 9: Cooling Water Intake Structures	☐ w/ attachments
☑ Section 10: Variance Requests	☑ w/ attachments
☑ Section 11: Checklist and Certification Statement	☑ w/ attachments

11.2 **Certification Statement**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name (print or type first and last name)	Official title
Kenneth Ohr	Site Vice President
Signature	**Date signed**
	12-12-19

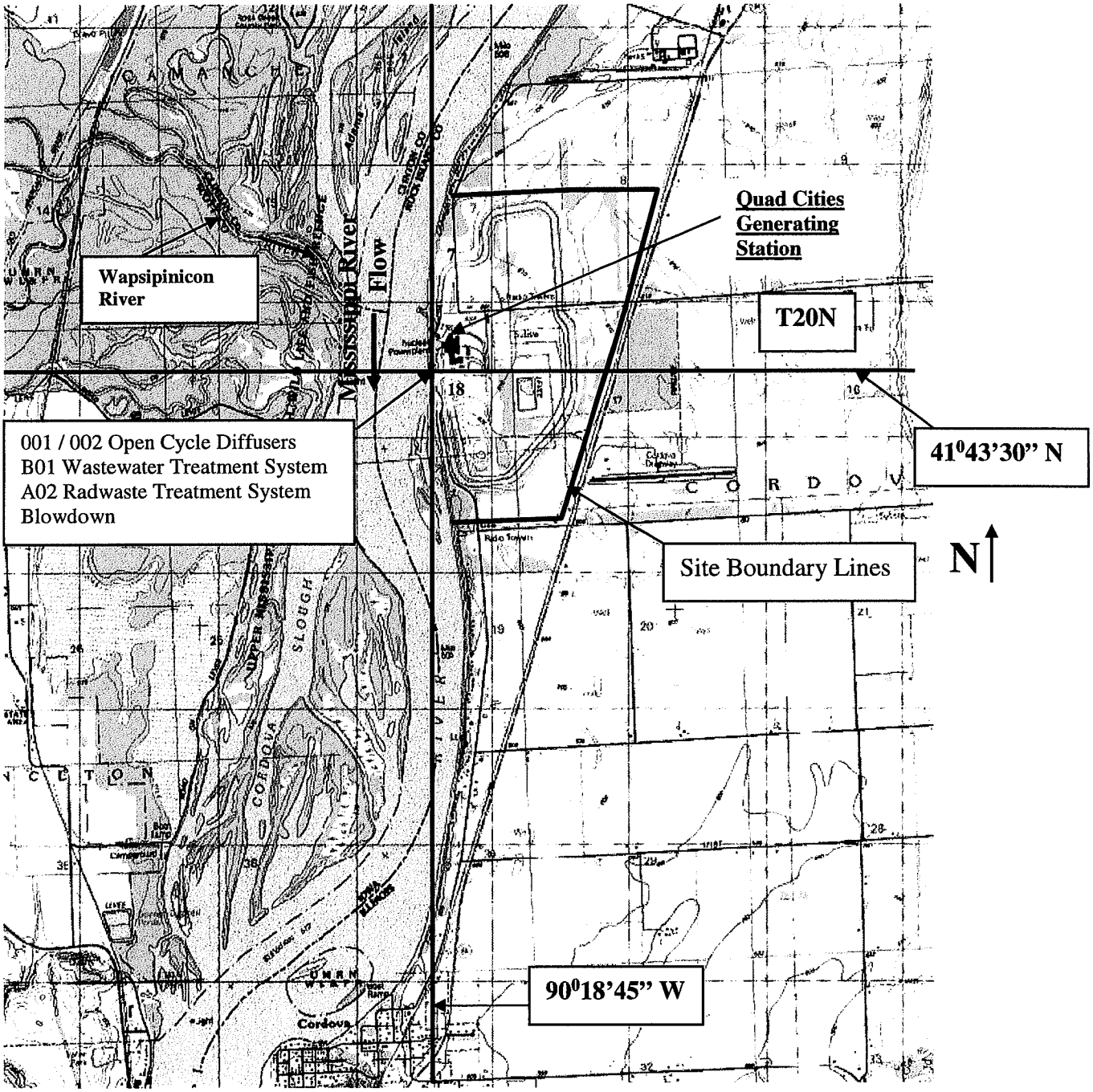
X. EXISTING ENVIRONMENTAL PERMITS cont.

A. NPDES *(Discharges to Surface Water)*

ILG870021	General NPDES Permit for Pesticide Application Point Source

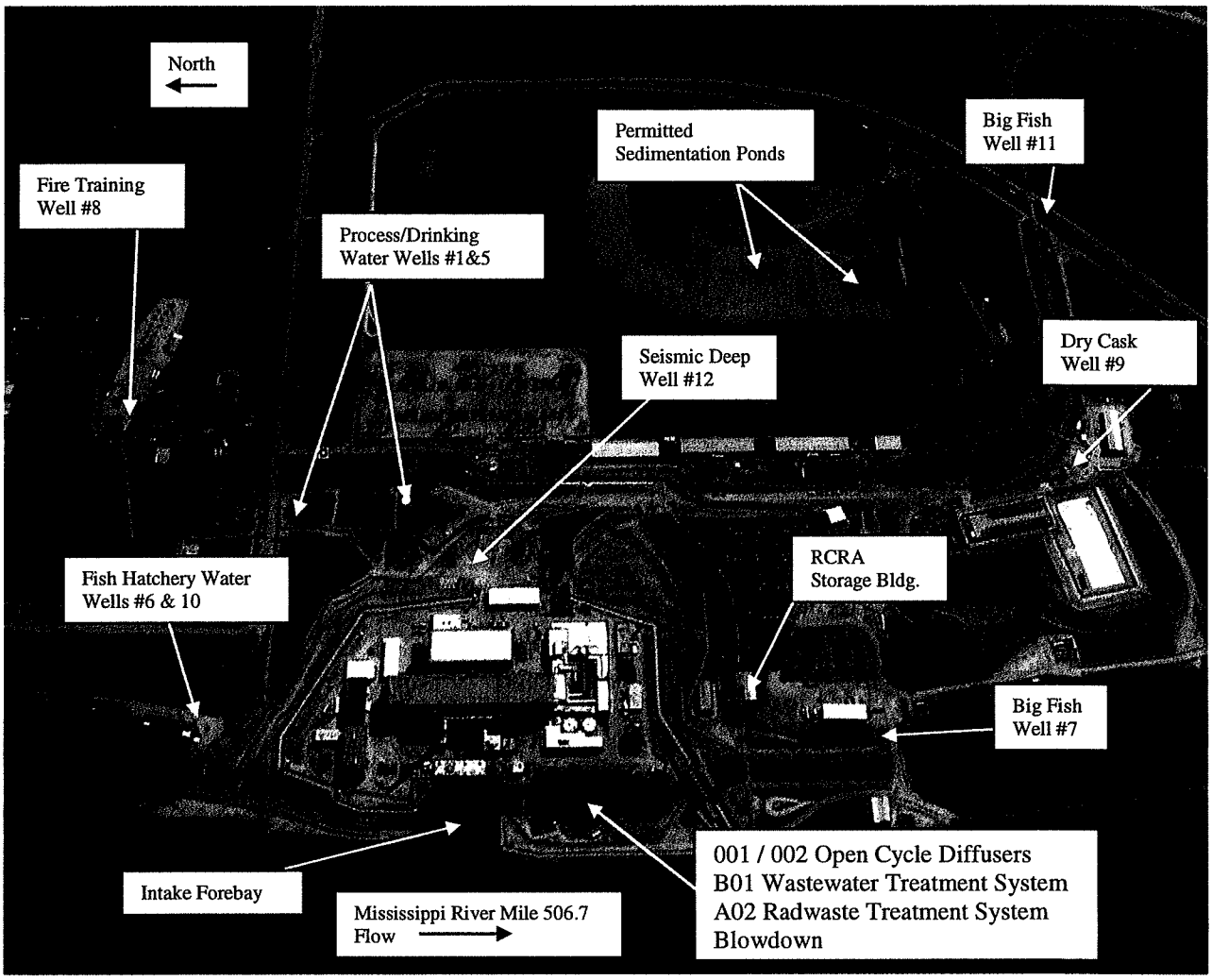
E. Other *(Specify)*

CEMVR-OD-P-2016-1115	U.S. Army Corps of Engineers Rock Island District Maintenance Dredging Permit
2016-EA-61407	Quad Cities Dredge Material Disposal Basin
TE17852A-0	USEPA Incidental Take Authorization



Topographic Map
USGS Map
41° 43' 30"N, 90° 18' 45"W (WGS84/NAD83)
Cordova quadrangle
Projection is UTM Zone 15 NAD83 Datum
1:24K / 25K Series
1:100,000 Scale

Location:
Exelon Generation Co, LLC
Quad Cities Generating Station
Cordova, Illinois 61242
Permit No. IL0005037



Site Area Map

Location:
Exelon Generation Co, LLC
Quad Cities Generating Station
Cordova, Illinois 61242
Permit No. IL0005037

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110041007111	IL0005037	Quad Cities Generating Station	

Form 2C NPDES

EPA

U.S. Environmental Protection Agency
Application for NPDES Permit to Discharge Wastewater

EXISTING MANUFACTURING, COMMERCIAL, MINING, AND SILVICULTURE OPERATIONS

SECTION 1. OUTFALL LOCATION (40 CFR 122.21(g)(1))

Outfall Location

1.1 Provide information on each of the facility's outfalls in the table below.

Outfall Number	Receiving Water Name	Latitude	Longitude
001/002	Mississippi River	41° 43′ 30.40″ N	90° 18′ 45.40″ W
B01	Mississippi River	41° 43′ 30.40″ N	90° 18′ 45.40″ W
A02	Mississippi River	41° 43′ 30.40″ N	90° 18′ 45.40″ W

SECTION 2. LINE DRAWING (40 CFR 122.21(g)(2))

Line Drawing

2.1 Have you attached a line drawing to this application that shows the water flow through your facility with a water balance? (See instructions for drawing requirements. See Exhibit 2C–1 at end of instructions for example.)

☑ Yes ☐ No

SECTION 3. AVERAGE FLOWS AND TREATMENT (40 CFR 122.21(g)(3))

Average Flows and Treatment

3.1 For each outfall identified under Item 1.1, provide average flow and treatment information. Add additional sheets if necessary.

****Outfall Number**** 001/002

Operations Contributing to Flow

Operation	Average Flow
001/002 Open Cycle Diffusers (Total Flow)	1067.4 mgd
Continued On Attached	mgd
	mgd
	mgd

Treatment Units

Description (include size, flow rate through each treatment unit, retention time, etc.)	Code from Table 2C-1	Final Disposal of Solid or Liquid Wastes Other Than by Discharge
Main Condenser Cooling Water, 706,000 gpm (avg), 15 min	4-A, 2-E	
U-1 and U-2 Oil Water Separators (30,000 gal each), 3 hrs	1-H, 1-U, 5-H	Landfill (radioactive burial)

Average Flows and Treatment Continued

3.1 cont.

****Outfall Number**** B01

Operations Contributing to Flow

Operation	Average Flow
Crib House Floor Drain Sump	.037 mgd
Auxilliary Boiler Blowdown	0 mgd
Roof and Floor Drains	.003 mgd
Portable Dimeneralizer Rinse Water	0 mgd

Treatment Units

Description (include size, flow rate through each treatment unit, retention time, etc.)	Code from Table 2C-1	Final Disposal of Solid or Liquid Wastes Other Than by Discharge
Oil/Water Separation, Equalization	1-H, 1-U	
Coagulation, Flocculation	2-D, 1-G	
Multimedia Filtration	1-Q	
Drying Beds	5-H	Landfill (radioactive burial)

****Outfall Number**** A02

Operations Contributing to Flow

Operation	Average Flow
Laundry Wastewater, Groundwater	.001 mgd
Floor/Equipment Drains	.025 mgd
Reactor Cleanup/Condensate Filter Backwash	.025 mgd
Laboratory Waste Water	.0001 mgd

Treatment Units

Description (include size, flow rate through each treatment unit, retention time, etc.)	Code from Table 2C-1	Final Disposal of Solid or Liquid Wastes Other Than by Discharge
Filtration and Dimeneralization	1-Q, 2-J	Landfill (radioactive burial)
Reuse/Recycle of Treated Effluent	4-C	
On-Site Storage of Radioactive Waste	X-X	

System Users

3.2 Are you applying for an NPDES permit to operate a privately owned treatment works?

☐ Yes ☑ No → SKIP to Section 4.

3.3 Have you attached a list that identifies each user of the treatment works?

☐ Yes ☐ No

Form 2C NPDES | **EPA**

U.S. Environmental Protection Agency
Application for NPDES Permit to Discharge Wastewater
EXISTING MANUFACTURING, COMMERCIAL, MINING, AND SILVICULTURE OPERATIONS

SECTION 3. AVERAGE FLOWS AND TREATMENT (40 CFR 122.21(g)(3))

Average Flows and Treat

3.1 For each outfall identified under Item 1.1, provide average flow and treatment information. Add additional sheets if necessary.

****Outfall Number**** 001/002

Operations Contributing to Flow

Operation	Average Flow
Main Condenser Cooling Water	1016.6 mgd
House Service Water	43.3 mgd
Intake Screen Sprays	4.42 mgd
House Service Water Strainer Backwash	0.126 mgd
Radwaste Treatment System Blowdown (B01)	0.051 mgd
Wastewater Treatment Plant (A02)	0.04 mgd
Units 1 and 2 Oil Water Separators (stormwater)	2.3 mgd
Fish Culture Facilities	0.54 mgd
Groundwater	0.01 mgd
Crib House Floor Drain Sump	0 mgd

Treatment Units

Description (include size, flow rate through each treatment unit, retention time, etc.)	Code from Table 2C-1	Final Disposal of Solid or Liquid Wastes Other Than by Discharge

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110041007111	IL0005037	Quad Cities Generating Station	

SECTION 4. INTERMITTENT FLOWS (40 CFR 122.21(g)(4))

Intermittent Flows

4.1 Except for storm runoff, leaks, or spills, are any discharges described in Sections 1 and 3 intermittent or seasonal?

☑ Yes ☐ No ➔ SKIP to Section 5.

4.2 Provide information on intermittent or seasonal flows for each applicable outfall. Attach additional pages, if necessary.

Outfall Number	Operation (list)	Frequency: Average Days/Week	Frequency: Average Months/Year	Flow Rate: Long-Term Average	Flow Rate: Maximum Daily	Duration
001/002	Groundwater	7 days/week	9 months/year	.01 mgd	.01 mgd	270 days
	Fish Culture Facilities	7 days/week	11 months/year	.54 mgd	2.6 mgd	330 days
		days/week	months/year	mgd	mgd	days
B01	Aux. Boiler Blowdown	7 days/week	5 months/year	.00001 mgd	.0015 mgd	150 days
	Portable Demin. Rinse	1 days/week	12 months/year	.004 mgd	.006 mgd	1 days
	Roof and Floor Drains	2 days/week	12 months/year	.003 mgd	.03 mgd	1 days
A02	Radwaste Blowdown	1 days/week	3 months/year	.051 mgd	.056 mgd	1 days
		days/week	months/year	mgd	mgd	days
		days/week	months/year	mgd	mgd	days

SECTION 5. PRODUCTION (40 CFR 122.21(g)(5))

Applicable ELGs

5.1 Do any effluent limitation guidelines (ELGs) promulgated by EPA under Section 304 of the CWA apply to your facility?

☑ Yes ☐ No ➔ SKIP to Section 6.

5.2 Provide the following information on applicable ELGs.

ELG Category	ELG Subcategory	Regulatory Citation
Steam Electric Power Generation	Nuclear	40 CFR Part 423

Production-Based Limitations

5.3 Are any of the applicable ELGs expressed in terms of production (or other measure of operation)?

☐ Yes ☑ No ➔ SKIP to Section 6.

5.4 Provide an actual measure of daily production expressed in terms and units of applicable ELGs.

Outfall Number	Operation, Product, or Material	Quantity per Day	Unit of Measure

SECTION 6. IMPROVEMENTS (40 CFR 122.21(g)(6))

Upgrades and Improvements

6.1 Are you presently required by any federal, state, or local authority to meet an implementation schedule for constructing, upgrading, or operating wastewater treatment equipment or practices or any other environmental programs that could affect the discharges described in this application?

☐ Yes ☑ No ➔ SKIP to Item 6.3.

6.2 Briefly identify each applicable project in the table below.

Brief Identification and Description of Project	Affected Outfalls (list outfall number)	Source(s) of Discharge	Final Compliance Dates	
			Required	Projected

6.3 Have you attached sheets describing any additional water pollution control programs (or other environmental projects that may affect your discharges) that you now have underway or planned? *(optional item)*

☐ Yes ☐ No ☑ Not applicable

SECTION 7. EFFLUENT AND INTAKE CHARACTERISTICS (40 CFR 122.21(g)(7))

Effluent and Intake Characteristics

See the instructions to determine the pollutants and parameters you are required to monitor and, in turn, the tables you must complete. Not all applicants need to complete each table.

Table A. Conventional and Non-Conventional Pollutants

7.1 Are you requesting a waiver from your NPDES permitting authority for one or more of the Table A pollutants for any of your outfalls?

☑ Yes ☐ No ➔ SKIP to Item 7.3.

7.2 If yes, indicate the applicable outfalls below. Attach waiver request and other required information to the application.

Outfall Number B01 Outfall Number A02 Outfall Number _____

7.3 Have you completed monitoring for all Table A pollutants at each of your outfalls for which a waiver has not been requested and attached the results to this application package?

☑ Yes ☐ No; a waiver has been requested from my NPDES permitting authority for all pollutants at all outfalls.

Table B. Toxic Metals, Cyanide, Total Phenols, and Organic Toxic Pollutants

7.4 Do any of the facility's processes that contribute wastewater fall into one or more of the primary industry categories listed in Exhibit 2C-3? (See end of instructions for exhibit.)

☑ Yes ☐ No ➔ SKIP to Item 7.8.

7.5 Have you checked "Testing Required" for all toxic metals, cyanide, and total phenols in Section 1 of Table B?

☑ Yes ☐ No

7.6 List the applicable primary industry categories and check the boxes indicating the required GC/MS fraction(s) identified in Exhibit 2C-3.

Primary Industry Category	Required GC/MS Fraction(s) (Check applicable boxes.)			
Steam Electric Power Plant	☑ Volatile	☑ Acid	☐ Base/Neutral	☐ Pesticide
	☐ Volatile	☐ Acid	☐ Base/Neutral	☐ Pesticide
	☐ Volatile	☐ Acid	☐ Base/Neutral	☐ Pesticide

Effluent and Intake Characteristics Continued

7.7	Have you checked "Testing Required" for all required pollutants in Sections 2 through 5 of Table B for each of the GC/MS fractions checked in Item 7.6? ☑ Yes ☐ No
7.8	Have you checked "Believed Present" or "Believed Absent" for all pollutants listed in Sections 1 through 5 of Table B where testing is not required? ☑ Yes ☐ No
7.9	Have you provided (1) quantitative data for those Section 1, Table B, pollutants for which you have indicated testing is required or (2) quantitative data or other required information for those Section 1, Table B, pollutants that you have indicated are "Believed Present" in your discharge? ☑ Yes ☐ No
7.10	Does the applicant qualify for a small business exemption under the criteria specified in the instructions? ☐ Yes ➔ Note that you qualify at the top of Table B, then SKIP to Item 7.12. ☑ No
7.11	Have you provided (1) quantitative data for those Sections 2 through 5, Table B, pollutants for which you have determined testing is required or (2) quantitative data or an explanation for those Sections 2 through 5, Table B, pollutants you have indicated are "Believed Present" in your discharge? ☑ Yes ☐ No
Table C. Certain Conventional and Non-Conventional Pollutants	
7.12	Have you indicated whether pollutants are "Believed Present" or "Believed Absent" for all pollutants listed on Table C for all outfalls? ☑ Yes ☐ No
7.13	Have you completed Table C by providing (1) quantitative data for those pollutants that are limited either directly or indirectly in an ELG and/or (2) quantitative data or an explanation for those pollutants for which you have indicated "Believed Present"? ☑ Yes ☐ No
Table D. Certain Hazardous Substances and Asbestos	
7.14	Have you indicated whether pollutants are "Believed Present" or "Believed Absent" for all pollutants listed in Table D for all outfalls? ☑ Yes ☐ No
7.15	Have you completed Table D by (1) describing the reasons the applicable pollutants are expected to be discharged and (2) by providing quantitative data, if available? ☐ Yes ☑ No
Table E. 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (2,3,7,8-TCDD)	
7.16	Does the facility use or manufacture one or more of the 2,3,7,8-TCDD congeners listed in the instructions, or do you know or have reason to believe that TCDD is or may be present in the effluent? ☐ Yes ➔ Complete Table E. ☑ No ➔ SKIP to Section 8.
7.17	Have you completed Table E by reporting *qualitative* data for TCDD? ☐ Yes ☐ No

SECTION 8. USED OR MANUFACTURED TOXICS (40 CFR 122.21(g)(9))

Used or Manufactured Toxics

8.1	Is any pollutant listed in Table B a substance or a component of a substance used or manufactured at your facility as an intermediate or final product or byproduct? ☐ Yes ☑ No ➔ SKIP to Section 9.		
8.2	List the pollutants below.		
	1.	4.	7.
	2.	5.	8.
	3.	6.	9.

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110041007111	IL0005037	Quad Cities Generating Station	

SECTION 9. BIOLOGICAL TOXICITY TESTS (40 CFR 122.21(g)(11))

Biological Toxicity Tests

9.1 Do you have any knowledge or reason to believe that any biological test for acute or chronic toxicity has been made within the last three years on (1) any of your discharges or (2) on a receiving water in relation to your discharge?

☐ Yes ☑ No ➔ SKIP to Section 10.

9.2 Identify the tests and their purposes below.

Test(s)	Purpose of Test(s)	Submitted to NPDES Permitting Authority?	Date Submitted
		☐ Yes ☐ No	
		☐ Yes ☐ No	
		☐ Yes ☐ No	

SECTION 10. CONTRACT ANALYSES (40 CFR 122.21(g)(12))

Contract Analyses

10.1 Were any of the analyses reported in Section 7 performed by a contract laboratory or consulting firm?

☑ Yes ☐ No ➔ SKIP to Section 11.

10.2 Provide information for each contract laboratory or consulting firm below.

	Laboratory Number 1	Laboratory Number 2	Laboratory Number 3
Name of laboratory/firm	PDC Laboratories, Inc	Eurofins TestAmerica, St. Louis	
Laboratory address	2231 W Altorfer Drive Peoria, IL 61615	13715 Rider Trail North Earth City, MO 63045	
Phone number	(800) 752-6651	(314) 298-8566	
Pollutant(s) analyzed	Anions, General Chemistry, Nitrients, Total Metals, Radioactivity	Anions, Metals, General Chemistry, Radiactivity	

SECTION 11. ADDITIONAL INFORMATION (40 CFR 122.21(g)(13))

Additional Information

11.1 Has the NPDES permitting authority requested additional information?

☐ Yes ☑ No ➔ SKIP to Section 12.

11.2 List the information requested and attach it to this application.

1.	4.
2.	5.
3.	6.

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110041007111	IL0005037	Quad Cities Generating Station	

SECTION 12. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(a) and (d))

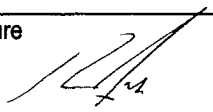
Checklist and Certification Statement

12.1 In Column 1 below, mark the sections of Form 2C that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing to alert the permitting authority. Note that not all applicants are required to complete all sections or provide attachments.

Column 1	Column 2			
☑ Section 1: Outfall Location	☐ w/ attachments			
☑ Section 2: Line Drawing	☑ w/ line drawing	☐ w/ additional attachments		
☑ Section 3: Average Flows and Treatment	☑ w/ attachments	☐ w/ list of each user of privately owned treatment works		
☑ Section 4: Intermittent Flows	☐ w/ attachments			
☑ Section 5: Production	☐ w/ attachments			
☐ Section 6: Improvements	☐ w/ attachments	☐ w/ optional additional sheets describing any additional pollution control plans		
☑ Section 7: Effluent and Intake Characteristics	☑ w/ request for a waiver and supporting information	☐ w/ explanation for identical outfalls		
	☐ w/ small business exemption request	☑ w/ other attachments		
	☑ w/ Table A	☑ w/ Table B		
	☑ w/ Table C	☑ w/ Table D		
	☑ w/ Table E	☐ w/ analytical results as an attachment		
☐ Section 8: Used or Manufactured Toxics	☐ w/ attachments			
☐ Section 9: Biological Toxicity Tests	☐ w/ attachments			
☑ Section 10: Contract Analyses	☐ w/ attachments			
☐ Section 11: Additional Information	☐ w/ attachments			
☑ Section 12: Checklist and Certification Statement	☐ w/ attachments			

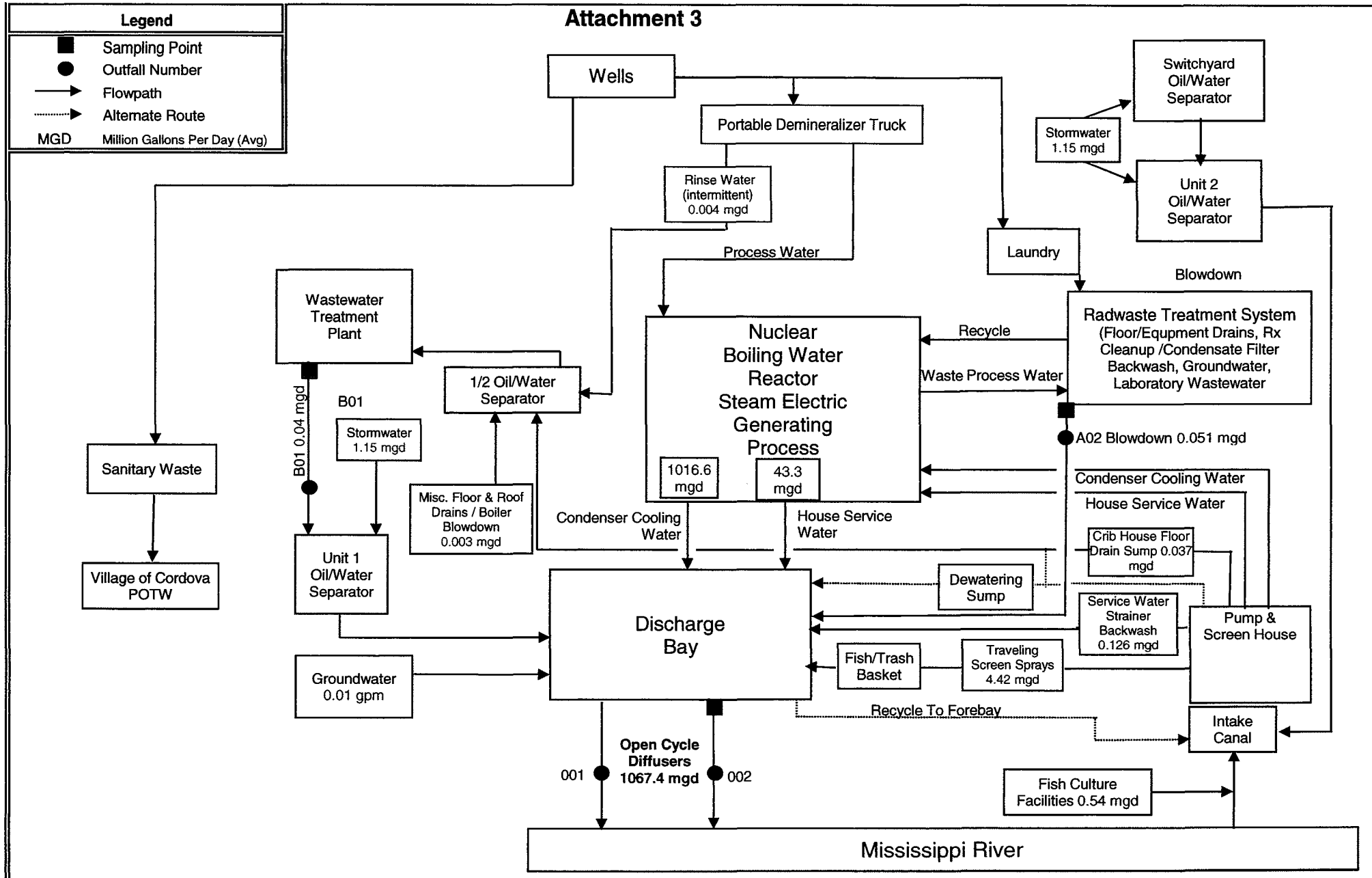
12.2 **Certification Statement**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name (print or type first and last name)	Official title
Kenneth Ohr	Site Vice President
Signature 	Date signed 12-12-19

This page intentionally left blank.

Attachment 3



Schematic of Water Flow NPDES IL0005037

Exelon Generation Company, LLC
Quad Cities Nuclear Power Station
Cordova, Illinois

Line Drawing - 12/4/19

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE A. CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(iii))[1]

	Pollutant	Waiver Requested (if applicable)	Units (specify)		Effluent: Maximum Daily Discharge (required)	Effluent: Maximum Monthly Discharge (if available)	Effluent: Long-Term Average Daily Discharge (if available)	Effluent: Number of Analyses	Intake (Optional): Long-Term Average Value	Intake (Optional): Number of Analyses
☐	Check here if you have applied to your NPDES permitting authority for a waiver for *all* of the pollutants listed on this table for the noted outfall.									
1.	Biochemical oxygen demand (BOD_5)	☐	Concentration	mg/L	<4.0			1	<4.0	1
			Mass	lbs	<35,630			1		
2.	Chemical oxygen demand (COD)	☐	Concentration	mg/L	25.0			1	22.0	1
			Mass	lbs	222,686			1		
3.	Total organic carbon (TOC)	☐	Concentration	mg/L	6.8			1	6.6	1
			Mass	lbs	60,571			1		
4.	Total suspended solids (TSS)	☐	Concentration	mg/L	110.0	57.1	30.4	52	33.5	52
			Mass	lbs	979,820	508,616	270,787	52		
5.	Ammonia (as N)	☐	Concentration	mg/L	<0.10			1	<0.10	1
			Mass	lbs	<890.8			1		
6.	Flow	☐	Rate	mgd	1436	1424	1067.4	365		
7.	Temperature (winter)	☐	°C	°C	27.9	25.9	25.5	90		
	Temperature (summer)	☐	°C	°C	44.4	42.6	40.5	92		
8.	pH (minimum)	☐	Standard units	s.u.	7.5	7.5	7.8	12	7.3	52
	pH (maximum)	☐	Standard units	s.u.	8.1	8.1	7.9	12	8.7	52

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
☐	Check here if you qualify as a small business per the instructions to Form 2C and, therefore, do not need to submit quantitative data for any of the organic toxic pollutants in Sections 2 through 5 of this table. Note, however, that you must still indicate in the appropriate column of this table if you believe any of the pollutants listed are present in your discharge.											
Section 1. Toxic Metals, Cyanide, and Total Phenols												
1.1	Antimony, total (7440-36-0)	☑	☑	☐	Concentration	mg/L	<0.020			1	<0.020	1
					Mass	lbs	<178.15			1		
1.2	Arsenic, total (7440-38-2)	☑	☐	☑	Concentration	mg/L	<0.020			1	<0.020	1
					Mass	lbs	<178.15			1		
1.3	Beryllium, total (7440-41-7)	☑	☐	☑	Concentration	mg/L	<0.0050			1	<0.0050	1
					Mass	lbs	<44.54			1		
1.4	Cadmium, total (7440-43-9)	☑	☐	☑	Concentration	mg/L	<0.0050			1	<0.0050	1
					Mass	lbs	<44.54			1		
1.5	Chromium, total (7440-47-3)	☑	☐	☑	Concentration	mg/L	<0.0050			1	<0.0050	1
					Mass	lbs	<44.54			1		
1.6	Copper, total (7440-50-8)	☑	☑	☐	Concentration	mg/L	<0.030			1	<0.030	1
					Mass	lbs	<267.22			1		
1.7	Lead, total (7439-92-1)	☑	☐	☑	Concentration	mg/L	<0.015			1	<0.015	1
					Mass	lbs	<133..61			1		
1.8	Mercury, total (7439-97-6)	☑	☐	☑	Concentration	mg/L	<0.00020			1	<0.00020	1
					Mass	lbs	<1.781			1		
1.9	Nickel, total (7440-02-0)	☑	☐	☑	Concentration	mg/L	<0.030			1	<0.030	1
					Mass	lbs	<267.22			1		
1.10	Selenium, total (7782-49-2)	☑	☑	☐	Concentration	mg/L	<0.03			1	<0.030	1
					Mass	lbs	<267.22			1		
1.11	Silver, total (7440-22-4)	☑	☐	☑	Concentration	mg/L	<0.010			1	<0.010	1
					Mass	lbs	<89.07			1		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
1.12	Thallium, total (7440-28-0)	☑	☐	☑	Concentration	mg/L	<0.030			1	<0.030	1
					Mass	lbs	<267.22			1		
1.13	Zinc, total (7440-66-6)	☑	☑	☐	Concentration	mg/L	.064			1	.042	1
					Mass	lbs	570.08			1		
1.14	Cyanide, total (57-12-5)	☑	☐	☑	Concentration	mg/L	<0.0050			1	<0.0050	1
					Mass	lbs	<44.54			1		
1.15	Phenols, total	☑	☐	☑	Concentration	mg/L	<0.0050			1	<0.0050	1
					Mass	lbs	<44.54			1		
Section 2. Organic Toxic Pollutants (GC/MS Fraction—Volatile Compounds)												
2.1	Acrolein (107-02-8)	☑	☐	☑	Concentration							
					Mass							
2.2	Acrylonitrile (107-13-1)	☑	☐	☑	Concentration							
					Mass							
2.3	Benzene (71-43-2)	☑	☐	☑	Concentration							
					Mass							
2.4	Bromoform (75-25-2)	☑	☐	☑	Concentration							
					Mass							
2.5	Carbon tetrachloride (56-23-5)	☑	☐	☑	Concentration							
					Mass							
2.6	Chlorobenzene (108-90-7)	☑	☐	☑	Concentration							
					Mass							
2.7	Chlorodibromomethane (124-48-1)	☑	☐	☑	Concentration							
					Mass							
2.8	Chloroethane (75-00-3)	☑	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
2.9	2-chloroethylvinyl ether (110-75-8)	☑	☐	☑	Concentration							
					Mass							
2.10	Chloroform (67-66-3)	☑	☐	☑	Concentration							
					Mass							
2.11	Dichlorobromomethane (75-27-4)	☑	☐	☑	Concentration							
					Mass							
2.12	1,1-dichloroethane (75-34-3)	☑	☐	☑	Concentration							
					Mass							
2.13	1,2-dichloroethane (107-06-2)	☑	☐	☑	Concentration							
					Mass							
2.14	1,1-dichloroethylene (75-35-4)	☑	☐	☑	Concentration							
					Mass							
2.15	1,2-dichloropropane (78-87-5)	☑	☐	☑	Concentration							
					Mass							
2.16	1,3-dichloropropylene (542-75-6)	☑	☐	☑	Concentration							
					Mass							
2.17	Ethylbenzene (100-41-4)	☑	☐	☑	Concentration							
					Mass							
2.18	Methyl bromide (74-83-9)	☑	☐	☑	Concentration							
					Mass							
2.19	Methyl chloride (74-87-3)	☑	☐	☑	Concentration							
					Mass							
2.20	Methylene chloride (75-09-2)	☑	☐	☑	Concentration							
					Mass							
2.21	1,1,2,2- tetrachloroethane (79-34-5)	☑	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
2.22	Tetrachloroethylene (127-18-4)	☑	☐	☑	Concentration							
					Mass							
2.23	Toluene (108-88-3)	☑	☐	☑	Concentration							
					Mass							
2.24	1,2-trans-dichloroethylene (156-60-5)	☑	☐	☑	Concentration							
					Mass							
2.25	1,1,1-trichloroethane (71-55-6)	☑	☐	☑	Concentration							
					Mass							
2.26	1,1,2-trichloroethane (79-00-5)	☑	☐	☑	Concentration							
					Mass							
2.27	Trichloroethylene (79-01-6)	☑	☐	☑	Concentration							
					Mass							
2.28	Vinyl chloride (75-01-4)	☑	☐	☑	Concentration							
					Mass							
Section 3. Organic Toxic Pollutants (GC/MS Fraction—Acid Compounds)												
3.1	2-chlorophenol (95-57-8)	☑	☐	☑	Concentration							
					Mass							
3.2	2,4-dichlorophenol (120-83-2)	☑	☐	☑	Concentration							
					Mass							
3.3	2,4-dimethylphenol (105-67-9)	☑	☐	☑	Concentration							
					Mass							
3.4	4,6-dinitro-o-cresol (534-52-1)	☑	☐	☑	Concentration							
					Mass							
3.5	2,4-dinitrophenol (51-28-5)	☑	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
3.6	2-nitrophenol (88-75-5)	☑	☐	☑	Concentration							
					Mass							
3.7	4-nitrophenol (100-02-7)	☑	☐	☑	Concentration							
					Mass							
3.8	p-chloro-m-cresol (59-50-7)	☑	☐	☑	Concentration							
					Mass							
3.9	Pentachlorophenol (87-86-5)	☑	☐	☑	Concentration							
					Mass							
3.10	Phenol (108-95-2)	☑	☐	☑	Concentration							
					Mass							
3.11	2,4,6-trichlorophenol (88-05-2)	☑	☐	☑	Concentration							
					Mass							
Section 4. Organic Toxic Pollutants (GC/MS Fraction—Base /Neutral Compounds)												
4.1	Acenaphthene (83-32-9)	☐	☐	☑	Concentration							
					Mass							
4.2	Acenaphthylene (208-96-8)	☐	☐	☑	Concentration							
					Mass							
4.3	Anthracene (120-12-7)	☐	☐	☑	Concentration							
					Mass							
4.4	Benzidine (92-87-5)	☐	☐	☑	Concentration							
					Mass							
4.5	Benzo (a) anthracene (56-55-3)	☐	☐	☑	Concentration							
					Mass							
4.6	Benzo (a) pyrene (50-32-8)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.7	3,4-benzofluoranthene (205-99-2)	☐	☐	☑	Concentration							
					Mass							
4.8	Benzo (ghi) perylene (191-24-2)	☐	☐	☑	Concentration							
					Mass							
4.9	Benzo (k) fluoranthene (207-08-9)	☐	☐	☑	Concentration							
					Mass							
4.10	Bis (2-chloroethoxy) methane (111-91-1)	☐	☐	☑	Concentration							
					Mass							
4.11	Bis (2-chloroethyl) ether (111-44-4)	☐	☐	☑	Concentration							
					Mass							
4.12	Bis (2-chloroisopropyl) ether (102-80-1)	☐	☐	☑	Concentration							
					Mass							
4.13	Bis (2-ethylhexyl) phthalate (117-81-7)	☐	☐	☑	Concentration							
					Mass							
4.14	4-bromophenyl phenyl ether (101-55-3)	☐	☐	☑	Concentration							
					Mass							
4.15	Butyl benzyl phthalate (85-68-7)	☐	☐	☑	Concentration							
					Mass							
4.16	2-chloronaphthalene (91-58-7)	☐	☐	☑	Concentration							
					Mass							
4.17	4-chlorophenyl phenyl ether (7005-72-3)	☐	☐	☑	Concentration							
					Mass							
4.18	Chrysene (218-01-9)	☐	☐	☑	Concentration							
					Mass							
4.19	Dibenzo (a,h) anthracene (53-70-3)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.20	1,2-dichlorobenzene (95-50-1)	☐	☐	☑	Concentration							
					Mass							
4.21	1,3-dichlorobenzene (541-73-1)	☐	☐	☑	Concentration							
					Mass							
4.22	1,4-dichlorobenzene (106-46-7)	☐	☐	☑	Concentration							
					Mass							
4.23	3,3-dichlorobenzidine (91-94-1)	☐	☐	☑	Concentration							
					Mass							
4.24	Diethyl phthalate (84-66-2)	☐	☐	☑	Concentration							
					Mass							
4.25	Dimethyl phthalate (131-11-3)	☐	☐	☑	Concentration							
					Mass							
4.26	Di-n-butyl phthalate (84-74-2)	☐	☐	☑	Concentration							
					Mass							
4.27	2,4-dinitrotoluene (121-14-2)	☐	☐	☑	Concentration							
					Mass							
4.28	2,6-dinitrotoluene (606-20-2)	☐	☐	☑	Concentration							
					Mass							
4.29	Di-n-octyl phthalate (117-84-0)	☐	☐	☑	Concentration							
					Mass							
4.30	1,2-Diphenylhydrazine (as azobenzene) (122-66-7)	☐	☐	☑	Concentration							
					Mass							
4.31	Fluoranthene (206-44-0)	☐	☐	☑	Concentration							
					Mass							
4.32	Fluorene (86-73-7)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.33	Hexachlorobenzene (118-74-1)	☐	☐	☑	Concentration							
					Mass							
4.34	Hexachlorobutadiene (87-68-3)	☐	☐	☑	Concentration							
					Mass							
4.35	Hexachlorocyclopentadiene (77-47-4)	☐	☐	☑	Concentration							
					Mass							
4.36	Hexachloroethane (67-72-1)	☐	☐	☑	Concentration							
					Mass							
4.37	Indeno (1,2,3-cd) pyrene (193-39-5)	☐	☐	☑	Concentration							
					Mass							
4.38	Isophorone (78-59-1)	☐	☐	☑	Concentration							
					Mass							
4.39	Naphthalene (91-20-3)	☐	☐	☑	Concentration							
					Mass							
4.40	Nitrobenzene (98-95-3)	☐	☐	☑	Concentration							
					Mass							
4.41	N-nitrosodimethylamine (62-75-9)	☐	☐	☑	Concentration							
					Mass							
4.42	N-nitrosodi-n-propylamine (621-64-7)	☐	☐	☑	Concentration							
					Mass							
4.43	N-nitrosodiphenylamine (86-30-6)	☐	☐	☑	Concentration							
					Mass							
4.44	Phenanthrene (85-01-8)	☐	☐	☑	Concentration							
					Mass							
4.45	Pyrene (129-00-0)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.46	1,2,4-trichlorobenzene (120-82-1)	☐	☐	☑	Concentration							
					Mass							
Section 5. Organic Toxic Pollutants (GC/MS Fraction—Pesticides)												
5.1	Aldrin (309-00-2)	☐	☐	☑	Concentration							
					Mass							
5.2	α-BHC (319-84-6)	☐	☐	☑	Concentration							
					Mass							
5.3	β-BHC (319-85-7)	☐	☐	☑	Concentration							
					Mass							
5.4	γ-BHC (58-89-9)	☐	☐	☑	Concentration							
					Mass							
5.5	δ-BHC (319-86-8)	☐	☐	☑	Concentration							
					Mass							
5.6	Chlordane (57-74-9)	☐	☐	☑	Concentration							
					Mass							
5.7	4,4'-DDT (50-29-3)	☐	☐	☑	Concentration							
					Mass							
5.8	4,4'-DDE (72-55-9)	☐	☐	☑	Concentration							
					Mass							
5.9	4,4'-DDD (72-54-8)	☐	☐	☑	Concentration							
					Mass							
5.10	Dieldrin (60-57-1)	☐	☐	☑	Concentration							
					Mass							
5.11	α-endosulfan (115-29-7)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
5.12	β-endosulfan (115-29-7)	☐	☐	☑	Concentration							
					Mass							
5.13	Endosulfan sulfate (1031-07-8)	☐	☐	☑	Concentration							
					Mass							
5.14	Endrin (72-20-8)	☐	☐	☑	Concentration							
					Mass							
5.15	Endrin aldehyde (7421-93-4)	☐	☐	☑	Concentration							
					Mass							
5.16	Heptachlor (76-44-8)	☐	☐	☑	Concentration							
					Mass							
5.17	Heptachlor epoxide (1024-57-3)	☐	☐	☑	Concentration							
					Mass							
5.18	PCB-1242 (53469-21-9)	☐	☐	☑	Concentration							
					Mass							
5.19	PCB-1254 (11097-69-1)	☐	☐	☑	Concentration							
					Mass							
5.20	PCB-1221 (11104-28-2)	☐	☐	☑	Concentration							
					Mass							
5.21	PCB-1232 (11141-16-5)	☐	☐	☑	Concentration							
					Mass							
5.22	PCB-1248 (12672-29-6)	☐	☐	☑	Concentration							
					Mass							
5.23	PCB-1260 (11096-82-5)	☐	☐	☑	Concentration							
					Mass							
5.24	PCB-1016 (12674-11-2)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
5.25	Toxaphene (8001-35-2)	☐	☐	☑	Concentration							
					Mass							

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))[1]

	Pollutant	Presence or Absence (check one)		Units (specify)		Effluent				Intake (Optional)	
		Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
☐	Check here if you believe all pollutants on Table C to be ***present*** in your discharge from the noted outfall. You need *not* complete the "Presence or Absence" column of Table C for *each* pollutant.										
☐	Check here if you believe all pollutants on Table C to be ***absent*** in your discharge from the noted outfall. You need *not* complete the "Presence or Absence" column of Table C for *each* pollutant.										
1.	Bromide (24959-67-9)	☐	☑	Concentration	mg/L	<1.0			1	<1.0	1
				Mass	lbs	<8907.45			1		
2.	Chlorine, total residual	☑	☐	Concentration	mg/L	0.03	<0.02	<0.02	12		
				Mass	lbs	267.22	<178.15	<178.15	12		
3.	Color	☑	☐	Concentration	Pt-Co	30			1	35	1
				Mass							
4.	Fecal coliform	☐	☑	Concentration							
				Mass							
5.	Fluoride (16984-48-8)	☐	☑	Concentration	mg/L	<0.250			1	<0.250	1
				Mass	lbs	<2226.86			1		
6	Nitrate-nitrite	☑	☐	Concentration	mg/L	1.5			1	1.6	1
				Mass	lbs	13,361.18			1		
7.	Nitrogen, total organic (as N)	☑	☐	Concentration	mg/L	1.2			1	<1.0	1
				Mass	lbs	10,688.9			1		
8.	Oil and grease	☐	☑	Concentration	mg/L	<6.0			1	<6.0	1
				Mass	lbs	<53,445			1		
9.	Phosphorus (as P), total (7723-14-0)	☑	☐	Concentration	mg/L	<0.10			1	<0.10	1
				Mass	lbs	<890.75			1		
10.	Sulfate (as SO_4) (14808-79-8)	☑	☐	Concentration	mg/L	35			1	31	1
				Mass	lbs	311,761			1		
11.	Sulfide (as S)	☐	☑	Concentration	mg/L	<2.0			1	<2.0	1
				Mass	lbs	<17,815			1		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))[1]

	Pollutant	Presence or Absence (check one)		Units (specify)		Effluent				Intake (Optional)	
		Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
12.	Sulfite (as SO_3) (14265-45-3)	☐	☑	Concentration	mg/L						
				Mass	lbs						
13.	Surfactants	☑	☐	Concentration	mg/L	<0.20			1	<0.20	1
				Mass	lbs	<1781.5			1		
14.	Aluminum, total (7429-90-5)	☑	☐	Concentration	mg/L	0.29			1	0.52	1
				Mass	lbs	2583.2			1		
15.	Barium, total (7440-39-3)	☑	☐	Concentration	mg/L	0.042			1	.047	1
				Mass	lbs	374.1			1		
16.	Boron, total (7440-42-8)	☑	☐	Concentration	mg/L	0.044			1	.057	1
				Mass	lbs	391.9			1		
17.	Cobalt, total (7440-48-4)	☐	☑	Concentration	mg/L	<0.0050			1	<0.0050	1
				Mass	lbs	<44.5			1		
18.	Iron, total (7439-89-6)	☑	☐	Concentration	mg/L	0.41			1	0.91	1
				Mass	lbs	3652			1		
19.	Magnesium, total (7439-95-4)	☑	☐	Concentration	mg/L	16			1	15	1
				Mass	lbs	142,519			1		
20.	Molybdenum, total (7439-98-7)	☐	☑	Concentration	mg/L	<0.010			1	<0.010	1
				Mass	lbs	<89.1			1		
21.	Manganese, total (7439-96-5)	☑	☐	Concentration	mg/L	0.050			1	.11	1
				Mass	lbs	445.4			1		
22.	Tin, total (7440-31-5)	☐	☑	Concentration	mg/L	<0.060			1	<0.060	1
				Mass	lbs	<534.4			1		
23.	Titanium, total (7440-32-6)	☐	☑	Concentration	mg/L	0.0073			1	.018	1
				Mass	lbs	65.0			1		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))[1]

	Pollutant	Presence or Absence (check one)		Units (specify)		Effluent				Intake (Optional)	
		Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
24.	**Radioactivity**										
	Alpha, total	☑	☐	Concentration	pCi/L	1.71			1	1.89	1
				Mass							
	Beta, total	☑	☐	Concentration	pCi/L						
				Mass							
	Radium, total	☑	☐	Concentration	pCi/L	<0.856			1	<0.912	1
				Mass							
	Radium 226, total	☑	☐	Concentration	pCi/L	0.425			1	<0.658	1
				Mass							

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
1.	Asbestos	☐	☑		
2.	Acetaldehyde	☐	☑		
3.	Allyl alcohol	☐	☑		
4.	Allyl chloride	☐	☑		
5.	Amyl acetate	☐	☑		
6.	Aniline	☐	☑		
7.	Benzonitrile	☐	☑		
8.	Benzyl chloride	☐	☑		
9.	Butyl acetate	☐	☑		
10.	Butylamine	☐	☑		
11.	Captan	☐	☑		
12.	Carbaryl	☐	☑		
13.	Carbofuran	☐	☑		
14.	Carbon disulfide	☐	☑		
15.	Chlorpyrifos	☐	☑		
16.	Coumaphos	☐	☑		
17.	Cresol	☐	☑		
18.	Crotonaldehyde	☐	☑		
19.	Cyclohexane	☐	☑		

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
20.	2,4-D (2,4-dichlorophenoxyacetic acid)	☐	☑		
21.	Diazinon	☐	☑		
22.	Dicamba	☐	☑		
23.	Dichlobenil	☐	☑		
24.	Dichlone	☐	☑		
25.	2,2-dichloropropionic acid	☐	☑		
26.	Dichlorvos	☐	☑		
27.	Diethyl amine	☐	☑		
28.	Dimethyl amine	☐	☑		
29.	Dintrobenzene	☐	☑		
30.	Diquat	☐	☑		
31.	Disulfoton	☐	☑		
32.	Diuron	☐	☑		
33.	Epichlorohydrin	☐	☑		
34.	Ethion	☐	☑		
35.	Ethylene diamine	☐	☑		
36.	Ethylene dibromide	☐	☑		
37.	Formaldehyde	☐	☑		
38.	Furfural	☐	☑		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
39.	Guthion	☐	☑		
40.	Isoprene	☐	☑		
41.	Isopropanolamine	☐	☑		
42.	Kelthane	☐	☑		
43.	Kepone	☐	☑		
44.	Malathion	☐	☑		
45.	Mercaptodimethur	☐	☑		
46.	Methoxychlor	☐	☑		
47.	Methyl mercaptan	☐	☑		
48.	Methyl methacrylate	☐	☑		
49.	Methyl parathion	☐	☑		
50.	Mevinphos	☐	☑		
51.	Mexacarbate	☐	☑		
52.	Monoethyl amine	☐	☑		
53.	Monomethyl amine	☐	☑		
54.	Naled	☐	☑		
55.	Naphthenic acid	☐	☑		
56.	Nitrotoluene	☐	☑		
57.	Parathion	☐	☑		

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
58.	Phenolsulfonate	☐	☑		
59.	Phosgene	☐	☑		
60.	Propargite	☐	☑		
61.	Propylene oxide	☐	☑		
62.	Pyrethrins	☐	☑		
63.	Quinoline	☐	☑		
64.	Resorcinol	☐	☑		
65.	Strontium	☐	☑		
66.	Strychnine	☐	☑		
67.	Styrene	☐	☑		
68.	2,4,5-T (2,4,5-trichlorophenoxyacetic acid)	☐	☑		
69.	TDE (tetrachlorodiphenyl ethane)	☐	☑		
70.	2,4,5-TP [2-(2,4,5-trichlorophenoxy) propanoic acid]	☐	☑		
71.	Trichlorofon	☐	☑		
72.	Triethanolamine	☐	☑		
73.	Triethylamine	☐	☑		
74.	Trimethylamine	☐	☑		
75.	Uranium	☐	☑		
76.	Vanadium	☐	☑		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	001/002

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
77.	Vinyl acetate	☐	☑		
78.	Xylene	☐	☑		
79.	Xylenol	☐	☑		
80.	Zirconium	☐	☑		

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

TABLE E. 2,3,7,8 TETRACHLORODIBENZO P DIOXIN (2,3,7,8 TCDD) (40 CFR 122.21(g)(7)(viii))

Pollutant	TCDD Congeners Used or Manufactured	Presence or Absence (check one)		Results of Screening Procedure
		Believed Present	Believed Absent	
2,3,7,8-TCDD	☐	☐	☑	

Outfall B01 Wastewater Treatment System Waiver Request:

Table A – Temperature: Quad Cities Station NPDES permit IL0005037 does not require Temperature monitoring of Outfall B01 and therefore does not have installed temperature monitoring probes. B01 effluent is a sub-stream of Outfall 001/002 Open Cycle Diffusers of which temperature data has been provided.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE A. CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(iii))[1]

	Pollutant	Waiver Requested (if applicable)	Units (specify)		Effluent: Maximum Daily Discharge (required)	Effluent: Maximum Monthly Discharge (if available)	Effluent: Long-Term Average Daily Discharge (if available)	Effluent: Number of Analyses	Intake (Optional): Long-Term Average Value	Intake (Optional): Number of Analyses
☐	Check here if you have applied to your NPDES permitting authority for a waiver for *all* of the pollutants listed on this table for the noted outfall.									
1.	Biochemical oxygen demand (BOD_5)	☐	Concentration	mg/L	<4.0			1		
			Mass	lbs	<1.34			1		
2.	Chemical oxygen demand (COD)	☐	Concentration	mg/L	12			1		
			Mass	lbs	4.01			1		
3.	Total organic carbon (TOC)	☐	Concentration	mg/L	4.6			1		
			Mass	lbs	1.54			1		
4.	Total suspended solids (TSS)	☐	Concentration	mg/L	2.0	<2.0	<1.7	12		
			Mass	lbs	0.67	<0.67	<0.57	12		
5.	Ammonia (as N)	☐	Concentration	mg/L	<0.10			1		
			Mass	lbs	<0.03			1		
6.	Flow	☐	Rate	mgd	0.059	0.059	0.040	13		
7.	Temperature (winter)	☑	°C	°C						
	Temperature (summer)	☑	°C	°C						
8.	pH (minimum)	☐	Standard units	s.u.	7.3	7.3		12		
	pH (maximum)	☐	Standard units	s.u.	7.9	7.9		12		

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
☐	Check here if you qualify as a small business per the instructions to Form 2C and, therefore, do not need to submit quantitative data for any of the organic toxic pollutants in Sections 2 through 5 of this table. Note, however, that you must still indicate in the appropriate column of this table if you believe any of the pollutants listed are present in your discharge.											
Section 1. Toxic Metals, Cyanide, and Total Phenols												
1.1	Antimony, total (7440-36-0)	☑	☑	☐	Concentration	mg/L	<0.020			1		
					Mass	lbs	<0.007			1		
1.2	Arsenic, total (7440-38-2)	☑	☐	☑	Concentration	mg/L	<0.020			1		
					Mass	lbs	<0.0067			1		
1.3	Beryllium, total (7440-41-7)	☑	☐	☑	Concentration	mg/L	<0.0050			1		
					Mass	lbs	<0.0017			1		
1.4	Cadmium, total (7440-43-9)	☑	☐	☑	Concentration	mg/L	<0.0050			1		
					Mass	lbs	<0.0017			1		
1.5	Chromium, total (7440-47-3)	☑	☐	☑	Concentration	mg/L	<0.0050			1		
					Mass	lbs	<0.0017			1		
1.6	Copper, total (7440-50-8)	☑	☑	☐	Concentration	mg/L	<0.030			1		
					Mass	lbs	<0.010			1		
1.7	Lead, total (7439-92-1)	☑	☐	☑	Concentration	mg/L	<0.010			1		
					Mass	lbs	<0.0033			1		
1.8	Mercury, total (7439-97-6)	☑	☐	☑	Concentration	mg/L	<0.00020			1		
					Mass	lbs	<0.00007			1		
1.9	Nickel, total (7440-02-0)	☑	☐	☑	Concentration	mg/L	<0.030			1		
					Mass	lbs	<0.010			1		
1.10	Selenium, total (7782-49-2)	☑	☑	☐	Concentration	mg/L	<0.030			1		
					Mass	lbs	<0.010			1		
1.11	Silver, total (7440-22-4)	☑	☐	☑	Concentration	mg/L	<0.010			1		
					Mass	lbs	<0.0033			1		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
1.12	Thallium, total (7440-28-0)	☑	☐	☑	Concentration	mg/L	<0.030			1		
					Mass	lbs	<0.010			1		
1.13	Zinc, total (7440-66-6)	☑	☑	☐	Concentration	mg/L	.037			1		
					Mass	lbs	0.012			1		
1.14	Cyanide, total (57-12-5)	☑	☐	☑	Concentration	mg/L	<0.0050			1		
					Mass	lbs	<0.002			1		
1.15	Phenols, total	☑	☐	☑	Concentration	mg/L	<0.0050			1		
					Mass	lbs	<0.002			1		
Section 2. Organic Toxic Pollutants (GC/MS Fraction—Volatile Compounds)												
2.1	Acrolein (107-02-8)	☑	☐	☑	Concentration							
					Mass							
2.2	Acrylonitrile (107-13-1)	☑	☐	☑	Concentration							
					Mass							
2.3	Benzene (71-43-2)	☑	☐	☑	Concentration							
					Mass							
2.4	Bromoform (75-25-2)	☑	☐	☑	Concentration							
					Mass							
2.5	Carbon tetrachloride (56-23-5)	☑	☐	☑	Concentration							
					Mass							
2.6	Chlorobenzene (108-90-7)	☑	☐	☑	Concentration							
					Mass							
2.7	Chlorodibromomethane (124-48-1)	☑	☐	☑	Concentration							
					Mass							
2.8	Chloroethane (75-00-3)	☑	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
2.9	2-chloroethylvinyl ether (110-75-8)	☑	☐	☑	Concentration							
					Mass							
2.10	Chloroform (67-66-3)	☑	☐	☑	Concentration							
					Mass							
2.11	Dichlorobromomethane (75-27-4)	☑	☐	☑	Concentration							
					Mass							
2.12	1,1-dichloroethane (75-34-3)	☑	☐	☑	Concentration							
					Mass							
2.13	1,2-dichloroethane (107-06-2)	☑	☐	☑	Concentration							
					Mass							
2.14	1,1-dichloroethylene (75-35-4)	☑	☐	☑	Concentration							
					Mass							
2.15	1,2-dichloropropane (78-87-5)	☑	☐	☑	Concentration							
					Mass							
2.16	1,3-dichloropropylene (542-75-6)	☑	☐	☑	Concentration							
					Mass							
2.17	Ethylbenzene (100-41-4)	☑	☐	☑	Concentration							
					Mass							
2.18	Methyl bromide (74-83-9)	☑	☐	☑	Concentration							
					Mass							
2.19	Methyl chloride (74-87-3)	☑	☐	☑	Concentration							
					Mass							
2.20	Methylene chloride (75-09-2)	☑	☐	☑	Concentration							
					Mass							
2.21	1,1,2,2- tetrachloroethane (79-34-5)	☑	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
2.22	Tetrachloroethylene (127-18-4)	☑	☐	☑	Concentration							
					Mass							
2.23	Toluene (108-88-3)	☑	☐	☑	Concentration							
					Mass							
2.24	1,2-trans-dichloroethylene (156-60-5)	☑	☐	☑	Concentration							
					Mass							
2.25	1,1,1-trichloroethane (71-55-6)	☑	☐	☑	Concentration							
					Mass							
2.26	1,1,2-trichloroethane (79-00-5)	☑	☐	☑	Concentration							
					Mass							
2.27	Trichloroethylene (79-01-6)	☑	☐	☑	Concentration							
					Mass							
2.28	Vinyl chloride (75-01-4)	☑	☐	☑	Concentration							
					Mass							
Section 3. Organic Toxic Pollutants (GC/MS Fraction—Acid Compounds)												
3.1	2-chlorophenol (95-57-8)	☑	☐	☑	Concentration							
					Mass							
3.2	2,4-dichlorophenol (120-83-2)	☑	☐	☑	Concentration							
					Mass							
3.3	2,4-dimethylphenol (105-67-9)	☑	☐	☑	Concentration							
					Mass							
3.4	4,6-dinitro-o-cresol (534-52-1)	☑	☐	☑	Concentration							
					Mass							
3.5	2,4-dinitrophenol (51-28-5)	☑	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
3.6	2-nitrophenol (88-75-5)	☑	☐	☑	Concentration							
					Mass							
3.7	4-nitrophenol (100-02-7)	☑	☐	☑	Concentration							
					Mass							
3.8	p-chloro-m-cresol (59-50-7)	☑	☐	☑	Concentration							
					Mass							
3.9	Pentachlorophenol (87-86-5)	☑	☐	☑	Concentration							
					Mass							
3.10	Phenol (108-95-2)	☑	☐	☑	Concentration							
					Mass							
3.11	2,4,6-trichlorophenol (88-05-2)	☑	☐	☑	Concentration							
					Mass							
Section 4. Organic Toxic Pollutants (GC/MS Fraction—Base /Neutral Compounds)												
4.1	Acenaphthene (83-32-9)	☐	☐	☑	Concentration							
					Mass							
4.2	Acenaphthylene (208-96-8)	☐	☐	☑	Concentration							
					Mass							
4.3	Anthracene (120-12-7)	☐	☐	☑	Concentration							
					Mass							
4.4	Benzidine (92-87-5)	☐	☐	☑	Concentration							
					Mass							
4.5	Benzo (a) anthracene (56-55-3)	☐	☐	☑	Concentration							
					Mass							
4.6	Benzo (a) pyrene (50-32-8)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.7	3,4-benzofluoranthene (205-99-2)	☐	☐	☑	Concentration							
					Mass							
4.8	Benzo (ghi) perylene (191-24-2)	☐	☐	☑	Concentration							
					Mass							
4.9	Benzo (k) fluoranthene (207-08-9)	☐	☐	☑	Concentration							
					Mass							
4.10	Bis (2-chloroethoxy) methane (111-91-1)	☐	☐	☑	Concentration							
					Mass							
4.11	Bis (2-chloroethyl) ether (111-44-4)	☐	☐	☑	Concentration							
					Mass							
4.12	Bis (2-chloroisopropyl) ether (102-80-1)	☐	☐	☑	Concentration							
					Mass							
4.13	Bis (2-ethylhexyl) phthalate (117-81-7)	☐	☐	☑	Concentration							
					Mass							
4.14	4-bromophenyl phenyl ether (101-55-3)	☐	☐	☑	Concentration							
					Mass							
4.15	Butyl benzyl phthalate (85-68-7)	☐	☐	☑	Concentration							
					Mass							
4.16	2-chloronaphthalene (91-58-7)	☐	☐	☑	Concentration							
					Mass							
4.17	4-chlorophenyl phenyl ether (7005-72-3)	☐	☐	☑	Concentration							
					Mass							
4.18	Chrysene (218-01-9)	☐	☐	☑	Concentration							
					Mass							
4.19	Dibenzo (a,h) anthracene (53-70-3)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.20	1,2-dichlorobenzene (95-50-1)	☐	☐	☑	Concentration							
					Mass							
4.21	1,3-dichlorobenzene (541-73-1)	☐	☐	☑	Concentration							
					Mass							
4.22	1,4-dichlorobenzene (106-46-7)	☐	☐	☑	Concentration							
					Mass							
4.23	3,3-dichlorobenzidine (91-94-1)	☐	☐	☑	Concentration							
					Mass							
4.24	Diethyl phthalate (84-66-2)	☐	☐	☑	Concentration							
					Mass							
4.25	Dimethyl phthalate (131-11-3)	☐	☐	☑	Concentration							
					Mass							
4.26	Di-n-butyl phthalate (84-74-2)	☐	☐	☑	Concentration							
					Mass							
4.27	2,4-dinitrotoluene (121-14-2)	☐	☐	☑	Concentration							
					Mass							
4.28	2,6-dinitrotoluene (606-20-2)	☐	☐	☑	Concentration							
					Mass							
4.29	Di-n-octyl phthalate (117-84-0)	☐	☐	☑	Concentration							
					Mass							
4.30	1,2-Diphenylhydrazine (as azobenzene) (122-66-7)	☐	☐	☑	Concentration							
					Mass							
4.31	Fluoranthene (206-44-0)	☐	☐	☑	Concentration							
					Mass							
4.32	Fluorene (86-73-7)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.33	Hexachlorobenzene (118-74-1)	☐	☐	☑	Concentration							
					Mass							
4.34	Hexachlorobutadiene (87-68-3)	☐	☐	☑	Concentration							
					Mass							
4.35	Hexachlorocyclopentadiene (77-47-4)	☐	☐	☑	Concentration							
					Mass							
4.36	Hexachloroethane (67-72-1)	☐	☐	☑	Concentration							
					Mass							
4.37	Indeno (1,2,3-cd) pyrene (193-39-5)	☐	☐	☑	Concentration							
					Mass							
4.38	Isophorone (78-59-1)	☐	☐	☑	Concentration							
					Mass							
4.39	Naphthalene (91-20-3)	☐	☐	☑	Concentration							
					Mass							
4.40	Nitrobenzene (98-95-3)	☐	☐	☑	Concentration							
					Mass							
4.41	N-nitrosodimethylamine (62-75-9)	☐	☐	☑	Concentration							
					Mass							
4.42	N-nitrosodi-n-propylamine (621-64-7)	☐	☐	☑	Concentration							
					Mass							
4.43	N-nitrosodiphenylamine (86-30-6)	☐	☐	☑	Concentration							
					Mass							
4.44	Phenanthrene (85-01-8)	☐	☐	☑	Concentration							
					Mass							
4.45	Pyrene (129-00-0)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.46	1,2,4-trichlorobenzene (120-82-1)	☐	☐	☑	Concentration							
					Mass							
Section 5. Organic Toxic Pollutants (GC/MS Fraction—Pesticides)												
5.1	Aldrin (309-00-2)	☐	☐	☑	Concentration							
					Mass							
5.2	α-BHC (319-84-6)	☐	☐	☑	Concentration							
					Mass							
5.3	β-BHC (319-85-7)	☐	☐	☑	Concentration							
					Mass							
5.4	γ-BHC (58-89-9)	☐	☐	☑	Concentration							
					Mass							
5.5	δ-BHC (319-86-8)	☐	☐	☑	Concentration							
					Mass							
5.6	Chlordane (57-74-9)	☐	☐	☑	Concentration							
					Mass							
5.7	4,4'-DDT (50-29-3)	☐	☐	☑	Concentration							
					Mass							
5.8	4,4'-DDE (72-55-9)	☐	☐	☑	Concentration							
					Mass							
5.9	4,4'-DDD (72-54-8)	☐	☐	☑	Concentration							
					Mass							
5.10	Dieldrin (60-57-1)	☐	☐	☑	Concentration							
					Mass							
5.11	α-endosulfan (115-29-7)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
5.12	β-endosulfan (115-29-7)	☐	☐	☑	Concentration							
					Mass							
5.13	Endosulfan sulfate (1031-07-8)	☐	☐	☑	Concentration							
					Mass							
5.14	Endrin (72-20-8)	☐	☐	☑	Concentration							
					Mass							
5.15	Endrin aldehyde (7421-93-4)	☐	☐	☑	Concentration							
					Mass							
5.16	Heptachlor (76-44-8)	☐	☐	☑	Concentration							
					Mass							
5.17	Heptachlor epoxide (1024-57-3)	☐	☐	☑	Concentration							
					Mass							
5.18	PCB-1242 (53469-21-9)	☐	☐	☑	Concentration							
					Mass							
5.19	PCB-1254 (11097-69-1)	☐	☐	☑	Concentration							
					Mass							
5.20	PCB-1221 (11104-28-2)	☐	☐	☑	Concentration							
					Mass							
5.21	PCB-1232 (11141-16-5)	☐	☐	☑	Concentration							
					Mass							
5.22	PCB-1248 (12672-29-6)	☐	☐	☑	Concentration							
					Mass							
5.23	PCB-1260 (11096-82-5)	☐	☐	☑	Concentration							
					Mass							
5.24	PCB-1016 (12674-11-2)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
5.25	Toxaphene (8001-35-2)	☐	☐	☑	Concentration							
					Mass							

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))[1]

	Pollutant	Presence or Absence (check one)		Units (specify)	Effluent				Intake (Optional)	
		Believed Present	Believed Absent		Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
☐	Check here if you believe all pollutants on Table C to be ***present*** in your discharge from the noted outfall. You need *not* complete the "Presence or Absence" column of Table C for *each* pollutant.									
☐	Check here if you believe all pollutants on Table C to be ***absent*** in your discharge from the noted outfall. You need *not* complete the "Presence or Absence" column of Table C for *each* pollutant.									
1.	Bromide (24959-67-9)	☐	☑	Concentration	mg/L	<1.0			1		
				Mass	lbs	<0.334			1		
2.	Chlorine, total residual	☐	☑	Concentration							
				Mass							
3.	Color	☑	☐	Concentration	Pt-Co	10			1		
				Mass							
4.	Fecal coliform	☐	☑	Concentration							
				Mass							
5.	Fluoride (16984-48-8)	☐	☑	Concentration	mg/L	<0.250			1		
				Mass	lbs	<0.083			1		
6	Nitrate-nitrite	☑	☐	Concentration	mg/L	2.0			1		
				Mass	lbs	0.668			1		
7.	Nitrogen, total organic (as N)	☑	☐	Concentration	mg/L	<1.0			1		
				Mass	lbs	<0.0334			1		
8.	Oil and grease	☐	☑	Concentration	mg/L	<1.4	<1.4	<1.4	12		
				Mass	lbs	<0.467	<0.467	<0.467	12		
9.	Phosphorus (as P), total (7723-14-0)	☑	☐	Concentration	mg/L	<0.10			1		
				Mass	lbs	<0.033			1		
10.	Sulfate (as SO_4) (14808-79-8)	☑	☐	Concentration	mg/L	39			1		
				Mass	lbs	13.0			1		
11.	Sulfide (as S)	☐	☑	Concentration	mg/L	<2.0			1		
				Mass	lbs	<0.668			1		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))[1]

	Pollutant	Presence or Absence (check one)		Units (specify)		Effluent				Intake (Optional)	
		Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
12.	Sulfite (as SO_3) (14265-45-3)	☐	☑	Concentration							
				Mass							
13.	Surfactants	☑	☐	Concentration	mg/L	<0.20			1		
				Mass	lbs	<0.067			1		
14.	Aluminum, total (7429-90-5)	☑	☐	Concentration	mg/L	0.17			1		
				Mass	lbs	0.057			1		
15.	Barium, total (7440-39-3)	☑	☐	Concentration	mg/L	0.033			1		
				Mass	lbs	0.011			1		
16.	Boron, total (7440-42-8)	☑	☐	Concentration	mg/L	0.044			1		
				Mass	lbs	0.015			1		
17.	Cobalt, total (7440-48-4)	☐	☑	Concentration	mg/L	<0.0050			1		
				Mass	lbs	<0.002			1		
18.	Iron, total (7439-89-6)	☑	☐	Concentration	mg/L	0.020			1		
				Mass	lbs	0.007			1		
19.	Magnesium, total (7439-95-4)	☑	☐	Concentration	mg/L	18			1		
				Mass	lbs	6.01			1		
20.	Molybdenum, total (7439-98-7)	☐	☑	Concentration	mg/L	<0.010			1		
				Mass	lbs	<0.003			1		
21.	Manganese, total (7439-96-5)	☑	☐	Concentration	mg/L	<0.010			1		
				Mass	lbs	<0.003			1		
22.	Tin, total (7440-31-5)	☐	☑	Concentration	mg/L	<0.060			1		
				Mass	lbs	<0.002			1		
23.	Titanium, total (7440-32-6)	☐	☑	Concentration	mg/L	<0.0050			1		
				Mass	lbs	<0.002			1		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))[1]

	Pollutant	Presence or Absence (check one)		Units (specify)		Effluent				Intake (Optional)	
		Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
24.	**Radioactivity**										
	Alpha, total	☑	☐	Concentration	pCi/L	<1.26			1		
				Mass							
	Beta, total	☑	☐	Concentration	pCi/L	4.14	4.14	<4.3	11		
				Mass							
	Radium, total	☑	☐	Concentration	pCi/L	<0.856			1		
				Mass							
	Radium 226, total	☑	☐	Concentration	pCi/L	<0.604			1		
				Mass							

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
1.	Asbestos	☐	☑		
2.	Acetaldehyde	☐	☑		
3.	Allyl alcohol	☐	☑		
4.	Allyl chloride	☐	☑		
5.	Amyl acetate	☐	☑		
6.	Aniline	☐	☑		
7.	Benzonitrile	☐	☑		
8.	Benzyl chloride	☐	☑		
9.	Butyl acetate	☐	☑		
10.	Butylamine	☐	☑		
11.	Captan	☐	☑		
12.	Carbaryl	☐	☑		
13.	Carbofuran	☐	☑		
14.	Carbon disulfide	☐	☑		
15.	Chlorpyrifos	☐	☑		
16.	Coumaphos	☐	☑		
17.	Cresol	☐	☑		
18.	Crotonaldehyde	☐	☑		
19.	Cyclohexane	☐	☑		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
20.	2,4-D (2,4-dichlorophenoxyacetic acid)	☐	☑		
21.	Diazinon	☐	☑		
22.	Dicamba	☐	☑		
23.	Dichlobenil	☐	☑		
24.	Dichlone	☐	☑		
25.	2,2-dichloropropionic acid	☐	☑		
26.	Dichlorvos	☐	☑		
27.	Diethyl amine	☐	☑		
28.	Dimethyl amine	☐	☑		
29.	Dintrobenzene	☐	☑		
30.	Diquat	☐	☑		
31.	Disulfoton	☐	☑		
32.	Diuron	☐	☑		
33.	Epichlorohydrin	☐	☑		
34.	Ethion	☐	☑		
35.	Ethylene diamine	☐	☑		
36.	Ethylene dibromide	☐	☑		
37.	Formaldehyde	☐	☑		
38.	Furfural	☐	☑		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	B01

Form Approved 03/05/19
OMB No. 2040-0004

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
39.	Guthion	☐	☑		
40.	Isoprene	☐	☑		
41.	Isopropanolamine	☐	☑		
42.	Kelthane	☐	☑		
43.	Kepone	☐	☑		
44.	Malathion	☐	☑		
45.	Mercaptodimethur	☐	☑		
46.	Methoxychlor	☐	☑		
47.	Methyl mercaptan	☐	☑		
48.	Methyl methacrylate	☐	☑		
49.	Methyl parathion	☐	☑		
50.	Mevinphos	☐	☑		
51.	Mexacarbate	☐	☑		
52.	Monoethyl amine	☐	☑		
53.	Monomethyl amine	☐	☑		
54.	Naled	☐	☑		
55.	Naphthenic acid	☐	☑		
56.	Nitrotoluene	☐	☑		
57.	Parathion	☐	☑		

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
58.	Phenolsulfonate	☐	☑		
59.	Phosgene	☐	☑		
60.	Propargite	☐	☑		
61.	Propylene oxide	☐	☑		
62.	Pyrethrins	☐	☑		
63.	Quinoline	☐	☑		
64.	Resorcinol	☐	☑		
65.	Strontium	☐	☑		
66.	Strychnine	☐	☑		
67.	Styrene	☐	☑		
68.	2,4,5-T (2,4,5-trichlorophenoxyacetic acid)	☐	☑		
69.	TDE (tetrachlorodiphenyl ethane)	☐	☑		
70.	2,4,5-TP [2-(2,4,5-trichlorophenoxy) propanoic acid]	☐	☑		
71.	Trichlorofon	☐	☑		
72.	Triethanolamine	☐	☑		
73.	Triethylamine	☐	☑		
74.	Trimethylamine	☐	☑		
75.	Uranium	☐	☑		
76.	Vanadium	☐	☑		

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
77.	Vinyl acetate	☐	☑		
78.	Xylene	☐	☑		
79.	Xylenol	☐	☑		
80.	Zirconium	☐	☑		

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

TABLE E. 2,3,7,8 TETRACHLORODIBENZO P DIOXIN (2,3,7,8 TCDD) (40 CFR 122.21(g)(7)(viii))

Pollutant	TCDD Congeners Used or Manufactured	Presence or Absence (check one)		Results of Screening Procedure
		Believed Present	Believed Absent	
2,3,7,8-TCDD	☐	☐	☑	

Outfall A02 Radwaste Treatment System Blowdown Waiver Request: The majority of the water discharged (approximately 95%) is processed water that has failed limits for reuse in systems that require high purity water. This processed water has been filtered to remove solids, then sent through resin to reduce amount of the radioactivity. The remainder of the water is from the laundry sample tank that consists primarily of water from washing masks and personal clothing that has become radioactively contaminated which has been filtered to remove solids, groundwater from remediation efforts, and groundwater intrusion. A02 effluent is a sub-stream of Outfall 001/002 Open Cycle Diffusers of which all Table A pollutants were analyzed.

Table A – BOD/COD/*Ammonia: Quad Cities Station NPDES permit IL0005037 does not require BOD/COD/Ammonia monitoring of Outfall A02. There are no inputs to the radwaste system that contain these pollutants.

Temperature: Quad Cities Station NPDES permit IL0005037 does not require Temperature monitoring of Outfall A02 and therefore does not have installed temperature monitoring probes. Radwaste blowdown is batch discharged with the storage tank at ambient temperature.

*Sample of A02 was analyzed for Total Kjeldahl Nitrogen (ammonia, organic nitrogen, and reduced nitrogen) with sample result of 1.7 ppm.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE A. CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(iii))[1]

	Pollutant	Waiver Requested (if applicable)	Units (specify)		Effluent: Maximum Daily Discharge (required)	Effluent: Maximum Monthly Discharge (if available)	Effluent: Long-Term Average Daily Discharge (if available)	Effluent: Number of Analyses	Intake (Optional): Long-Term Average Value	Intake (Optional): Number of Analyses
☐	Check here if you have applied to your NPDES permitting authority for a waiver for *all* of the pollutants listed on this table for the noted outfall.									
1.	Biochemical oxygen demand (BOD_5)	☑	Concentration							
			Mass							
2.	Chemical oxygen demand (COD)	☑	Concentration							
			Mass							
3.	Total organic carbon (TOC)	☐	Concentration	mg/L	2.7			1		
			Mass	lbs	1.15			1		
4.	Total suspended solids (TSS)	☐	Concentration	mg/L	14.5	<4.8	<3.2	12		
			Mass	lbs	6.17	<2.04	<1.36	12		
5.	Ammonia (as N)	☑	Concentration							
			Mass							
6.	Flow	☐	Rate	mgd	0.056	0.056	0.051	12		
7.	Temperature (winter)	☑	°C	°C						
	Temperature (summer)	☑	°C	°C						
8.	pH (minimum)	☐	Standard units	s.u.	7.1			1		
	pH (maximum)	☐	Standard units	s.u.	7.1			1		

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
☐	Check here if you qualify as a small business per the instructions to Form 2C and, therefore, do not need to submit quantitative data for any of the organic toxic pollutants in Sections 2 through 5 of this table. Note, however, that you must still indicate in the appropriate column of this table if you believe any of the pollutants listed are present in your discharge.											
Section 1. Toxic Metals, Cyanide, and Total Phenols												
1.1	Antimony, total (7440-36-0)	☑	☑	☐	Concentration	mg/L	<0.0040			1		
					Mass	lbs	<0.0017			1		
1.2	Arsenic, total (7440-38-2)	☑	☐	☑	Concentration	mg/L	<0.0040			1		
					Mass	lbs	<0.0017			1		
1.3	Beryllium, total (7440-41-7)	☑	☐	☑	Concentration	mg/L	<0.0015			1		
					Mass	lbs	<0.0006			1		
1.4	Cadmium, total (7440-43-9)	☑	☐	☑	Concentration	mg/L	<0.0015			1		
					Mass	lbs	<0.0006			1		
1.5	Chromium, total (7440-47-3)	☑	☐	☑	Concentration	mg/L	<0.0030			1		
					Mass	lbs	<0.0013			1		
1.6	Copper, total (7440-50-8)	☑	☑	☐	Concentration	mg/L	0.0070			1		
					Mass	lbs	<0.0030			1		
1.7	Lead, total (7439-92-1)	☑	☐	☑	Concentration	mg/L	<0.0030			1		
					Mass	lbs	<0.0013			1		
1.8	Mercury, total (7439-97-6)	☑	☐	☑	Concentration	mg/L	<0.00010			1		
					Mass	lbs	<0.00004			1		
1.9	Nickel, total (7440-02-0)	☑	☐	☑	Concentration	mg/L	<0.010			1		
					Mass	lbs	<0.0043			1		
1.10	Selenium, total (7782-49-2)	☑	☑	☐	Concentration	mg/L	<0.0080			1		
					Mass	lbs	<0.0034			1		
1.11	Silver, total (7440-22-4)	☑	☐	☑	Concentration	mg/L	<0.0030			1		
					Mass	lbs	<0.0013			1		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
1.12	Thallium, total (7440-28-0)	☑	☐	☑	Concentration	mg/L	<0.0060			1		
					Mass	lbs	<0.0026			1		
1.13	Zinc, total (7440-66-6)	☑	☑	☐	Concentration	mg/L	0.069			1		
					Mass	lbs	0.029			1		
1.14	Cyanide, total (57-12-5)	☑	☐	☑	Concentration	mg/L	<0.0050			1		
					Mass	lbs	<0.002			1		
1.15	Phenols, total	☑	☐	☑	Concentration	mg/L	0.011			1		
					Mass	lbs	0.005			1		
Section 2. Organic Toxic Pollutants (GC/MS Fraction—Volatile Compounds)												
2.1	Acrolein (107-02-8)	☑	☐	☑	Concentration							
					Mass							
2.2	Acrylonitrile (107-13-1)	☑	☐	☑	Concentration							
					Mass							
2.3	Benzene (71-43-2)	☑	☐	☑	Concentration							
					Mass							
2.4	Bromoform (75-25-2)	☑	☐	☑	Concentration							
					Mass							
2.5	Carbon tetrachloride (56-23-5)	☑	☐	☑	Concentration							
					Mass							
2.6	Chlorobenzene (108-90-7)	☑	☐	☑	Concentration							
					Mass							
2.7	Chlorodibromomethane (124-48-1)	☑	☐	☑	Concentration							
					Mass							
2.8	Chloroethane (75-00-3)	☑	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
2.9	2-chloroethylvinyl ether (110-75-8)	☑	☐	☑	Concentration							
					Mass							
2.10	Chloroform (67-66-3)	☑	☐	☑	Concentration							
					Mass							
2.11	Dichlorobromomethane (75-27-4)	☑	☐	☑	Concentration							
					Mass							
2.12	1,1-dichloroethane (75-34-3)	☑	☐	☑	Concentration							
					Mass							
2.13	1,2-dichloroethane (107-06-2)	☑	☐	☑	Concentration							
					Mass							
2.14	1,1-dichloroethylene (75-35-4)	☑	☐	☑	Concentration							
					Mass							
2.15	1,2-dichloropropane (78-87-5)	☑	☐	☑	Concentration							
					Mass							
2.16	1,3-dichloropropylene (542-75-6)	☑	☐	☑	Concentration							
					Mass							
2.17	Ethylbenzene (100-41-4)	☑	☐	☑	Concentration							
					Mass							
2.18	Methyl bromide (74-83-9)	☑	☐	☑	Concentration							
					Mass							
2.19	Methyl chloride (74-87-3)	☑	☐	☑	Concentration							
					Mass							
2.20	Methylene chloride (75-09-2)	☑	☐	☑	Concentration							
					Mass							
2.21	1,1,2,2- tetrachloroethane (79-34-5)	☑	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
2.22	Tetrachloroethylene (127-18-4)	☑	☐	☑	Concentration							
					Mass							
2.23	Toluene (108-88-3)	☑	☐	☑	Concentration							
					Mass							
2.24	1,2-trans-dichloroethylene (156-60-5)	☑	☐	☑	Concentration							
					Mass							
2.25	1,1,1-trichloroethane (71-55-6)	☑	☐	☑	Concentration							
					Mass							
2.26	1,1,2-trichloroethane (79-00-5)	☑	☐	☑	Concentration							
					Mass							
2.27	Trichloroethylene (79-01-6)	☑	☐	☑	Concentration							
					Mass							
2.28	Vinyl chloride (75-01-4)	☑	☐	☑	Concentration							
					Mass							
Section 3. Organic Toxic Pollutants (GC/MS Fraction—Acid Compounds)												
3.1	2-chlorophenol (95-57-8)	☑	☐	☑	Concentration							
					Mass							
3.2	2,4-dichlorophenol (120-83-2)	☑	☐	☑	Concentration							
					Mass							
3.3	2,4-dimethylphenol (105-67-9)	☑	☐	☑	Concentration							
					Mass							
3.4	4,6-dinitro-o-cresol (534-52-1)	☑	☐	☑	Concentration							
					Mass							
3.5	2,4-dinitrophenol (51-28-5)	☑	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
3.6	2-nitrophenol (88-75-5)	☑	☐	☑	Concentration							
					Mass							
3.7	4-nitrophenol (100-02-7)	☑	☐	☑	Concentration							
					Mass							
3.8	p-chloro-m-cresol (59-50-7)	☑	☐	☑	Concentration							
					Mass							
3.9	Pentachlorophenol (87-86-5)	☑	☐	☑	Concentration							
					Mass							
3.10	Phenol (108-95-2)	☑	☐	☑	Concentration							
					Mass							
3.11	2,4,6-trichlorophenol (88-05-2)	☑	☐	☑	Concentration							
					Mass							
Section 4. Organic Toxic Pollutants (GC/MS Fraction—Base /Neutral Compounds)												
4.1	Acenaphthene (83-32-9)	☐	☐	☑	Concentration							
					Mass							
4.2	Acenaphthylene (208-96-8)	☐	☐	☑	Concentration							
					Mass							
4.3	Anthracene (120-12-7)	☐	☐	☑	Concentration							
					Mass							
4.4	Benzidine (92-87-5)	☐	☐	☑	Concentration							
					Mass							
4.5	Benzo (a) anthracene (56-55-3)	☐	☐	☑	Concentration							
					Mass							
4.6	Benzo (a) pyrene (50-32-8)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.7	3,4-benzofluoranthene (205-99-2)	☐	☐	☑	Concentration							
					Mass							
4.8	Benzo (ghi) perylene (191-24-2)	☐	☐	☑	Concentration							
					Mass							
4.9	Benzo (k) fluoranthene (207-08-9)	☐	☐	☑	Concentration							
					Mass							
4.10	Bis (2-chloroethoxy) methane (111-91-1)	☐	☐	☑	Concentration							
					Mass							
4.11	Bis (2-chloroethyl) ether (111-44-4)	☐	☐	☑	Concentration							
					Mass							
4.12	Bis (2-chloroisopropyl) ether (102-80-1)	☐	☐	☑	Concentration							
					Mass							
4.13	Bis (2-ethylhexyl) phthalate (117-81-7)	☐	☐	☑	Concentration							
					Mass							
4.14	4-bromophenyl phenyl ether (101-55-3)	☐	☐	☑	Concentration							
					Mass							
4.15	Butyl benzyl phthalate (85-68-7)	☐	☐	☑	Concentration							
					Mass							
4.16	2-chloronaphthalene (91-58-7)	☐	☐	☑	Concentration							
					Mass							
4.17	4-chlorophenyl phenyl ether (7005-72-3)	☐	☐	☑	Concentration							
					Mass							
4.18	Chrysene (218-01-9)	☐	☐	☑	Concentration							
					Mass							
4.19	Dibenzo (a,h) anthracene (53-70-3)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.20	1,2-dichlorobenzene (95-50-1)	☐	☐	☑	Concentration							
					Mass							
4.21	1,3-dichlorobenzene (541-73-1)	☐	☐	☑	Concentration							
					Mass							
4.22	1,4-dichlorobenzene (106-46-7)	☐	☐	☑	Concentration							
					Mass							
4.23	3,3-dichlorobenzidine (91-94-1)	☐	☐	☑	Concentration							
					Mass							
4.24	Diethyl phthalate (84-66-2)	☐	☐	☑	Concentration							
					Mass							
4.25	Dimethyl phthalate (131-11-3)	☐	☐	☑	Concentration							
					Mass							
4.26	Di-n-butyl phthalate (84-74-2)	☐	☐	☑	Concentration							
					Mass							
4.27	2,4-dinitrotoluene (121-14-2)	☐	☐	☑	Concentration							
					Mass							
4.28	2,6-dinitrotoluene (606-20-2)	☐	☐	☑	Concentration							
					Mass							
4.29	Di-n-octyl phthalate (117-84-0)	☐	☐	☑	Concentration							
					Mass							
4.30	1,2-Diphenylhydrazine (as azobenzene) (122-66-7)	☐	☐	☑	Concentration							
					Mass							
4.31	Fluoranthene (206-44-0)	☐	☐	☑	Concentration							
					Mass							
4.32	Fluorene (86-73-7)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.33	Hexachlorobenzene (118-74-1)	☐	☐	☑	Concentration							
					Mass							
4.34	Hexachlorobutadiene (87-68-3)	☐	☐	☑	Concentration							
					Mass							
4.35	Hexachlorocyclopentadiene (77-47-4)	☐	☐	☑	Concentration							
					Mass							
4.36	Hexachloroethane (67-72-1)	☐	☐	☑	Concentration							
					Mass							
4.37	Indeno (1,2,3-cd) pyrene (193-39-5)	☐	☐	☑	Concentration							
					Mass							
4.38	Isophorone (78-59-1)	☐	☐	☑	Concentration							
					Mass							
4.39	Naphthalene (91-20-3)	☐	☐	☑	Concentration							
					Mass							
4.40	Nitrobenzene (98-95-3)	☐	☐	☑	Concentration							
					Mass							
4.41	N-nitrosodimethylamine (62-75-9)	☐	☐	☑	Concentration							
					Mass							
4.42	N-nitrosodi-n-propylamine (621-64-7)	☐	☐	☑	Concentration							
					Mass							
4.43	N-nitrosodiphenylamine (86-30-6)	☐	☐	☑	Concentration							
					Mass							
4.44	Phenanthrene (85-01-8)	☐	☐	☑	Concentration							
					Mass							
4.45	Pyrene (129-00-0)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
4.46	1,2,4-trichlorobenzene (120-82-1)	☐	☐	☑	Concentration							
					Mass							
Section 5. Organic Toxic Pollutants (GC/MS Fraction—Pesticides)												
5.1	Aldrin (309-00-2)	☐	☐	☑	Concentration							
					Mass							
5.2	α-BHC (319-84-6)	☐	☐	☑	Concentration							
					Mass							
5.3	β-BHC (319-85-7)	☐	☐	☑	Concentration							
					Mass							
5.4	γ-BHC (58-89-9)	☐	☐	☑	Concentration							
					Mass							
5.5	δ-BHC (319-86-8)	☐	☐	☑	Concentration							
					Mass							
5.6	Chlordane (57-74-9)	☐	☐	☑	Concentration							
					Mass							
5.7	4,4'-DDT (50-29-3)	☐	☐	☑	Concentration							
					Mass							
5.8	4,4'-DDE (72-55-9)	☐	☐	☑	Concentration							
					Mass							
5.9	4,4'-DDD (72-54-8)	☐	☐	☑	Concentration							
					Mass							
5.10	Dieldrin (60-57-1)	☐	☐	☑	Concentration							
					Mass							
5.11	α-endosulfan (115-29-7)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
5.12	β-endosulfan (115-29-7)	☐	☐	☑	Concentration							
					Mass							
5.13	Endosulfan sulfate (1031-07-8)	☐	☐	☑	Concentration							
					Mass							
5.14	Endrin (72-20-8)	☐	☐	☑	Concentration							
					Mass							
5.15	Endrin aldehyde (7421-93-4)	☐	☐	☑	Concentration							
					Mass							
5.16	Heptachlor (76-44-8)	☐	☐	☑	Concentration							
					Mass							
5.17	Heptachlor epoxide (1024-57-3)	☐	☐	☑	Concentration							
					Mass							
5.18	PCB-1242 (53469-21-9)	☐	☐	☑	Concentration							
					Mass							
5.19	PCB-1254 (11097-69-1)	☐	☐	☑	Concentration							
					Mass							
5.20	PCB-1221 (11104-28-2)	☐	☐	☑	Concentration							
					Mass							
5.21	PCB-1232 (11141-16-5)	☐	☐	☑	Concentration							
					Mass							
5.22	PCB-1248 (12672-29-6)	☐	☐	☑	Concentration							
					Mass							
5.23	PCB-1260 (11096-82-5)	☐	☐	☑	Concentration							
					Mass							
5.24	PCB-1016 (12674-11-2)	☐	☐	☑	Concentration							
					Mass							

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

TABLE B. TOXIC METALS, CYANIDE, TOTAL PHENOLS, AND ORGANIC TOXIC POLLUTANTS (40 CFR 122.21(g)(7)(v))[1]

	Pollutant/Parameter (and CAS Number, if available)	Testing Required	Presence or Absence (check one)		Units (specify)		Effluent				Intake (optional)	
			Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
5.25	Toxaphene (8001-35-2)	☐	☐	☑	Concentration							
					Mass							

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))[1]

	Pollutant	Presence or Absence (check one)		Units (specify)	Effluent				Intake (Optional)	
		Believed Present	Believed Absent		Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
☐	Check here if you believe all pollutants on Table C to be ***present*** in your discharge from the noted outfall. You need *not* complete the "Presence or Absence" column of Table C for *each* pollutant.									
☐	Check here if you believe all pollutants on Table C to be ***absent*** in your discharge from the noted outfall. You need *not* complete the "Presence or Absence" column of Table C for *each* pollutant.									
1.	Bromide (24959-67-9)	☐	☑	Concentration						
				Mass						
2.	Chlorine, total residual	☐	☑	Concentration						
				Mass						
3.	Color	☑	☐	Concentration	Pt-Co	15		1		
				Mass						
4.	Fecal coliform	☐	☑	Concentration						
				Mass						
5.	Fluoride (16984-48-8)	☐	☑	Concentration	mg/L	<0.026		1		
				Mass	lbs	<0.011		1		
6	Nitrate-nitrite	☑	☐	Concentration	mg/L	0.17		1		
				Mass	lbs	0.072		1		
7.	Nitrogen, total organic (as N)	☑	☐	Concentration	mg/L	1.7		1		
				Mass	lbs	.72		1		
8.	Oil and grease	☐	☑	Concentration	mg/L	3.0	<2.2	2		
				Mass	lbs	1.277	<0.94	2		
9.	Phosphorus (as P), total (7723-14-0)	☐	☑	Concentration						
				Mass						
10.	Sulfate (as SO_4) (14808-79-8)	☑	☐	Concentration	mg/L	1.8		1		
				Mass	lbs	0.77		1		
11.	Sulfide (as S)	☐	☑	Concentration	mg/L	<0.50		1		
				Mass	lbs	<0.021		1		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))[1]

	Pollutant	Presence or Absence (check one)		Units (specify)		Effluent				Intake (Optional)	
		Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
12.	Sulfite (as SO_3) (14265-45-3)	☐	☑	Concentration							
				Mass							
13.	Surfactants	☐	☑	Concentration							
				Mass							
14.	Aluminum, total (7429-90-5)	☑	☐	Concentration	mg/L	<0.050			1		
				Mass	lbs	<0.021			1		
15.	Barium, total (7440-39-3)	☑	☐	Concentration	mg/L	0.032			1		
				Mass	lbs	0.014			1		
16.	Boron, total (7440-42-8)	☑	☐	Concentration	mg/L	1.5			1		
				Mass	lbs	0.64			1		
17.	Cobalt, total (7440-48-4)	☐	☑	Concentration	mg/L	<0.015			1		
				Mass	lbs	<0.006			1		
18.	Iron, total (7439-89-6)	☑	☐	Concentration	mg/L	0.85			1		
				Mass	lbs	0.36			1		
19.	Magnesium, total (7439-95-4)	☑	☐	Concentration	mg/L	0.34			1		
				Mass	lbs	0.14			1		
20.	Molybdenum, total (7439-98-7)	☐	☑	Concentration	mg/L	<0.010			1		
				Mass	lbs	<0.004			1		
21.	Manganese, total (7439-96-5)	☑	☐	Concentration	mg/L	0.160			1		
				Mass	lbs	0.068			1		
22.	Tin, total (7440-31-5)	☐	☑	Concentration	mg/L	<0.030			1		
				Mass	lbs	<0.013			1		
23.	Titanium, total (7440-32-6)	☐	☑	Concentration	mg/L	<0.0050			1		
				Mass	lbs	<0.002			1		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE C. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.21(g)(7)(vi))[1]

	Pollutant	Presence or Absence (check one)		Units (specify)		Effluent				Intake (Optional)	
		Believed Present	Believed Absent			Maximum Daily Discharge (required)	Maximum Monthly Discharge (if available)	Long-Term Average Daily Discharge (if available)	Number of Analyses	Long-Term Average Value	Number of Analyses
24.	**Radioactivity**										
	Alpha, total	☑	☐	Concentration	pCi/L	11.3			1		
				Mass							
	Beta, total	☑	☐	Concentration	pCi/L	16,800			1		
				Mass							
	Radium, total	☑	☐	Concentration	pCi/L	1.83			1		
				Mass							
	Radium 226, total	☑	☐	Concentration	pCi/L	<0.347			1		
				Mass							

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
1.	Asbestos	☐	☑		
2.	Acetaldehyde	☐	☑		
3.	Allyl alcohol	☐	☑		
4.	Allyl chloride	☐	☑		
5.	Amyl acetate	☐	☑		
6.	Aniline	☐	☑		
7.	Benzonitrile	☐	☑		
8.	Benzyl chloride	☐	☑		
9.	Butyl acetate	☐	☑		
10.	Butylamine	☐	☑		
11.	Captan	☐	☑		
12.	Carbaryl	☐	☑		
13.	Carbofuran	☐	☑		
14.	Carbon disulfide	☐	☑		
15.	Chlorpyrifos	☐	☑		
16.	Coumaphos	☐	☑		
17.	Cresol	☐	☑		
18.	Crotonaldehyde	☐	☑		
19.	Cyclohexane	☐	☑		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
20.	2,4-D (2,4-dichlorophenoxyacetic acid)	☐	☑		
21.	Diazinon	☐	☑		
22.	Dicamba	☐	☑		
23.	Dichlobenil	☐	☑		
24.	Dichlone	☐	☑		
25.	2,2-dichloropropionic acid	☐	☑		
26.	Dichlorvos	☐	☑		
27.	Diethyl amine	☐	☑		
28.	Dimethyl amine	☐	☑		
29.	Dintrobenzene	☐	☑		
30.	Diquat	☐	☑		
31.	Disulfoton	☐	☑		
32.	Diuron	☐	☑		
33.	Epichlorohydrin	☐	☑		
34.	Ethion	☐	☑		
35.	Ethylene diamine	☐	☑		
36.	Ethylene dibromide	☐	☑		
37.	Formaldehyde	☐	☑		
38.	Furfural	☐	☑		

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

Form Approved 03/05/19
OMB No. 2040-0004

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
39.	Guthion	☐	☑		
40.	Isoprene	☐	☑		
41.	Isopropanolamine	☐	☑		
42.	Kelthane	☐	☑		
43.	Kepone	☐	☑		
44.	Malathion	☐	☑		
45.	Mercaptodimethur	☐	☑		
46.	Methoxychlor	☐	☑		
47.	Methyl mercaptan	☐	☑		
48.	Methyl methacrylate	☐	☑		
49.	Methyl parathion	☐	☑		
50.	Mevinphos	☐	☑		
51.	Mexacarbate	☐	☑		
52.	Monoethyl amine	☐	☑		
53.	Monomethyl amine	☐	☑		
54.	Naled	☐	☑		
55.	Naphthenic acid	☐	☑		
56.	Nitrotoluene	☐	☑		
57.	Parathion	☐	☑		

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
58.	Phenolsulfonate	☐	☑		
59.	Phosgene	☐	☑		
60.	Propargite	☐	☑		
61.	Propylene oxide	☐	☑		
62.	Pyrethrins	☐	☑		
63.	Quinoline	☐	☑		
64.	Resorcinol	☐	☑		
65.	Strontium	☐	☑		
66.	Strychnine	☐	☑		
67.	Styrene	☐	☑		
68.	2,4,5-T (2,4,5-trichlorophenoxyacetic acid)	☐	☑		
69.	TDE (tetrachlorodiphenyl ethane)	☐	☑		
70.	2,4,5-TP [2-(2,4,5-trichlorophenoxy) propanoic acid]	☐	☑		
71.	Trichlorofon	☐	☑		
72.	Triethanolamine	☐	☑		
73.	Triethylamine	☐	☑		
74.	Trimethylamine	☐	☑		
75.	Uranium	☐	☑		
76.	Vanadium	☐	☑		

TABLE D. CERTAIN HAZARDOUS SUBSTANCES AND ASBESTOS (40 CFR 122.21(g)(7)(vii))[1]

	Pollutant	Presence or Absence (check one)		Reason Pollutant Believed Present in Discharge	Available Quantitative Data (specify units)
		Believed Present	Believed Absent		
77.	Vinyl acetate	☐	☑		
78.	Xylene	☐	☑		
79.	Xylenol	☐	☑		
80.	Zirconium	☐	☑		

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cities Generating Station	A02

TABLE E. 2,3,7,8 TETRACHLORODIBENZO P DIOXIN (2,3,7,8 TCDD) (40 CFR 122.21(g)(7)(viii))

Pollutant	TCDD Congeners Used or Manufactured	Presence or Absence (check one)		Results of Screening Procedure
		Believed Present	Believed Absent	
2,3,7,8-TCDD	☐	☐	☑	

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110041007111	IL0005037	Quad Cites Generating Station	

Form 2F NPDES

EPA

U.S Environmental Protection Agency
Application for NPDES Permit to Discharge Wastewater

STORMWATER DISCHARGES ASSOCIATED WITH INDUSTRIAL ACTIVITY

SECTION 1. OUTFALL LOCATION (40 CFR 122.21(g)(1))

Outfall Location

1.1 Provide information on each of the facility's outfalls in the table below

Outfall Number	Receiving Water Name	Latitude	Longitude
001/002	Mississippi River	41° 43′ 30.40″ N	90° 18′ 45.40″ W
B01	Mississippi River	41° 43′ 30.40″ N	90° 18′ 45.40″ W
A02	Mississippi River	41° 43′ 30.40″ N	90° 18′ 45.40″ W
		° ′ ″	° ′ ″
		° ′ ″	° ′ ″
		° ′ ″	° ′ ″

SECTION 2. IMPROVEMENTS (40 CFR 122.21(g)(6))

Improvements

2.1 Are you presently required by any federal, state, or local authority to meet an implementation schedule for constructing, upgrading, or operating wastewater treatment equipment or practices or any other environmental programs that could affect the discharges described in this application?

☐ Yes ☑ No → SKIP to Section 3.

2.2 Briefly identify each applicable project in the table below.

Brief Identification and Description of Project	Affected Outfalls (list outfall numbers)	Source(s) of Discharge	Final Compliance Dates	
			Required	Projected

2.3 Have you attached sheets describing any additional water pollution control programs (or other environmental projects that may affect your discharges) that you now have underway or planned? (Optional Item)

☐ Yes ☐ No

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110041007111	IL0005037	Quad Cites Generating Station	

SECTION 3. SITE DRAINAGE MAP (40 CFR 122.26(c)(1)(i)(A))

Site Drainage Map

3.1 Have you attached a site drainage map containing all required information to this application? (See instructions for specific guidance.)

☑ Yes ☐ No

SECTION 4. POLLUTANT SOURCES (40 CFR 122.26(c)(1)(i)(B))

Pollutant Sources

4.1 Provide information on the facility's pollutant sources in the table below.

Outfall Number	Impervious Surface Area (within a mile radius of the facility)		Total Surface Area Drained (within a mile radius of the facility)	
001/002	58	*specify units* acres	116	*specify units* acres
		specify units		*specify units*
		specify units		*specify units*
		specify units		*specify units*
		specify units		*specify units*
		specify units		*specify units*

4.2 Provide a narrative description of the facility's significant material in the space below. (See instructions for content requirements.)

Quad Cities Station does not store/stockpile any significant or raw materials outside that are exposed to the weather.

4.3 Provide the location and a description of existing structural and non-structural control measures to reduce pollutants in stormwater runoff. (See instructions for specific guidance.)

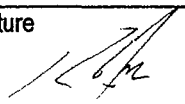
Stormwater Treatment		
Outfall Number	Control Measures and Treatment	Codes from Exhibit 2F-1 (list)
001/002	Stormwater runoff is routed though oil/water separators prior to discharge	1-H, 1-U

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110041007111	IL0005037	Quad Cites Generating Station	

SECTION 5. NON STORMWATER DISCHARGES (40 CFR 122.26(c)(1)(i)(C))

Non-Stormwater Discharges

5.1 *I certify under penalty of law that the outfall(s) covered by this application have been tested or evaluated for the presence of non-stormwater discharges. Moreover, I certify that the outfalls identified as having non-stormwater discharges are described in either an accompanying NPDES Form 2C, 2D, or 2E application.*

Name (print or type first and last name)	Official title
Kenneth Ohr	Site Vice President
Signature	**Date signed**
	12-12-19

5.2 Provide the testing information requested in the table below.

Outfall Number	Description of Testing Method Used	Date(s) of Testing	Onsite Drainage Points Directly Observed During Test
001/002	Stormwater and non-stormwater combine prior to	06/04/2019	Discharge Bay
	discharge through Outfall 001/002 Open Cycle		
	Diffusers as verified by review of plant drawings		
	and drainage maps		

SECTION 6. SIGNIFICANT LEAKS OR SPILLS (40 CFR 122.26(c)(1)(i)(D))

Significant Leaks or Spills

6.1 Describe any significant leaks or spills of toxic or hazardous pollutants in the last three years.

NA - no spills of toxic or hazardous pollutants within the three years.

SECTION 7. DISCHARGE INFORMATION (40 CFR 122.26(c)(1)(i)(E))

Discharge Information

See the instructions to determine the pollutants and parameters you are required to monitor and, in turn, the tables you must complete. Not all applicants need to complete each table.

7.1 Is this a new source or new discharge?

☐ Yes ➔ See instructions regarding submission of *estimated* data. ☑ No ➔ See instructions regarding submission of *actual* data.

Tables A, B, C, and D

7.2 Have you completed Table A for each outfall?

☑ Yes ☐ No

Discharge Information Continued

7.3	Is the facility subject to an effluent limitation guideline (ELG) or effluent limitations in an NPDES permit for its process wastewater?	☑ Yes ☐ No → SKIP to Item 7.5.
7.4	Have you completed Table B by providing quantitative data for those pollutants that are (1) limited either directly or indirectly in an ELG and/or (2) subject to effluent limitations in an NPDES permit for the facility's process wastewater?	☑ Yes ☐ No
7.5	Do you know or have reason to believe any pollutants in Exhibit 2F–2 are present in the discharge?	☑ Yes ☐ No → SKIP to Item 7.7.
7.6	Have you listed all pollutants in Exhibit 2F–2 that you know or have reason to believe are present in the discharge and provided quantitative data or an explanation for those pollutants in Table C?	☑ Yes ☐ No
7.7	Do you qualify for a small business exemption under the criteria specified in the Instructions?	☐ Yes →SKIP to Item 7.18. ☑ No
7.8	Do you know or have reason to believe any pollutants in Exhibit 2F–3 are present in the discharge?	☑ Yes ☐ No → SKIP to Item 7.10.
7.9	Have you listed all pollutants in Exhibit 2F–3 that you know or have reason to believe are present in the discharge in Table C?	☑ Yes ☐ No
7.10	Do you expect any of the pollutants in Exhibit 2F–3 to be discharged in concentrations of 10 ppb or greater?	☑ Yes ☐ No → SKIP to Item 7.12.
7.11	Have you provided quantitative data in Table C for those pollutants in Exhibit 2F–3 that you expect to be discharged in concentrations of 10 ppb or greater?	☑ Yes ☐ No
7.12	Do you expect acrolein, acrylonitrile, 2,4-dinitrophenol, or 2-methyl-4,6-dinitrophenol to be discharged in concentrations of 100 ppb or greater?	☐ Yes ☑ No → SKIP to Item 7.14.
7.13	Have you provided quantitative data in Table C for the pollutants identified in Item 7.12 that you expect to be discharged in concentrations of 100 ppb or greater?	☐ Yes ☐ No
7.14	Have you provided quantitative data or an explanation in Table C for pollutants you expect to be present in the discharge at concentrations less than 10 ppb (or less than 100 ppb for the pollutants identified in Item 7.12)?	☐ Yes ☑ No
7.15	Do you know or have reason to believe any pollutants in Exhibit 2F–4 are present in the discharge?	☐ Yes ☑ No → SKIP to Item 7.17.
7.16	Have you listed pollutants in Exhibit 2F–4 that you know or believe to be present in the discharge and provided an explanation in Table C?	☐ Yes ☐ No
7.17	Have you provided information for the storm event(s) sampled in Table D?	☐ Yes ☑ No

Discharge Information Continued

Used or Manufactured Toxics

7.18 Is any pollutant listed on Exhibits 2F–2 through 2F–4 a substance or a component of a substance used or manufactured as an intermediate or final product or byproduct?

☐ Yes ☑ No → SKIP to Section 8.

7.19 List the pollutants below, including TCDD if applicable.

1.	4.	7.
2.	5.	8.
3.	6.	9.

SECTION 8. BIOLOGICAL TOXICITY TESTING DATA (40 CFR 122.21(g)(11))

Biological Toxicity Testing Data

8.1 Do you have any knowledge or reason to believe that any biological test for acute or chronic toxicity has been made on any of your discharges or on a receiving water in relation to your discharge within the last three years?

☐ Yes ☑ No → SKIP to Section 9.

8.2 Identify the tests and their purposes below.

Test(s)	Purpose of Test(s)	Submitted to NPDES Permitting Authority?	Date Submitted
		☐ Yes ☐ No	
		☐ Yes ☐ No	
		☐ Yes ☐ No	

SECTION 9. CONTRACT ANALYSIS INFORMATION (40 CFR 122.21(g)(12))

Contract Analysis Information

9.1 Were any of the analyses reported in Section 7 (on Tables A through C) performed by a contract laboratory or consulting firm?

☑ Yes ☐ No → SKIP to Section 10.

9.2 Provide information for each contract laboratory or consulting firm below.

	Laboratory Number 1	Laboratory Number 2	Laboratory Number 3
Name of laboratory/firm	PDC Laboratories, Inc.		
Laboratory address	2231 W Altorfer Drive Peoria, IL 61615		
Phone number	(800) 752-6651		
Pollutant(s) analyzed	Anions, General Chemistry, Nutrients, Total Metals, Radioactivity		

EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110041007111	IL0005037	Quad Cites Generating Station	

SECTION 10. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(a) and (d))

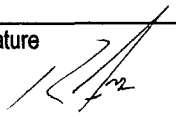
Checklist and Certification Statement

10.1 In Column 1 below, mark the sections of Form 2F that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing to alert the permitting authority. Note that not all applicants are required to complete all sections or provide attachments.

Column 1	Column 2
☑ Section 1	☐ w/ attachments (e.g., responses for additional outfalls)
☐ Section 2	☐ w/ attachments
☑ Section 3	☑ w/ site drainage map
☑ Section 4	☐ w/ attachments
☑ Section 5	☐ w/ attachments
☑ Section 6	☐ w/ attachments
☑ Section 7	☑ Table A ☐ w/ small business exemption request ☑ Table B ☐ w/ analytical results as an attachment ☑ Table C ☐ Table D
☐ Section 8	☐ w/attachments
☑ Section 9	☐ w/attachments (e.g., responses for additional contact laboratories or firms)
☑ Section 10	☐

10.2 **Certification Statement**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name (print or type first and last name)	Official title
Kenneth Ohr	Site Vice President
Signature	Date signed
	12-12-19

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cites Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE A. CONVENTIONAL AND NON CONVENTIONAL PARAMETERS (40 CFR 122.26(c)(1)(i)(E)(3))[1]

You must provide the results of at least one analysis for every pollutant in this table. Complete one table for each outfall. See instructions for additional details and requirements.

	Pollutant or Parameter	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Number of Storm Events Sampled	Source of Information (new source/new dischargers only; use codes in instructions)
		Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite		
1.	Oil and grease	<6.0 mg/L				0	
2.	Biochemical oxygen demand (BOD_5)		<4.0 mg/L			0	
3.	Chemical oxygen demand (COD)		25.0 mg/L			0	
4.	Total suspended solids (TSS)		110.0 mg/L			0	
5.	Total phosphorus		<0.10 mg/L			0	
6.	Total Kjeldahl nitrogen (TKN)		1.2 mg/L			0	
7.	Total nitrogen (as N)		1.2 mg/L			0	
8.	pH (minimum)	7.5				0	
	pH (maximum)	8.1				0	

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cites Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. CERTAIN CONVENTIONAL AND NON CONVENTIONAL POLLUTANTS (40 CFR 122.26(c)(1)(i)(E)(4) and 40 CFR 122.21(g)(7)(vi)(A))[1]

List each pollutant that is limited in an effluent limitation guideline (ELG) that the facility is subject to or any pollutant listed in the facility's NPDES permit for its process wastewater (if the facility is operating under an existing NPDES permit). Complete one table for each outfall. See the instructions for additional details and requirements.

Pollutant and CAS Number (if available)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Number of Storm Events Sampled	Source of Information (new source/new dischargers only; use codes in instructions)
	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite		
Total Suspened Solids		110.0 mg/L		30.4 mg/L	0	
Oil & Grease		<6.0 mg/L			0	
Total Residual Oxidant		0.03 mg/L		<0.02 mg/L	0	

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110041007111	IL0005037	Quad Cites Generating Station	001/002

Form Approved 03/05/19
OMB No. 2040-0004

TABLE C. TOXIC POLLUTANTS, CERTAIN HAZARDOUS SUBSTANCES, AND ASBESTOS (40 CFR 122.26(c)(1)(i)(E)(4) and 40 CFR 122.21(g)(7)(vi)(B) and (vii))[1]

List each pollutant shown in Exhibits 2F–2, 2F–3, and 2F–4 that you know or have reason to believe is present. Complete one table for each outfall. See the instructions for additional details and requirements.

Pollutant and CAS Number (if available)	Maximum Daily Discharge (specify units)		Average Daily Discharge (specify units)		Number of Storm Events Sampled	Source of Information (new source/new dischargers only; use codes in instructions)
	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite	Grab Sample Taken During First 30 Minutes	Flow-Weighted Composite		
Color		30 C.U.			0	
Nitrogen, total organic (as N)		1.2 mg/L			0	
Sulfate		35 mg/L			0	
Nitrate/Nitrite		1.5 mg/L			0	
Barium, total		0.042 mg/L			0	
Boron, total		0.044 mg/L			0	
Aluminum, total		0.29 mg/L			0	
Iron, total		0.41 mg/L			0	
Magnesium, total		16 mg/L			0	
Manganese, total		0.050 mg/L			0	
Titanium, total		0.0073 mg/L			0	
Zinc, total		0.064 mg/L			0	

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

This page intentionally left blank.

EPA Identification Number	NPDES Permit Number	Facility name	Outfall Number
110041007111	IL0005037	Quad Cites Generating Station	001/002

TABLE D. STORM EVENT INFORMATION (40 CFR 122.26(c)(1)(i)(E)(6))

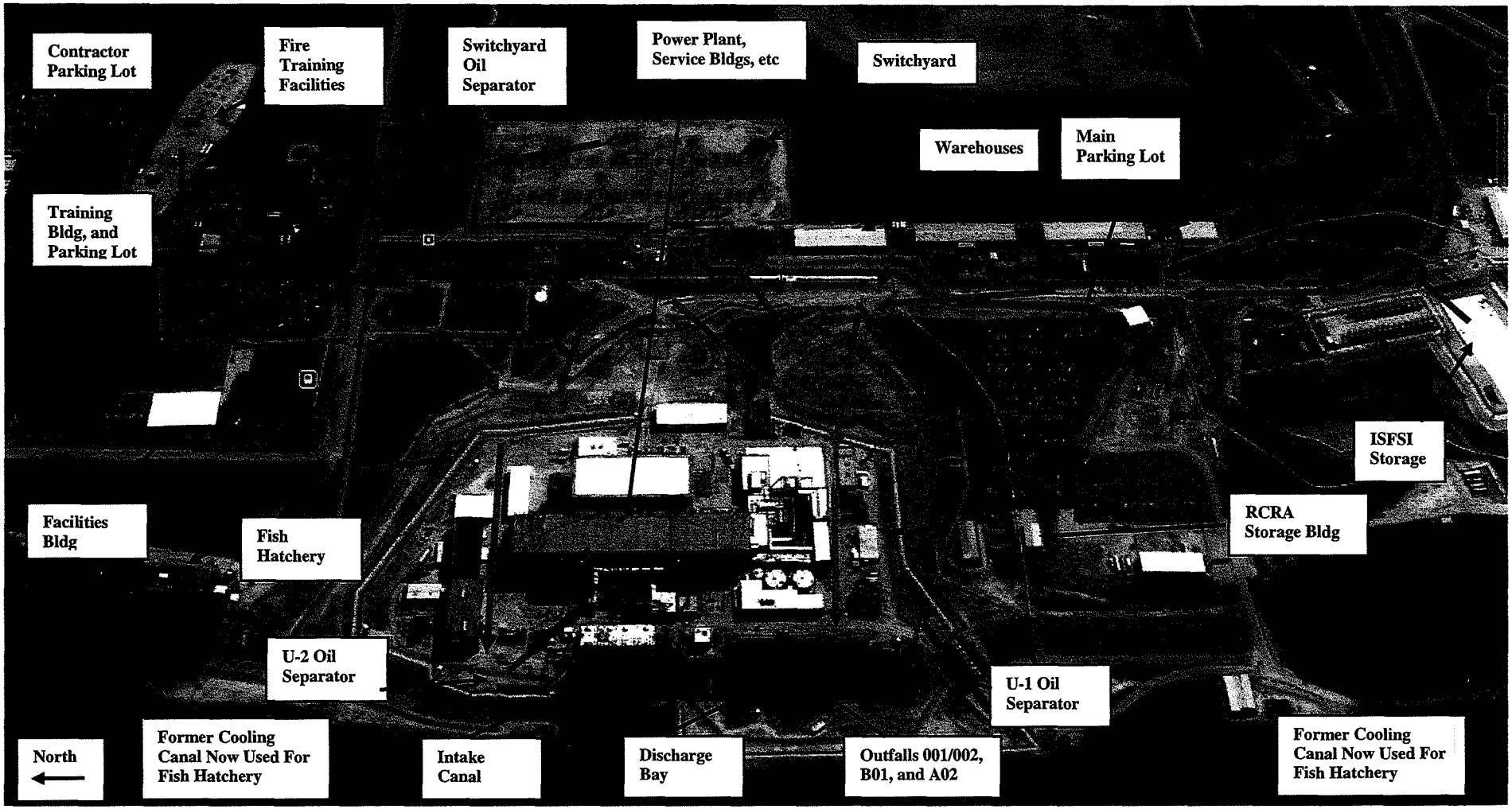
Provide data for the storm event(s) that resulted in the maximum daily discharges for the flow-weighted composite sample.

Date of Storm Event	Duration of Storm Event (in hours)	Total Rainfall During Storm Event (in inches)	Number of Hours Between Beginning of Storm Measured and End of Previous Measurable Rain Event	Maximum Flow Rate During Rain Event (in gpm or specify units)	Total Flow from Rain Event (in gallons or specify units)

Provide a description of the method of flow measurement or estimate.

NA - Quad Cities Station is not required to sample stormwater per the current NPDES permit.

Attachment 4
Quad Cities Generating Station Site Drainage Map



Direction of Storm Water Flow

All Stormwater from Impervious Surfaces (parking lots, concrete surfaces, rocked ditches, roof drains) is routed to either the U-1 or U-2 Oil/Water Separators. Runoff from parking lots, ditches on north side of station are routed to storm sewer and into U-2 Oil/Water Separator. Runoff from parking lots, ditches on south side of station are routed to storm sewer and into U-1 Oil/Water Separator. U-1 & U-2 Oil/Water Separators discharge through Outfall 001/002 Open Cycle Diffusers. Quad Cities Station does not store or stockpile any significant or raw materials outside that are exposed to weather.

Attachment 5

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

www.exeloncorp.com

SVP-19-071

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

October 8, 2019

Darin LeCrone
Manager, Industrial Unit, Permit Section
Division of Water Pollution Control
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

Subject: Exelon Generation Company
Quad Cities Nuclear Power Station
Renewal of NPDES Permit No. IL0005037, Issue Date: July 20, 2015

Dear Mr. LeCrone:

Exelon Generation Co., LLC, Quad Cities Nuclear Power Station, would like to request an exemption from the sampling and analysis for pollutants categorized as GC/MS Fraction Compounds in Part V-C of the Consolidated Permit Application for the subject NPDES permit application. Quad Cities Station does not have any processes that would be suspect of introducing these pollutants into our systems/NPDES outfalls. Relief from this sampling requirement was requested and granted with the previous NPDES permit application in December 2014, per 40 CFR, Part 122, Subpart B, Section 122.21. Based on the above information, we believe that this request is appropriate and would like to thank you in advance for your consideration in this matter.

If you have any questions or need additional information, please contact Mark Stuhlman at (309) 227-2765.

Sincerely,

Kenneth Ohr
Site Vice President
Quad Cities Station

KO/MS

CC: Mark Stuhlman
Letterbook
Mark Liska, IEPA Permitting

Attachment 6
Analysis of Crappie and Sauger Populations in Pool 14

Prepared by Jeremiah Haas
Exelon Nuclear, Quad Cities Station

1 Introduction

As part of the Quad Cities Nuclear Station NPDES Permit No. IL 0005037, Special Condition 7d, the permitee must conduct a study of White Crappie, Black Crappie, and Sauger populations in Pool 14 of the Mississippi River. The permitee must conduct this study during the term of the first NPDES permit containing IPCB Order 14-123 alternative thermal effluent limitations. The results of this study must be made available to Illinois EPA, Illinois DNR, and Iowa DNR when the permittee applies for renewal of this NPDES permit.

This white paper will discuss the populations and life histories of the three species as well as how those populations have changed over the past 40 plus years.

1.1 Background

A longterm monitoring program of all fishes was initiated in 1971 in conjunction with the construction and operation of Quad Cities Nuclear Station, which is located on Pool 14 of the Mississippi River. The principal objectives of this program have been aimed at determining whether the Station operation has had any measurable effects upon the fish community in Pool 14. Freshwater Drum was selected as an indicator species because its believed it would be most affected by Station operation through impingement and entrainment. Freshwater Drum ranks second to Gizzard Shad in terms of numerical contribution to annual impingement and previous entrainment studies have shown that Freshwater Drum contribute a significant portion of the available entrainable animals in the river. The earliest studies considered a wide range of potential biological effects, including those on lower trophic levels. As a result, a variety of sampling methods have been utilized during the 40-year study. However, initial concerns regarding lower trophic levels were resolved by 1978 and recent sampling efforts summarized herein have focused on the fish community in Pool 14.

In reviewing this longterm database, it became apparent that the pooled portion of the Upper Mississippi River is an extremely complex ecosystem influenced by both natural and anthropogenic factors. This monitoring program has not identified any verifiable effects of Station operations on the fishery of Pool 14. They have, however, led to the conclusion that the physical characteristics of the river can be highly variable and subject to relatively rapid changes (Lippincott and Bowzer, 2000).

Gizzard shad and Freshwater Drum dominate the fish community, with Emerald Shiner, River Shiner, Bullhead Minnow, Common Carp, Largemouth Bass and Bluegill also being abundant in Pool 14. Several other species, including Mooneye, River Carpsucker, Smallmouth Buffalo, Shorthead and Golden Redhorse, Channel and Flathead Catfish, White Bass, Black Crappie, Sauger and Walleye have been commonly collected during this monitoring effort. Walleye abundance in Pool 14 has increased measurably since 1985, due in large part to a stocking program of fingerling fish that were reared in Quad Cities Station's inactive cooling canal. Hybrid Striped Bass have also been taken in increasing numbers due to the same stocking program.

Individual fish species in Pool 14 have exhibited both long-term and short-term fluctuations in abundance. Overall, the fish population of Pool 14 is extremely dynamic and resilient, and in high abundance. This long term data set has afforded an opportunity to observe multiple occurrences of short term cycles, which has provided a more complete characterization of the fish community. Conversely, short term data sets can be misleading simply because of their tenure. Therefore, resource managers and

regulators who must base decisions and recommendations on short-term data sets are urged to exercise a reasonable degree of caution.

1.2 Questions to Examine

The salient questions considered in this white paper are:

1) Have the populations of Black Crappie, White Crappie, and Sauger changed over the past 40+ years and if so, why?
2) Is the thermal discharge of a contributor to such changes?

2 Fish Population Changes

To complete this requirement, data has been compiled from both the Exelon Long Term Monitoring Program and the USGS Upper Mississippi River Restoration Long Term Monitoring Program (UMRR LTRMP). Forty years of data was selected as a cutoff for the review because it encompassed multiple generations of potential changes in the fishery. The LTRMP is being used as a control even though there are differences between Pools 13 and 14. Pool 13 ends the "hilled" pools of the Mississippi River, while Pool 14 begins the "leveed" portions of the Mississippi River. Pool 13 has more backwater areas compared to Pool 14, although Pool 14 does have a significantly larger amount of backwater than most leveed pools downstream of the Quad Cities.

The principal objectives of the USGS LTRMP are to determine species composition and relative species abundance in the various habitat types that occur in Pool 13. The sampling techniques employed through 2013 included electrofishing, hoop netting, fyke netting, and haul seining. Mississippi River Monitoring Station team conducts annual monitoring of fisheries, water quality, and aquatic vegetation in Pool 13 of the Mississippi River (from Bellevue, Iowa, to Clinton, Iowa). This monitoring area begins 18 river miles north of the Exelon Station, well outside the zone of influence of the Station. Activities undertaken by this management team include:

1) conducting water quality monitoring of local Mississippi River tributaries,
2) monitors local Mississippi River environmental restoration projects (i.e., backwater dredging) to evaluate the ecological response of these projects,
3) enhances the scientific understanding of the Upper Mississippi River ecosystem,
4) collaborates with federal partners and neighboring states on Mississippi River management and potential habitat restoration projects,
5) and assists other Mississippi River teams with monitoring plans and data collection efforts.

The LTRMP and Exelon contractors have been sampling the river for decades, with the same individuals conducting most of the field work. This continuity allows sampler efficiency and minimizes the variables to cloud data interpretation. River conditions also dictate the ability to catch fish during a sample; however, by increasing the sample size, you can lower the variability of sampling and draw closer to the true population number. Time and resources dictate the amount of sampling that can be conducted in any fisheries sampling program.

2.1 Black and White Crappie Life History (from UMRCC, 2004, page 175)

2.1.1 Fecundity and Breeding Habits

The number of eggs produced per female for both species average from 20,000 to 60,000 ranging up to 150,000. Both species of crappie normally spawn in late April to June with water temperatures in the mid-50s to mid-60s (°F). Most nests occur in water depths of 3–6 ft, but nesting may occur as deep as 20 ft. Males normally build colonial nests on a sandy substrate and guard the eggs until hatching is complete in 3 to 7 days.

2.1.2 Life History

Schooling is a characteristic of both species and begins early in life. Zooplankton, insects, and other small invertebrates are the principal diet of young crappie. Crappies switch to a diet of fish and larger invertebrates when their gape reaches an adequate size. This usually occurs during the second growing season. Crappies feed at all times of the day; but, are most active in the evening or early morning. Crappies prefer relatively deep, off-channel areas with adequate food and dissolved oxygen, but can be found in all river habitats with suitable water quality and moderate flow. Crappies are attracted to fallen

trees or brush and tend to aggregate near these structures particularly in spring and fall. However, Crappie (especially young Crappie) can also be found suspended over deep water away from structure. Studies conducted on Crappie movements do not indicate a tendency to migrate. However, they will move within and between habitat types, likely in response to food and water quality conditions. Pitlo (2001b) found White Crappie traveled an average of 1.9 miles and Black Crappie traveled an average of 3.4 miles to reach suitable overwinter habitat. Backwater habitats that Crappies tend to favor during winter have very low flow, the warmest available temperatures, and dissolved oxygen concentrations above 3 mg/L (Knights et al. 1999; Pitlo 2001b).

2.1.3 Age and Growth

Age and growth are similar for both Crappie species with six years being about the maximum age and 14 inches about the greatest length attained in the Mississippi River. Most of the fishable population consists of three and four-year old fish ranging from 7 to 12 inches in total length. Crappie growth rate diminishes significantly after the third or fourth year of life. Average length at age for Mississippi River Black Crappie from Pool 5 are shown below (Knights, U.S. Geological Survey, La Crosse, Wisconsin, personal communication):

Age	Mean Length (in.)	Age	Mean Length (in.)
I	3.6	IV	9.9
II	6.0	V	11.0
III	8.2	VI	11.8

2.1.4 Age and Size at Maturity

Crappie mature sexually between Ages II and III at average total lengths of about 8 inches.

2.1.5 Survival Ability

Crappie recruitment can vary greatly from year to year and is likely related to river conditions. Variables such as the timing or duration of the spring flood pulse may have significant impact on annual recruitment. Boland et al. (2000) reported five-year cyclic changes in catch per effort of fyke nets for Black Crappie. Although White Crappie showed similar cycles in some pools the trends were not as clear. Studies have shown that annual natural mortality of Crappies can be as high as 60 to 70%, while fishing mortality ranges from 18 to 30%. This suggests that, fishing mortality of Crappie in the river is not likely to affect the fishable population from year to year. Rather environmental factors affecting Crappie recruitment and natural mortality will have a greater influence. This also suggests that more restrictive harvest regulations would not result in significant increases in Crappie of harvestable size.

2.1.6 Relative Importance to the Fishery

Crappies are present in all pools and provide an excellent year around sport fishery. Crappies were the second most important species harvested according to the 1962–63, 1967–68, and 1972–73 creel surveys. (Nord 1964; Wright 1970; Fleener 1975). However, the estimated number of Crappie harvested by anglers declined during the period covered by the three creel surveys, contributing an estimated 397,322; 366,469 and 219,445 fish, respectively. Crappies were considered a legal commercial species in Illinois from 1955 to 1962. During this period a total of 140,663 pounds valued at $26,522 were taken. The largest catch (30,474 lbs.) was reported for 1962. Recent creel surveys still indicate that Crappies are ranked as one of the top two most harvested sport fish in various pools in the Upper Mississippi River (Dewey and Holland-Bartels 1987; Ackerman et al. 1992; Stevens 1997b). Data from standardized sampling in Pools 4, 8, 13, and 26 from 1990 through 1997, indicates that Black Crappie abundance is variable from year to year, with no observable trend. (Bartels 2000).

2.1.7. Identifying Local Crappie Trends from Exelon & LTRMP Data

The Quad Cities Station Longterm Monitoring Program has been recording the fish population changes in the Mississippi River since 1971, whereas the USGS LTRMP program has been operating since 1991. The programs have different methods for sampling, but can be used as comparative indexes, especially in a long term trending review.

To highlight the changes for Crappie over the past few decades, data from both programs were compared. Although gear and protocols are different, population trends over time can be comparable. Key differences between the programs are:

1) The LTRMP program began in 1991 while the Exelon program began in 1971.
2) The LTRMP program uses modified random sites within specific habitats in Pool 13 whereas the Exelon program has used the same fixed sites within Pool 14 over the past 40 years with few exceptions.
3) The LTRMP program used randomized fyke nets in backwater sites for these data whereas the Exelon program is reporting data from electrofishing.
4) The LTRMP sampling is conducted in a more preferred habitat for the species in question, whereas the Exelon data is for all habitats sampled.

Also note, the early years of the Quad Cities Station monitoring program were different than today. Many sampling stations that were used in the early days have been discontinued or moved due to the river changes, typically backwater electrofishing stations have silted in to the point they are no longer accessible. These backwater or side channel areas with habitat (Areas 3, 6, 9, 10) had preferable characteristics for Crappies in the early years but are no longer suitable. Area 10 was moved to an alternate backwater in Grant Slough, which seasonally can hold some Crappies, but not comparable to the previous site.

2.1.7.1. Black Crappie

Black Crappies use a variety of habitats throughout the year, and populations tend to fluctuate based on the conditions of the river (Figure 1). The figure shows the high variability of Black Crappie populations over a 23-year period in Pool 13.

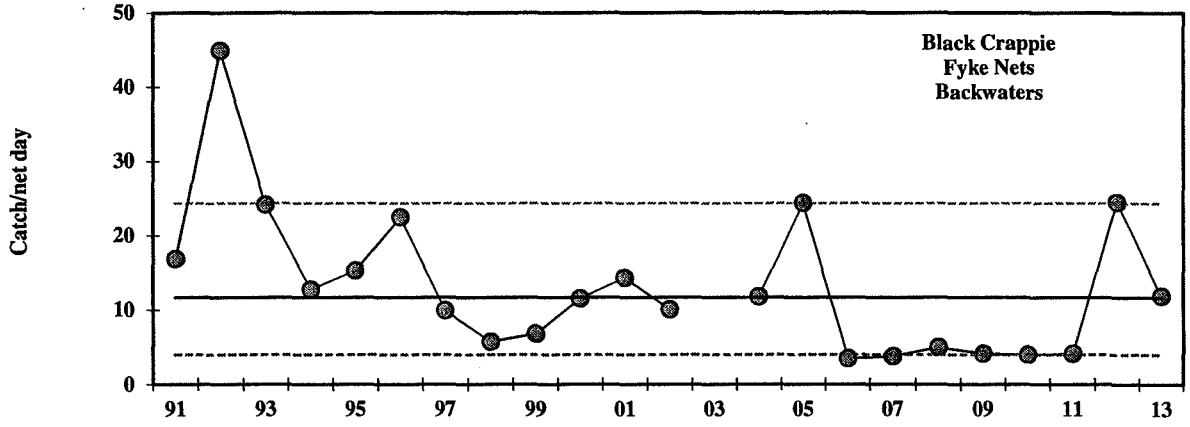


Figure 1. Black Crappie collections by the LTRMP in Pool 13, 1991-2013.

Attachment 6
Analysis of Crappie and Sauger Populations in Pool 14

Black Crappie are relatively abundant in the backwaters of Pool 13; however, over the 23 years reviewed, numbers have deviated by a degree of magnitude, showing the high variability of the populations and the effectiveness of sampling these particular species. There was no sampling in 2003 due to budgetary issues.

Overall, Black Crappie were below the long-term mean prior to 2003 only 4 of 12 years. However, since 2004, only 2 years exceeded the longterm mean for the species. As stated earlier, environmental factors, including adequate backwater overwintering habitat and backwater siltation are likely affecting Black Crappie recruitment and natural mortality. These factors are likely having a greater influence on the longterm population trends than either fishing mortality or anthropogenic impacts occurring on Pool 13. While the LTRMP has been documenting the abundance of Black Crappie in Pool 13 since 1991, Exelon has been monitoring since 1971. When the Pool 13 data set is overlaid on the Pool 14 data set captured by the Exelon long term monitoring program, we see a moderately strong correlation between the two data sets (Figure 2).

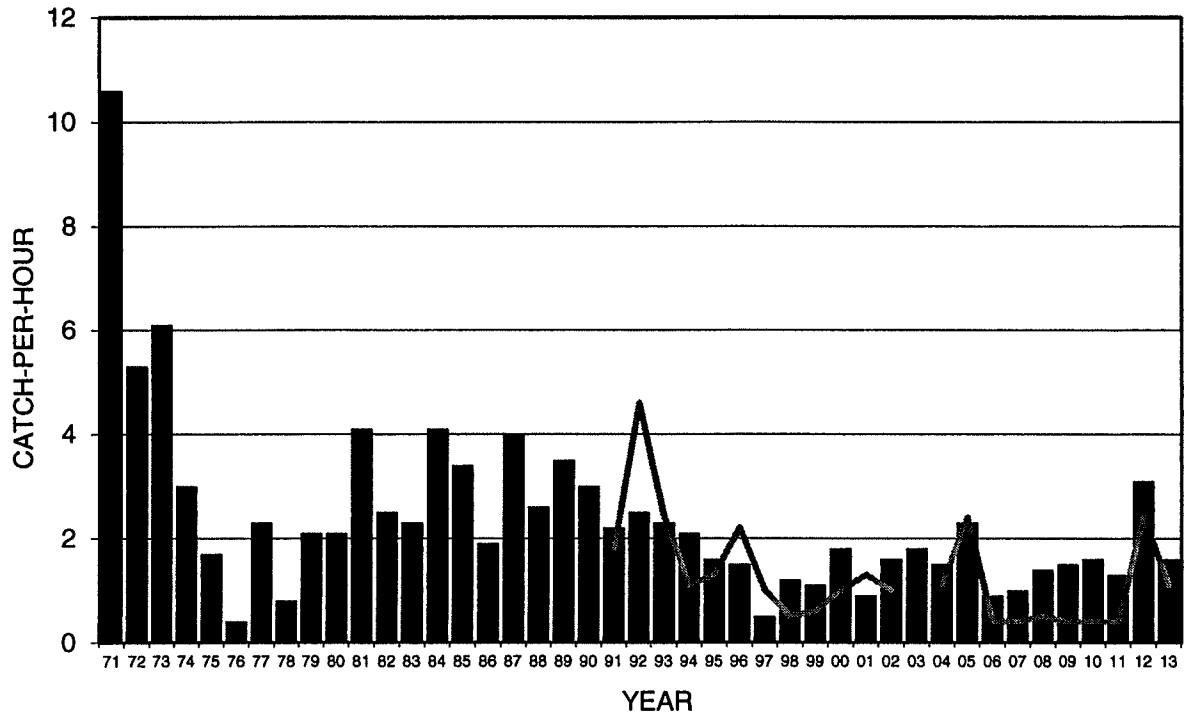


Figure 2. Black Crappie collections by Exelon in Pool 14 (bar graph), 1971-2013 with the LTRMP collections (line graph).

Even though the methods used to collect these data differ, the trend of the Crappie populations between the 2 pools continues to run in a moderately parallel fashion. Variability between the 2 data sets is most likely a sampling bias as compared to significant differences between the populations in the two pools. The early years of the Exelon study (included additional sampling, which would bias the Crappie numbers higher) showed higher numbers than present, but fall collections can be very high when downed trees or other woody habitats are available for the Crappies to congregate on. Those early studies are discussed in the Section 2.1.7. The Quad Cities Station began open cycle operation in 1984, allowing 13 years of pre-open cycle operations when the impact of the Station should be minimal.

2.1.7.2. White Crappie

White Crappie populations have also been highly variable over the last 40 years in Pools 13 & 14. The population density of White Crappie is significantly lower than the density of Black Crappie on both Pools that are being reviewed. Figure 3 shows the LTRMP backwater sampling by fyke nets in Pool 13 backwaters. Similar trends are seen in White Crappie which were seen in Black Crappie. Prior to 2003, White Crappies maintained a higher year-to-year average than the data set seen after 2003. Over the long term, White Crappie collections have decreased in Pool 13.

Figure 4 contains the Pool 13 data overlaid on the Pool 14 index. White Crappies have seen a precipitous drop since the 1970s, likely due to habitat changes as the pools age.

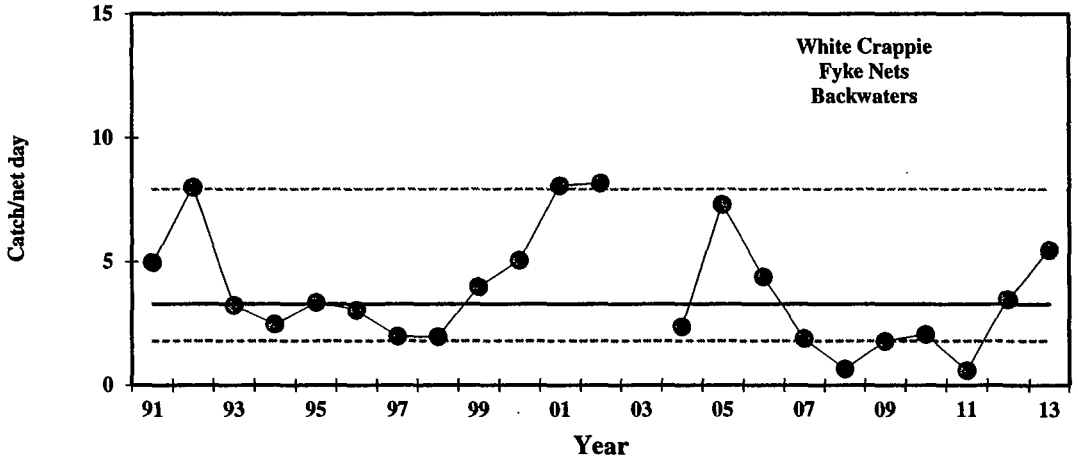


Figure 3. White Crappie collections by the LTRMP in Pool 13, 1991-2013.

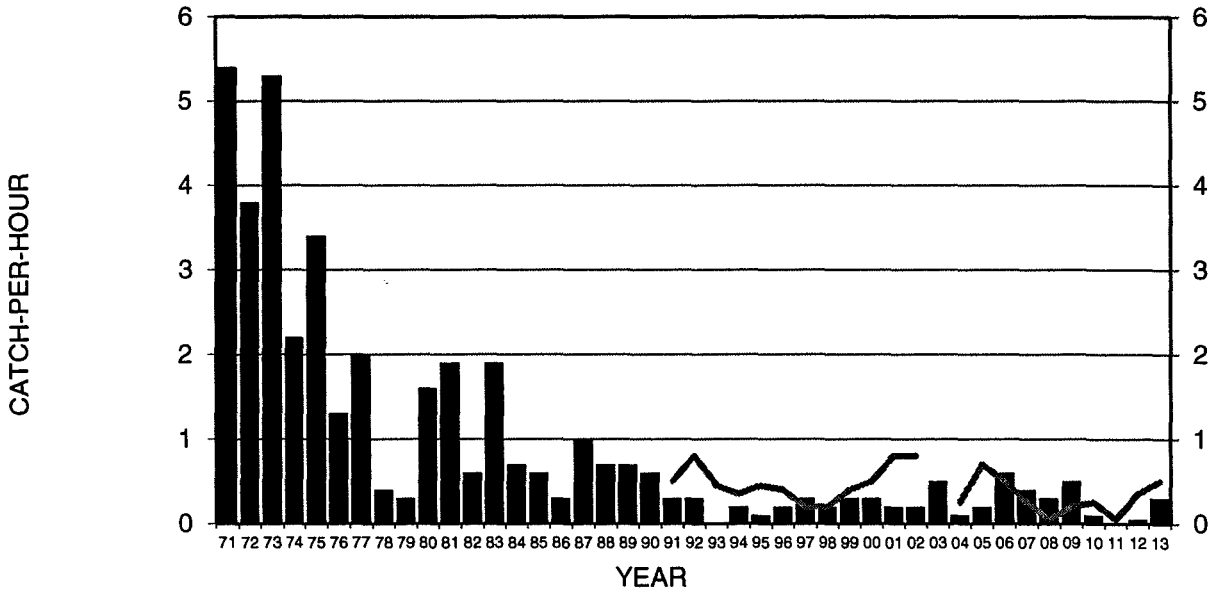


Figure 4. White Crappie collections by Exelon in Pool 14 (bar graph), 1971-2013 with the LTRMP collections (line graph).

Attachment 6
Analysis of Crappie and Sauger Populations in Pool 14

The Quad Cities Station began open cycle operation in 1984, allowing 13 years of pre-open cycle operations when the impact of the Station should be minimal.

Sampling numbers from Black Crappie parallel well between the two sampling programs, whereas the White Crappie trends are not as clear. While there are some general parallels, this could be classified as marginal at best. There has been a general declining trend in White Crappie in Pool 13 since 1991. White Crappie populations have been low in Pool 14 since the late 1970's.

The early years of the Exelon sampling consisted of electrofishing on prime locations from April through December, whereas the current program only samples from June through September. Crappies tend to move to the side channel and main channel border habitats when flows and temperatures decrease.

2.1.8. Other Considerations when viewing the Exelon Data Set

The early years of the Exelon Sampling program were substantially larger than the current program. The original electrofishing program ran from April through December, whereas the current program only samples from June through September currently. In the early years, the habitat was significantly different within these sampling areas as well. They were chosen, at the time, because they had the most potential to catch fish. For example, Area 10 initially was in a backwater in the middle of Steamboat Island. In mid-late fall, Black and White Crappie could be found in excess at this spot because of the deep-water overwintering habitat it provided. That location was abandoned in 1987 after siltation and low water no longer allowed boat access to the site. Today, most of that site is well above grade during normal summer water levels. When the data was reviewed, that site alone accounted for a substantial amount of the Crappies captured in the surveys. The alternate spot chosen in 1987 was Grant Slough, which was the closest habitat similar to Steamboat Island, but it has never held the numbers of fish when compared to Steamboat Island.

Also, timing of the sampling is critical when discussion population changes. Sampling from June to September maintains a "Summer Only" sample, giving a more consistent interpretation over time. Water levels are typically normalized during this period. Unlike lake sampling, the river is very diverse in its habitat based on the current flows and stage heights. Sampling a habitat from April to December expands the usage of a particular habitat for multiple stages in an animal's annual migration cycle, making your sample more physical habitat specific, which gives less concise information about the particular species of fish you are examining, especially over long periods of time.

2.1.9 Crappie Conclusions

Black and White Crappie are very popular species found in the Mississippi River. As the river has aged from the initial pooling (lock and dam placement in the 1930s), habitats have changed, and the fishery has changed with it. This trend can be clearly seen in both Pool 13 and 14 over long periods of time. The decrease in Crappie abundance on the river can be attributed primarily to natural process, such as habitat degradation, as opposed to overfishing or impacts from the Quad Cities Nuclear Station.

2.2 Sauger (from UMRCC, 2004, page 187)

2.2.1 Fecundity and Breeding Habits

Spawning occurs when water temperatures range from 40–52 °F (Gebken and Wright 1972; Pitlo 1989, 1998; Ickes et al. 2000). The timing of these water temperatures varies annually, but generally occurs from late March through April. Water temperature recorded from 1984–1995 at Lock and Dam 5 averaged 40.2 °F on April 1 and 54.4 °F on April 30. Areas of the Mississippi River further downstream generally warm earlier.

Radio telemetry and tagging studies have tracked Sauger spawning movements. During the late winter months, Sauger staged in main channel and main channel border habitat in upper Pool 4 (Ickes et al. 2000). They found Sauger traveled long distances to this staging area, both from upstream and downstream locations. Also in Pool 4, Thorn (1984) found Sauger making upstream movements during the spring. Spring movements into tributaries have been documented on Pool 2 (Gangl et al. 2000); they found Sauger travel into the Minnesota River with the greatest upstream movement 56 miles. Sauger in Pools 11 and 13 moved into the tailwaters and remained at the dam until mid-April (Pitlo 1984).

Between pool movements are also possible, as Hubley (1963) recovered a Sauger 35 miles from the point of tagging. Boland and Ackerman (1982) reported tagged Sauger were recovered outside the pool of tagging at the rate of 21% and 17% respectively for Pools 11 and 13. Most fish moved upstream, and the average distance was 59 miles for Pool 11 and 44 miles for Pool 13. Floy-tagged Sauger were recovered from tributary streams, the Volga and Turkey Rivers in Iowa and the Wisconsin River in Wisconsin (Boland and Ackerman 1982).

Spawning sites have not been well documented in the Upper Mississippi River (UMR). A few locations have been associated near wing dams and side channel margins (Freiermuth 1986; Ickes et al. 2000). These areas had sand substrates. In Pool 7, Sauger were found spawning over riprap in depths ranging from 1.0–4.5 feet (Gebken and Wright 1972). In Pool 13, Pitlo (1989) found Sauger spawning over gravel or mussel bed substrate.

The UMR Sauger spawn is likely similar when compared to other parts of the United States. Some spawning habits may be comparable to Walleye. Males reach the spawning grounds earlier and stay longer than females. Because of this, males concentrate at higher numbers than the females in the spawning area. The females do not enter the spawning area until their eggs are ripe. The females also likely enter the grounds only after dusk.

Saugers are broadcast spawners and do not build nests. Their eggs are non-adhesive, and after deposition either settle on the bottom or drift with the current (Holland 1985). While the number of eggs produced by individual Saugers varies, Nelson (1969) found female Sauger in South Dakota to average 30,000 eggs per pound of body weight. The females leave the spawning grounds soon after spawning, recuperate and then disperse. Ickes et al. (2000) found a short time period between fish migrating from their pre-spawn staging area to areas used by fish to recuperate post-spawn. The males will stay on the spawning grounds, not for parental care but to wait for more females to arrive. The spawning process is thought to last approximately two weeks.

2.2.2 Life History

After fertilization, Sauger egg incubation ranges from 7 to 28 days depending on water temperature; the higher the water temperature the sooner the eggs will hatch. Pitlo (1998) found incubation to last around 24 days when water temperatures ranged from 42–62 °F.

Larval Sauger first prey upon zooplankton. A study on Lake Winnebago, Wisconsin, found Sauger up to two inches long fed heavily on zooplankton, primarily Daphnia and to a lesser extent Cyclops (Priegel 1969). In Pool 13, Cyclops, Daphnia and Bosmina were most abundant in zooplankton samples during the larval Sauger drift (Pitlo 1998). As Sauger size increased to six inches, insect larvae, such as chironomids, became more important (Priegel 1969).

Holzer (1978) found Upper Mississippi River (UMR) Sauger six to twelve inches in length were primarily piscivorous, with fish being 97.9% of their total food volume. Forage fish species in the UMR are numerous; Gizzard Shad and nine minnow species (Cyprinidae) are considered abundant or common (Pitlo et al. 1995).

During a summer following successful spring reproduction, young Sauger can be found in most habitats of the Mississippi River. Biologists find them in backwater, side channel, main channel border and tailwater habitat. Substrates include silt, sand, rock, and detritus. Although Sauger may seem ubiquitous, a sand substrate often appears to be preferred.

Annual Sauger collections have provided opportunities to develop indices of year class strength. Index information may be used to affect an angler's fishing expectation. The time when year class strength is measured varies, but surveys generally occur by age-III. Although it is possible that larval drift be used to assess year class strength, Pitlo (2002) found no correlation between the density of larval Sauger in the spring drift and the density of young-of-the-year (YOY) Sauger during October.

Electrofishing surveys conducted during the fall have been an accepted initial indicator of year class strength. These surveys have shown recruitment through the first six months to be highly variable from year to year. The Wisconsin Department of Natural Resources electrofished the tailwaters of Pools 5, 8, and 10 and found a range of nearly complete recruitment failure (1 YOY per hour) to over 400 YOY Sauger per hour. Stevens (1997a) assessed Lake Pepin in Pool 4 and found a multiple gear multiple age class approach reduced variability and provided reliable indices of year class strength.

The sources affecting recruitment variability are numerous and complex. Relationships between water temperature, discharge, spawner condition and abundance, dispersal, towboat propeller mortality, and available quality nursery habitat likely influence recruitment. Pitlo (2002) reported a strong correlation between the daily rate of water warming during the spawning and incubation period (April 15–May 5) and the catch rate of YOY during fall electrofishing in Pool 13. He documented the strongest year classes when water temperatures increased above 0.4 °F/day. Ickes (2000) analyzed 36 years of Sauger recruitment data from Pool 4 and found spawning stock abundance and discharge fluctuations to be significant recruitment determinants.

From still backwaters to fast flowing channel areas, UMR Sauger are adept at living within highly variable habitats differing in flow, cover, structure and substrate. Juvenile and adult Sauger have been found spatially distributed in Pool 8 (Bartels 2000). Although they are found widespread, Bartels found tailwater zone samples provided the large Sauger catches. The spatial distribution likely occurred due to their preference to riverine habitat offered in the tailwater zone. Other than the channels associated with the tailwater zone, Bartels found no indication that Sauger preferred sites associated with channels more than those sites associated with off-channel areas.

2.2.3 Age and Growth

As with other fishes, Mississippi River Sauger growth rates may be influenced by many variables including genetics, water temperature, forage base, and habitat conditions. Hatched in mid-April to mid-May, growth is usually fast. In Pool 4, from 1986–2000, mean lengths during mid-July ranged from 2.5–

3.6 inches while averaging 3.1 inches (Hoxmeier 2001). Because growth rates can be influenced by many variables, YOY Sauger length in October or November is highly variable between years and between pools. Pitlo (2001a) found fall average lengths in Pool 13 ranged from 6.2 inches to 7.5 inches over a nine-year period. During twenty-two years of sampling YOY in Pool 5 from 1980–2001, the fall average lengths ranged from 5.6 inches to 8.0 inches. Similar ranges have been shown for Pools 4, 8, 10, and 11.

Length-at-age and length-at-capture studies have been conducted on UMR Sauger on many occasions. Age and growth studies were completed for Pools 8 and 9 in 1948 and 1956 (Wisconsin Department of Natural Resources 1980). Growth rates appear little changed, as the results of these early studies are similar to studies completed more recently in Pools 4, 5, 8, 11, and 13. Hoxmeier (2001) found female Sauger to grow slightly faster than male Sauger in Pool 4. At the same age, he found females to be about an inch longer than the males.

Pitlo (2001a) measured the Relative Weight (Wr) of Saugers in Pools 11 and 13. Relative weight is an index of condition reflecting an individual fish's nutritional state; in concept, a mean Wr of 100 reflects ecological and physiological optimality. During his nine-year study conducted from 1992–2000, Pitlo found the Wr of Sauger in Pools 11 and 13 to range from 76.0–101.7 while averaging 89.8. It appears that Sauger in Pools 11 and 13 are in relatively good condition.

2.2.4 Age and Size at Maturity

Although considerable variation has been observed in age at maturity, it is thought that most male and female Sauger mature at age II and age IV, respectfully. Gebken and Wright (1972) reported female Sauger matured as early as age III. Length at maturity for either sex will vary slightly by pool. The Iowa Department of Natural Resources surveyed Pool 13 and found male Sauger begin to mature at 11.5 inches and females at 13 inches. Immature fish were still found at 15 inches.

2.2.5 Survival Ability

Population estimates are extremely difficult to obtain for Sauger on the UMR. Immigration, emigration, pools that span more than 30 miles, and Sauger that inhabit deep water habitats are just a few of the problems that confront biologists trying to conduct these estimates. However, biologists have implemented annual Navigation Pool surveys to index the strength of particular year classes of Sauger. Sampling gear includes electrofishing, seining, gill netting, and trawling. Although estimates fluctuate, annual surveys indicate the Sauger fishery is surviving and thriving in the UMR. The Minnesota Department Natural Resources, with 36 years of data from Pool 4, has found no evident discernible trend. Both natural mortality and angler exploitation has been estimated for Sauger on the Mississippi River. Thorn (1984) estimated Pool 4 total annual mortality to range from 59–63%, with angler exploitation accounting for 38% while natural mortality accounted for 21–25%. During a nine-year study, Pitlo (2001a) reported total annual mortality averaged 80% for Pool 11 and 65% for Pool 13. His angler exploitation rates averaged near 18%.

2.2.6 Relative Importance to the Fishery

The Sauger is an extremely important recreational fish species in the UMR fishery. Creel surveys have been used since the 1960s on the UMR to estimate angling effort, catch and harvest for gamefish species. Creels that concentrate on tailwater anglers continue to be conducted, as Sauger continually show preferences to this area during most of the year.

Attachment 6
Analysis of Crappie and Sauger Populations in Pool 14

	Navigation Pool							
Year	4[a]	5[b]	8[c]	10[c]	11[d]	13[d]	14[e]	15[e]
1980		11						
1981		53						
1982		31						
1983		64	95					
1984		5	26				8	2
1985		11	55				2	2
1986	35	15	20					
1987	39	37	89				19	8
1988	3	31	19	15			25	11
1989	26	24	42	65			5	4
1990	42	28	8	26			0.3	0
1991	7	47	158	151			13	1
1992	38	115	402	99		170	8	6
1993	53	1	209	14	29	28	1	1
1994	252	29	29	102	47	132	21	11
1995	41	14	64	40	22	40	5	3
1996	115	301	91	152	49	180	11	11
1997	114	332	308	247	63	312	21	7
1998	266	167	190	127	70	126	8	4
1999	6	112	59	68	17	181	14	5
2000	9	82	90	55	34	135	8	3
2001	8	138	207	314	187	253	35	7

[a]Hoxmeier 2001
[b]Brecka 2001
[c]Von Ruden 2001
[d]Pitlo 2001a
[e]LaJeone 1984–2001

Table 1. Average catch per effort of young-of-the-year Sauger (#YOY/hr) as determined by electrofishing in various pools of the Upper Mississippi River.

When comparing overall Sauger populations in Pools 13 & 14, the best comparable databases are the LTRMP and Exelon's Longterm Monitoring Program (Table 1). When the year classes are compared on an annual basis, a trend can be seen, even though river conditions, which can change daily, may dictate the sampling efficiencies of electrofishing. These trends can generally be seen in Pools 4 through 15.

While there is a lot of variability within the samples, there has been a general trend of increasing Sauger abundance. While not published yet, the data for Pool 14 has shown a continued increasing trend of YOY Sauger in the tailwaters of Navigation Pool 14 through 2013, the 40-year period being reviewed.

Attachment 6
Analysis of Crappie and Sauger Populations in Pool 14

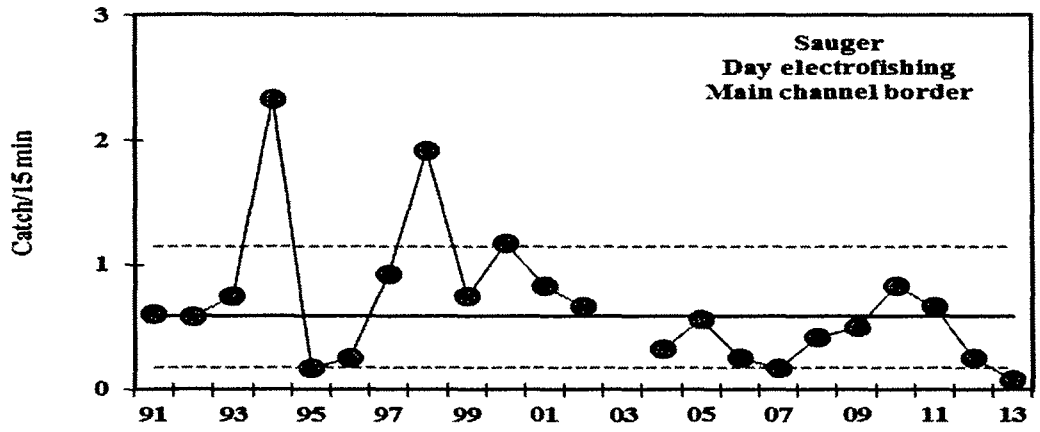


Figure 5. Sauger collections by the LTRMP in Pool 13, 1991-2013.

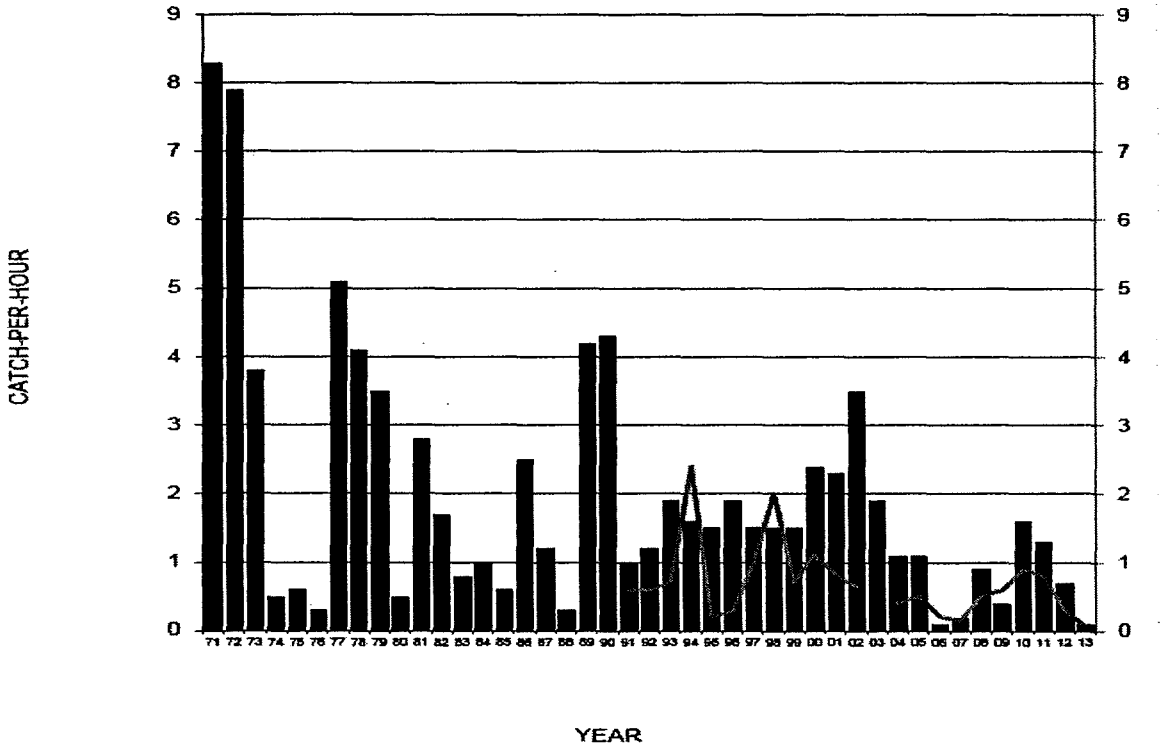


Figure 6. Sauger collections by Exelon in Pool 14 (bar graph), 1971-2013 with the LTRMP collections (line graph).

With only a few species that seemingly differ, most species standing stocks in Pools 13 and 14 tend to trend in the same directions year after year. Changes in habitat within the sample area can affect those trends, but most programs can identify those biases. Tailwater surveys have shown a significantly closer trend than main pool, summertime sampling.

2.2.7. Other Considerations

The early years of the Exelon Sampling program were significantly different than the current program, as explained earlier, however sauger tailwater sampling, which has occurred since 1984, has not changed since its inception. That program may be the least biased in regard to habitat or river conditions over time. Pitlo (1987) found that Sauger was significantly more abundant than Walleye throughout Pool 14 from rotenone studies conducted in multiple areas in the 1970s and 1980s. The rise of the walleye populations through regulation changes and stocking may have had a negative influence on the overall population in Pool 14 over several decades. While this could have happened over several decades, regulation changes, such as the closure of tailwaters where Sauger tend to migrate and over winter, have been implemented in multiple pools upstream of Pool 14 due to similar trends in the Sauger populations. These seasonal tailwater fisheries can be intensively fished and have potentially large negative impacts on the Sauger population.

2.2.8 Sauger Conclusions

The Sauger population in Pool 14 has been highly variable but resilient over the 40-years reviewed. Sauger populations have been studied from Minnesota to the Quad Cities in depth over these decades. Overall, the standard sampling techniques used in the tailwaters of the Locks and Dams has shown a positive trend over the past 30 years. This popular fishery is highly maintained, reviewed, and profiled by fishermen and managers alike. The Quad Cities Longterm Monitoring Program has shown that the approved programs at the site are applicable to state and federal monitoring programs when monitoring the population changes of Sauger. Tailwater surveys continue to show that the populations are healthy and growing.

3 Impacts from the Quad Cities Nuclear Station Discharge

The Quad Cities Nuclear Station has been monitoring the potential impacts of their operations on the fisheries of Pool 14 since the late 1960s in the pre-construction surveys. This monitoring has been occurring continuously since that time. All data collected by the 3rd party contractors has been submitted and reviewed by the Quad Cities Environmental Steering Committee on an annual basis. Over 40 years of operations, no significant impacts have been identified within the river due to thermal discharge, impingement, or entrainment.

In Minnesota, Prairie Island Nuclear Generating Station (PINGS) also uses water from Pool 4 of the Mississippi River. Extensive studies have occurred to identify any operational measures that could be detrimental to the fisheries of Pool 4. Their Sauger research, conducted by MNDNR and the University of Minnesota, demonstrated that a thermal effect on Lake Pepin is possible during full-capacity operations. While no direct thermal preference, and hence impact, could be demonstrated for Walleye and Sauger, secondary effects related to changes in forage distribution attributable to thermal effects are potentially possible, although they could not be identified in situ (Ickes, et al., 2000).

Recently, the Quad Cities Nuclear Station went through a 316(a) Demonstration. In a 316(a) Demonstration, the ultimate standard used in the assessment of the thermal component of power plant discharges is whether a balanced indigenous community (BIC) of shellfish, fish, and wildlife has been and will be maintained in or on the receiving water body despite the thermal discharge. We believe that standard -- protection of the BIC-- is satisfied if the following criteria are met:

- No substantial increase in abundance or distribution of any nuisance species or heat- tolerant community
- No substantial decreases of formerly abundant indigenous species or community structure to resemble a simpler successional stage than is natural for the locality and season, other than nuisance species
- No unaesthetic appearance, odor, or taste of the water
- No elimination of an established or potential economic or recreational use of the waters
- No reduction in the successful completion of life cycles of indigenous species, including those of migratory species
- No substantial reduction of community heterogeneity or trophic structure
- No adverse impact on threatened or endangered species
- No destruction of unique or rare habitat, without a detailed and convincing justification of why the destruction should not constitute a basis of denial
- No detrimental interaction with other pollutants, discharges, or water-use activities.

All of these criteria were met prior to the Illinois Pollution Control Board granting the thermal relief to the Station in 2015.

4 Discussion

Population changes on large bodies of water tend to occur slowly as habitat and inputs to the system change over time. The Quad Cities Nuclear Station has been operating since 1973 and in its current open-cycle mode since 1984. Several species have seen dramatic changes over the 40 years of data reviewed for this document. Stressors such as siltation, zebra mussels, and the impact of elongated high-water events has changed the river and its fishery substantially over time.

Crappie and Sauger are species with somewhat specific requirements for habitat. Slight modifications to the stretches sampled can have a dramatic difference in the samples. Over time these three species have seen a decrease while other species have seen significant increases. These are natural fluctuations in a dynamic system such as the Mississippi River, which is verified by upstream populations mirroring those of Pool 14.

The monitoring program in Pool 14 of the Upper Mississippi River has provided valuable information over its 40+ year history. Third party and agency oversight through the Quad Cities Station Environmental Steering Committee Meeting have reviewed the data, suggested sampling programs, and approved the annual scopes-of-work since the Station started construction. While the Crappie and Sauger populations have fluctuate over the decades in Pool 14, there have been no discernable changes to the fisheries of Pool 14 that can be attributed to the operation of the Quad Cities Nuclear Station since operations began in 1973.

5 References

Ackerman, G. R. DeCook, and A. Brimmer. 1992. Baseline Studies of a Mississippi River backwater slough prior to major rehabilitation. Project Report, Iowa Department of Natural Resources, Des Moines, Iowa. 9pp.

Bartels, A. D. 2000. Fish sampling data from navigation Pool 8 of the Upper Mississippi River, 1991–1997. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin, April 2000. LTRMP 2000-S001. 105pp.

Boland, T. and G. Ackerman. 1982. Investigations of tailwater walleye and sauger fisheries of the Upper Mississippi River. Iowa Conservation Commission, Des Moines.

Boland, T., Schonhoff, B., and Gritters, S. 2000. Long-Term Fish Monitoring Program 15 Year Summary. In: Fisheries Management Investigations 2000 Annual Report. Iowa Department of Natural Resources. Des Moines, Iowa. pp: 141–159.

Bowzer, T.W. and B.L. Lippincott. 2000. A summary review of long-term fisheries monitoring in Pool 14 of the Upper Mississippi River near Quad Cities Station (1971-1999). Prepared for Commonwealth Edison Company. Chicago, IL. 67 p.

Brecka, B. J. 2001. Walleye and sauger recruitment assessment in Pool 5 of the Mississippi River. Summary Report. Wisconsin Department of Natural Resources, Alma.

Dewey, M. R. and L. E. Holland-Bartels. 1987. Ackermans Cut and Cassville Slough follow-up biological monitoring study. Submitted to: Ecological Services, U.S. Fish and Wildlife Service, Rock Island Field Office, Rock Island, Illinois. 42pp.

Fleener, G. G. 1975. The 1972–1973 sport fishery survey of the Upper Mississippi River. Upper Mississippi River Conservation Committee Special Publication 28pp + App. A-B.

Freiermuth, R. 1986. Spring movements of sauger in Pool 4 of the Mississippi River. Minnesota Department of Natural Resources, Division of Fish and Wildlife, Section of Fisheries Completion Report, St. Paul.

Gangl, R. S., D. L. Pereira and R. J. Walsh. 2000. Seasonal movements, habitat use, and spawning areas of walleye Stizostedion vitreum and sauger S. canadense in Pool 2 of the Upper Mississippi River. Minnesota Department of Natural Resources. Investigational Report 482, St. Paul.

Gebken, D. F. and K. J. Wright. 1972. Walleye and sauger spawning areas study, Pool 7, Mississippi River 1960–1970. Wisconsin Department of Natural Resources, Bureau of Fisheries Management Report No. 60, Madison.

Holland, L. E. 1985. Survey of ichthyoplankton drift at Lock and Dam 5 Upper Mississippi River. U.S. Fish and Wildlife Service, National Fishery Research Laboratory, LaCrosse, Wisconsin.

Holzer, J. A. 1978. Food habit study of walleye and sauger in Pool 8 of the Upper Mississippi River during the summer of 1977. Summary Report. Wisconsin Department of Natural Resources, LaCrosse.

Hoxmeier, J. 2001. Lake Pepin 2000. Minnesota Department of Natural Resources, Division of Fish and Wildlife, Section of Fisheries Completion Report, St. Paul.

Hubley R. C., Jr. 1963. Second year of walleye and sauger tagging on the upper Mississippi River. Wisconsin Conservation Department Investigation Memo 16.

Ickes, B. S., A. G. Stevens, and D. L. Pereira. 2000. Seasonal distribution, habitat use, and spawning locations of walleye Stizostedion vitreum and sauger S. canadense in Pool 4 of the upper Mississippi River, with special emphasis on winter distribution related to a thermally altered environment. Minnesota Department of Natural Resources. Investigational Report 481, St. Paul.

Knights, B. C., B. L. Johnson, and M. B. Sandheinrich. 1999. Responses of bluegill and black crappies to dissolved oxygen, temperature, and current in backwater lakes of the Upper Mississippi River during winter. North American Journal of Fisheries Management 15:390–399.

LaJeone, L. 1984–2001. Commonwealth Edison, Cordova Nuclear Power Facility. Annual Reports.Cordova, Illinois.

Nelson, W. R. 1969. Biological characteristics of the sauger population in Lewis and Clark Lake. U.S. Bureau of Sport Fisheries Wildlife Technical Paper 21.

Nord, R. C. 1964. The 1962–1963 sport fishery survey of the Upper Mississippi River. Upper Mississippi River Conservation Committee Special Publication. 209pp.

Pitlo J., Jr. 1984. Wing and closing dam investigations. Federal Aid to Fish Restoration, Project No. F-96-R. Iowa Conservation Commission, Des Moines.

Pitlo, J. Jr. 1987. Standing Stock of Fishes in the Upper Mississippi River. Upper Mississippi River Conservation Committee Special Publication. 76 pp.

Pitlo J., Jr. 1989. Walleye spawning habitat in Pool 13 of the upper Mississippi River. North American Journal of Fisheries Management 9:303–308.

Pitlo J., Jr. 1998. An evaluation of walleye and sauger populations and associated fisheries in Pools 11 and 13 of the Upper Mississippi River. Federal Aid to Fish Restoration, Project No. F-160-R. Iowa Department of Natural Resources, Des Moines.

Pitlo J., Jr. 2001a. An evaluation of walleye and sauger populations and associated fisheries in Pools 11 and 13 of the Upper Mississippi River. Federal Aid to Fish Restoration, Project No. F-160-R, Study 7017. Iowa Department of Natural Resources, Des Moines.

Pitlo J., Jr. 2001b. An evaluation of winter habitats used by bluegill, black crappie and white crappie in Pool 13 of the Upper Mississippi River. Iowa Department of Natural Resources Federal Aid Fish Research Annual Report. Study No. 7021, Des Moines.

Pitlo J., Jr. 2002. Effects of environmental factors on walleye and sauger recruitment in Pool 13 of the Upper Mississippi River. North American Journal of Fisheries Management 22:1021–1031.

Pitlo J., Jr., A. Van Vooren, and J. Rasmussen. 1995. Distribution and relative abundance of Upper Mississippi River fishes. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Priegel, G. R. 1969. The Lake Winnebago sauger – age, growth, reproduction, food habits and early life history. Wisconsin Department of Natural Resources, Technical Bulletin 43, Madison.

Stevens, A. G. 1997a. A method to estimate walleye and sauger year-class-strength and predict their availability on Lake Pepin (Pool 4, Mississippi River). Minnesota Department of Natural Resources, Division of Fish and Wildlife, Section of Fisheries Completion Report, St. Paul.

Stevens, A. 1997b. Winter angling survey of the Finger Lakes, Pool 5, Mississippi River during winter seasons 1991–1993 and 1995–1997. Project Report, Minnesota Department of Natural Resources, Section of Fisheries, Lake City, Minnesota. 41pp.

Thorn, W. C. 1984. Effects of continuous fishing on the walleye and sauger population in Pool 4, Mississippi River. Minnesota Department of Natural Resources. Investigational Report 378, St. Paul.

UMRCC Fisheries Compendium, 3rd Edition. 2004. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

Von Ruden, K. L. 2001. Walleye and sauger recruitment assessment in Pools 5, 8, and 10 of the Upper Mississippi River. Summary Report. Wisconsin Department of Natural Resources, LaCrosse.

Wisconsin Department of Natural Resources. 1980. Age and growth of walleye and sauger sampled during 1948, 1956, and 1978 from Pools 8 and 9. Mississippi River Work Unit Annual Report, 1979–1980. Wisconsin Department of Natural Resources, LaCrosse.

Wright, K. J. 1970. The 1967–1968 sport fishery survey of the Upper Mississippi River. Upper Mississippi River Conservation Committee Special Publication. 116pp.

Attachment 7

Continuation of 316(a) Alternative
Thermal Effluent Limits and Supporting Documentation

Alternative Thermal Effluent Limits Studies Review

The Quad Cities Nuclear Station (QCNS) continues to monitor the river and look for any potential impacts from Station operations under open-cycle operation. Since the approval of the Alternative Thermal Effluent Limits, the Station has performed continuous monitoring of fishes, as part of the Long-term Monitoring program as well as a mussel survey, conducted under the guidelines of the Habitat Conservation Plan for endangered and threatened mussels in Pool 14 of the Mississippi River. Both programs were conducted by 3rd party contractors to minimize any potential perceptions of bias towards the data. Both HDR Engineering, Inc., and Ecological Specialists, Inc. are considered premier companies in their field of work. There have been no operational changes, changes to flow/temperature, or changes in effluent characteristics, since the issuance of the Alternative Thermal Effluent Limits in the current NPDES permit with effective date of July 20, 2015.

Mussel Studies Summary

Mussel monitoring was conducted in 2016 to follow-up on previous surveys conducted in 2004, 2005, 2006, 2007, 2008, and 2012. Outside of the Exelon surveys, the US Army Corps of Engineers also surveys the Cordova bed on a rolling 5-year basis, exhibiting additional external sampling of the beds.

Overall, the results of the 2016 survey concluded that community characteristics within unionid mussel beds upstream and downstream of the QCNS diffuser have fluctuated over time, but these beds continue to support low to moderate density, species rich unionid communities. The monitoring program focused on unionid beds with similar habitat characteristics upstream and downstream of the diffuser; Cordova (downstream) was most similar to Albany (Upstream), Steamboat Slough (downstream) had similar characteristics to both UP and Hanson Slough beds (upstream). Characteristics of all these communities varied slightly from previous monitoring events, and some significant differences among years were observed. However, no consistent increasing or decreasing trends were apparent when all monitoring years were considered. Rather, characteristics observed in 2016 were similar to previous monitoring events and likely reflect natural fluctuations. Recruitment appeared to be lower in some of the beds than in previous years, but this may be due to higher water levels in the last few years, as recruitment of many species seems to be lower during high water years.

Results of this study also show that community characteristics within the beds sampled in this study do not seem to be significantly affected by the QCNS thermal effluent. Unionid beds downstream of the QCNS exhibited similarities and differences in habitat and unionid community characteristics with unionid beds upstream of the QCNS, and no significant trends were observed that distinguished the downstream beds from the upstream beds.

Fisheries Studies Summary

This report presents the 2018 results of QCNS's Long-Term Fisheries Monitoring Program in Pool 14 of the Mississippi River near the Station. The objective of this program is to determine if Station operations are having any measurable impact on the fishery of the Pool. Studies included Long-Term Fisheries Monitoring; a study of the Life History and Population Dynamics of the Freshwater Drum (a major sport and commercial species in Pool 14); Channel and Flathead Catfish, Walleye, and Sauger Studies; Impingement Monitoring; a Fall Stock Assessment Program; and Hydrological Data. The Long-Term Fisheries Monitoring Program was initiated in 1971. The Impingement Monitoring, Freshwater Drum,

Channel and Flathead Catfish, and Fall Stock Assessment studies were added to the program in 1973, 1978, 1983, and 1984, respectively.

The principal objectives of the Long-Term Fisheries Monitoring Program are to determine species composition and relative species abundance in the various habitat types that occur in Pool 14. The sampling techniques employed in 2018 included electrofishing, hoop netting, and haul seining.

Overall, the results of the 2018 surveys concluded that community characteristics within fishery has fluctuated over time but have been in lockstep with other Pools upstream of the Station, which are well outside of the influence of Station operations. No issues were observed during 2018 to warrant further in-depth study or concerns for the fishery of Pool 14. All study information has been turned over to area regulatory agencies and other stakeholders. These studies were delivered to IEPA on 2/21/2019.

After extensive review of the fisheries populations of Pool 14 over the past 48 years, it is abundantly clear that Station operations, cooling water or thermal discharge, have had little effect on the fishery of Pool 14. These conclusions were presented to the river stakeholders at the bi-annual steering committee meeting held most recently at the station on March 26, 2019. There were no objections by the steering committee to these conclusions at the meeting.

Additional information about the local fishery can be found in the Quad Cities 316(b) report which was submitted on June 17, 2019, to the IEPA. No operational or flow changes have occurred since these reports were initiated.

References

Ecological Specialists, Inc. 2016 Results of Unionid Mussel Monitoring Near Quad Cities Nuclear Station, Mississippi River Miles 495 to 515

HDR Engineering, Inc. Quad Cities Aquatic Program 2018 Annual Report

Attachment 7

2016 Results of Unionid Mussel Monitoring near Quad Cities Nuclear Station, Mississippi River Miles 495 to 515

Prepared for:

Exelon Generation Company
Warrenville, IL

Prepared by:

Ecological Specialists, Inc.
O'Fallon, Missouri
an EcoAnalysts company

May 2017
(ESI Project #16-013)

Acknowledgements

Exelon Generation Company (Exelon) contracted Ecological Specialists, Inc. (ESI) to monitor unionid beds near its Quad Cities Nuclear Power Station (QCNS). Mr. Mark Stulman (Exelon) managed the project and provided intake and discharge records from QCNS. Mr. Eric J. Belt (ESI) was the principal investigator. Mr. Belt, Mr. Kendall Cranny, Mr. Benjamin Dunn, Mr. Jacob McCarthy, and Mr. Jeremy Gottman (all ESI) conducted the fieldwork. Mr. Belt and Ms. Heidi L. Dunn co-authored the report. Ms. Emily Grossman and Mr. Ryan Foley assisted with report preparation.

Table of Contents

List of Figures

List of Tables

1.0 Introduction

Exelon Generation (Exelon) requested alternate thermal standards pursuant to Section 316(a) of the Clean Water Act from the Illinois Pollution Control Board for its Quad Cities Nuclear Station (QCNS), which they received in July 2015 along with renewal of their National Pollutant Discharge Elimination System (NPDES) permit. Freshwater unionid mussel (unionid) beds harboring federal, Iowa, and/or Illinois threatened and endangered (T&E) species *Lampsilis higginsii*, *Plethobasus cyphyus*, *Ellipsaria lineolata*, *Ligumia recta*, *Pleurobema sintoxia*, *Lampsilis teres*, and *Strophitus undulatus* occur upstream and downstream of the QCNS. Additionally, the Cordova Essential Habitat Area (EHA) for *Lampsilis higginsii* occurs downstream and the Hansons Slough EHA occurs upstream of the QCNS plant (USFWS, 2008). In 2004, Exelon established a monitoring program for freshwater unionids near the QCNS thermal discharge diffuser. The purpose of the monitoring program was to provide data and information regarding the unionid community, to evaluate the effects QCNS discharge has had on the community, and to compare community characteristics observed following the approval of alternate thermal standards to the baseline unionid community characteristics.

Three unionid beds occur within 3500 m (approximately 2 river miles) of the QCNS thermal diffuser: the Steamboat Slough (SS) Bed, located approximately 675 to 1125 meters (m) downstream of the QCNS mixing zone; the Upstream (UP) Bed, located approximately 730 to 1130 m upstream of the QCNS diffuser; and the Cordova Bed, located about 3300 to 3700 m downstream of QCNS (Figure 1-1). Ecological Specialists, Inc. (ESI) monitored each of these unionid beds in 2004, 2005, 2006, 2007, 2008, and 2012. In 2007, the monitoring program added 400 m sections of 3 additional beds to further evaluate unionid community characteristics among and within unionid beds. The 3 additions were: the Albany Bed, located approximately 14,000 to 14,400 m upstream of the diffuser; the Hansons Slough (HS) Bed, located approximately 5000 to 5400 m upstream of the diffuser; and the Woodwards Grove (WG) Bed, located approximately 10,500 to 10,900 m downstream of the diffuser (Figure 1-1). All 6 beds were sampled in 2007, 2008, and 2012.

QCNS currently operates under NPDES permit conditions that allow 219 (2.5%) exclusion hours per year, during which the plant may cause river temperatures to exceed maximum temperature standards by up to 3° F, except during July, August, and September, the temperature standards may be exceeded by up to 5° F for no more than 131.4 hours of the annual 219-hour allotment. Prior to July 2015, QCNS operated under NPDES permit conditions that allowed 87.6 (1%) excursion hours per year, during which the plant may cause rivet temperatures to exceed maximum temperature standards by up to 3° F. QCNS operated within these permit conditions between 2000 and 2016, except for 2006 and 2012. Less than the allotted 87.6 excursion hours were used in 2001 (57.35 hours), 2005 (42.50 hours), 2007 (74.00 hours), 2009 (5.00 hours), 2010 (36.00 hours), and 2011 (33.00 hours; Table 1-1). No excursion hours were used between 2013 and 2016. In 2006 and 2012, QCNS was granted provisional variances from these permit conditions that allowed additional excursion hours at temperatures up to 5° F. The provisional variances were granted to address periods of low Mississippi River flows and high ambient river temperatures experienced in the summer of 2006 and in the spring and summer of 2012. QCNS used 222.75 (2.5%) excursion hours in 2006, and water temperature during excursion hour events exceeded maximum temperature standards by up to 5°F. Similar conditions (low river flows and/or high river temperatures) occurred in the spring and summer of 2012. QCNS used 442.50 (5.1%) excursion hours in 2012.

The Exelon mussel bed monitoring program specifies that monitoring will be conducted in years when excursion hours exceed the allotted 87.6 excursion hours or if monitoring has not occurred for 4 years. 2016 met the latter condition since excursion hours were not exceeded from 2013 – 2016. Monitoring was conducted at all 6 mussel beds near QCNS in 2016. This report presents the results of the 2016 monitoring activities and compares results with previous years.

2.0 Sampling and Analytical Methods

The Albany, Hansons Slough, Upstream, Steamboat Slough, Cordova, and Woodwards Grove beds (Table 2-1) were sampled between October 25 and November 3, 2016, using the same methods ESI used in 2007, 2008, and 2012 (ESI, 2013). Density, age distribution, and observed mortality were estimated using quantitative sampling methods. Species richness was estimated from qualitative samples. The extent of infestation by zebra mussels (*Dreissena polymorpha*) in the beds was also observed and recorded during monitoring events.

At each of the 6 sites, 90 0.25m^2 quantitative quadrat samples were collected. Sampling locations in each bed were randomly selected using GIS, and points were plotted on a Trimble Juno GPS. Samples were obtained from each location by a diver who excavated all substrate material from the quadrat to a depth of 15 cm into a 6-mm mesh bag. A surface crew retrieved the bag and rinsed material through 12 mm and 6 mm sieves. Substrate and debris were searched and unionids removed. All live unionids were identified to species, measured (length in millimeters [mm]), aged (external annuli count), and returned to the river. Freshly dead shells (FD; dead within the past year, nacre shiny, hinge flexible, valves attached, with or without tissue) were identified, counted, and classified as young unionids (Ambleminae ≤5 years old; Lampsilinae and Anodontinae ≤3 years old) or adults. Weathered shells (WD; dead many months to years, nacre chalky, hinge brittle, valves typically separated, periostracum intact) and subfossil shells (SF; dead many years to decades, periostracum eroded, valves separate, very chalky) were noted as present. Water depths (pneumometer) were recorded for each sample location. Substrate composition was estimated using a modified pebble count (Wolman, 1954). The substrate particle category (Wentworth scale) was recorded for each corner and the center of each quadrat (90 x 5 = 450 substrate observations per site). The percentage of each substrate category was calculated for each site.

The qualitative sampling approach was designed to collect as many individuals as possible, thereby increasing the probability of finding rare species (Kovalak et al., 1986). For each qualitative sample, a diver searched for and collected unionids for 5-minute intervals at 25 locations spread throughout each bed. All live and fresh shells of unionids were identified, designated as adults or young unionids, and counted. Live unionids were returned to the river. The position of each qualitative sample was recorded with a Trimble Juno GPS. Bottom water temperature, dissolved oxygen (DO) levels, and current velocity (meters/second) were recorded at each location.

Data regarding the mussel bed community characteristics were analyzed using Analysis of Variance methodology (ANOVA). The following parameters were analyzed: differences in total, young and adult density; differences in Ambleminae and Lampsilinae density; and differences in density of freshly dead shells based on sampling dates and bed location. The data were log (x+1) transformed for ANOVAs and significance level was $p<0.05$ for all tests. Bonferroni post-hoc tests were used to detect differences among dates within each site. Regression analysis was used to determine the slope (rate of increase) of species with respect to cumulative individuals, using the equation: cumulative species = slope * log (cumulative individuals). The intercept constant was set to zero, as no species are present if no individuals are collected. Rarefaction species richness (number of species based on an equal number of individuals) was calculated to compare species richness among years. EstimateS v9.1.0 (Colwell, 2013) was used to calculate rarefaction richness.

3.0 Results and Discussion

3.1 River Flow Rates and Water Temperatures

River flow was relatively high in 2016. Average monthly flow in August and September 2016 was higher than all previous monitoring years and October was higher than all but 2010 (Figure 3-1). Ambient river temperatures were relatively normal in 2016 and no excursion hours were used.

3.2 Upstream Beds

3.2.1 Albany Bed

Albany Bed was the upstream-most bed sampled. The bed extends upstream from Albany, IL (near RM 513) to Cattail Slough (near RM 516). Although very long, the bed is narrow, extending an average of only about 40 m from the bank into the river. The widest portion of the bed (about 70 m wide) was within the town of Albany, IL, near RM 513 and was selected for sampling (Figure 1-1). Land use along the riverbank is residential, and the bank is lined with rip-rap.

The Albany Bed was most similar to the Cordova Bed in habitat characteristics. Substrate was primarily zebra mussel shells mixed with gravel and sand (Table 3-1). Zebra shell increased while cobble and sand decreased in 2016, but this may be due to sample location rather than habitat change, as the values seem to be within the range of previous years (Table 3-2). As in previous years, zebra mussel shells were still a significant substrate component, particularly near the riverward edge of the bed. Depth within the bed ranged from 1.5 to 6.1 m, and DO (8.5 to 8.9 mg/L) was consistent with other sites at the time of sampling (Table 3-1). Similar to 2012, water temperature was relatively low (range 52.9 to 53.5°F), as sampling was conducted in late October. Water temperature in the Albany Bed was generally consistent with other sites. Current velocity (0 to 0.7 m/sec) was higher than previous years due to high water conditions in 2016. No zebra mussel infestation was observed in 2016, which was a decline from 2008 to 2012 (11.2 and 3.8 zebra mussels/unionid in 2008 and 2012, respectively), but was similar to 2007 (0.1 zebra mussels/unionid), and was comparable to the low infestation rates observed in 2016 at other sites (Tables 3-1 and 3-2).

Since habitat was similar between the Albany and Cordova beds, the unionids communities should be similar unless other factors were affecting community characteristics. The Albany Bed unionid community was most like the Cordova Bed community. *Amblema p. plicata* was the dominant species in both beds, Lampsilinae and Ambleminae were similar in abundance, and relative abundance of most species was similar (Table 3-3). However, *Quadrula p. pustulosa* (10.0%) and *Truncilla donaciformis* (11.3%) appeared more abundant in the Albany Bed (5.6% and 3.0%, respectively, Cordova Bed), and *Leptodea fragilis* (15.4%) was more abundant in the Cordova Bed than in the Albany Bed ((4.9%); Table 3-3). Both beds contained the live threatened or endangered species (T&E species) *L. recta*, *L. higginsii*, *E. lineolata*, and *S. undulatus* (Table 3-3). *Ligumia recta* were more abundant in the Albany and Cordova beds than in the other beds in this monitoring study. *Lampsilis teres* (found in the Albany bed in 2012) was collected live in the Cordova bed in 2016.

Density did not differ significantly between Cordova and Albany beds for live unionids, adults, young, Ambleminae, Lampsilinae, or freshly dead unionids (Table 3-4). Species richness regression slopes were 8.17 and 7.58, respectively,

and percentage of young unionids averaged 40.6% and 31.8% in the Albany and Cordova beds, respectively (Table 3-4). Both beds also contain an abundance of weathered and subfossil shells, some representing species that no longer appear to be extant in Pool 14, suggesting that these beds have existed for an extended time-period. Data on the mussel community in the Cordova Bed dates to 1988 (Miller and Payne, 1996). Although the Albany Bed has not been extensively monitored, the presence of subfossil shells of species that historically occurred in Pool 14, but have not been collected alive for at least 30 years, such as *Cumberlandia monodonta*, *Cyclonaias tuberculata*, *Elliptio crassidens*, and *Tritogonia verrucosa* (Kelner, 2011), suggests this bed has also existed for at least several decades. The similarity in unionid community characteristics between the Albany and Cordova beds suggests that water temperature effects associated with the QCNS discharge may not have a significant effect on the Cordova Bed unionid community.

Species composition and relative abundance was similar within the Albany Bed between 2007, 2008, and 2012; however, some changes in community characteristics were noted. *Amblema p. plicata* was the dominant species in both 2007 and 2008, but *T. donaciformis* (25.5%) was the most abundant species in 2012 and *L. recta* (14.1%) was the most abundant species in 2016 (Table 3-5). Previous high recruitment of *T. donaciformis* led to the increased overall abundance of this species in 2012, but abundance appeared to decline to the 2007 and 2008 abundance range in 2016 (Table 3-6). Although *Quadrula p. pustulosa* appeared to be declining in this bed in 2012, relative abundance of this species appeared stable among 2008, 2012, and 2016 (8.7%, 6.0%, and 7.7, respectively).

A total of 18 species were collected in the Albany Bed in 2016. No species not collected in 2007, 2008, or 2012 were collected in 2016. Two listed species, *L. recta* and *L. higginsii* increased in abundance in 2016 as did *Lasmigona complanata complanata*, *Utterbackia imbecillis*, and *Obliquaria reflexa*, while *Amblema plicata* and *Lampsilis cardium* decreased in abundance (Table 3-5). The abundance of Ambleminae and Lampsilinae species were similar to previous years and Anodontinae species increased slightly.

Overall unionid density in the Albany Bed did not change significantly between 2007, 2008, 2012, and 2016: Density ranged from 3.5 to 6.6/m^2 and averaged 5.3/m^2 (Table 3-6). The density of fresh dead shells was similar 2007 and 2008, but significantly lower than in 2012, and mortality decreased to 8.2% (Table 3-6). Juvenile density (1.0 ± 0.5 unionids/m^2) was significantly less than in all previous years. Density of Ambleminae as a whole did not change throughout monitoring events, but density of young Ambleminae remained similar to 2012 and significantly lower than 2007 and 2008 (Table 3-6). Ambleminae recruitment increased from 2012 but was still notably lower (34.3% - 45.7% in 2007 - 2008 vs. 14.5% - 24.1% in 2012 - 2016), while fresh dead density and mortality of Ambleminae were similar among all years (Table 3-6). Density of Lampsilinae significantly decreased compared to 2012, but was not significantly different from 2007 and 2008 (Table 3-6). Juvenile Lampsilinae density also decreased; the difference was significant compared to 2012 and 2007, but was not significantly different to 2008, while adult Lampsilinae density did not significantly change between any year. Density of fresh dead Lampsilinae was similar to 2007 and 2008, but was significantly lower than 2012 as mortality was highest (20.5%) in that year (Table 3-6). In 2007, 2008, and 2016, density of Lampsilinae and Ambleminae were not significantly different; however, in 2012, density of Lampsilinae species was

significantly higher than that of Ambleminae species. Similar community changes were observed in the Cordova Bed in 2012, again indicating that discharge from QCNS may not be affecting unionids in the Cordova Bed.

Age of unionids collected in quantitative samples ranged from 2 to 24 years old (Table 3-7). Three of the 6 Ambleminae species and 5 of 8 Lampsilinae species aged were represented by young individuals. *Lampsilis higginsii* were collected from this bed in 2016 (Table 3-8). *Lampsilis higginsii* ages ranged from 12 to 17 years old (based on external annuli count), and lengths ranged from 71 to 94 mm. Males, females (gravid and not gravid), and young individuals were all collected in 2016 (Table 3-8).

3.2.2 Hansons Slough Bed

The Hansons Slough Bed (HS Bed) is upstream of the QCNS diffuser, approximately 4600 to 6400 m (Table 2-1). The bed appears to extend from approximately RM 509.1 to 510.1. This bed was designated (USFWS, 2008) as an Essential Habitat Area (EHA) based the criteria for designation listed in the Higgins' Eye recovery plan (USFWS, 2004). These criteria include *L. higginsii* comprise at least 0.25% of the community (0.4% in 2008 HS Bed), density >10/m^2 (HS Bed density 11.1/m^2 in 2007), and the bed contains at least 15 other unionid species with density >0.01/m^2 (19 other species in HS Bed >0.01/m^2). The bed is within the upstream portion of Hansons Slough and within a dike field, similar to the SS Bed. Habitat characteristics are similar to the SS bed (Table 3-1), although proportions of sand and silt fluctuate between monitoring years. Depth (0.6 to 3.7 m) was similar albeit shallower than in the SS Bed. Dissolved oxygen averaged 9.2 mg/L and was highest compared to other sites sampled in 2016. Like all sites in 2016, current velocity (0.2 to 0.5 m/s) was higher than past years due to high water conditions (Table 3-9). No zebra mussel infestation was recorded, which was similar to previous years (all <1 zebra mussel/unionid) and different than the SS Bed which had the highest infestation among all sites in 2016 (Table 3-1).

Relative abundance of most species in the HS Bed did not change significantly among monitoring years. *Quadrula p. pustulosa* (32.5%) remained the dominant species in this bed, and contributed to the high overall abundance of Ambleminae (66.3%, Table 3-10). Of all beds sampled, HS and SS Beds were the only 2 sites where the density and abundance of Ambleminae were consistently higher than Lampsilinae. A total of 15 species were collected live from this bed in 2016. Several species were collected in this bed in previous years but were not collected in 2016; however, these species were rare in previous years and may still be present in low numbers. *Lampsilis higginsii* was present in quantitative samples in 2007 and 2008, but was only collected in qualitative samples in 2012 and 2016 (Table 3-10). Four *L. higginsii* were collected from this bed in 2016: 1 male and 3 gravid females (Table 3-8). Age of unionids collected in quantitative samples ranged from 2 to 20 years old (Table 3-11). One of the 7 Ambleminae species and 3 of the 7 Lampsilinae species in this bed were represented by young individuals. No juvenile T&E species were observed.

Overall unionid density within the HS Bed decreased significantly in 2016 compared to previous monitoring years, as did adult and juvenile density; recruitment also decreased (5.2%) compared to previous years (17.9% - 37.1%; Table 3-12). The density of fresh dead shells in 2016 was similar to 2008, and mortality within this bed remained below 10%.

The slope of the species richness curve decreased slightly from previous years, and was generally lower than most other sites when all monitoring events were averaged (Table 3-4). This bed continues to be dominated by Ambleminae; Ambleminae density was significantly higher than Lampsilinae density in all 4 sampling years. Ambleminae density was significantly lower than all previous years as was juvenile density; adult Amblemine density was not significantly different from 2008 (Table 3-12). Ambleminae recruitment also decreased in 2016. The density of fresh dead Ambleminae decreased slightly, but overall mortality remained below 10%. Lampsilinae density decreased between 2008 and 2016, but was not significantly different between 2012 and 2016 (Table 3-12). The density of Lampsilinae juveniles was similar to 2012. No Lampsilinae mortality was observed, but density of fresh dead Lampsilinae was not significantly different than in 2008 or 2012.

The HS Bed shares some community characteristics with both the SS and UP Beds. Both the HS and SS Beds experienced decreased recruitment in Ambleminae and Lampsilinae alike in 2016, and the slopes of the species richness curves for both sites were, on average, lower compared to other beds included in this monitoring study (Table 3-13). However, unionid density in the HS Bed was generally higher than that in the SS Bed, and was comparable to density in the UP Bed (Table 3-4). *Quadrula p. pustulosa* was much more common in the HS Bed (35.1%) than in the UP (8.2%) or SS Bed (7.7%), and *Obliquaria reflexa* was more common in the UP (29.4%) and SS Bed (21.9%) than in the HS Bed (14.5%), but relative abundance of most other species was very similar between these 3 beds (Table 3-3).

3.2.3 Upstream Bed

The UP Bed habitat has remained relatively consistent among monitoring events (July 2004, July and October 2005, August and September 2006, October 2007, August 2008, October 2012, October 2016; Table 3-14). The UP Bed is located near the mouth of the Wapsipinicon River and upstream of QCNS diffuser discharge (Figure 1-1). Substrate in the bed was a mixture of sand, silt, and clay, with sand being the major constituent (Table 3-14). However, substrate constituents varied considerably among sample points. Substrate in the shallower areas near the bank contained more clay, and was covered by a layer of silt.

Water depth within the sampled area averaged 3.6 m, and ranged from 0.6 to 7.6 m (Table 3-14). DO levels were slightly (>75% but <100%) below saturation during July 2004, October 2005, September 2006, October 2007, and October 2016, supersaturated (>100%) in July 2005 and August 2006, and 100% saturation in August 2008 and October 2012. Current velocity averaged ≤0.5 m/s in all years, and was measurable (>0) in all years except August 2006 (Table 3-14). Current velocity in 2016 was higher than in most other years, perhaps due to higher discharge during sampling. Water temperature averaged 54.8°F at this site in 2016, and was consistent with steadily declining temperatures throughout the study period.

Zebra mussel infestation was moderate (a few zebra mussels on most unionids) in 2004, but declined to low levels from 2005 to 2007 (<1 zebra mussel/unionid in most monitoring events; Table 3-14). Zebra mussel infestation increased in

2008 and 2012, but decreased again in 2016, averaging 0.4 zebra mussels/unionid. Zebra mussel infestation rates were comparable to the Woodwards Grove bed in 2016.

Species richness, composition and relative abundance have remained similar throughout monitoring events at this site. Twenty to 24 species have been collected from this bed in each monitoring event, with 20 species collected in 2016 (Table 3-15). As in previous years, *A. plicata* (28.5%) and *Obliquaria reflexa* (22.5%) were the dominant species in the UP Bed in 2016 (Table 3-16). The relative abundance of individual species in this bed did not change significantly over the years, but Ambleminae abundance has gradually increased. Two species, *Quadrula metanevra* and *Actinonaias ligamentina*, were collected from this bed in 2004 but have not been collected since. In contrast, *Utterbackia imbecillis* and *Truncilla truncata* were collected in most monitoring events, but were not collected in 2016. No new species were collected in 2016.

Total density and density of adult and juvenile unionids has remained consistent among monitoring events. Total density has ranged from 6.9 (±3.1) in July 2005 to 12.1 (±3.4) in 2012 (Table 3-15). Densities of adult and juvenile unionids have varied somewhat, but estimates have not differed significantly among monitoring events (Table 3-15). Young unionids have comprised an average of 29.4% of the UP Bed unionid community throughout monitoring events. Recruitment in 2016 was lower than in previous years, but was still within the range of variability over time. Overall mortality at this site was below 10% in 2016, and densities of fresh dead shells did not vary significantly over time. Densities of Ambleminae and Lampsilinae have been consistent throughout monitoring events, and relative abundance of Ambleminae and Lampsilinae in this bed continues to remain fairly equal (Table 3-16). Ambleminae recruitment was lower in 2016 than in the previous few years, but Lampsilinae recruitment was similar to previous years. Mortality of Ambleminae was low (0.7%) in 2016, and no mortality of Lampsilinae was observed (Table 3-15). Age of individuals collected in quantitative samples ranged from 2 to 28 years old (Table 3-17). Four of the 6 Ambleminae species and 8 of the 11 Lampsilinae species collected in 2016 were represented by young individuals.

T&E species found in the UP Bed included *E. lineolata* and *L. recta* (collected in all monitoring events), *L. higginsii* (collected in all but the 2004 monitoring), and *L. teres* (collected in 2005, 2007, 2008, 2012, and 2016). *Pleurobema sintoxia*, *Tritogonia verrucosa*, *S. undulatus*, and *Potamilus capax* were also found, but only as weathered shells. *Lampsilis higginsii* abundance has been relatively low in this bed, with 1 to 3 individuals collected per monitoring event. One adult female *L. higginsii* was collected in 2016.

The UP Bed shares some characteristics with most of the other beds sampled (Tables 3-3 and 3-4). The UP Bed species composition shares some characteristics with the SS Bed in that *O. reflexa* and *A. plicata* were among the most abundant species; however, Lampsilinae were more abundant in the UP Bed and Ambleminae were more abundant in the SS Bed. Species richness regression slope was high, similar to Albany, Cordova, and WG beds. The average percentage of young unionids (29.4%) was most similar to the Cordova (31.8%) bed. Total live unionid density in the UP Bed was similar to the HS and WG beds, but higher than the Albany, SS, and Cordova beds.

3.3 Downstream Beds

3.3.1 Steamboat Slough Bed

The SS Bed is located approximately 750 m downstream of the QCNS mixing zone (Figure 1-1). Substrate in the SS Bed consisted of sand and silt, with some clay also present in 2016. While silt typically comprised 25-50% of the substrate in previous years, it was not a significant component of the substrate in 2016. Water depth ranged from 0.9 to 4.3 m and averaged 2.3 m (Table 3-18). Current velocity has varied from 0 (August 2006) to 0.6 m/sec (July 2004) and in 2016 ranged from 0.2 to 0.5 m/sec. Dissolved oxygen ranged from a low of 5.1 mg/L in August 2006 to a high of 12.8 mg/L in July 2005. In 2016, DO averaged 8.3 mg/L and was similar to DO in other unionid beds downstream of the QCNS facility (Table 3-1). Very few zebra mussels were found in the SS Bed in previous monitoring events. However, zebra mussel infestation was higher in 2016 than in previous years, and was the highest of all beds sampled in 2016. Water temperature ranged from 53.1 to 53.6°F and was consistent with declining water temperatures throughout the 2016 study period.

The SS Bed continues to support a less dense and less species rich unionid community than the UP Bed, although dominant species were similar between the 2 beds. *Obliquaria reflexa* (25.0%) was the most frequently encountered species in 2016, followed by *Quadrula quadrula* (20.5%), a species which has increased in abundance in the past 2 monitoring events. *Amblema plicata* and *Quadrula p. pustulosa* (18.2% each) were also commonly encountered (Table 3-19). One new species, *Quadrula metanevra,* was collected in 2016.

Density in the SS Bed has been relatively consistent in prior years. Density in 2016 (2.0 unionids/m^2) was lower than in all previous monitoring events, but was not significantly different from density in July 2004 or August 2008 (Table 3-20). Ambleminae continue to comprise a higher percent of the community than Lampsilinae (63.4% vs. 34.6%), and overall, Ambleminae density (1.3/m^2) was significantly greater than Lampsilinae (0.6/m^2) density. Ambleminae density was significantly higher than Lampsilinae density in 2008, 2012, and 2016, but did not differ from Lampsilinae density in previous years (Table 3-20). Density of total live adults, total live young, live Ambleminae, Ambleminae adults and young, live Lampsilinae, and Lampsilinae adults and young have all fluctuated over time (significantly higher or lower in some monitoring events), but no increasing or decreasing trends were apparent. No significant differences were detected in density of fresh dead unionids (total, Lampsilinae, or Ambleminae) in the SS Bed among monitoring years. Mortality was ≤10% overall as well as for both Amblemines and Lampsilines, and was consistent with mortality in previous years. Overall recruitment has fluctuated over the years, but was relatively low (20.8%) in 2016. On average, though, the SS Bed tends to have lower recruitment than most other beds in the study. Ambleminae recruitment (21.2%) was similar to previous years, but Lampsilinae recruitment was notably lower (7.1%) than in previous years. Similar declines in Lampsilinae recruitment were observed in several other beds in 2016.

Age of unionids collected in quantitative samples ranged from 2 to 24 years old (Table 3-21). Four of the 6 Ambleminae species were represented by young individuals. Although no Ambleminae juveniles ≤3 years old were collected in

quantitative samples in 2012, several individuals in this age class were present in 2016. Only 2 of the 5 Lampsilinae species were represented by young individuals, and only 1 individual ≤3 years old was collected.

T&E species occurred at a very low frequency in the SS Bed, with only a few individuals collected in any year and/or only sporadically collected (Table 3-19). *Ligumia recta* have been consistently collected in the last 7 monitoring events. *Pleurobema sintoxia* was collected in August 2006 and October 2007. *Ellipsaria lineolata* were found in July 2004 and 2005, but have not been collected since. *Lampsilis teres* was only found alive in 2007 and 2012, and all individuals collected in 2012 were 0-1 years old. Two individuals of *Lampsilis higginsii*, previously thought to not occur in the SS Bed, were found in the SS Bed in 2008; however, no *L. higginsii* have been collected since.

3.3.2 Cordova Bed

The Cordova Bed is one of the Essential Habitat Areas designated in the *L. higginsii* recovery plan (USFWS, 2004). This bed has historically harbored a dense and diverse unionid community. However, density within this bed has declined in recent years primarily due to heavy zebra mussel infestation. The portion of the Cordova Bed sampled in this study is approximately 3300 m downstream of QCNS mixing zone, on the Illinois bank of the river (Figure 1-1).

Zebra mussels were more abundant in the Cordova Bed than other beds during most past monitoring events. In 1994, zebra mussel density in the Cordova bed was <10/m^2 (Miller and Payne, 1995). In 1999, most unionids in the Cordova Bed had <50 zebra mussels attached. By 2000, zebra mussels encrusted all unionids and covered the substrate in most of the Cordova Bed. In 2001, few zebra mussels were found within 20 m of the bank, but density further from the bank averaged 3000 to 4000/m^2. However, in 2002, zebra mussels declined appreciably and only one-third of the unionids had a few zebra mussels attached. Zebra mussel density in 2003 had declined to <1000/m^2. Zebra mussel density increased in the Cordova Bed in 2004; however, density declined in 2005 and remained low in 2006 and 2007 (Table 3-22). Infestation was very high in 2008 and then declined appreciably in later sampling years; no unionids were infested with zebra mussels in 2016 (Table 3-22). Zebra mussel infestation in the Cordova Bed was comparable to the Albany and Hansons Slough Beds in 2016.

Zebra mussel infestation has resulted in high unionid mortality and reduced density within the Cordova Bed. Before heavy zebra mussel infestation (1994), density in the Cordova Bed ranged from 51 to 83 unionids/m^2 and recruitment (measured as percentage of unionids ≤30 mm) ranged from 10 to 49% (Miller and Payne, 1996). In 1999, zebra mussel density was extremely high, unionid mortality was near 50%, and recruitment was near zero at RM 504.3 (ESI, 1999). Between 2001 and 2003, zebra mussel density declined, unionid density and recruitment increased, and mortality declined. Density in 2002 and 2003 ranged from 3.6 to 8.1 unionids/m^2 and, in 2003, recruitment was near 44% (Farr et al., 2002; ERDC, 2003 preliminary data). Unionid density and recruitment have remained stable since 2004, with density averaging 4.7 unionids/m^2 and percentage young unionids averaging 31.8% (Table 3-23). Strayer and Malcolm (2007) also noted a dramatic decline in unionid density in the Hudson River following zebra mussel infestation, followed by a lower density unionid community coexisting with zebra mussels for several years until other invasive species affected

unionid abundance (blue crabs that were feeding on zebra mussels, shifted to juvenile unionids when zebra mussels declined; Strayer, personal communication, 2017).

The Cordova Bed differs from the UP and SS beds in that it occurs along a slight outside bend in the river, and its substrate has been coarser (higher percentages of gravel, cobble, shell; Table 3-1). Substrate in 2016 was similar to previous years, and still contained a relatively high percentage of zebra mussel shells. Depth ranged from 0.1 to 7.3 m over all monitoring events, and averaged 3.1 m in 2016. Dissolved oxygen in the Cordova Bed was similar to previous years, averaging 8.3 mg/L (range, 8.2 to 8.6 mg/L; Table 3-22). Current velocity (average, 0.5 m/sec) was higher than in previous years, perhaps due to high discharge during sampling. Water temperature in 2016 was consistent with declining water temperatures throughout the study period, and ranged from 55.0 to 55.8°F.

Species composition and relative abundance in the Cordova Bed were similar to the Albany Bed, and similar trends in unionid community characteristics were observed at both sites. Average relative abundance of Ambleminae (46.3%) and Lampsilinae (48.5%) in this bed was fairly equal (Table 3-24). As in all prior monitoring events, *A. plicata* (33.7%) dominated the community in 2016. *Quadrula p. pustulosa* appeared to be declining somewhat in this bed, but relative abundance of this species was higher in 2016 (12.2%) than in all previous years. Recruitment was markedly lower (11.2%) in 2016 than in all previous monitoring events. Species richness was similar to previous years (20 species collected in 2016), and the slope of the species richness curve remained consistent. Total density and density of adults and juveniles all fluctuated throughout monitoring events, with no apparent increasing or decreasing trends, though juvenile density was significantly lower in 2016 than in 2012. Density of fresh dead shells and overall mortality were lower than in previous monitoring events, as no mortality was observed in 2016 (Table 3-23).

Characteristics specific to Ambleminae and Lampsilinae were similar between the Cordova Bed and the Albany Bed in 2012. Density of total Ambleminae, total Lampsilinae, Ambleminae adults and juveniles, and Lampsilinae adults and juveniles fluctuated throughout monitoring events, with no apparent increasing or decreasing trends, as did density of fresh dead shells and overall mortality. No mortality was observed in either subfamily. Recruitment of both Ambleminae (7.7%) and Lampsilinae (2.4%) was the lowest recorded in all monitoring events thus far; however, recruitment was relatively low in several other beds as well. Density of Ambleminae and Lampsilinae did not differ in 2016 (Table 3-23).

Age of unionids collected in quantitative samples from the Cordova Bed ranged from 1 to 28 years old (Table 3-25). Only 2 of the 5 Ambleminae species and 3 of the 10 Lampsilinae species in this bed were represented by young individuals. The majority of juveniles collected were *Quadrula p. pustulosa*, a species previously thought to be declining somewhat in this bed.

Threatened and endangered species, including *E. lineolata, L. recta,* and *L. higginsii,* continue to be collected regularly from the Cordova Bed. All 3 of these species were present in 2016. *Ligumia recta* and *L. higginsii* have been collected in all monitoring events, while *E. lineolata* has only been collected since 2005. *Lampsilis teres*, not previously collected

live in the Cordova bed, was collected in 2016. *Plethobasus cyphyus* has not been found in this monitoring study, but was reported from this bed in 2006 (D. Sallee, pers. comm., IDNR). *Lampsilis higginsii* was collected in the Cordova Bed in 2016. Abundance of this species was higher than in 2012, but was still lower than most other years (Table 3-8).

3.3.3 Woodwards Grove Bed

The WG Bed is downstream of the QCNS diffuser, approximately 8300 to 10,900 m (Table 2-1). The bed appears to extend from approximately RM 499.5 to 500.8 along the Iowa bank within a slight outside bend. The bed extends from the bank at least 150 m riverward. Zebra mussel infestation in this bed was low in 2007, increased in 2008, and was once again relatively low in 2012 and 2016 (Table 3-26). Zebra mussel shells were not a significant component of the substrate in 2012, but were present in 2007, 2008, and 2016. Other than zebra mussels, substrate was primarily silt and clay closer to the bank, turning to finer sand riverward and upstream. Depth varied from 1.5 m near the bank to 7.6 m riverward in 2016. Current velocity was higher than in previous years, averaging 0.4 m/sec in 2016 (Table 3-26). This may be due to high discharge during 2016 sampling. Dissolved oxygen was lower than in previous years, but was similar to the other downstream sites sampled this year (range, 7.9 to 8.4 mg/L). As at all other sites, water temperature in the WG Bed was consistent with steadily declining temperatures during the 2016 study period, and averaged 55.6°F.

The WG Bed harbors a moderately dense and species rich bed compared to other sites. In all 4 monitoring years at this site, 21 to 23 species have been collected. The slope of the species richness curve averaged 7.49 and was comparable to the UP and Cordova Beds, but slightly lower than the Albany Bed (Table 3-27). Species composition and community characteristics changed significantly in this bed between 2012 and 2016; community metrics in 2016 were more similar to 2007 and 2008. Overall density was comparable to 2007 and 2008. However, juvenile density was significantly lower than in previous years. Overall recruitment (22.8%) was also lower than in previous years, but was higher than most other beds sampled in 2016. Juveniles of 11 species were present (Table 3-28). Overall mortality and mortality of Ambleminae and Lampsilinae remained under 10% in all years, and was <1% in 2016. The proportion of Ambleminae to Lampsilinae changed appreciably in 2012, due to high recruitment of certain Lampsilinae species, but relative abundance of these subfamilies in 2016 was once again comparable to 2007 and 2008. As in 2007 and 2008, Ambleminae were over twice as abundant as Lampsilinae (65.6% Ambleminae vs. 27.6%.Lampsilinae in 2016) and were significantly denser than Lampsilinae. Recruitment for both subfamilies was lower than in previous years. Additionally, the abundance of Anodontinae increased from 9.6% in 2008 to 23.8% in 2012 due to a large increase in the abundance of young *U. imbecillis,* but abundance of this subfamily decreased to 6.8% in 2016 (Table 3-29). While *U. imbecillis* was the most abundant species collected in 2012, species relative abundance in 2016 was similar to 2007 and 2008, with *Quadrula quadrula* (28.7%) and *Amblema plicata* (19.3%) being the 2 most commonly encountered species. Threatened and endangered species *E. lineolata* and *L. recta* were collected from the WG Bed in all 3 monitoring events. *Lampsilis higginsii* was collected in 2007, 2008, and 2016 (Table 3-8).

4.0 Conclusions

Community characteristics within unionid mussel beds upstream and downstream of the QCNS diffuser discharge have fluctuated over time, but these beds continue to support low to moderate density, species rich unionid communities. The monitoring program focused on unionid beds with similar habitat characteristics upstream and downstream of the diffuser; Cordova (downstream) was most similar to Albany (Upstream), Steamboat Slough (downstream) had similar characteristics to both UP and Hanson Slough beds (upstream). Characteristics of all of these communities varied slightly from previous monitoring events, and some significant differences among years were observed. However, no consistent increasing or decreasing trends were apparent when all monitoring years were considered. Rather, characteristics observed in 2016 were similar to previous monitoring events and likely reflect natural fluctuations. Recruitment appeared to be lower in some of the beds than in previous years, but this may be due to higher water levels in the last few years, as recruitment of many species seems to be lower during high water years.

Results of this study also show that community characteristics within the beds sampled in this study do not seem to be significantly affected by the QCNS thermal effluent. Unionid beds downstream of the QCNS exhibited similarities and differences in habitat and unionid community characteristics with unionid beds upstream of the QCNS, and no significant trends were observed that distinguished the downstream beds from the upstream beds.

5.0 Literature Cited

Colwell, R. K. 2013. EstimateS: Statistical estimation of species richness and shared species from samples. Version 9.1.0. <viceroy.eeb.ucon.edu/estimates/index.html>

Ecological Specialists, Inc. (ESI). 1999. Biological assessment for Higgins' Eye pearlymussel (*Lampsilis higginsi*) at discharge outfall locations. Prepared for Cordova Energy Company LLC, Davenport, IA. 59pp.

Ecological Specialists, Inc. (ESI). 2009. Draft report: 2008 results of unionid mussel monitoring near Quad Cities Nuclear Station, Mississippi River Miles 495 to 515. Prepared for Exelon Generation Company, Warrenville, IL. 57pp.

Ecological Specialists, Inc. (ESI). 2013. 2012 Results of Unionid Mussel Monitoring near Quad Cities Nuclear Station, Mississippi River Miles 495 to 515. Prepared for Exelon Generation Company, Warrenville, IL. 57pp.

Farr, M. D., A. C. Miller, and B. S. Payne. 2002. Ecological aspects of native and non-native bivalves at selected sites in the Upper Mississippi River, 2001 studies. Draft. Prepared for U.S. Army Corps of Engineers, St. Paul District, St. Paul, MN.

Kelner, D. E. 2011. Upper Mississippi River mussel species list. U.S. Army Corps of Engineers, St. Paul District, St. Paul, MN.

Kovalak, W. P., S. D. Dennis, and J. M. Bates. 1986. Sampling effort required to find rare species of freshwater mussels. Pages 35-45 *in* B. G. Isom (ed.). Rationale for sampling and interpretation of ecological data in the assessment of freshwater ecosystems. ASTM STP 894.

Miller, A. C., and B. S. Payne. 1995. Effects of increased commercial navigation traffic on freshwater mussels in the Upper Mississippi River: 1993 studies. Prepared for U.S. Army Corps of Engineer District, St. Louis. Technical report EL-95-11.

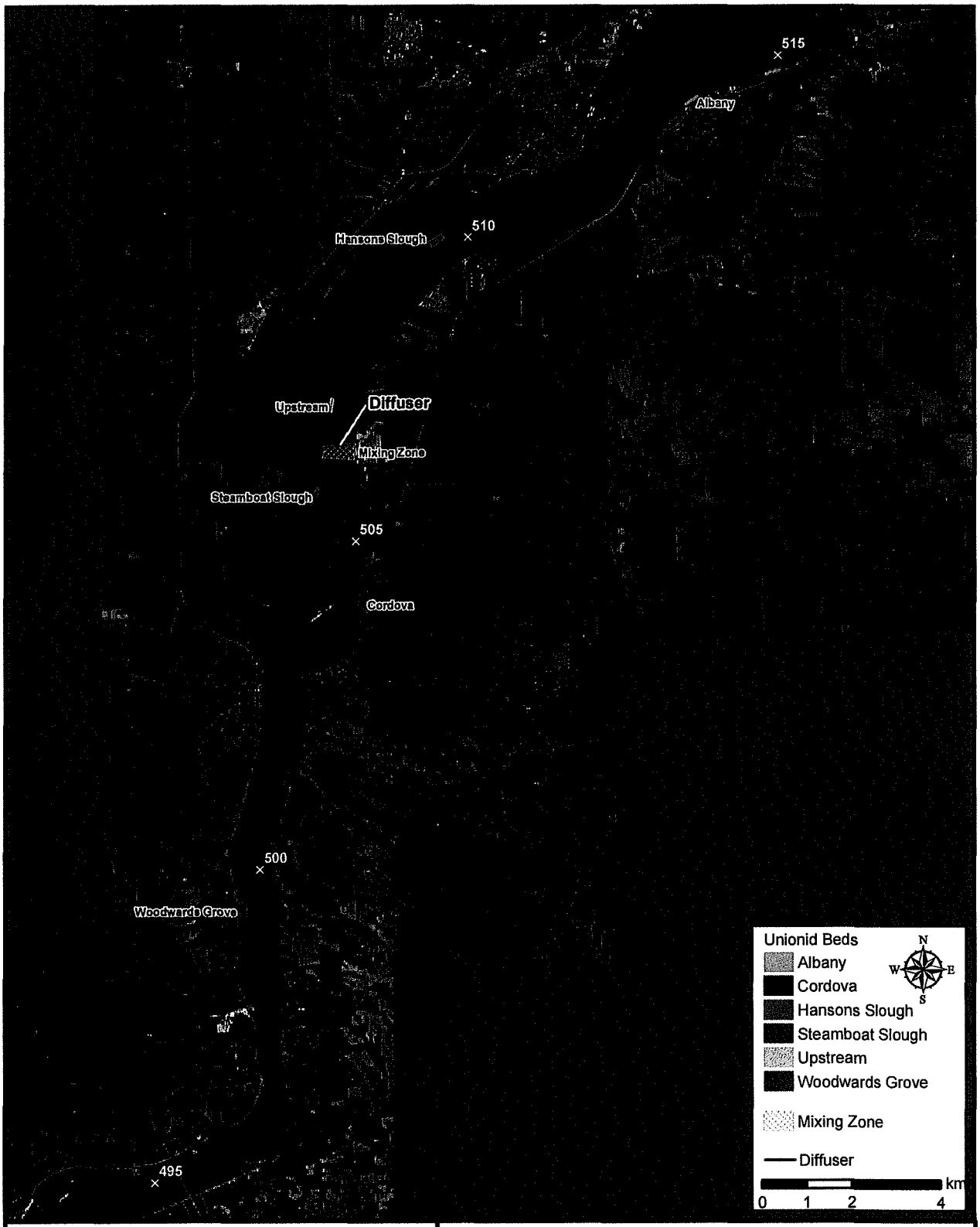
Miller, A. C., and B. S. Payne. 1996. Effects of increased commercial navigation traffic on freshwater mussels in the Upper Mississippi River: Final Synthesis Report. Prepared for U.S. Army Corps of Engineer District, St. Louis. Technical report EL-96-6.

Strayer, D. L. and H. M. Malcolm. 2007. Effects of zebra mussels (*Dreissena polymorpha*) on native bivalves: the beginning of the end or the end of the beginning? JNABS 26:111-122.

U.S. Fish and Wildlife Service (USFWS). 2004. Higgins Eye Pearlymussel (*Lampsilis higginsii*) recovery plan: first revision. Ft. Snelling, MN. 126pp.

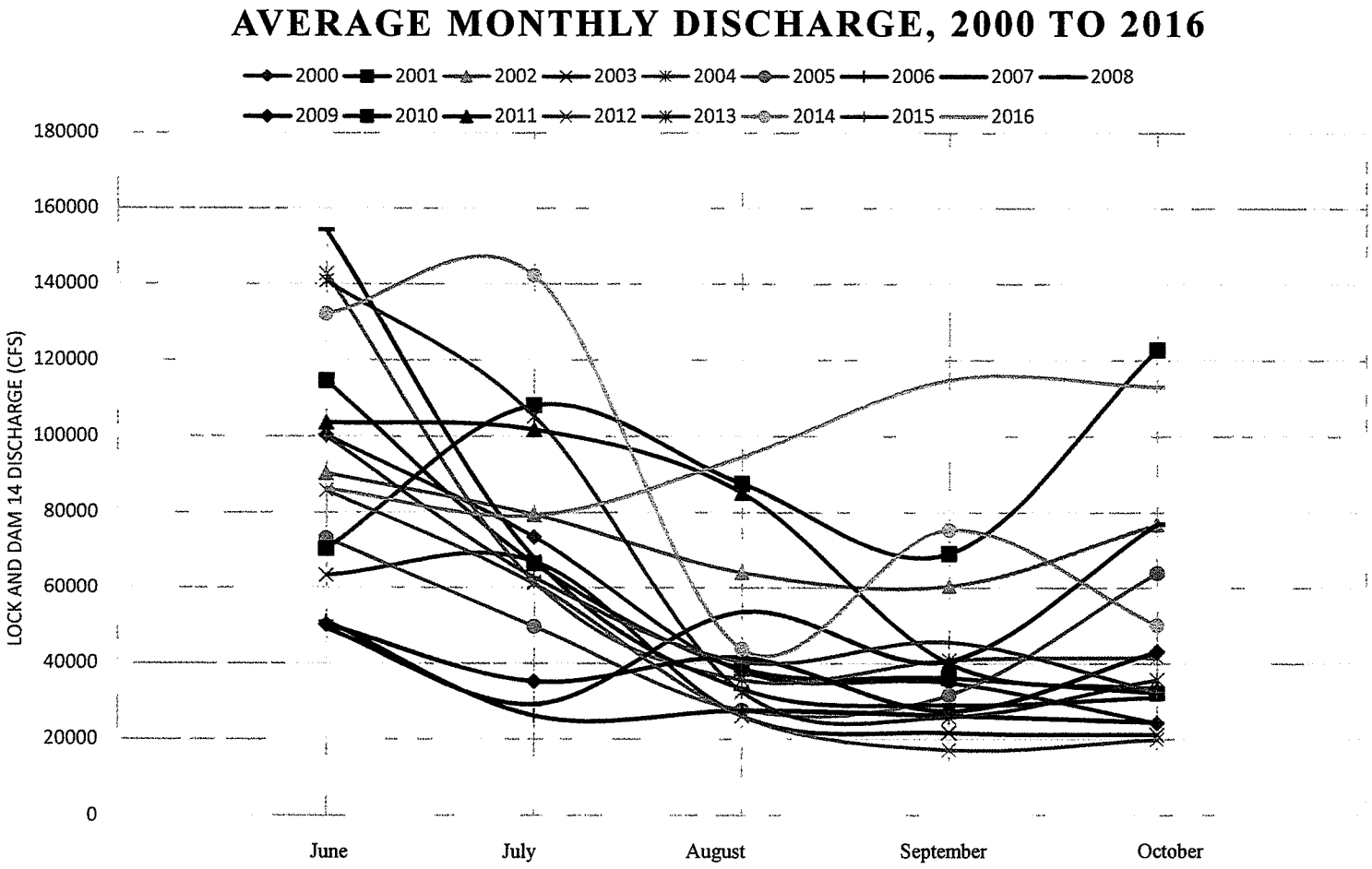
U.S. Fish and Wildlife Service (USFWS). 2008. Higgins eye (*Lampsilis higginsii*) Essential Habitat Areas 2008 review and additions of new EHAs. Twin Cities Field Office, St. Paul, MN. 9pp.

Wolman, M. G. 1954. A method of sampling coarse river-bed material. Transactions of the American Geophysical Union (EOS) 35:951-956.



Ecological Specialists, INC.
An EcoAnalysts Company

Figure 1-1. Unionid bed monitoring areas near QCNS, 2004 through 2016.



Ecological Specialists, INC.
An EcoAnalysts Company

Figure 3-1. Mississippi River, Lock and Dam 14, average monthly discharge, June 2000 to October 2016.

Table 1-1. Summary of QCNS excursion hours used between 2000 and 2016.

	River discharge (cfs)		Intake temperature (°F)		Max dn temp (°F)		Excursion hours	
	Min	Max	Min	Max	Calculated	Measured[1]	Cumulative	%
2000								
June	55,400	131,000	65.7	75.1	75.7	-	0	0
July	39,500	102,000	73.4	82.1	82.7	-	0	0
August	26,500	55,100	73.8	82.8	84.7	-	0	0
September	22,000	50,000	59.0	81.4	83.1	-	0	0
2001								
June	94,900	129,000	60.0	80.4	80.8	-	0	0
July	36,700	131,000	75.2	86.5	87.7	87.0	25.25	0.3
August	25,600	56,800	73.5	87.8	88.3	87.0	57.35	0.7
September	25,800	45,200	59.7	76.9	78.9	-	57.35	0.7
2002								
June	63,900	154,000	64.5	82.1	82.7	81.0	0	0
July	62,700	104,000	77.3	84.8	85.5	83.0	0	0
August	54,300	90,200	74.7	84.2	85.2	84.0	0	0
September	38,900	74,400	63.5	79.6	80.5	-	0	0
2003								
June	39,600	94,300	64.7	80.3	80.8	-	0	0
July	41,500	89,900	74.9	83.2	84.0	-	0	0
August	16,200	34,100	77.0	86.2	89.6	86.0	0	0
September	13,600	43,500	59.9	81.6	86.3	82.0	0	0
2004								
June	103,000	169,000	64.9	76.6	76.8	-	0	0
July	32,100	100,000	72.5	81.2	82.1	-	0	0
August	26,800	49,300	68.2	79.6	81.0	-	0	0
September	23,100	58,300	65.2	78.8	81.1	-	0	0
2005								
June	64,500	81,718	67.4	83.0	83.4	82.0	0	
July	27,980	74,820	75.2	86.4	88.1	88.0	42.50	0.5
August	18,030	34,998	75.7	85.4	87.8	85.0	42.50	0.5
September	19,064	45,317	63.6	79.8	82.5	79.0	42.50	0.5
2006								
June	42,023	72,849	68.0	79.1	80.2	-	0	0
July	12,700	37,600	76.9	91.1	95.8	91.0	117.25	1.3
August	12,600	39,800	73.8	91.6	96.0	91.0	222.75	2.5
September	21,200	37,600	60.0	76.6	79.4	-	222.75	2.5
2007								
June	34,100	63,700	69.8	81.9	83.4	82.0	0	0
July	21,200	47,400	76.6	84.5	87.3	84.0	0	0
August	18,600	123,000	72.8	87.3	90.4	87.6	74.00	0.8
September	27,500	77,300	65.0	78.2	79.7	-	74.00	0.8
2008								
June	92,000	236,200	66.6	76.1	76.6	-	0	0
July	44,600	104,150	74.2	82.4	83.9	-	0	0
August	27,200	44,100	74.8	83.3	84.8	-	0	0
September	23,100	39,400	65.6	78.6	80.9	-	0	0

Table 1-1. Summary of QCNS excursion hours used between 2000 and 2016 (cont.).

	River discharge (cfs)		Intake temperature (°F)		Max dn temp (°F)		Excursion hours	
	Min	Max	Min	Max	Calculated	Measured[1]	Cumulative	%
2009								
June	43,500	65,200	65.7	84.2	85.6	85.6	5.00	0.1
July	24,300	55,800	71.3	77.1	79.2	-	0	0
August	23,000	73,500	66.7	80.0	82.6	-	0	0
September	21,000	49,000	61.6	74.6	77.3	-	0	0
2010								
May	47,400	85,800	55.0	79.1	80.1	79.7	36.00	0.4
June	47,000	104,400	72.3	80.4	81.0	-	0	0
July	81,600	168,600	76.5	83.8	84.5	-	0	0
August	65,100	120,300	76.2	83.9	84.4	-	0	0
September	55,500	121,900	63.4	77.5	78.5	-	0	0
2011								
June	84,500	116,700	-	79	79.3	-	0	0
July	76,600	153,000	-	88	88.8		33.00	0.4
August	51,700	128,000	-	86	86.6		0	0
September	29,200	53,600	-	80	81.3	-	0	0
2012								
March	34,200	89,000	36.0	64.1	64.4	62.2	223.50	2.6
June	70,100	103,200	66.8	81.8	82.7	-	0	0
July	35,100	94,400	80.8	89.9	91.0	88.5	219.00	5.1
August	21,000	35,300	74.0	85.6	87.5	86.2	0	0
September	12,200	23,200	64.0	83.9	87.1	81.7	0	0
2013								
June	99,400	175,200	65.6	77.9	78.5	-	0	0
July	34,200	169,500	72.8	86.9	87.7	85.5	0	0
August	25,500	38,800	72.8	83.8	86.2	84.9	0	0
September	22,700	30,000	67.7	83.1	85.5	81.7	0	0
2014								
June	110,200	169,400	71.4	78.8	79.2	-	0	0
July	55,100	207,400	72.6	78.9	79.6	-	0	0
August	33,100	54,800	74.5	81.1	82.5	-	0	0
September	49,100	101,000	62.7	79.7	80.9	-	0	0
2015								
June	71,700	110,700	67.4	77.6	78.5	-	0	0
July	41,200	71,600	73.1	82.3	73.7	-	0	0
August	27,200	46,100	71.0	82.9	84.5	-	0	0
September	34,200	60,000	67.2	80.8	82.7	-	0	0
2016								
May	54,900	95,400	53.3	77.4	78.4	77.7	0	0
June	64,700	108,200	73.3	82.2	83.0	-	0	0
July	45,400	115,600	75.7	83.0	83.6	80.8	0	0
August	66,300	131,400	75.2	82.8	83.6	-	0	0
September	81,200	157,600	63.4	77.5	78.3	-	0	0

Exelon discharge records 2000 to 2016

[1]Maximum termperature measured as an average across the channel at various depths 500 feet downstream of the diffuser; temperature is measured only during high ambient temperature and low discharge situations

Table 2-1. Unionid sample sites within the QCNS study area, 2004 to 2016.

Site	MRM	Sample area (m)	Distance from diffuser (km)	Sample dates								
				Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Oct-07	Aug-08	Oct-12	Oct-16
Albany Bed	513.5	400 x 70	14.0 -14.8						x	x	x	x
Hansons Slough (HS)	509.5	400 x 150	5.0 - 5.4						x	x	x	x
Upstream Bed (UP)	507.0	400 x 80	0.7 - 1.1	x	x	x	x	x	x	x	x	x
Steamboat Slough Bed (SS)	505.6	400 x 50	0.9 - 1.3	x	x	x	x	x	x	x	x	x
Cordova Bed	504.0	400 x 100	3.3 - 3.7	x	x	x	x	x	x	x	x	x
Woodwards Grove Bed (WG)	499.5	400 x 150	10.5 - 10.9						x	x	x	x

MRM= Mississippi River Mile

Table 3-1. Comparison of habitat conditions among unionid beds sampled in October 2016.

	Upstream Beds			Downstream Beds		
	Albany	HS	UP	SS	Cordova	WG
Sample date	Oct 27, 28, 31	Oct 25, 31	Oct 25, 27, 28, Nov 3	Oct 28, Nov 2	Oct 29, Nov 1	Oct 30, Nov 1
Discharge (cfs)[1]	93,807 to 98,771	87,775 to 98,771	87,775 to 97,592	96,878 to 97,327	97,592 to 98,231	98,231 to 98,963
Dist from bank (m)	10 to 70	10 to 150	45 to 115	35 to 115	10 to 90	10 to 150
Dist from mix zone (m)	14,000 to 14,400	5,000 to 5,400	730 to 1,130	675 to 1,125	3,030 to 3,365	10,500 to 10,900
Substrate						
% Bedrock	8	0	0	0	0	0
% Boulder	3	0	0	0	6	0
% Cobble	9	0	0	1	3	1
% Gravel	11	0	0	0	24	0
% Sand	14	70	60	87	14	58
% Silt	5	20	1	0	11	7
% Clay	5	8	32	12	6	15
% Detritus	0	0	0	0	0	0
% Shell	45	1	5	0	37	18
% Vegetation	0	0	0	0	0	0
Depth (m)						
Ave.	3.6	2.2	4.8	3.2	3.1	4.3
Range	(1.5 to 6.1)	(0.6 to 3.7)	(2.1 to 7.6)	(1.8 to 3.9)	(1.2 to 7.3)	(1.5 to 7.6)
CV[2]	33.0	29.0	28.0	15.0	34.0	26.0
Bottom temp (°F)						
Ave.	53.2	53.7	54.8	53.4	55.5	55.6
Range	(52.9 to 53.5)	(53.6 to 53.8)	(54.4 to 54.9)	(53.1 to 53.6)	(55.0 to 55.8)	(55.2 to 55.8)
CV[2]	0.8	0.3	0.5	0.6	0.7	0.5
Bottom DO (mg/L)						
% saturation	83.1	87.5	83.9	78.6	80.7	80.7
Ave.	8.8	9.2	8.7	8.3	8.3	8.3
Range	(8.5 to 8.9)	(8.9 to 9.6)	(7.7 to 8.9)	(8.2 to 8.4)	(8.2 to 8.6)	(7.9 to 8.4)
CV[2]	1.2	2.4	2.4	0.6	1.0	1.4
Bottom current velocity (m/sec)						
Ave.	0.5	0.4	0.5	0.4	0.5	0.4
Range	(>0 to 0.7)	(0.2 to 0.5)	(0.4 to 0.5)	(0.2 to 0.5)	(0.3 to 0.7)	(0.1 to 0.5)
CV[2]	26.0	19.0	7.0	24.0	23.0	23.0
Rel. zebra mussel inf.[3]	0.0	0.0	0.4 (0 - 10)	6.8 (0 - 10)	0.0	0.6 (0 - 10)

[1]Lock and Dam 14 (LeClaire, IA; MRM 493.3)

[2]CV = coefficient of variation (Standard deviation*100/mean)

[3]Average and range of zebra mussels per unionid

Table 3-2. Habitat conditions within the Albany bed, October 2007, August 2008, October 2012, and October 2016.

	Oct-07	Aug-08	Oct-12	Oct-16
Sample date	Oct 10 to 14	Aug 18 to 25	Oct 24 to 25	Oct 27, 28, 31
Discharge (cfs)[1]	74,700 to 77,700	27,291 to 33,497	23,405 to 23,741	93,807 to 98,771
Dist from bank (m)	10 to 70	10 to 70	10 to 70	10 to 70
Dist from mix zone (m)	14,000 to 14,400	14,000 to 14,400	14,000 to 14,400	14,000 to 14,400
Substrate				
% Bedrock	2	3	0	8
% Boulder	0	1	14	3
% Cobble	7	6	21	9
% Gravel	24	18	10	11
% Sand	18	43	25	14
% Silt	4	2	7	5
% Clay	1	0	5	5
% Detritus	0	0	0	0
% Shell	44	25	19	45
% Vegetation	<1	0	0	0
Depth (m)				
Ave.	1.4	2.2	2.3	3.6
Range	(0.6 to 2.4)	(0.6 to 4.6)	(0.3 to 4.6)	(1.5 to 6.1)
CV[2]	36	52	56	33
Bottom temp (°F)				
Ave.	59.0	73.6	58.2	53.2
Range	(58.1 to 59.0)	(69.8 to 84.2)	(57.4 to 59.9)	(52.9 to 53.5)
CV[2]	0.7	4.0	1.2	0.8
Bottom DO (mg/L)				
% saturation	81.3	92.1	115.7	83.1
Ave.	8.2	7.9	11.8	8.8
Range	(7.8 to 8.4)	(7.0 to 8.1)	(11.6 to 12.2)	(8.5 to 8.9)
CV[2]	1.8	3.1	1.4	1.2
Bottom current velocity (m/sec)				
Ave.	0.1	0.1	0.05	0.5
Range	(>0 to 0.3)	(>0 to 0.2)	(0 to 0.12)	(>0 to 0.7)
CV[2]	67	51	58	26
Rel. zebra mussel inf.[3]	0.01 (0 to 1)	11.2 (0 to 50)	3.8 (0 to 150)	0.0

[1]Lock and Dam 14 (LeClaire, IA; MRM 493.3)

[2]CV = coefficient of variation (Standard deviation*100/mean)

[3]Average and range of zebra mussels per unionid

Table 3-3. Comparison of average species relative abundance (%)[1] among unionid beds upstream and downstream of QCNS.

	Upstream beds			Downstream beds		
	Albany[2]	HS[2]	UP[3]	SS[3]	Cordova[3]	WG[2]
Margaritiferidae						
Cumberlandia monodonta	**SF**	-	-	-	-	-
Ambleminae						
Amblema plicata	21.4	18.9	22.2	27.7	34.2	15.2
Cyclonaias tuberculata	**WD**	-	**SF**	-	**SF**	**SF**
Elliptio crassidens	**SF**	-	-	-	-	-
Elliptio dilatata	**SF**	-	-	-	**SF**	**WD**
Fusconaia ebena	WD	-	WD	WD	WD	WD
Fusconaia flava	3.6	5.1	5.2	2.8	2.1	0.4
Megalonaias nervosa	1.7	0.1	0.4	X	2.4	3.8
Plethobasus cyphyus	**SF**	-	-	-	**P**	**SF**
Pleurobema sintoxia	**SF**	**0.2**	**WD**	**X**	**WD**	**X**
Quadrula metanevra	X	X	0.1	X	WD	SF
Quadrula nodulata	0.5	3.8	1.2	11.3	0.3	6.1
Quadrula p. pustulosa	10.0	35.1	8.2	7.7	5.6	2.8
Quadrula quadrula	4.3	5.7	6.8	13.8	1.7	25.6
Tritogonia verrucosa	**SF**	-	**WD**	**WD**	**WD**	**WD**
Total Ambleminae	41.4	68.8	44.1	63.4	46.3	53.8
Anodontinae						
Anodonta suborbiculata	-	-	-	-	-	X
Arcidens confragosus	0.5	X	0.4	0.5	0.5	1.4
Lasmigona c. complanata	1.4	0.2	1.6	0.8	0.6	1.2
Lasmigona costata	-	-	-	-	-	SF
Pyganodon grandis	1.2	0.2	0.2	3.8	1.5	1.2
Strophitus undulatus	**0.2**	**WD**	**WD**	-	**0.1**	-
Utterbackia imbecillis	2.6	WD	0.5	FD	2.5	7.7
Total Anodontinae	5.9	0.4	2.7	2.0	5.1	11.6
Lampsilinae						
Actinonaias ligamentina	WD	0.1	X	X	0.3	SF
Ellipsaria lineolata	**0.5**	**1.7**	**0.5**	**0.3**	**0.4**	**0.4**
Lampsilis cardium	8.2	7.8	7.2	2.9	8.2	1.5
Lampsilis higginsii	**1.3**	**0.3**	**0.1**	**X**	**2.0**	**0.2**
Lampsilis ovata	-	-	X	-	-	-
Lampsilis siliquoidea	SF	-	-	-	0.1	-
Lampsilis teres	**0.3**	**X**	**0.5**	**0.5**	**WD**	**0.3**
Leptodea fragilis	4.9	0.8	5.8	1.7	15.4	8.9
Ligumia recta	**7.5**	**0.9**	**0.9**	**0.2**	**4.3**	**0.4**
Obliquaria reflexa	12.7	14.5	29.4	21.9	7.5	12.7
Obovaria olivaria	1.8	1.6	2.7	0.6	0.3	0.2
Potamilus alatus	1.1	0.2	0.4	0.5	1.7	2.1
Potamilus capax	-	-	**WD**	-	-	-
Potamilus ohiensis	0.2	1.0	1.1	3.5	0.6	2.9
Toxolasma parvus	2.6	0.2	0.3	0.1	2.6	0.3
Truncilla donaciformis	11.3	1.4	3.8	2.2	3.0	6.4
Truncilla truncata	0.3	0.3	0.5	0.1	0.5	0.2
Total Lampsilinae	52.7	30.8	53.1	34.6	48.5	36.6
No. species live/FD	25	25	26	26	26	25
Total species	35	27	32	28	33	33
No. live/FD T&E species	5	5	4	5	5	5
Total no. T&E species	11	6	9	6	10	9

[1]Numbers represent % that species represents in quantitative samples. X=not collected in quantitative samples, but found in qualitative samples

[2]Average of October 2007, August 2008, and October 2012

[3]Average of all monitoring events 2004 to 2016

FD = freshly dead shell, WD = weathered shell, SF = subfossil shell, P=collected in a recent study by ILDNR (D. Sallee, pers. com)

Bold indicates Illinois, Iowa and Federally threatened and endangered species

Table 3-4. Comparison of average community characteristics among unionid beds upstream and downstream of QCNS.

	Upstream beds			Downstream beds		
	Albany[4]	HS[4]	UP[5]	SS[5]	Cordova[5]	WG[4]
Total no.[1]	404	1082	735	557	436	905
Ave. no./m^{2,2}	5.3 ± 0.8A	8.3 ± 1.3B	9.9 ± 1.1B	4.1 ± 0.4A	4.7 ± 0.5A	8.8 ± 1.2B
Ave. CPUE[3]	10.0	32.2	25.5	21.8	15.2	24.8
Ave. no. species/qual sample[3]	5.1	7.1	6.9	6.2	5.9	7.0
Total no. live/FD species[1]	20.5	20.3	21.6	16.2	20.3	22.3
Cumulative live/FD species	25	25	26	26	25	25
Rarefaction species richness[3]						
100	17	11	13	10	15	14
250	20	15	17	14	19	18
500	21	18	20	16	20	20
750	-	20	22	16	-	22
Regression slope	8.17	6.30	7.32	5.64	7.58	7.49
Ave. no. young/m^{2,2}	2.0 ± 0.4AC	2.1 ± 0.4AC	2.6 ± 0.4CD	0.9 ± 0.2B	1.6 ± 0.3A	3.6 ± 0.8D
Ave. no. adults/m^{2,2}	3.1 ± 0.5A	6.1 ± 1.1B	7.0 ± 0.9B	3.1 ± 0.4A	3.1 ± 0.3A	4.8 ± 0.7B
% young[2]	40.6	22.4	29.4	22.1	31.8	41.6
% of species w/ ≤5 yrs[2]	64.0	66.8	69.1	58.6	60.5	66.6
Ave. no. FD/m^{2,2}	0.5 ± 0.2A	0.4 ± 0.2AB	0.6 ± 0.1A	0.2 ± 0.1B	0.5 ± 0.2A	0.3 ± 0.1AB
%Mortality[2]	8.8	5.1	4.9	3.6	12.1	2.8
% adult mortality[2]	10.7	6.6	6.1	4.4	11.8	6.0
% juvenile mortality[2]	6.6	1.0	7.5	2.8	12.6	0.9
Ambleminae						
Total no.[2]	50.0	127.8	84.6	48.1	39.2	95.8
Total no.[1]	152.8	597.5	259.0	334.1	205.4	436.0
Ave. no./m^{2,2}	2.2 ± 0.4A*	5.7 ± 0.9BC*	4.6 ± 0.6C*	2.6 ± 0.3A*	2.1 ± 0.3A*	4.3 ± 0.6BC*
Ave. no.≤5yrs/m^{2,2}	0.7 ± 0.2A	1.5 ± 0.3B	1.3 ± 0.2B	0.6 ± 0.1A	0.5 ± 0.1A	1.3 ± 0.3B
Ave. no.>5yrs/m^{2,2}	1.6 ± 0.4A	4.2 ± 0.8B	3.2 ± 0.5CD	2.0 ± 0.3AC	1.6 ± 0.2A	3.0 ± 0.5BD
% young[2]	29.7	22.9	28.6	23.2	26.0	30.3
Total no. species[1]	5.8	6.8	5.9	5.4	5.4	6.3
Total no. species w/young[1]	4.3	5.0	5.1	4.4	4.1	5.5
Total no. adult species[1]	5.8	6.3	5.7	5.4	5.2	6.3
Ave. no. FD/m^{2,2}	0.2 ± 0.1AB	0.3 ± 0.1B	0.1 ± 0.1AB	0.1 ± 0.0A	0.2 ± 0.1AB	0.0 ± 0.1A
%Mortality[2]	9.2	4.9	2.4	2.2	8.8	1.1
% adult mortality[2]	6.5	5.4	2.9	1.9	5.9	1.7
% juvenile mortality[2]	8.2	0.0	3.6	1.4	17.9	0.0
Lampsilinae						
Total no.[2]	63.5	56.5	94.0	26.4	43.3	73.3
Total no.[1]	124.5	265.3	294.3	159.4	125.9	161.8
Ave. no./m^{2,2}	2.8 ± 0.5A#	2.5 ± 0.5A#	5.1 ± 0.6C#	1.4 ± 0.2B#	2.3 ± 0.3A*	3.3 ± 0.6A#
Ave. no.≤3yrs/m^{2,2}	1.3 ± 0.3AD	0.6 ± 0.2BC	1.4 ± 0.2D	0.3 ± 0.1C	0.9 ± 0.2AB	1.8 ± 0.5D
Ave. no.>3yrs/m^{2,2}	1.6 ± 0.3AB	1.9 ± 0.4A	3.6 ± 0.5C	1.1 ± 0.2B	1.4 ± 0.2AB	1.4 ± 0.3AB
% young[2]	39.3	19.4	29.4	20.3	33.5	48.5
Total no. species[1]	10.0	10.5	11.6	8.2	10.9	11.8
Total no. species w/young[1]	7.3	6.0	8.6	4.7	6.1	7.5
Total no. adult species[1]	8.8	9.0	10.0	7.3	10.0	10.5
Ave. no. FD/m^{2,2}	0.3 ± 0.1AB	0.2 ± 0.1AB	0.4 ± 0.1B	0.1 ± 0.0A	0.3 ± 0.1AB	0.1 ± 0.1AB
%Mortality[2]	7.6	5.2	6.0	5.4	13.1	4.3
% adult mortality[2]	15.4	8.3	7.4	8.2	13.4	12.8
% juvenile mortality[2]	5.0	6.7	11.5	2.4	8.6	0.0

[1]Quantitative and Qualitative combined; [2]Quantitative data only; [3]Qualitative data only

[4]Average of October 2007, August 2008, October 2012, and October 2016

[5]Average of all monitoring events 2004 to 2016

Different letters within a row indicates a significant difference (ANOVA, $p<0.05$)

Different symbols within a column indicate a significant difference (t-test, $p\leq0.05$)

Table 3-5. Relative abundance (%) of unionid species within the Albany bed, October 2007, August 2008, October 2012, and October 2016[1].

	2007	2008	2012	2016	Ave.
Margaritiferidae					
Cumberlandia monodonta	-	**SF**	**SF**	-	**SF**
Ambleminae					
Amblema plicata	20.3	28.8	22.2	14.1	21.4
Cyclonaias tuberculata	-	**SF**	**WD**	-	**WD**
Elliptio crassidens	-	**SF**	-	-	**SF**
Elliptio dilatata	-	**SF**	**SF**	-	**SF**
Fusconaia ebena	-	-	WD	-	WD
Fusconaia flava	4.7	2.9	4.0	2.6	3.6
Megalonaias nervosa	1.4	1.0	0.7	3.9	1.7
Plethobasus cyphyus	-	**SF**	**SF**	-	**SF**
Pleurobema sintoxia	-	-	**SF**	-	**SF**
Quadrula metanevra	-	-	X	-	X
Quadrula nodulata	0.7	WD	SF	1.3	0.5
Quadrula p. pustulosa	17.6	8.7	6.0	7.7	10.0
Quadrula quadrula	2.7	2.9	4.0	7.7	4.3
Tritogonia verrucosa	-	**SF**	**SF**	-	**SF**
Total Ambleminae	47.3	44.2	36.9	37.3	41.4
Anodontinae					
Arcidens confragosus	0.7	X	X	1.3	0.5
Lasmigona c. complanata	X	1.0	0.7	3.9	1.4
Pyganodon grandis	2.0	2.9	X	X	1.2
Strophitus undulatus	**X**	**1.0**	**X**	-	**0.2**
Utterbackia imbecillis	2.0	1.9	1.3	5.1	2.6
Total Anodontinae	4.7	6.7	2.0	10.3	5.9
Lampsilinae					
Actinonaias ligamentina	-	-	WD	-	WD
Ellipsaria lineolata	-	**1.9**	**X**	-	**0.5**
Lampsilis cardium	8.8	11.5	8.7	3.9	8.2
Lampsilis higginsii	**1.4**	**X**	**1.3**	**2.6**	**1.3**
Lampsilis siliquoidea	-	-	SF	-	SF
Lampsilis teres	-	-	**1.3**	-	**0.3**
Leptodea fragilis	9.5	4.8	4.0	1.3	4.9
Ligumia recta	**2.7**	**8.7**	**4.7**	**14.1**	**7.5**
Obliquaria reflexa	12.8	10.6	8.0	19.2	12.7
Obovaria olivaria	1.4	1.9	1.3	2.6	1.8
Potamilus alatus	0.7	2.9	0.7	-	1.1
Potamilus ohiensis	0.7	-	-	-	0.2
Toxolasma parvus	2.7	1.0	4.0	2.6	2.6
Truncilla donaciformis	7.4	5.8	25.5	6.4	11.3
Truncilla truncata	-	WD	1.3	-	0.3
Total Lampsilinae	48.0	49.0	61.1	52.7	52.7

[1]Numbers represent % that species represents in quantitative samples. X=not collected in quantitative samples, but found in qualitative samples
FD = freshly dead shell, WD = weathered shell, SF = subfossil shell
Bold indicates Illinois, Iowa and Federally threatened and endangered species

Table 3-6. Age (external annuli count) frequency of unionid species collected in the Albany Bed, October 2016.

Subfamily	Species	Young[2]	Age (external annuli count)[1]																				
			2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	20	21	23	24	Total
Ambleminae	*Amblema plicata*	Y	-	1	1	2	-	-	-	-	-	-	1	2	2	-	-	1	-	1	-	-	11
	Fusconaia flava	N	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	2
	Megalonaias nervosa	N	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	1	-	-	-	3
	Quadrula nodulata	N	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	Quadrula p. pustulosa	Y	-	-	1	-	-	1	-	-	1	-	1	-	1	-	-	1	-	-	-	-	6
	Quadrula quadrula	Y	-	2	-	-	-	-	-	-	-	1	-	-	-	1	2	-	-	-	-	-	6
Ambleminae Total			0	3	2	2	1	3	0	0	1	1	2	2	3	2	3	2	1	1	0	0	29
Anodontinae	*Arcidens confragosus*	N	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1	1	4
	Lasmigona c. complanata	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Pyganodon grandis	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Utterbackia imbecillis	Y	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Anodontinae Total			0	3	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	8
Lampsilinae	*Lampsilis cardium*	N	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	3
	Lampsilis higginsii	**N**	-	-	-	-	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-	-	**2**
	Leptodea fragilis	Y	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	Ligumia recta	**N**	-	-	-	-	-	-	**1**	-	**1**	**2**	-	**2**	**3**	**1**	**1**	-	-	-	-	-	**11**
	Obliquaria reflexa	Y	-	1	-	3	5	1	1	-	-	1	**1**	2	-	-	-	-	-	-	-	-	15
	Obovaria olivaria	Y	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2
	Toxolasma parvus	Y	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	Truncilla donaciformis	Y	-	-	1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Lampsilinae Total			1	1	3	7	6	1	2	0	1	3	1	6	3	4	1	1	0	0	0	0	41
Total			1	7	6	9	7	4	2	0	2	4	3	9	6	6	4	3	1	2	1	1	78

Bold indicates Illinois, Iowa, and Federally threatened and endangered species

[1]Quantitative samples only

[2]All sample methods

Table 3-7. Comparison of Albany Bed community characteristics between October 2007, August 2008, October 2012, and October 2016.

	2007	2008	2012	2016	Ave.
Total no.[1]	659	306	442	208	404
Ave. no./m^{2}[2,2]	6.6 ± 1.8AB	4.6 ± 1.7AB	6.5 ± 1.6A	3.5 ± 1.0B	5.3 ± 0.8
Ave. CPUE [3]	15.1	8.1	11.7	5.2	10.0
Ave. no. species/qual sample[3]	7.3	4.1	5.8	3.1	5.1
Total no. live/FD species[1]	21	20	23	18	20.5
Cumulative live/FD species	21	22	25	25	25
Rarefaction species richness[3]					
100	17	17	17	16	17
250	20	20	21	-	20
500	21	-	-	-	21
750	-	-	-	-	-
Regression slope	8.04	8.20	8.67	7.76	8.17
Regression slope - 95% CI	7.29 - 8.78	6.69 - 9.71	7.83 - 9.51	7.11 - 8.41	
Ave. no. young/m^{2}[2,2]	2.8 ± 0.8A	2.0 ± 0.9A	3.1 ± 1.0A	1.0 ± 0.5B	2.0 ± 0.4
Ave. no. adults/m^{2}[2,2]	3.8 ± 1.3A	2.6 ± 1.0A	3.5 ± 1.1A	2.4 ± 0.8A	3.1 ± 0.5
% young[2]	41.9	44.2	47.0	29.1	40.6
% of species w/ ≤5 yrs[2]	81.0	75.0	50.0	50.0	64.0
Ave. no. FD/m^{2}[2,2]	0.6 ± 0.3AC	0.4 ± 0.3ABC	1.1 ± 0.5B	0.3 ± 0.2C	0.5 ± 0.2
%Mortality[2]	5.1	8.0	13.9	8.2	8.8
% adult mortality[2]	8.5	9.4	14.1	-	10.7
% juvenile mortality[2]	0.0	6.1	13.6	-	6.6
Ambleminae					
Total no. [2]	70	46	55	29	50.0
Total no. [1]	286	125	133	67	152.8
Ave. no./m^{2}[2,2]	3.1±1.1A*	2.0 ±0.9A*	2.4 ± 0.9A*	1.3 ± 0.5A*	2.2 ± 0.4*
Ave. no.≤5yrs/m^{2}[2,2]	1.1±0.5A	0.9 ± 0.5A	0.4 ± 0.2B	0.3 ± 0.2B	0.7 ± 0.2
Ave. no.>5yrs/m^{2}[2,2]	2.0±0.9A	1.1 ±0.6A	2.1 ± 0.8A	1.0 ± 0.4A	1.6 ± 0.4
% young[2]	34.3	45.7	14.5	24.1	29.7
Total no. species[1]	6	5	6	6	5.8
Total no. species w/young[1]	6	5	3	3	4.3
Total no. adult species[1]	6	5	6	6	5.8
Ave. no. FD/m^{2}[2,2]	0.1 ± 0.2A	0.1 ± 0.1A	0.3 ± 0.3A	0.3 ± 0.2A	0.2 ± 0.1
%Mortality[2]	4.1	4.2	11.3	17.1	9.2
% adult mortality[2]	6.1	3.8	9.6	-	6.5
% juvenile mortality[2]	0.0	4.5	20.0	-	8.2
Lampsilinae					
Total no. [2]	71	51	91	41	63.5
Total no. [1]	165	152	137	44	124.5
Ave. no./m^{2}[2,2]	3.2 ± 1.1AB*	2.3 ± 1.0A*	4.0 ± 1.1B#	1.8 ± 0.7A*	2.8 ± 0.5#
Ave. no.≤3yrs/m^{2}[2,2]	1.4 ± 0.5AB	0.9 ± 0.6AC	2.6 ± 0.9B	0.5 ± 0.3C	1.3 ± 0.3
Ave. no.>3yrs/m^{2}[2,2]	1.7 ± 0.8A	1.3 ± 0.6A	1.4 ± 0.6A	1.3 ± 0.5A	1.6 ± 0.3
% young[2]	45.1	41.2	65.9	4.8	39.3
Total no. species[1]	10	10	12	8	10.0
Total no. species w/young[1]	7	8	9	5	7.3
Total no. adult species[1]	10	8	10	7	8.8
Ave. no. FD/m^{2}[2,2]	0.2 ±0.2AB	0.3 ± 0.3AB	0.5 ± 0.4A	0.0 ± 0.0B	0.3 ± 0.1
%Mortality[2]	6.6	12.1	11.7	0.0	7.6
% adult mortality[2]	11.4	14.3	20.5	-	15.4
% juvenile mortality[2]	0.0	8.7	6.3	-	5.0

[1]Quantitative and Qualitative combined; [2]Quantitative data only; [3]Qualitative data only

Different letters within a row within a site indicates a significant difference (ANOVA, $p<0.05$)

Different symbols within a column indicate a significant difference (t-test, $p\leq0.05$)

Table 3-8. Number, length (mm), and age (external annuli count) of *L. higginsii* collected near QCNS, 2004 to 2016.

Bed	Year	Sex[1]	No. live	No. FD	Age range	Length range (mm)
Albany	2007	M	5	0	10-14	80-91
		F-FG/NG	5/3	0	7-12	72-85
		Young	0	0		
		NR	1	0	4	50
	2008	M	2	0	8-10	90-93
		F-FG/NG	3/1	0	7-12	80-88
		Young	0	0		
	2012	M	4	0	10-12	87-109
		F-FG/NG	2/1	0	8	71-81
		Young	3	0	2-3	26-36
	2016	M	1	0	16	98
		F-FG/NG	3/1	0	12-17	71-94
		Young	0	0		
HS	2007	M	1	0	14	90
		F	0	0		
		Young	0	0		
	2008	M	3	0	5-13	90-117
		F-FG	2	0	5-6	66
		Young	0	0		
		NR	1	0	6	48
	2012	M	1	0	12	107
		F	0	0		
		Young	0	0		
	2016	M	1	0	10	111
		F-FG	3	0	7-14	85-105
		Young	0	0		
		NR	1	0	10	103
UP	2004	M	0	0		
		F	0	0		
		Young	0	0		
	2005	M	0	0		
		F-FG/NG	1/1	0	7-18	78-96
		NR	1	0	6	38
	2006	M	0	0		
		F	0	0		
		Young	1	0	3	38
	2007	M	0	0		
		F-NG	1	0	12	73
		Young	0	0		
	2008	M	1	0	12	92
		F	1	0	9	84
		Young	1	0	2	48
	2012	M	0	0		
		F-FC	1	0	15	85
		Young	0	0		
	2016	M	0	0		
		F-FG/FNG	1	0	15	88
		Young	0	0		

Table 3-8. Number, length (mm), and age (external annuli count) of *L. higginsii* collected near QCNS, 2004 to 2016 (cont.).

Bed	Year	Sex	No. live	No. FD	Age range	Length range
SS	2004	M	0	0		
		F	0	0		
		Young	0	0		
	2005	M	0	0		
		F	0	0		
		Young	0	0		
	2006	M	0	0		
		F	0	0		
		Young	0	0		
	2007	M	0	0		
		F	0	0		
		Young	0	0		
	2008	M	2	0	10-11	77-78
		F	0	0		
		Young	0	0		
	2016	M	0	0		
		F	0	0		
		Young	0	0		
Cordova	2004	M	2	0	7	82
		F	4	0	NR	NR
		Young	0	0		
		NR	3	0	NR	NR
	2005	M	8	0	11-18	56-90
		F-NR/FG	1/1	0	14-15	72-79
		Young	0	0		
		NR	2	0	16-17	88-90
	2006	M	9	0	4-11	40-96
		F-NR/FG/NG	3/2/3	0	5-11	52-94
		Young	1	0	3	33
		NR	3	0	5-10	56-105
	2007	M	14	0	4-13	56-105
		F-NR/FG/NG	1/1/1	0	7-12	74-110
		Young	0	0		
	2008	M	8	0	7-16	80-95
		F-FG/NG	3/1	1	5-11	66-86
		Young	2	0	2-3	22-24
		NR	1	0	12	96
	2012	M	1	0	16	96
		F-FC/FG	1/1	1	9-14	73-90
		Young	0	0		
		NR	1	0	16	98
	2016	M	4	0	14-18	93-103
		M	1	0	NR	NR
		F-FG/NG	1/1	0	14-15	81-90
		Young	0	0		

Table 3-8. Number, length (mm), and age (external annuli count) of *L. higginsii* collected near QCNS, 2004 to 2016 (cont.).

Bed	Year	Sex	No. live	No. FD	Age range	Length range
WG	2007	M	1	0	NR	NR
		F	0	0		
		Young	0	0		
	2008	M	1	0	11	100
		F	0	0		
		Young	0	0		
		NR	1	0	14	101
	2016	M	1	0	17	106
		F	0	0		
		Young	0	0		

FD = Fresh Dead

[1]M=male, F=female, FC=female charging, FG=female gravid, NG=not gravid, NR=not recorded

Table 3-9. Habitat conditions within the HS bed, October 2007, August 2008, October 2012, and October 2016.

	Oct-07	Aug-08	Oct-12	Oct-16
Sample date	October 9 to 13	Aug 18 to 23	Oct 25 to 26	Oct 25, 31
Discharge (cfs)[1]	75,200 to 77,700	27,594 to 33,497	23,405 to 23,684	87,775 to 98,771
Dist from bank (m)	10 to 150	10 to 150	10 to 150	10 to 150
Dist from mix zone (m)	5000 to 5400	5000 to 5400	5000 to 5400	5000 to 5400
Substrate				
% Bedrock	0	0	0	0
% Boulder	<1	0	0	0
% Cobble	<1	0	0	0
% Gravel	<1	1	1	0
% Sand	82	81	70	70
% Silt	11	9	21	20
% Clay	6	6	8	8
% Detritus	<1	1	0	0
% Shell	0	1	0	1
% Vegetation	0	0	0	0
Depth (m)				
Ave.	1.5	1.7	1.3	2.2
Range	(0.6 to 2.7)	(0.3 to 2.7)	(0.3 to 2.7)	(0.6 to 3.7)
CV[2]	41	34	46	29
Bottom temp (°F)				
Ave.	59.5	77.5	57.9	53.7
Range	(57.2 to 60.8)	(77.2 to 80.6)	(57.2 to 59.0)	(53.6 to 53.8)
CV[2]	2.7	1.3	0.7	0.3
Bottom DO (mg/L)				
% saturation	81.8	95.1	111.2	87.5
Ave.	8.2	7.8	11.4	9.2
Range	(8.0 to 8.3)	(6.8 to 9.6)	(10.3 to 13.1)	(8.9 to 9.6)
CV[2]	1.0	10.5	5.1	2.4
Bottom current velocity (m/sec)				
Ave.	0.2	0.1	0.06	0.4
Range	(0.1 to 0.3)	(>0 to 0.2)	(0 to 0.2)	(0.2 to 0.5)
CV[2]	22	41	94	19
Rel. zebra mussel inf.[3]	0.1 (0 to 4)	0.2 (0 to 5)	0.7 (0 to 6)	0.0

[1]Lock and Dam 14 (LeClaire, IA; MRM 493.3)

[2]CV = coefficient of variation (Standard deviation*100/mean)

[3]Average and range of zebra mussels per unionid

Table 3-10. Relative abundance (%) of unionid species within the HS Bed, October 2007, August 2008, October 2012, and October 2016[1].

	2007	2008	2012	2016	Ave.
Ambleminae					
Amblema plicata	16.0	16.5	22.1	20.8	18.9
Fusconaia flava	5.6	5.4	6.8	2.6	5.1
Megalonaias nervosa	0.4	X	X	X	0.1
Pleurobema sintoxia	**0.8**	**X**	-	-	**0.2**
Quadrula metanevra	-	-	-	X	X
Quadrula nodulata	6.0	4.0	1.1	3.9	3.8
Quadrula p. pustulosa	32.4	34.8	40.5	32.5	35.1
Quadrula quadrula	6.8	4.9	4.7	6.5	5.7
Total Ambleminae	68.0	65.6	75.3	66.3	68.8
Anodontinae					
Arcidens confragosus	-	X	X	X	X
Lasmigona c. complanata	0.4	0.4	X	-	0.2
Pyganodon grandis	X	0.9	X	-	0.2
Strophitus undulatus	**X**	**WD**	**WD**	-	**WD**
Utterbackia imbecillis	-	-	WD	-	WD
Total Anodontinae	0.4	1.3	0.0	0.0	0.4
Lampsilinae					
Actinonaias ligamentina	-	0.4	-	-	0.1
Ellipsaria lineolata	**0.8**	**0.9**	**X**	5.2	1.7
Lampsilis cardium	7.2	7.1	10.5	6.5	7.8
Lampsilis higginsii	**0.4**	**0.9**	**X**	**X**	0.3
Lampsilis teres	**X**	-	**X**	-	**X**
Leptodea fragilis	0.8	2.2	FD	-	0.8
Ligumia recta	**0.8**	**X**	**X**	**2.6**	0.9
Obliquaria reflexa	14.8	16.1	12.6	14.3	14.5
Obovaria olivaria	1.2	1.3	X	3.9	1.6
Potamilus alatus	0.8	X	-	-	0.2
Potamilus ohiensis	1.6	0.9	FD	1.3	1.0
Toxolasma parvus	-	0.4	0.5	-	0.2
Truncilla donaciformis	2.4	2.2	1.1	-	1.4
Truncilla truncata	0.8	0.4	WD	-	0.3
Total Lampsilinae	31.6	33.0	24.7	33.8	30.8

[1]Numbers represent % that species represents in quantitative samples. X=not collected in quantitative samples, but found in qualitative samples
FD = freshly dead shell, WD = weathered shell, SF = subfossil shell
Bold indicates Illinois, Iowa and Federally threatened and endangered species

Table 3-11. Age (external annuli count) frequency of unionid species collected in the HS Bed, October 2016.

Subfamily	Species	Young[2]	Age (external annuli count)[1]																		
			2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	Total
Ambleminae	*Amblema plicata*	N	-	-	-	-	1	-	1	1	1	-	2	3	1	4	1	1	-	-	16
	Fusconaia flava	N	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2
	Megalonaias nervosa	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Quadrula metanevra	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Quadrula nodulata	N	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	3
	Quadrula p. pustulosa	Y	1	1	-	-	-	1	1	2	1	1	2	6	4	2	2	1	-	-	25
	Quadrula quadrula	N	-	-	-	-	-	-	-	-	1	-	-	-	-	2	-	1	1	-	5
Ambleminae Total			1	1	0	0	1	3	2	3	4	3	4	9	5	8	3	3	1	0	51
Anodontinae	*Arcidens confragosus*	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Anodontinae Total			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lampsilinae	***Ellipsaria lineolata***	**N**	-	-	-	-	-	-	-	-	-	-	**3**	**1**	-	-	-	-	-	-	**4**
	Lampsilis cardium	Y	-	-	-	-	-	**1**	-	1	2	-	-	-	1	-	-	-	-	-	**5**
	Lampsilis higginsii	**N**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0**
	Ligumia recta	**N**	-	-	-	-	-	-	-	-	-	-	-	-	**1**	**1**	-	-	-	-	**2**
	Obliquaria reflexa	Y	-	-	1	-	-	1	-	2	-	-	-	**6**	**1**	-	-	-	-	-	**11**
	Obovaria olivaria	N	-	-	-	-	-	-	-	-	-	-	-	-	**1**	-	**1**	-	-	**1**	**3**
	Potamilus ohiensis	Y	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1**
Lampsilinae Total			1	0	1	0	0	2	0	3	2	0	3	7	4	1	1	0	0	1	26
Total			2	1	1	0	1	5	2	6	6	3	7	16	9	9	4	3	1	1	77

Bold indicates Illinois, Iowa, and Federally threatened and endangered species

[1]Quantitative samples only

[2]All sample methods

Table 3-12. Comparison of HS Bed community characteristics between October 2007, August 2008, October 2012, and October 2016.

	2007	2008	2012	2016	Ave.
Total no.[1]	1311	1721	840	457	1082
Ave. no./m^{2}[2,2]	11.1±3.1A	10.0 ± 2.7A	8.5 ± 2.5A	3.4 ± 1.2B	8.3 ± 1.3
Ave. CPUE[3]	27.6	59.9	26.0	15.2	32.2
Ave. no. species/qual sample[3]	7.4	9.8	6.5	4.8	7.1
Total no. live/FD species[1]	22	24	20	15	20.3
Cumulative live/FD species	22	25	25	25	25
Rarefaction species richness[3]					
100	12	11	10	10	11
250	16	16	13	13	15
500	19	19	16	-	18
750	20	21	18	-	20
Regression slope	6.99	7.02	5.81	5.37	6.30
Regression slope - 95% CI	5.07 - 8.91	6.29 - 7.75	4.83 - 6.80	3.60 - 7.13	
Ave. no. young/m^{2}[2,2]	3.2±0.9A	3.7 ± 1.1A	1.5 ± 0.6B	0.2 ± 0.2C	2.1 ± 0.4
Ave. no. adults/m^{2}[2,2]	7.9±2.9A	6.3 ± 2.1A	7.0 ± 2.2A	3.2 ± 1.2B	6.1 ± 1.1
% young[2]	29.2	37.1	17.9	5.2	22.4
% of species w/ ≤5 yrs[2]	69.6	70.8	100.0	26.7	66.8
Ave. no. FD/m^{2}[2,2]	0.1 ± 0.2A	0.6 ± 0.3AB	0.8 ± 0.4B	0.2 ± 0.2A	0.4 ± 0.2
%Mortality[2]	1.2	5.5	8.7	4.9	5.1
% adult mortality[2]	1.7	8.4	9.8	-	6.6
% juvenile mortality[2]	0.0	0.0	2.9	-	1.0
<u>Ambleminae</u>					
Total no.[2]	170	147	143	51	127.8
Total no.[1]	638	1060	464	228	597.5
Ave. no./m^{2}[2,2]	7.6±2.2A*	6.5 ± 1.8A*	6.4 ± 2.1A*	2.3 ± 0.8B*	5.7 ± 0.9
Ave. no.≤5yrs/m^{2}[2,2]	2.3±0.8AB	2.4 ± 0.8A	1.3 ± 0.5B	0.1 ± 0.1C	1.5 ± 0.3
Ave. no.>5yrs/m^{2}[2,2]	5.2±2.0A	4.1 ± 1.4AB	5.1 ± 1.9A	2.2 ± 0.8B	4.2 ± 0.8
% young[2]	30.6	36.7	20.3	3.9	22.9
Total no. species[1]	7	7	6	7	6.8
Total no. species w/young[1]	6	7	6	1	5.0
Total no. adult species[1]	6	6	6	7	6.3
Ave. no. FD/m^{2}[2,2]	0.1 ± 0.1A	0.2 ± 0.2AB	0.5 ± 0.3B	0.2 ± 0.2AB	0.3 ± 0.1
%Mortality[2]	1.2	3.3	7.7	7.3	4.9
% adult mortality[2]	1.7	5.1	9.5	-	5.4
% juvenile mortality[2]	0.0	0.0	0.0	-	0.0
<u>Lampsilinae</u>					
Total no.[2]	79	74	47	26	56.5
Total no.[1]	106	640	164	151	265.3
Ave. no./m^{2}[2,2]	3.5±1.1A#	3.3 ± 1.1A#	2.1 ± 0.8AB#	1.2 ± 0.6B#	2.5 ± 0.5
Ave. no.≤3yrs/m^{2}[2,2]	0.9±0.4A	1.2 ± 0.5A	0.2 ± 0.2B	0.1 ± 0.1B	0.6 ± 0.2
Ave. no.>3yrs/m^{2}[2,2]	2.6±1.1A	2.1 ± 0.9AB	1.9 ± 0.7AB	1.1 ± 0.6B	1.9 ± 0.4
% young[2]	26.6	36.5	10.6	3.8	19.4
Total no. species[1]	12	13	10	7	10.5
Total no. species w/young[1]	8	8	5	3	6.0
Total no. adult species[1]	11	12	7	6	9.0
Ave. no. FD/m^{2}[2,2]	0.0 ± 0.1A	0.4 ± 0.2B	0.2 ± 0.2AB	0.0 ± 0.0A	0.2 ± 0.1
%Mortality[2]	1.3	9.8	9.6	0.0	5.2
% adult mortality[2]	1.7	14.5	8.7	-	8.3
% juvenile mortality[2]	0.0	0.0	20.0	-	6.7

[1]Quantitative and Qualitative combined; [2]Quantitative data only; [3]Qualitative data only
Different letters within a row within a site indicates a significant difference (ANOVA, $p<0.05$)
Different symbols within a column indicate a significant difference (t-test, $p\leq0.05$)

Table 3-13. Comparison of community characteristics among unionid beds upstream and downstream of QCNS, 2016.

	Upstream beds			Downstream beds		
	Albany	HS	UP	SS	Cordova	WG
Total no.[1]	208	457	673	313	342	445
Ave. no./m^{2,2}	3.5 ± 1.0A	3.4 ± 1.2A	11.2 ± 3.4B	2.0 ± 0.7A	4.4 ± 1.2AC	7.6 ± 2.1BC
Ave. CPUE[3]	5.2	15.2	16.8	10.7	9.8	11.0
Ave. no. species/qual sample[3]	3.1	4.8	4.5	4.3	5.0	4.8
Total no. live/FD species[1]	18	15	20	14	20	21
Cumulative live/FD species	25	25	26	26	25	25
Rarefaction species richness[3]						
100	16	10	13	9	15	14
250	-	13	17	13	19	18
500	-	-	19	-	-	-
750	-	-	-	-	-	-
Regression slope	7.76	5.37	7.10	5.08	7.72	7.61
Regression slope - 95% CI	7.11 - 8.41	3.60 - 7.13	5.98 - 8.21	3.39 - 6.76	6.42 - 9.03	6.26 - 8.96
Ave. no. young/m^{2,2}	1.0 ± 0.5A	0.2 ± 0.2A	2.2 ± 1.0A	0.4 ± 0.3A	0.5 ± 0.3A	1.7 ± 0.6A
Ave. no. adults/m^{2,2}	2.4 ± 0.8AB	3.2 ± 1.2ABC	9.1 ± 3.1C	1.6 ± 0.6AC	3.9 ± 1.0ABC	5.9 ± 1.8C
% young[2]	29.1	5.2	19.4	20.8	11.2	22.8
% of species w/ ≤5 yrs[2]	50.0	26.7	60.0	42.9	31.6	52.4
Ave. no. FD/m^{2,2}	0.3 ± 0.2A	0.2 ± 0.2AB	0.0 ± 0.1AB	0.0 ± 0.1AB	0.0 ± 0.0B	0.0 ± 0.1AB
%Mortality[2]	8.2	4.9	0.4	2.2	0.0	0.6
% adult mortality[2]	-	-	-	-	-	-
% juvenile mortality[2]	-	-	-	-	-	-
Ambleminae						
Total no.[2]	29	51	142	30	52	112
Total no.[1]	67	228	211	221	126	188
Ave. no./m^{2,2}	1.3 ± 0.5A*	2.3 ± 0.8A*	6.3 ± 2.3B*	1.3 ± 0.6A*	2.3 ± 0.7A*	5.0 ± 1.4B*
Ave. no.≤5yrs/m^{2,2}	0.3 ± 0.2AB	0.1 ± 0.1B	0.6 ± 0.4AB	0.3 ± 0.3B	0.2 ± 0.2B	0.8 ± 0.4A
Ave. no.>5yrs/m^{2,2}	1.0 ± 0.4AB	2.2 ± 0.8B	5.7 ± 2.2AB	1.1 ± 0.5B	2.1 ± 0.7B	4.2 ± 1.3A
% young[2]	24.1	3.9	9.2	21.2	7.7	16.1
Total no. species[1]	6	7	6	6	5	6
Total no. species w/young[1]	3	1	4	4	2	4
Total no. adult species[1]	6	7	6	6	5	6
Ave. no. FD/m^{2,2}	0.3 ± 0.2A	0.2 ± 0.2AB	0.0 ± 0.1AB	0.0 ± 0.1AB	0.0 ± 0.0B	0.0 ± 0.1AB
%Mortality[2]	17.1	7.3	0.7	3.2	0.0	0.9
% adult mortality[2]	-	-	-	-	-	-
% juvenile mortality[2]	-	-	-	-	-	-
Lampsilinae						
Total no.[2]	41	26	104	13	41	47
Total no.[1]	44	151	196	90	102	73
Ave. no./m^{2,2}	1.8 ± 0.7AB#	1.2 ± 0.6AB#	4.6 ± 1.4C#	0.6 ± 0.3B#	1.9 ± 0.6A*	2.1 ± 0.8AB#
Ave. no.≤3yrs/m^{2,2}	0.5 ± 0.3A	0.1 ± 0.1A	1.6 ± 0.7B	0.1 ± 0.2A	0.2 ± 0.2A	0.6 ± 0.3A
Ave. no.>3yrs/m^{2,2}	1.3 ± 0.5ABC	1.1 ± 0.6AC	3.0 ± 1.2B	0.4 ± 0.3C	1.6 ± 0.6AB	1.5 ± 0.7ABC
% young[2]	4.8	3.8	24.0	7.1	2.4	12.8
Total no. species[1]	8	7	11	6	10	11
Total no. species w/young[1]	5	3	8	2	3	6
Total no. adult species[1]	7	6	10	5	10	11
Ave. no. FD/m^{2,2}	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
%Mortality[2]	0.0	0.0	0.0	0.0	0.0	0.0
% adult mortality[2]	-	-	-	-	-	-
% juvenile mortality[2]	-	-	-	-	-	-

[1]Quantitative and Qualitative combined; [2]Quantitative data only; [3]Qualitative data only
Different letters within a row indicates a significant difference (ANOVA, $p<0.05$)
Different symbols within a column indicate a significant difference (t-test, $p\leq0.05$)

Table 3-14. Comparison of UP Bed habitat conditions between July 2004, July and October 2005, August and September 2006, October 2007, August 2008, October 2012, and October 2016.

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Oct-07	Aug-08	Oct-12	Oct-16	Ave.
Sample date	July 15-16, 2004	July 28, 2005	Oct. 6, 2005	Aug. 5, 2006	Sept. 22-25, 2006	Oct. 4-13, 2007	Aug. 21-23, 2008	Oct. 30-Nov. 1, 2012	Oct 25, 27, 28, Nov 3	
Discharge (cfs)[1]	67,226 to 65,969	41,262	52,887	35,139	21,257 to 25,820	45,500 to 77,800	27,594 to 33,497	26,725 to 26,994	87,775 to 97,592	
Substrate temp (°F)	-	-	-	84.7	-	61.3 to 68.4	77.0 to 79.4	-	-	
Dist from bank (m)	45 to 115	45 to 115	45 to 115	45 to 115	45 to 115	45 to 115	45 to 115	45 to 115	45 to 115	
Dist from mix zone (m)	730 to 1130	730 to 1130	730 to 1130	730 to 1130	730 to 1130	730 to 1130	730 to 1130	730 to 1130	730 to 1130	
Substrate										
% Boulder	0	0	0	0	0	0	0	0	0	0
% Cobble	0	0	0	0	0	<1	0	0	0	<1
% Gravel	1	<1	2	1	<1	3	7	<1	0	2
% Sand	57	88	56	71	64	66	60	33	60	62
% Silt	36	11	15	9	12	5	6	59	1	17
% Clay	5	1	26	18	21	25	21	7	32	17
% Detritus	<1	0	<1	0	1	<1	0	0	0	<1
% Shell	<1	0	1	1	<1	1	5	0	5	2
% Vegetation	0	0	0	0	0	0	1	0	0	<1
Depth (m)										
Ave.	3.4	2.7	4.9	3.3	3.4	3.1	3.7	3.4	4.8	3.6
Range	(0.9 to 6.4)	(0.6 to 5.8)	(0.9 to 7.3)	(0.9 to 5.8)	(0.6 to 6.4)	(0.6 to 5.2)	(1.5 to 6.4)	(0.9 to 6.1)	(2.1 to 7.6)	
CV[2]	16	51	102	36	30	43	31	38	28.0	
Bottom temp (°F)										
Ave.	77.9	80.4	67.8	85.3	62.1	60.8	79.0	47.5	54.8	68.4
Range	(77.5 to 79.0)	(79.7 to 80.6)	(67.5 to 68.2)	(84.6 to 85.6)	(61.0 to 62.2)	(59.9 to 60.8)	(75.9 to 87.8)	(47.1 to 48.0)	(54.4 to 54.9)	
CV[2]	1.6	0.9	0.6	0.5	0.8	0.3	4.6	0.6	0.5	
Bottom DO (mg/L)										
% saturation	82.0	151.8	92.4	148.5	82.9	76.0	100.0	101.2	83.9	
Ave.	6.2	12.1	8.4	11.3	8.1	7.5	8.1	11.8	8.7	9.1
Range	(6.0 to 7.2)	(11.1 to 12.5)	(8.1 to 8.9)	(9.7 to 11.8)	(7.1 to 9.4)	(7.2 to 8.4)	(7.5 to 8.7)	(11.4 to 12.3)	(7.7 to 8.9)	
CV[2]	21.8	2.3	2.9	0.5	5.5	4.0	4.7	2.1	2.4	
Bottom current velocity (m/sec)										
Ave.	0.5	0.3	0.4	<0.1	0.1	0.2	0.1	0.1	0.5	0.3
Range	(0.2 to 0.6)	(>0.0 to 0.6)	(0.2 to 0.5)	(0 to 0.2)	(0.1 to 0.2)	(>0 to 0.4)	(>0 to 0.2)	(>0 to 0.2)	(0.4 to 0.5)	
CV[2]	30	53	27	165	25	35	73	43	7	
Rel. zebra mussel inf.[3]	Moderate	0.1 (0 to 2)	0.7 (0 to 7)	0.8 (0 to 15)	1.4 (0 to 30)	0.1 (0 to 5)	6.7 (0 to 50)	6.9 (0 to 90)	0.4 (0 - 10)	2.1

[1]Lock and Dam 14 (LeClaire, IA; MRM 493.3)

[2]CV = coefficient of variation (Standard deviation*100/mean)

[3]Moderate = a few zebra mussels attached to most unionids; 2005, 2006, 2007, 2008 2012 average and range of zebra mussels per unionid

Table 3-15. Comparison of UP Bed community characteristics between July 2004, July and October 2005, August and September 2006, October 2007, August 2008, October 2012, and October 2016.

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Oct-07	Aug-08	Oct-12	Oct-16	Ave.
Total no.[1]	902	399	822	609	508	958	857	884	673	735
Ave. no./m^{2}[2,2]	8.1±3.1A	6.9±3.1A	11.2±2.6A	8.3±4.2A	11.0±4.3A	8.7±2.1A	8.3 ± 2.7A	12.1 ± 3.4A	11.2 ± 3.4A	9.9 ± 1.1
Ave. CPUE [3]	53.7	15.7	22.8	26.3	12.4	30.5	26.8	24.4	16.8	25.5
Ave. no. species/qual sample[3]	10.6	6.0	6.3	7.4	6.1	7.1	7.5	6.6	4.5	6.9
Total no. live/FD species[1]	21	21	21	20	21	24	23	23	20	21.6
Cumulative live/FD species	21	24	25	25	25	26	26	26	26	26
Rarefaction species richness[3]										
100	12	14	13	14	15	12	14	13	13	13
250	16	19	17	18	19	17	18	17	17	17
500	19	-	20	20	21	20	21	20	19	20
750	20	-	21	-	-	22	23	22	-	22
Regression slope	6.85	7.65	7.16	7.15	7.63	7.28	7.68	7.36	7.10	7.32
Regression slope - 95% CI	5.16 - 8.54	5.48 - 9.81	6.35 - 7.97	6.24 - 8.05	6.78 - 8.49	5.88 - 8.67	6.52 - 8.84	6.56 - 8.16	5.98 - 8.21	
Ave. no. young/m^{2}[2,2]	1.3 ±0.9AB	1.5 ±0.9AB	3.7 ±1.1A	3.8±2.2A	3.8±1.2A	2.8±0.9A	3.0 ± 1.1A	3.0 ± 1.0A	2.2 ± 1.0B	2.6 ± 0.4
Ave. no. adults/m^{2}[2,2]	6.8 ±2.5A	5.4 ±2.8A	7.5±1.9A	4.5±2.4A	7.2±3.6A	5.9±1.7A	5.3 ± 1.8A	9.1 ± 2.7A	9.1 ± 3.1A	7.0 ± 0.9
% young[2]	16.5	21.7	33.3	45.8	34.3	32.3	36.0	24.9	19.4	29.4
% of species w/≤5 yrs[2]	73.3	46.7	80.0	46.7	81.3	78.2	78.3	77.3	60.0	69.1
Ave. no. FD/m^{2}[2,2]	0.6 ± 0.5A	0.1 ± 0.2A	0.4 ± 0.3A	0.6 ± 0.5A	2.0 ± 0.8B	0.4 ± 0.3A	0.3 ± 0.2A	0.4 ± 0.3A	0.0 ± 0.1A	0.6 ± 0.1
%Mortality[2]	6.7	1.4	3.1	6.7	15.1	4.4	3.1	3.5	0.4	4.9
% adult mortality[2]	-	-	-	10.0	8.9	4.3	4.0	3.3	-	6.1
% juvenile mortality[2]	-	-	-	2.6	24.8	4.5	1.5	4.2	-	7.5
Ambleminae										
Total no.[2]	39	22	103	36	112	87	84	136	142	84.6
Total no.[1]	396	145	236	230	128	317	354	314	211	259.0
Ave. no./m^{2}[2,2]	3.3±1.6A*	2.2±1.3A*	4.6±1.4A*	3.6±2.1A*	5.0±1.8A*	3.9±1.2A*	3.7 ± 1.3A*	6.0 ± 1.8A*	6.3 ± 2.3A*	4.6 ± 0.6*
Ave. no.≤5yrs/m^{2}[2,2]	0.5±0.4ABC	0.1±0.2AC	1.7±0.7ABC	1.6±1.1ABC	2.1±0.8AB	1.5±0.6ABC	1.5 ± 0.7ABC	1.6 ± 0.6ABC	0.6 ± 0.4BC	1.3 ± 0.2
Ave. no.>5yrs/m^{2}[2,2]	2.8±1.3A	2.1±1.2A	2.9±0.9A	2.0±1.6A	2.9±1.5A	2.4±0.9A	2.2 ± 0.9A	4.4 ± 1.5A	5.7 ± 2.2A	3.2 ± 0.5
% young[2]	15.4	4.5	36.9	44.4	42.0	37.9	40.5	26.5	9.2	28.6
Total no. species[1]	6	6	5	6	6	6	6	6	6	5.9
Total no. species w/young[1]	6	4	5	5	5	6	5	6	4	5.1
Total no. adult species[1]	5	6	5	6	6	5	6	6	6	5.7
Ave. no. FD/m^{2}[2,2]	0.1 ± 0.2A	0.0 ± 0.0A	0.1 ± 0.1A	0.1 ± 0.2A	0.3 ± 0.3A	0.2 ± 0.2A	0.0 ± 0.1A	0.1 ± 0.2A	0.0 ± 0.1A	0.1 ± 0.1
%Mortality[2]	2.5	0.0	1.9	2.7	5.9	4.4	1.2	2.2	0.7	2.4
% adult mortality[2]	-	-	-	4.8	3.0	3.6	0.0	2.9	-	2.9
% juvenile mortality[2]	-	-	-	0.0	9.6	5.7	2.9	0.0	-	3.6
Lampsilinae										
Total no.[2]	57	46	138	44	123	102	99	133	104	94.0
Total no.[1]	378	169	321	273	154	416	474	268	196	294.3
Ave. no./m^{2}[2,2]	4.8±2.0A#	4.6±2.1A#	6.1±1.5A#	4.4±2.1A*	5.5±2.5A*	4.5±1.2A*	4.4 ± 1.7A*	5.9 ± 1.7A*	4.6 ± 1.4A*	5.1 ± 0.6#
Ave. no.≤3yrs/m^{2}[2,2]	0.8±0.7A	1.4±0.9A	2.0±0.8A	2.2±1.5A	1.4±0.8A	1.3±0.5A	1.4 ± 0.7A	1.4 ± 0.6A	1.6 ± 0.7A	1.4 ± 0.2
Ave. no.>3yrs/m^{2}[2,2]	3.9±1.6A	3.2±1.7A	4.1±1.3A	2.2±1.1A	4.0±2.2A	3.2±1.0A	3.0 ± 1.2A	4.5 ± 1.4A	3.0 ± 1.2A	3.6 ± 0.5
% young[2]	17.5	30.4	32.6	50.0	26.0	28.4	32.3	23.3	24.0	29.4
Total no. species[1]	11	10	12	10	11	14	13	12	11	11.6
Total no. species w/young[1]	9	5	9	10	8	10	10	8	8	8.6
Total no. adult species[1]	11	9	11	7	10	12	11	9	10	10.0
Ave. no. FD/m^{2}[2,2]	0.4 ± 0.5A	0.0 ± 0.0A	0.2 ± 0.2A	0.4 ± 0.4A	1.5 ± 0.6B	0.1 ± 0.2A	0.2 ± 0.2A	0.3 ± 0.2A	0.0 ± 0.0A	0.4 ± 0.1
%Mortality[2]	8.1	0.0	3.5	8.3	21.7	2.9	4.8	4.3	0.0	6.0
% adult mortality[2]	-	-	-	12.0	12.5	2.7	6.9	2.9	-	7.4
% juvenile mortality[2]	-	-	-	4.3	39.6	3.3	1.5	8.8	-	11.5

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

Table 3-16. Comparison of UP Bed unionid relative abundance (%) between July 2004, July and October 2005, August and September 2006, October 2007, August 2008, October 2012, and October 2016[1].

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Oct-07	Aug-08	Oct-12	Oct-16	Ave.
Ambleminae										
Amblema plicata	17.5	20.3	18.7	22.9	25.0	17.4	27.4	22.3	28.5	22.2
Cyclonaias tuberculata	-	-	-	-	-	-	-	**SF**	-	**SF**
Fusconaia ebena	WD	-	WD	WD	-	-	WD	WD	-	WD
Fusconaia flava	6.2	1.4	5.2	4.8	4.8	6.7	4.3	5.5	7.9	5.2
Megalonaias nervosa	-	1.4	-	X	X	X	X	0.4	2.0	0.4
Pleurobema sintoxia	-	-	-	**WD**	-	-	**WD**	-	-	**WD**
Quadrula metanevra	1.0	-	WD	-	-	-	-	-	-	0.1
Quadrula nodulata	1.0	X	1.2	2.4	0.8	1.5	1.1	1.8	0.8	1.2
Quadrula p. pustulosa	8.2	4.3	9.1	6.0	5.2	12.3	9.7	9.9	8.7	8.2
Quadrula quadrula	6.2	4.3	6.7	7.2	9.3	6.7	2.7	9.9	8.3	6.8
Tritogonia verrucosa	**WD**	-	**WD**	-	-	-	**WD**	-	-	**WD**
Total Ambleminae	40.1	31.9	40.9	43.4	45.2	44.6	45.2	49.8	56.2	44.1
Anodontinae										
Arcidens confragosus	X	X	0.4	1.2	X	0.5	X	0.4	0.8	0.4
Lasmigona c. complanata	X	1.4	2.4	2.4	2.8	1.5	1.6	1.1	1.6	1.6
Pyganodon grandis	X	<0.5	1.2	X	X	0.5	X	X	0.4	0.2
Strophitus undulatus	**WD**	-	-	-	-	-	-	-	-	**WD**
Utterbackia imbecillis	1.0	<0.5	0.4	X	2.4	0.5	X	X	-	0.5
Total Anodontinae	1.0	1.4	4.4	3.6	5.2	3.1	1.6	1.5	2.8	2.7
Lampsilinae										
Actinonaias ligamentina	X	-	-	-	-	-	-	-	-	X
Ellipsaria lineolata	**1.0**	**1.4**	**X**	**X**	**X**	**X**	**0.5**	**1.1**	**0.4**	**0.5**
Lampsilis cardium	5.2	11.6	7.9	6.0	9.3	5.6	7.0	5.5	6.3	7.2
Lampsilis higginsii	-	**X**	**0.4**	**X**	**0.8**	**X**	**X**	**X**	**X**	**0.1**
Lampsilis ovata	-	-	-	-	-	X	-	-	-	X
Lampsilis teres	**WD**	**1.4**	**WD**	-	**WD**	**X**	**1.1**	**0.4**	**1.6**	**0.5**
Leptodea fragilis	6.2	11.6	7.1	6.0	4.8	4.6	5.9	1.8	4.4	5.8
Ligumia recta	**1.0**	**X**	**0.8**	**1.2**	**1.2**	**0.5**	**1.1**	**0.7**	**1.2**	**0.9**
Obliquaria reflexa	38.1	30.4	27.8	27.7	25.4	34.9	27.4	30.0	22.5	29.4
Obovaria olivaria	5.2	2.9	2.4	2.4	1.2	1.0	3.2	4.8	1.2	2.7
Potamilus alatus	X	X	X	2.4	X	X	X	X	1.6	0.4
Potamilus capax	-	-	-	-	-	**WD**	-	-	-	**WD**
Potamilus ohiensis	1.0	2.9	0.8	2.4	0.8	0.5	0.5	X	0.8	1.1
Toxolasma parvus	-	-	1.2	WD	-	1.0	0.5	FD	-	0.3
Truncilla donaciformis	X	4.3	5.6	4.8	4.8	3.6	5.9	3.7	1.2	3.8
Truncilla truncata	1.0	-	0.8	WD	1.2	0.5	X	0.7	-	0.5
Total Lampsilinae	58.7	66.7	54.8	53.0	49.6	52.3	53.2	48.7	41.2	53.1

[1]Numbers represent % that species represents in quantitative samples. X=not collected in quantitative samples, but found in qualitative samples

FD = freshly dead shell, WD = weathered shell, SF = subfossil shell

Bold indicates Illinois, Iowa and Federally threatened and endangered species

Table 3-17. Age (external annuli count) frequency of unionid species collected in the UP Bed, October 2016.

Subfamily	Species	Young[2]	Age (external annuli count)[1]																										
			2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	28	Total
Ambleminae	*Amblema plicata*	Y	3	1	2	1	4	-	1	1	4	8	7	13	6	7	8	1	2	-	-	-	-	-	1	1	1	72
	Fusconaia flava	Y	1	-	-	-	2	-	2	-	-	4	2	1	1	2	2	2	-	1	-	-	-	-	-	-	-	20
	Megalonaias nervosa	N	-	-	-	-	-	-	1	-	-	1	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	5
	Quadrula nodulata	N	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	Quadrula p. pustulosa	Y	1	-	2	1	-	1	4	-	1	1	-	2	2	1	3	2	-	-	-	-	1	-	-	-	-	22
	Quadrula quadrula	Y	-	1	-	-	-	1	1	-	1	4	2	3	1	2	4	-	-	-	1	-	-	-	-	-	-	21
Ambleminae Total			5	2	4	2	6	3	10	1	6	18	12	19	11	12	18	5	2	1	1	0	1	0	1	1	1	142
Anodontinae	*Arcidens confragosus*	N	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2
	Lasmigona c. complanata	N	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1	-	1	-	-	-	4
	Pyganodon grandis	N	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Anodontinae Total			0	0	0	0	0	0	0	0	0	1	0	1	1	2	0	0	0	0	0	1	0	1	0	0	0	7
Lampsilinae	***Ellipsaria lineolata***	**N**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1**	-	-	-	-	-	-	-	-	-	**1**
	Lampsilis cardium	Y	-	1	-	-	1	1	3	-	1	1	3	1	2	2	-	-	-	-	-	-	-	-	-	-	-	16
	Lampsilis higginsii	**N**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0**
	Lampsilis teres	**Y**	-	**1**	**1**	-	-	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**4**
	Leptodea fragilis	Y	6	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
	Ligumia recta	**Y**	-	-	-	**1**	-	-	-	-	**1**	-	-	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	**3**
	Obliquaria reflexa	Y	3	6	3	1	3	2	7	6	7	4	4	3	3	4	1	-	-	-	-	-	-	-	-	-	-	57
	Obovaria olivaria	N	-	-	-	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	3
	Potamilus alatus	Y	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	4
	Potamilus ohiensis	Y	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	Truncilla donaciformis	Y	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Lampsilinae Total			12	13	8	3	4	5	10	7	9	5	8	5	6	7	1	1	0	0	0	0	0	0	0	0	0	104
Total			17	15	12	5	10	8	20	8	15	24	20	25	18	21	19	6	2	1	1	1	1	1	1	1	1	253

Bold indicates Illinois, Iowa, and Federally threatened and endangered species

[1]Quantitative samples only

[2]All sample methods

Table 3-18. Comparison of SS Bed habitat conditions between July 2004, July and October 2005, August and September 2006, October 2007, August 2008, October 2012, and October 2016.

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Oct-07	Aug-08	Oct-12	Oct-16	Ave.
Sample date	July 16, 2004	July 26-28, 2005	Oct 5-6, 2005	Aug 4-5, 2006	Sept 20-24, 2006	Oct 5-13, 2007	Aug 20-23, 2008	Oct. 31-Nov. 1, 2012	Oct 28, Nov 2	
Discharge (cfs)[1]	65,969	39,203 to 41,262	54,383 to 52,887	27,695 to 35,189	21,257 to 30,178	56,600 to 77,700	27,594 to 33,497	26,878 to 26,994	96,878 to 97,327	
Substrate temp N end	-	-	-	88.0 to 87.4	-	62.0 to 70.1	80.0 to 82.0	-	-	
Substrate temp S end	-	-	-	88.0 to 87.1	-	61.4 to 70.1	80.2 to 83.5	-	-	
Dist from bank (m)	35 to 115	35 to 115	35 to 115	35 to 115	35 to 115	35 to 115	35 to 115	35 to 115	35 to 115	
Dist from mix zone (m)	675 to 1125	675 to 1125	675 to 1125	675 to 1125	675 to 1125	675 to 1125	675 to 1125	675 to 1125	675 to 1125	
Substrate										
% Boulder	0	0	2	0	0	0	1	0	0	<1
% Cobble	<1	0	0	0	0	0	2	0	0	<1
% Gravel	<1	0	0	0	0	0	1	0	1	<1
% Sand	90	91	95	69	71	49	55	49	87	73
% Silt	6	9	3	23	26	49	39	51	0	23
% Clay	3	<1	0	6	2	1	1	0	12	3
% Detritus	<1	1	0	2	1	1	1	0	0	<1
% Shell	0	0	<1	0	0	0	0	0	0	<1
Depth (m)										
Ave.	2.4	1.8	2.7	2.0	2.1	1.9	2.5	2.2	3.2	2.3
Range	(1.7 to 3.7)	(0.9 to 2.7)	(0.9 to 4.3)	(1.2 to 3.4)	(1.2 to 3.3)	(0.9 to 3.4)	(1.5 to 3.0)	(1.5 to 3.0)	(1.8 to 3.9)	
CV[2]	24	20	74	32	18	25	15	15	15	
Bottom temp (°F)										
Ave.	79.7	85.1	71.1	88.0	66.4	60.8	80.3	52.0	53.4	70.7
Range	(77.0 to 80.6)	(81.5 to 86.0)	(69.4 to 73.2)	(87.4 to 88.7)	(64.6 to 67.1)	60.8	(78.8 to 80.6)	(51.1 to 53.2)	(53.1 to 53.6)	
CV[2]	1.2	3.0	4.4	0.6	1.3	0.0	0.8	1.2	0.6	
Bottom DO (mg/L)										
% saturation	83.3	119.3	92.2	146.5	91.8	84.1	100.0	112.6	78.6	
Ave.	6.7	9.1	8.1	10.9	8.5	8.3	8.0	12.1	8.3	8.9
Range	(6.4 to 7.4)	(7.5 to 12.8)	(7.8 to 8.9)	(5.1 to 12.0)	(7.9 to 9.5)	(7.6 to 9.0)	(7.8 to 8.2)	(11.8 to 12.5)	(8.2 to 8.4)	
CV[2]	10.9	20.7	3.1	14.0	4.0	5.3	1.4	1.2	0.6	
Bottom current velocity (m/sec)										
Ave.	0.4	0.2	0.3	<0.1	0.1	0.2	0.1	0.1	0.4	0.2
Range	(0.2 to 0.6)	(0.1 to 0.3)	(0.1 to 0.5)	(0 to 0.2)	(0.1 to 0.2)	(0.1 to 0.4)	(>0 to 0.2)	(>0 to 0.2)	(0.2 to 0.5)	
CV[2]	16	21	31	185	23	226	37	48	24.0	
Rel. zebra mussel inf.[3]	Minor	0.1 (0 to 1)	0.1 (0 to 10)	0.0	0.02 (0 to 1)	0.01 (0 to 1)	0.1 (0 to 2)	0.7 (0 to 12)	6.8 (0 to 10)	1.0

[1]Lock and Dam 14 (LeClaire, IA; MRM 493.3)

[2]CV = coefficient of variation (Standard deviation*100/mean)

[3]Minor = a few zebra mussels attached to a few unionids; 2005, 2006, 2007, 2008, 2012 average and range of zebra mussels per unionid

Table 3-19. Comparison of SS Bed unionid relative abundance (%) between July 2004, July and October 2005, August and September 2006, October 2007, August 2008, October 2012, and October 2016[1].

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Oct-07	Aug-08	Oct-12	Oct-16	Ave.
Ambleminae										
Amblema plicata	41.5	26.8	30.9	32.2	22.3	22.6	26.8	28.2	18.2	27.7
Fusconaia ebena	-	-	-	-	-	-	SF	WD	-	WD
Fusconaia flava	X	9.8	2.1	1.1	3.2	2.2	4.9	X	2.3	2.8
Megalonaias nervosa	-	-	-	-	-	X	-	-	-	X
Pleurobema sintoxia	-	-	-	**X**	-	**X**	-	-	-	**X**
Quadrula metanevra	-	-	-	-	-	-	-	-	X	X
Quadrula nodulata	9.8	2.4	6.4	11.1	13.8	16.1	17.1	15.5	9.1	11.3
Quadrula p. pustulosa	4.9	7.3	5.3	4.4	3.2	10.8	4.9	10.7	18.2	7.7
Quadrula quadrula	4.9	14.6	17.0	12.2	11.7	9.7	13.4	20.4	20.5	13.8
Tritogonia verrucosa	-	-	-	-	-	-	-	**WD**	-	**WD**
Total Ambleminae	61.1	61.0	61.7	61.1	54.3	61.3	67.1	74.8	68.3	63.4
Anodontinae										
Arcidens confragosus	X	2.4	X	-	-	-	-	X	2.3	0.5
Lasmigona c. complanata	2.4	X	X	X	1.1	1.1	2.4	X	X	0.8
Pyganodon grandis	X	2.4	X	1.1	FD	X	2.4	WD	-	3.8
Utterbackia imbecillis	-	X	X		FD	-	-	-	-	FD
Total Anodontinae	2.4	4.9	0.0	1.1	1.1	1.1	4.9	0.0	2.3	2.0
Lampsilinae										
Actinonaias ligamentina	-	-	-	-	X	-	-	-	-	X
Ellipsaria lineolata	**2.4**	**X**	-	-	-	-	**WD**	-	-	**0.3**
Lampsilis cardium	4.9	X	5.3	4.4	7.4	2.2	X	1.9	X	2.9
Lampsilis higginsii	-	-	-	-	-	-	**X**	-	-	**X**
Lampsilis teres	-	-	**X**	-	-	**X**	**WD**	**4.9**	-	**0.5**
Leptodea fragilis	X	2.4	4.3	2.2	3.2	-	1.2	1.9	X	1.7
Ligumia recta	-	-	**1.1**	**X**	**1.1**	**X**	**X**	**X**	**X**	**0.2**
Obliquaria reflexa	26.8	22.0	22.3	23.3	19.1	28.0	18.3	12.6	25.0	21.9
Obovaria olivaria	2.4	-	X	X	2.1	X	X	1.0	-	0.6
Potamilus alatus	-	-	X	1.1	-	1.1	-	X	2.3	0.5
Potamilus ohiensis	X	7.3	3.2	4.4	7.4	3.2	3.7	-	2.3	3.5
Toxolasma parvus	-	-	WD	-	-	-	-	1.0	-	0.1
Truncilla donaciformis	-	2.4	2.1	2.2	4.3	2.2	4.9	1.9	-	2.2
Truncilla truncata	-	X	X	-	-	1.1	WD	-	-	0.1
Total Lampsilinae	36.5	34.1	38.3	37.8	44.7	37.6	28.0	25.2	29.6	34.6

[1]Numbers represent % that species represents in quantitative samples. X=not collected in quantitative samples, but found in qualitative samples
FD = freshly dead shell, WD = weathered shell, SF = subfossil shell
Bold indicates Illinois, Iowa and Federally threatened and endangered species

Table 3-20. Comparison of SS bed unionid community characteristics between July 2004, July and October 2005, August and September 2006, October 2007, August 2008, October 2012, and October 2016.

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Oct-07	Aug-08	Oct-12	Oct-16	Ave.
Total no.[1]	547	426	657	398	537	546	712	875	313	557
Ave. no./m^{2}[2,2]	3.4±2.0AC	4.1±1.2AB	4.2±0.9A	9.0±2.6B	4.2±1.0A	4.1±1.0A	3.6±1.0AC	4.6±1.3A	2.0±0.7C	4.1 ± 0.4
Ave. CPUE[3]	36.1	19.3	22.5	15.4	17.7	18.1	25.2	30.9	10.7	21.8
Ave. no. species/qual sample[3]	7.7	5.6	7.2	6.0	6.3	6.8	6.2	6.1	4.3	6.2
Total no. live/FD species[1]	15	16	19	16	16	18	15	17	14	16.2
Cumulative live/FD species	15	18	20	21	22	23	24	25	26	26
Rarefaction species richness[3]										
100	10	10	12	11	11	12	10	9	9	10
250	14	14	16	15	13	15	13	13	13	14
500	15	-	18	-	14	18	14	15	-	16
750	-	-	-	-	-	-	-	16	-	16
Regression slope	5.48	5.56	6.55	5.97	5.32	6.24	5.22	5.35	5.08	5.64
Regression slope - 95% CI	4.79 - 6.16	4.09 - 7.02	5.37 - 7.73	3.76 - 8.19	4.92 - 5.71	4.23 - 8.26	4.15 - 6.29	4.52 - 6.18	3.39 - 6.76	
Ave. no. young/m^{2}[2,2]	0.2 ±0.2A	0.4±0.4AC	0.4 ±0.2A	1.8±0.8B	1.5±0.5BC	1.3±0.5BC	1.8±0.6B	0.8±0.4ABC	0.4±0.3A	0.9 ± 0.2
Ave. no. adults/m^{2}[2,2]	3.3 ±1.9AC	3.7±1.2AB	3.8 ±0.9B	7.2±2.3B	2.7±0.8A	2.8±0.8AC	1.9±0.7AC	3.7±1.2AB	1.6±0.6C	3.1 ± 0.4
% young[2]	4.9	9.8	8.5	20.0	35.1	32.3	48.8	18.4	20.8	22.1
% of species w/ ≤5 yrs[2]	33.3	41.7	63.6	66.7	84.6	55.6	66.7	72.7	42.9	58.6
Ave. no. FD/m^{2}[2,2]	0.2 ±0.2A	0.1 ±0.2A	0.1 ±0.2A	0.1±0.2A	0.5±0.3A	0.1±0.1A	0.1±0.2A	0.2±0.2A	0.0±0.1A	0.2 ± 0.1
%Mortality[2]	4.7	2.4	3.1	1.1	8.7	2.1	3.5	4.6	2.2	3.6
% adult mortality[2]	-	-	-	1.4	9.0	1.6	4.5	5.6	-	4.4
% young mortality[2]	-	-	-	0.0	8.3	3.2	2.4	0.0	-	2.8
<u>Ambleminae</u>										
Total no.[2]	25	25	58	55	51	57	55	77	30	48.1
Total no.[1]	335	259	347	207	275	287	541	565	221	337.4
Ave. no./m^{2}[2,2]	2.1±1.4AC*	2.5±1.0ABC*	2.6±0.7ABC*	5.5±2.2B*	2.3±0.7AC*	2.5±0.7ABC*	2.4±0.8ABC*	3.4±1.0AB*	1.3±0.6C*	2.6 ± 0.3*
Ave. no.≤5yrs/m^{2}[2,2]	0.2±0.2AB	0.2±0.3AB	0.2±0.2A	1.2±0.7BC	0.8±0.4ABC	1.1±0.5BC	1.3±0.5C	0.4±0.3AB	0.3±0.3AB	0.6 ± 0.1
Ave. no.>5yrs/m^{2}[2,2]	1.9±1.3AB	2.3±1.0AB	2.4±0.7AB	4.3±1.9B	1.5±0.6A	1.4±0.5A	1.2±0.6A	3.0±1.0AB	1.1±0.5A	2.0 ± 0.3
% young[2]	8.0	8.0	6.9	21.8	33.3	43.9	52.7	13.0	21.2	23.2
Total no. species[1]	5	5	5	6	5	7	5	5	6	5.4
Total no. species w/young[1]	5	4	4	4	5	5	5	4	4	4.4
Total no. adult species[1]	5	5	5	6	5	7	5	5	6	5.4
Ave. no. FD/m^{2}[2,2]	0.1±0.2A	0.0±0.0A	0.0±0.1A	0.1±0.2A	0.0±0.1A	0.0±0.1A	0.0±0.1A	0.1±0.2A	0.0±0.1A	0.1 ± 0.0
%Mortality[2]	3.8	0.0	1.7	1.8	1.9	1.7	1.8	3.8	3.2	2.2
% adult mortality[2]	-	-	-	2.3	2.9	0.0	0.0	4.3	-	1.9
% young mortality[2]	-	-	-	0.0	0.0	3.8	3.3	0.0	-	1.4
<u>Lampsilinae</u>										
Total no.[2]	15	14	36	34	42	35	23	26	13	26.4
Total no.[1]	163	123	197	99	265	152	161	198	90	160.9
Ave. no./m^{2}[2,2]	1.3±0.9BC*	1.4±0.8ABC*	1.6±0.6ABC*	3.4±1.3A*	1.9±0.7AB*	1.6±0.6BC*	1.0±0.5BC#	1.2±0.5BC#	0.6±0.3C#	1.4 ± 0.2#
Ave. no.≤3yrs/m^{2}[2,2]	0.0±0.0A	0.2±0.3A	0.2±0.2A	0.6±0.5A	0.7±0.4A	0.2±0.2A	0.5±0.3A	0.4±0.3A	0.1±0.2A	0.3 ± 0.1
Ave. no.>3yrs/m^{2}[2,2]	1.3±0.9AB	1.2±0.7AB	1.4±0.6AB	2.8±1.3A	1.2±0.5AB	1.3±0.5AB	0.5±0.3B	0.8±0.4AB	0.4±0.3AB	1.1 ± 0.2
% young[2]	0.0	14.3	11.1	17.6	35.7	14.3	47.8	34.6	7.1	20.3
Total no. species[1]	9	7	10	8	8	9	8	9	6	8.2
Total no. species w/young[1]	7	3	5	6	6	4	4	5	2	4.7
Total no. adult species[1]	7	7	10	6	8	8	8	7	5	7.3
Ave. no. FD/m^{2}[2,2]	0.1±0.2A	0.1±0.2A	0.1±0.1A	0.0±0.0A	0.3±0.2A	0.0±0.1A	0.1±0.1A	0.1±0.1A	0.0±0.1A	0.1 ± 0.0
%Mortality[2]	6.3	6.7	5.3	0.0	12.5	2.8	8.0	7.1	0.0	5.4
% adult mortality[2]	-	-	-	0.0	12.9	3.2	14.3	10.5	-	8.2
% young mortality[2]	-	-	-	0.0	11.8	0.0	0.0	0.0	-	2.4

[1]Quantitative and Qualitative combined; [2]Quantitative data only; [3]Qualitative data only; Species richness includes preliminary samples in 2004

Different letters within a row indicates a significant difference (ANOVA, $p<0.05$)

Different symbols within a column indicates a significant difference (t-test; $p<0.10$)

Table 3-21. Age (external annuli count) frequency of unionid species collected in the SS Bed, October 2016.

Subfamily	Species	Young[2]	Age (external annuli count)[1]																			
			2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	24	Total
Ambleminae	*Amblema plicata*	Y	-	-	-	-	-	-	-	-	-	-	-	3	-	-	1	2	1	-	1	8
	Fusconaia flava	N	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
	Quadrula metanevra	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Quadrula nodulata	Y	1	1	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	4
	Quadrula p. pustulosa	Y	-	1	-	-	1	1	1	-	-	-	-	1	-	1	2	-	-	-	-	8
	Quadrula quadrula	Y	1	1	-	1	1	-	-	-	-	-	1	2	-	-	1	-	-	1	-	9
Ambleminae Total			2	3	0	1	2	2	1	0	0	0	2	7	0	1	4	2	1	1	1	30
Anodontinae	*Arcidens confragosus*	N	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
	Lasmigona c. complanata	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Anodontinae Total			0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Lampsilinae	*Lampsilis cardium*	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Leptodea fragilis	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Ligumia recta	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Obliquaria reflexa	Y	-	-	1	1	-	1	1	-	-	-	3	2	-	1	-	1	-	-	-	11
	Potamilus alatus	N	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	Potamilus ohiensis	Y	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Lampsilinae Total			1	0	1	1	0	2	1	0	0	0	3	2	0	1	0	1	0	0	0	13
Total			3	3	1	2	2	4	2	0	0	0	5	9	0	3	4	3	1	1	1	44

Bold indicates Illinois, Iowa, and Federally threatened and endangered species

[1]Quantitative samples only

[2]All sample methods

Table 3-22. Comparison of Cordova Bed habitat conditions between July 2004, July and October 2005, August and September 2006, October 2007, August 2008, October 2012, and October 2016.

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Oct-07	Aug-08	Oct-12	Oct-16	Ave.
Sample date	Jul 13-14, 2004	July 27, 2006	Oct 3-4, 2005	Aug 3-4, 2006	Sept 20-24, 2006	Oct 6-12, 2007	Aug 19-25, 2008	Oct. 28-29, 2012	Oct 29, Nov 1	
Discharge (cfs)[1]	72,916 to 69,220	38,153	47,125 to 52,245	18,544 to 27,695	21,257 to 30,178	67,300 to 77,700	27,439 to 33,497	26,697 to 26,704	97,592 to 98,231	
Substrate temp N end	-	-	-	-	-	60.8 to 69.3	76.6 to 80.4	-	-	
Substrate temp S end	-	-	-	-	-	61.0 to 69.0	77.1 to 81.0	-	-	
Dist from bank (m)	10 to 90	10 to 90	10 to 90	10 to 90	10 to 90	10 to 90	10 to 90	10 to 90	10 to 90	
Dist from mix zone (m)	3030 to 3365	3030 to 3365	3030 to 3365	3030 to 3365	3030 to 3365	3030 to 3365	3030 to 3365	3030 to 3365	3030 to 3365	
Substrate										
% Boulder	<1	3	2	0	0	3	2	3	6	2
% Cobble	2	0	1	<1	<1	<1	3	4	3	2
% Gravel	13	6	10	13	8	15	29	28	24	16
% Sand	33	77	66	40	43	17	23	23	14	37
% Silt	27	6	9	9	21	19	19	24	11	16
% Clay	13	0	0	19	7	1	5	0	6	6
% Detritus	<1	0	<1	0	<1	<1	2	0	0	<1
% Shell	12	8	13	18	18	44	13	16	37	20
% Vegetation	0	0	0	<1	1	1	4	0	0	1
Depth (m)										
Ave.	2.0	2.1	3.0	1.7	2.2	1.6	2.5	2.5	3.1	2.3
Range	(0.6 to 3.4)	(1.2 to 3.7)	(0.6 to 6.7)	(0.6 to 3.0)	(0.1 to 6.4)	(0.9 to 2.7)	(0.6 to 4.6)	(0.6 to 6.1)	(1.2 to 7.3)	
CV[2]	28	86	147	45	57	32	44	56	34	
Bottom temp (°F)										
Ave.	77.5	77.5	65.5	87.3	64.2	60.9	78.3	51.2	55.5	68.7
Range	(73.4 to 79.3)	(73.4 to 80.2)	(54.0 to 67.1)	(85.6 to 89.1)	(63.9 to 65.3)	(60.9 to 61.7)	(77.0 to 79.9)	(50.5 to 53.1)	(55.0 to 55.8)	
CV[2]	0.6	5.9	5.3	2.8	1.0	0.9	0.8	1.3	0.7	
Bottom DO (mg/L)										
% saturation	73.1	-	88.2	87.5	82.4	85.1	114.8	108.8	80.7	
Ave.	6.0	-	8.3	8.5	7.8	8.4	9.3	12.1	8.3	8.6
Range	(5.7 to 6.6)	-	(7.2 to 14.0)	(7.7 to 9.6)	(4.3 to 18.1)	(8.0 to 8.6)	(8.4 to 13.9)	(11.5 to 12.7)	(8.2 to 8.6)	
CV[2]	12.6	-	3.7	7.3	55.6	1.7	16.6	3.2	1.0	
Bottom current velocity (m/sec)										
Ave.	0.2	0.2	0.2	<0.1	0.1	0.2	<0.1	<0.1	0.5	4.0
Range	(0.1 to 0.4)	(0.1 to 0.3)	(0.1 to 0.5)	(0.0 to 0.2)	(>0.0 to 0.1)	(0.0 to 0.4)	(0.0 to 0.1)	(0.0 to 0.1)	(0.3 to 0.7)	
CV[2]	48	42	54	127	52	71	79	87	23	
Rel. zebra mussel inf.[3]	Very heavy	0.3 (0 to 5)	1.3 (0 to 50)	0.1 (0 to 20)	0.3 (0 to 12)	0.01 (0 to 1)	16.4 (0 to 100+)	3.1 (0 to 25)	0.0	2.7

[1]Lock and Dam 14 (LeClaire, IA; MRM 493.3)

[2]CV=coefficient of variation (Standard deviation*100/mean)

[3]Very heavy=most unionids coated or encased with zebra mussels; 2005, 2006, 2007, 2008, 2012 average and range of zebra mussels per unionid

Table 3-23. Comparison of Cordova Bed unionid community characteristics between July 2004, July and October 2005, August and September 2006, October 2007, August 2008, October 2012, and October 2016.

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Oct-07	Aug-08	Oct-12	Oct-16	Ave.
Total no.[1]	320	164	375	430	745	651	455	438	342	436
Ave. no./m^{2}[2]	5.7±1.9ABC	3.0±1.3AC	5.8±1.5AB	3.7±1.4ABC	3.0±1.1C	4.7±1.2ABC	4.6±1.0ABC	6.8±1.4B	4.4±1.2ABC	4.7 ± 0.5
Ave. CPUE[3]	15.8	6.7	10.2	19.7	27.1	21.8	14.1	11.4	9.8	15.2
Ave. no. species/qual sample[3]	6.6	3.3	5.1	7.4	7.5	7.6	5.8	5.2	5.0	5.9
Total no. live/FD species[1]	20	18	21	19	20	23	22	20	20	20.3
Cumulative live/FD species	20	20	22	23	24	25	25	25	25	25
Rarefaction species richness[3]										
100	15	15	16	15	13	15	15	16	15	15
250	19	-	19	18	16	19	19	19	19	19
500	-	-	-	-	18	22	-	-	-	20
750	-	-	-	-	-	-	-	-	-	-
Regression slope	7.76	7.20	7.89	7.36	6.58	7.91	7.96	7.82	7.72	7.58
Regression slope - 95% CI	5.96 - 9.56	6.18 - 8.22	5.66 - 10.13	5.33 - 9.39	5.13 - 8.03	6.21 - 9.61	6.19 - 9.73	7.45 - 8.19	6.42 - 9.03	
Ave. no. young/m^{2}[2]	2.2±1.0AC	0.6 ±0.5AB	2.1 ±0.9A	1.1±0.6AB	0.8±0.4AB	1.6±0.7A	2.0±0.6AC	3.5±1.0C	0.5±0.3B	1.6 ± 0.3
Ave. no. adults/m^{2}[2]	3.5 ±1.4A	2.4±1.2A	3.7 ±0.9A	2.6±1.3A	2.2±0.9A	3.0±0.9A	2.6±0.7A	3.3±0.9A	3.9±1.0A	3.1 ± 0.3
% young[2]	33.8	20.0	36.2	29.7	25.4	35.2	43.7	51.0	11.2	31.8
% of species w/ ≤5 yrs[2]	53.8	55.6	61.1	62.5	71.4	69.6	63.6	75.0	31.6	60.5
Ave. no. FD/m^{2}[2]	1.8 ±1.6AB	0.8 ±0.9AB	0.2±0.2B	0.6±0.5AB	1.4±0.6A	0.2±0.2B	0.2±0.2B	0.4±0.6B	0.0±0.0B	0.5 ± 0.2
%Mortality[2]	24.4	21.1	3.0	14.0	31.6	3.7	4.6	6.1	0.0	12.1
% adult mortality[2]	-	-	-	13.3	31.5	2.9	4.9	6.3	-	11.8
% juvenile mortality[2]	-	-	-	15.4	32.0	5.1	4.3	6.0	-	12.6
Ambleminae										
Total no.[2]	27	18	51	15	33	48	57	52	52	39.2
Total no.[1]	120	79	151	221	497	304	211	140	126	205.4
Ave. no./m^{2}[2]	2.3±1.1A*	1.8±1.1A*	2.3±0.8A*	1.5±0.8A*	1.5±0.7A*	2.1±0.8A*	2.5±0.7A*	2.3±0.7A*	2.3±0.7A*	2.1 ± 0.3*
Ave. no.≤5yrs/m^{2}[2]	0.8±0.6A	0.5±0.4A	0.5±0.4A	0.5±0.4A	0.4±0.3A	0.5±0.3A	1.0±0.5A	0.4±0.3A	0.2±0.2A	0.5 ± 0.1
Ave. no.>5yrs/m^{2}[2]	1.5±0.8A	1.3±1.0A	1.8±0.7A	1.0±0.6A	1.1±0.6A	1.6±0.7A	1.5±0.6A	1.9±0.7A	2.1±0.7A	1.6 ± 0.2
% young[2]	33.3	27.8	21.6	33.3	27.3	25.0	40.4	17.3	7.7	26.0
Total no. species[1]	6	5	5	6	5	6	6	5	5	5.4
Total no. species w/young[1]	4	2	4	6	5	6	4	4	2	4.1
Total no. adult species[1]	6	5	5	5	5	5	6	5	5	5.2
Ave. no. FD/m^{2}[2]	0.3±0.3A	0.3±0.5A	0.2±0.2A	0.2±0.3A	0.3±0.3A	0.1±0.2A	0.1±0.1A	0.2±0.4A	0.0±0.0A	0.2 ± 0.1
%Mortality[2]	10.0	14.3	7.3	11.8	17.5	5.9	3.4	8.8	0.0	8.8
% adult mortality[2]	-	-	-	9.1	7.7	5.3	2.9	4.4	-	5.9
% juvenile mortality[2]	-	-	-	16.7	35.7	7.7	4.2	25.0	-	17.9
Lampsilinae										
Total no.[2]	40	11	74	18	33	55	44	74	41	43.3
Total no.[1]	116	50	72	147	147	164	221	114	102	125.9
Ave. no./m^{2}[2]	3.3±1.2AB*	1.1±0.6A*	3.3±1.0AB*	1.8±0.9AB*	1.5±0.6A*	2.4±0.8AB*	2.0±0.6AB*	3.3±0.7B#	1.9±0.6AB*	2.3 ± 0.3*
Ave. no.≤3yrs/m^{2}[2]	1.4±0.7AB	0.1±0.2B	1.6±0.7A	0.5±0.4B	0.4±0.2B	1.1±0.5AB	0.9±0.4AB	2.0±0.6A	0.2±0.2B	0.9 ± 0.2
Ave. no.>3yrs/m^{2}[2]	1.9±0.8A	1.0±0.6A	1.7±0.6A	1.3±0.8A	1.1±0.5A	1.4±0.5A	1.1 ±0.4A	1.3±0.5A	1.6±0.6A	1.4 ± 0.2
% young[2]	42.5	9.1	47.3	27.8	24.2	43.6	45.5	59.5	2.4	33.5
Total no. species[1]	11	9	12	10	10	13	12	11	10	10.9
Total no. species w/young[1]	8	4	4	7	6	7	8	8	3	6.1
Total no. adult species[1]	9	9	12	10	9	12	11	8	10	10.0
Ave. no. FD/m^{2}[2]	1.5±1.2A	0.4±0.5AB	0.0±0.0B	0.2±0.3AB	0.9±0.5A	0.0±0.1B	0.1±0.1B	0.2±0.3B	0.0±0.0B	0.3 ± 0.1
%Mortality[2]	31.0	26.7	0.0	10.0	38.9	1.8	4.3	5.1	0.0	13.1
% adult mortality[2]	-	-	-	7.1	43.2	0.0	7.7	9.1	-	13.4
% juvenile mortality[2]	-	-	-	16.7	20.0	4.0	0.0	2.2	-	8.6

[1]Quantitative and Qualitative combined; [2]Quantitative data only; [3]Qualitative data only
Different letters within a row indicates a significant difference (ANOVA, $p<0.05$)
Different symbols within a column indicate a significant difference (t-test, $p\leq0.05$)

Table 3-24. Comparison of Cordova Bed unionid relative abundance (%) between July 2004, July and October 2005, August and September 2006, October 2007, August 2008, October 2012, and October 2016[1].

	Jul-04	Jul-05	Oct-05	Aug-06	Sep-06	Oct-07	Aug-08	Oct-12	Oct-16	Ave.
Ambleminae										
Amblema plicata	27.9	50.0	24.6	27.0	35.8	33.3	46.6	28.8	33.7	34.2
Cyclonaias tuberculata	-	-	-	-	-	-	**SF**	**SF**	-	**SF**
Elliptio dilatata	-	-	-	-	-	-	**SF**	-	-	**SF**
Fusconaia ebena	WD	-	-	-	-	-	SF	SF	-	WD
Fusconaia flava	X	3.3	3.1	2.7	4.5	1.0	1.0	1.3	2.0	2.1
Megalonaias nervosa	2.9	X	4.6	2.7	4.5	1.9	1.0	2.0	2.0	2.4
Pleurobema sintoxia	-	-	-	-	-	-	**WD**	**SF**	-	**WD**
Quadrula metanevra	X	-	-	WD	-	-	SF	SF	-	SF
Quadrula nodulata	-	-	-	2.7	FD	X	X	WD	-	0.3
Quadrula p. pustulosa	5.9	6.7	4.6	2.7	4.5	7.6	4.9	1.3	12.2	5.6
Quadrula quadrula	2.9	X	2.3	2.7	X	1.9	1.9	0.7	3.1	1.7
Tritogonia verrucosa	**WD**	-	**WD**	-	-	-	**SF**	-	-	**WD**
Total Ambleminae	39.6	60.0	39.2	40.5	49.3	45.7	55.3	34.0	53.0	46.3
Anodontinae										
Arcidens confragosus	X	3.3	X	X	X	X	X	X	1.0	0.5
Lasmigona c. complanata	1.5	X	1.5	WD	1.5	X	X	X	1.0	0.6
Pyganodon grandis	X	X	0.8	8.1	X	X	1.0	3.3	X	1.5
Strophitus undulatus	-	-	-	-	-	**1.0**	-	**SF**	-	**0.1**
Utterbackia imbecillis	X	FD	1.5	2.7	FD	1.0	1.0	14.4	2.0	2.5
Total Anodontinae	1.5	3.3	3.8	10.8	1.5	1.9	1.9	17.6	4.0	5.1
Lampsilinae										
Actinonaias ligamentina	X	-	-	-	1.5	1.0	-	SF	X	0.3
Ellipsaria lineolata	**WD**	-	**X**	**2.7**	**FD**	**X**	**X**	**1.3**	**X**	**0.4**
Lampsilis cardium	7.4	6.7	5.4	16.2	6.0	7.6	7.8	5.2	11.2	8.2
Lampsilis higginsii	**1.5**	**X**	**0.8**	**2.7**	**4.5**	**1.9**	**4.9**	**X**	**2.0**	**2.0**
Lampsilis siliquoidea	-	-	-	-	X	-	-	-	1.0	0.1
Lampsilis teres	-	-	-	**WD**	-	-	**WD**	-	-	**WD**
Leptodea fragilis	33.8	16.7	29.2	8.1	10.4	12.4	6.8	17.7	3.1	15.4
Ligumia recta	**1.5**	**X**	**6.2**	**5.4**	**7.5**	**2.9**	**2.9**	**3.9**	**8.2**	**4.3**
Obliquaria reflexa	8.8	3.3	6.9	5.4	-	8.6	8.7	11.1	14.3	7.5
Obovaria olivaria	X	X	0.8	X	-	X	1.9	X	X	0.3
Potamilus alatus	X	X	0.8	5.4	1.5	3.8	1.9	1.3	1.0	1.7
Potamilus ohiensis	1.5	3.3	X	-	-	X	X	0.7	-	0.6
Toxolasma parvus	1.5	6.7	3.8	FD	1.5	5.7	2.9	1.3	-	2.6
Truncilla donaciformis	2.9	-	2.3	X	1.5	8.6	3.9	5.9	2.0	3.0
Truncilla truncata	WD	-	0.8	2.7	WD	-	1.0	-	-	0.5
Total Lampsilinae	58.9	36.7	56.9	48.6	49.3	52.4	42.7	48.4	42.8	48.5

[1]Numbers represent % that species represents in quantitative samples. X=not collected in quantitative samples, but found in qualitative samples
FD = freshly dead shell, WD = weathered shell, SF = subfossil shell
Bold indicates Illinois, Iowa and Federally threatened and endangered species

Table 3-25. Age (external annuli count) frequency of unionid species collected in the Cordova Bed, October 2016.

			Age (external annuli count)[1]																							
Subfamily	Species	Young[2]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	28	Total
Ambleminae	*Amblema plicata*	Y	-	-	-	-	-	-	1	-	-	1	-	3	5	7	9	3	-	-	-	2	-	2	-	33
	Fusconaia flava	N	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	2
	Megalonaias nervosa	N	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2
	Quadrula p. pustulosa	Y	-	-	1	2	1	-	1	1	-	-	2	1	1	-	1	1	-	-	-	-	-	-	-	12
	Quadrula quadrula	N	-	-	-	-	-	1	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	3
Ambleminae Total			0	0	1	2	1	1	3	2	0	1	3	4	7	8	10	4	0	0	0	2	0	2	1	52
Anodontinae	*Arcidens confragosus*	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
	Lasmigona c. complanata	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
	Pyganodon grandis	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Utterbackia imbecillis	Y	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Anodontinae Total			1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	4
Lampsilinae	***Ellipsaria lineolata***	**N**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Lampsilis cardium	N	-	-	-	-	-	-	1	2	1	-	-	2	2	-	1	1	1	-	-	-	-	-	-	11
	Lampsilis higginsii	**N**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1**	**1**	-	-	-	-	-	-	-	2
	Lampsilis siliquoidea	N	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
	Leptodea fragilis	Y	-	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
	Ligumia recta	**Y**	-	-	-	-	-	-	-	**1**	-	-	**1**	-	**1**	-	**2**	-	-	-	-	-	**1**	**1**	-	7
	Obliquaria reflexa	Y	-	-	-	-	2	4	3	1	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	14
	Obovaria olivaria	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Potamilus alatus	N	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	Truncilla donaciformis	N	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Lampsilinae Total			0	1	0	1	2	7	5	4	3	0	3	3	3	0	4	2	1	0	0	0	1	1	0	41
Total			1	1	2	3	3	8	8	6	3	1	6	7	10	8	15	6	1	0	0	2	2	3	1	97

Bold indicates Illinois, Iowa, and Federally threatened and endangered species

[1]Quantitative samples only

[2]All sample methods

Table 3-26. Habitat conditions within the WG Bed, October 2007, August 2008, October 2012, and October 2016.

	Oct-07	Aug-08	Oct-12	Oct-16
Sample date	Oct. 8,12	Aug 17 to 24	Oct 27 to 28	Oct 30 to Nov 1
Discharge (cfs)[1]	70,600 to 77,700	27,439 to 33,497	26,501 to 26,704	98,231 to 98,963
Dist from bank (m)	10 to 150	10 to 150	10 to 150	10 to 150
Dist from mix zone (m)	10,500 to 10,900	10,500 to 10,900	10,500 to 10,900	10,500 to 10,900
Substrate				
% Boulder	<1	0	<1	0
% Cobble	0	3	6	1
% Gravel	1	14	14	0
% Sand	18	46	45	58
% Silt	33	26	32	7
% Clay	33	3	3	15
% Detritus	<1	0	0	0
% Shell	15	6	0	18
Depth (m)				
Ave.	2.8	3.8	3.8	4.3
Range	(0.3 to 4.3)	(2.7 to 5.5)	(0.6 to 6.7)	(1.5 to 7.6)
CV[2]	50	23	31	26
Bottom temp (°F)				
Ave.	61.6	79.2	53.6	55.6
Range	(59.0 to 62.6)	(77.0 to 80.6)	(52.3 to 54.5)	(55.2 to 55.8)
CV[2]	2.8	1.7	0.8	0.5
Bottom DO (mg/L)				
% saturation	84	101.5	92.8	80.7
Ave.	8.2	8.2	10.0	8.3
Range	(7.6 to 8.6)	(7.9 to 8.6)	(8.8 to 11.0)	(7.9 to 8.4)
CV[2]	3.3	2.6	5.2	1.4
Bottom current velocity (m/sec)				
Ave.	0.1	0.1	<0.1	0.4
Range	(>0.0 to 0.3)	(>0.0 to 0.3)	(0.0 to 0.1)	(0.1 to 0.5)
CV[2]	51	85	94	23
Rel. zebra mussel inf.[3]	0.1 (0 to 6)	8.6 (0 to 63)	0.6 (0 to 32)	0.6 (0 - 10)

[1]Lock and Dam 14 (LeClaire, IA; MRM 493.3)

[2]CV = coefficient of variation (Standard deviation*100/mean)

[3]Average and range of zebra mussels per unionid

Table 3-27. Comparison of WG Bed community characteristics between October 2007, August 2008, October 2012, and October 2016.

	2007	2008	2012	2016	Ave.
Total no.[1]	1339	879	957	445	905
Ave. no./$m^{2,2}$	5.9±1.3A	6.5 ± 1.7A	15.2 ± 3.5B	7.6 ± 2.1A	8.8 ± 1.2
Ave. CPUE[3]	34.2	29.3	24.6	11.0	24.8
Ave. no. species/qual sample[3]	7.4	7.7	8.1	4.8	7.0
Total no. live/FD species[1]	23	22	23	21	22.3
Cumulative live/FD species	23	23	25	25	25
Rarefaction species richness[3]					
100	13	14	15	14	14
250	17	18	19	18	18
500	19	20	22	-	20
750	20	22	23	-	22
Regression slope	7.01	7.44	7.89	7.61	7.49
Regression slope - 95% CI	6.23 - 7.79	6.00 - 8.88	7.20 - 8.59	6.26 - 8.96	
Ave. no. young/$m^{2,2}$	2.4±0.7A	2.7 ± 0.9A	9.2 ± 2.6B	1.7 ± 0.6C	3.6 ± 0.8
Ave. no. adults/$m^{2,2}$	3.5±1.0A	3.8 ± 1.1A	5.9 ± 1.7A	5.9 ± 1.8A	4.8 ± 0.7
% young[2]	40.6	41.8	61.0	22.8	41.6
% of species w/ ≤5 yrs[2]	60.9	81.8	71.4	52.4	66.6
Ave. no. FD/$m^{2,2}$	0.3±0.2AB	0.2 ± 0.2AB	0.5 ± 0.3A	0.0 ± 0.1B	0.3 ± 0.1
%Mortality[2]	4.3	3.3	3.1	0.6	2.8
% adult mortality[2]	7.1	4.5	6.3	-	6.0
% juvenile mortality[2]	0.0	1.6	1.0	-	0.9
Ambleminae					
Total no.[2]	80	85	106	112	95.8
Total no.[1]	606	570	380	188	436.0
Ave. no./$m^{2,2}$	3.6±1.0A*	3.8 ± 1.3A*	4.7 ± 1.4A*	5.0 ± 1.4A*	4.3 ± 0.6*
Ave. no.≤5yrs/$m^{2,2}$	1.2±0.5A	1.2 ± 0.5A	1.9 ± 0.7A	0.8 ± 0.4A	1.3 ± 0.3
Ave. no.>5yrs/$m^{2,2}$	2.4±0.8A	2.6 ± 0.9A	2.8 ± 1.0A	4.2 ± 1.3A	3.0 ± 0.5
% young[2]	33.8	30.6	40.6	16.1	30.3
Total no. species[1]	7	6	6	6	6.3
Total no. species w/young[1]	6	6	6	4	5.5
Total no. adult species[1]	7	6	6	6	6.3
Ave. no. FD/$m^{2,2}$	0.0±0.1A	0.0 ± 0.1A	0.0 ± 0.1A	0.0 ± 0.1A	0.0 ± 0.1
%Mortality[2]	1.2	1.2	0.9	0.9	1.1
% adult mortality[2]	1.9	1.7	1.6	-	1.7
% juvenile mortality[2]	0.0	0.0	0.0	-	0.0
Lampsilinae					
Total no.[2]	45	47	154	47	73.3
Total no.[1]	169	247	158	73	161.8
Ave. no./$m^{2,2}$	2.0±0.7A#	2.1 ± 0.8A#	6.8 ± 1.9B*	2.1 ± 0.8A#	3.3 ± 0.6#
Ave. no.≤3yrs/$m^{2,2}$	1.1±0.5AC	1.2 ± 0.5A	4.8 ± 1.6B	0.6 ± 0.3C	1.8 ± 0.5
Ave. no.>3yrs/$m^{2,2}$	0.9±0.5A	0.9 ± 0.5AB	2.0 ± 0.8B	1.5 ± 0.7AB	1.4 ± 0.3
% young[2]	55.6	55.3	70.1	12.8	48.5
Total no. species[1]	12	12	12	11	11.8
Total no. species w/young[1]	5	8	11	6	7.5
Total no. adult species[1]	10	11	10	11	10.5
Ave. no. FD/$m^{2,2}$	0.2 ± 0.2A	0.1 ± 0.1A	0.2 ± 0.2A	0.0 ± 0.0A	0.1 ± 0.1
%Mortality[2]	10.0	4.1	3.1	0.0	4.3
% adult mortality[2]	20.0	8.7	9.8	-	12.8
% juvenile mortality[2]	0.0	0.0	0.0	-	0.0

[1]Quantitative and Qualitative combined; [2]Quantitative data only; [3]Qualitative data only

Different letters within a row within a site indicates a significant difference (ANOVA, $p<0.05$)

Different symbols within a column indicate a significant difference (t-test, $p\leq0.05$)

Table 3-28. Age (external annuli count) frequency of unionid species collected in the WG Bed, October 2016.

Subfamily	Species	Young[2]	Age (external annuli count)[1]																					
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	34	77	Total
Ambleminae	*Amblema plicata*	Y	-	-	1	6	1	5	5	2	1	1	1	1	5	-	1	2	1	-	-	-	-	33
	Fusconaia flava	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Megalonaias nervosa	Y	-	-	-	3	-	-	-	-	2	-	1	-	-	-	-	-	-	-	2	1	1	10
	Quadrula nodulata	Y	-	-	-	1	2	4	1	1	-	1	-	-	1	-	-	-	-	-	-	-	-	11
	Quadrula p. pustulosa	N	-	-	-	-	-	2	3	-	2	-	1	1	-	-	-	-	-	-	-	-	-	9
	Quadrula quadrula	Y	-	-	2	1	1	6	6	3	1	4	5	6	4	4	4	2	-	-	-	-	-	49
Ambleminae Total			0	0	3	11	4	17	15	6	6	6	8	8	10	4	5	4	1	0	2	1	1	112
Anodontinae	*Arcidens confragosus*	N	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	Lasmigona c. complanata	N	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
	Pyganodon grandis	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
	Utterbackia imbecillis	Y	2	-	3	1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
Anodontinae Total			2	0	3	1	2	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	12
Lampsilinae	***Ellipsaria lineolata***	**Y**	-	-	-	-	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	Lampsilis cardium	N	-	-	-	-	-	1	-	-	-	1	-	2	-	1	-	-	-	-	-	-	-	5
	Lampsilis higginsii	**N**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1**	-	-	-	-	1
	Leptodea fragilis	Y	2	2	1	3	1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
	Ligumia recta	**N**	-	-	-	-	-	-	-	-	-	-	**1**	-	-	-	-	-	-	-	-	-	-	1
	Obliquaria reflexa	Y	-	-	-	-	-	4	1	1	1	-	-	1	2	1	-	-	-	-	-	-	-	11
	Obovaria olivaria	N	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
	Potamilus alatus	Y	-	-	-	-	-	3	1	-	-	-	-	1	1	-	1	-	-	-	-	-	-	7
	Potamilus ohiensis	Y	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
	Truncilla donaciformis	Y	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
	Truncilla truncata	N	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Lampsilinae Total			2	3	1	4	3	13	4	2	1	1	1	5	3	2	1	0	1	0	0	0	0	47
Total			4	3	7	16	9	33	19	8	7	7	9	13	14	6	6	4	2	0	2	1	1	171

Bold indicates Illinois, Iowa, and Federally threatened and endangered species

[1]Quantitative samples only

[2]All sample methods

Table 3-29. Relative abundance (%) of unionid species within the WG Bed, October 2007, August 2008, October 2012, and October 2016[1].

	2007	2008	2012	2016	Ave.
Ambleminae					
Amblema plicata	18.0	17.1	6.2	19.3	15.2
Cyclonaias tuberculata	-	**SF**	-	-	**SF**
Elliptio dilatata	-	**WD**	-	-	**WD**
Fusconaia ebena	-	WD	WD	-	WD
Fusconaia flava	1.5	X	X	X	0.4
Megalonaias nervosa	3.0	4.1	2.1	5.9	3.8
Plethobasus cyphyus	-	**SF**	-	-	**SF**
Pleurobema sintoxia	**X**	**SF**	-	-	**X**
Quadrula metanevra	-	SF	-	-	SF
Quadrula nodulata	6.8	6.8	4.4	6.4	6.1
Quadrula p. pustulosa	1.5	2.1	2.1	5.3	2.8
Quadrula quadrula	29.3	28.1	16.4	28.7	25.6
Tritogonia verrucosa	-	**SF**	**WD**	-	**WD**
Total Ambleminae	60.2	58.2	31.1	65.6	53.8
Anodontinae					
Anodonta suborbiculata	-	-	X	-	X
Arcidens confragosus	1.5	2.7	0.9	0.6	1.4
Lasmigona c. complanata	2.3	0.7	1.2	0.6	1.2
Lasmigona costata	-	SF	-	-	SF
Pyganodon grandis	2.3	2.1	0.6	X	1.2
Utterbackia imbecillis	0.0	4.1	21.1	5.6	7.7
Total Anodontinae	6.0	9.6	23.8	6.8	11.6
Lampsilinae					
Actinonaias ligamentina	-	-	SF	-	SF
Ellipsaria lineolata	**0.8**	**X**	**0.3**	**0.6**	**0.4**
Lampsilis cardium	2.3	0.7	0.3	2.9	1.5
Lampsilis higginsii	**X**	**X**	-	**0.6**	**0.2**
Lampsilis teres	**X**	**0.7**	**0.3**	-	0.3
Leptodea fragilis	8.3	8.2	11.1	8.2	8.9
Ligumia recta	**0.8**	**X**	**0.3**	**0.6**	0.4
Obliquaria reflexa	18.0	12.3	14.1	6.4	12.7
Obovaria olivaria	X	X	0.3	0.6	0.2
Potamilus alatus	X	2.1	2.1	4.1	2.1
Potamilus ohiensis	4.5	4.8	1.2	1.2	2.9
Toxolasma parvus	-	WD	1.2	-	0.3
Truncilla donaciformis	6.8	3.4	13.8	1.8	6.4
Truncilla truncata	X	X	0.3	0.6	0.2
Total Lampsilinae	41.4	32.2	45.2	27.6	36.6

[1]Numbers represent % that species represents in quantitative samples. X=not collected in quantitative samples, but found in qualitative samples
WD = weathered shell, SF = subfossil shell
Bold indicates Illinois, Iowa and Federally threatened and endangered species

Attachment 8
Water Treatment Additives

Quad Cities Generating Station
December 11, 2019

Raw Water Treatment Chemicals

1. Sodium Hypochlorite
2. Sodium Bisulfite
3. Nalco C-9 Corrosion Inhibitor (Zinc Phosphate)
4. Nalco 1393 Scale Inhibitor (HEDP)
5. Nalco pHree Guard 4500 Silt Dispersant (Polymer)

Wastewater / Sanitary Waste Treatment Chemicals

1. Aluminum Sulfate

Outfalls 001/002—Open Cycle Diffusers

No treatment applied to this discharge as wastewater. The station's circulating water is treated with **sodium hypochlorite** for biofouling control and **Nalco 1393** (a 60% HEDP liquid scale inhibitor) for scale control. Quad Cities continues to utilize a dechlorination system, which relies upon the addition of **sodium bisulfite** to the condenser cooling water outlet. Dechlorination is necessary in order to consistently meet the 0.05 mg/L Total Residual Oxidant (TRO) limitation.

The station's service water is treated with **sodium hypochlorite** for biofouling control, **Nalco pHree Guard 4500** (a polymeric dispersant) for silt control, and **Nalco C-9** (a zinc phosphate corrosion inhibitor containing 37% orthophosphate and 13% zinc) for corrosion inhibition.

Quad Cities also has obtained prior Agency approval to use the following products for water treatment and/or biofouling control within the station's safety and non-safety-related service water systems: **Nalclean 2568** (special use scale remover for non-safety-related biocide piping), **Devoe Bar-Rust 235** and **Devoe ABC #3** (anti-fouling coatings for safety-related system). Please refer to Agency correspondence dated February 2, 1998 and March 8, 1999 (respectively) for further information regarding the use of these products.

Outfall A02—Radwaste Treatment System Blowdown

No chemical additives are routinely used in this system.

Outfall B01—Wastewater Treatment System

Aluminum sulfate is used in the station's wastewater treatment system to assist in the settling of solids.

ROWELL Chemical Corporation

SAFETY DATA SHEET

Section 1 – Product and Company Identification

Product Name: HYPO 150, Bleach, Sodium Hypochlorite **Product Code:** HYPO150

Rowell Chemical Corporation
15 Salt Creek Lane – Suite 205
Hinsdale, IL 60521

Telephone Numbers:
During normal business hours: (630) 920-8833
Transportation emergency call Chemtrec: (800) 424-9300

Product Use: Industrial
It is a violation of federal law to use this product in a manner inconsistent with its labeling
Not recommended for: Household use

Section 2 – Hazards Identification

GHS Ratings:

DANGER

Corrosive to metals	1	Corrosive to metals
Skin corrosive	1B	Destruction of dermal tissue
Eye corrosive	1	Serious eye damage, Irreversible damage
Oxidizing liquid	3	May intensify fire, oxidizer
Organ toxin single exposure	3	Transient target organ effects: Respiratory, Inhalation
Aquatic toxicity	C2	Acute toxicity and lack of rapid degradability

GHS Hazards

EUH031	Contact with acids liberates toxic gas
H272	May intensify fire, oxidizer
H314	Causes severe skin burns and eye damage
H335	May cause respiratory irritation
H400+H411	Very toxic to aquatic life with long lasting effects

GHS Precautions

P234	Only keep in original container
P261	Avoid breathing dust/fume/gas/mist/vapors /spray
P264	Wash hands thoroughly after handling
P271	Use only outdoors or in well-ventilated area
P273	Avoid release to the environment
P280	Wear protective gloves/protective clothing/eye protection/face protection
P310	Immediately call a Poison Control Center or doctor/physician
P321	Specific treatment (See section 4 or First Aid section of the label)
P363	Wash contaminated clothing before reuse
P391	Collect spillage
P301+P330+P331	IF SWALLOWED: Rinse mouth. DO NOT induce vomiting.

P303+P361+P353 IF ON SKIN (or hair): Remove/take off immediately all contaminated clothing. Rinse skin with water/shower

P304+P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

P305+P351+P338 IF IN EYES: Rinse continuously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing

P405 Store locked up

P406 Store in a corrosion resistant container with a resistant liner

P403+P233 Store in a well ventilated place. Keep container tightly closed

P501 Dispose of contents/container to appropriate waste site or reclaim in accordance with local and national regulations

Section 3 – Composition/Information on Ingredients

Hazardous Components		
Chemical Name	**Identifiers**	**% (weight)**
Sodium Hypochlorite	7681-52-9	12.50 – 15.00%
Sodium Hydroxide	1310-73-2	0-5%

Section 4 – First Aid Measures

Inhalation:

Remove from further exposure. For those providing assistance, avoid exposure of yourself. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, a trained individual should attempt to resuscitate while medical assistance is obtained. Call a poison control center or physician for treatment advice.

Eye Contact:

Rinse cautiously with water for at least 15 minutes. Remove contact lenses if present and easy to do. Continue rinsing and contact medical assistance.

Skin Contact:

Remove all contaminated clothing. Flush skin with water for at least 15 minutes, then wash with soap and water. Contact medical assistance for advice.

Ingestion:

If victim is conscious, give 1-2 glasses of water or milk. Do not give anything to an unconscious victim. DO NOT induce vomiting and seek immediate medical assistance.

Notes to Physician:

Probable mucosal damage may contradict the use of gastric lavage. Corrosive material

Section 5 – Fire Fighting Measures

Flammable Limits:
Flash Point: Not flammable
UEL: NA LEL: NA
Extinguishing Media:
CO2, extinguishing powder or water spray. Fight larger fires with water spray.
Unusual Fire or Explosion Hazards:
Decomposes when heated. Decomposition products may cause containers to rupture or explode. May react vigorously with organic materials. Depending on temperature and concentration, decomposition products may cause other hazards. Sodium Chlorate crystals may cause fire or explosion if subjected to friction or impact.
Hazardous Combustion Products:
Hydrogen Chloride, Chlorine (if in contact with metals), Oxygen, Sodium Chlorate
Advice for Firefighters:
If evacuation of personnel is necessary, evacuate to an upwind location. Decontaminate personnel and equipment with water wash-down after fire and smoke exposure. Structural firefighters' protective clothing may only provide limited protection. Wear positive pressure self-contained breathing apparatus (SCBA). Move containers from fire area if you can do it without risk. Use water spray to cool containers exposed to fire.

Section 6 – Accidental Release Measures

Personal precautions, protective equipment and emergency procedures
Personal Precautions:
Wear appropriate protective equipment including respiratory protection as conditions warrant. Do not touch or walk through spilled material. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.
Emergency Procedures:
As an immediate precautionary measure, isolate spill or leak area. Keep out of low areas. Keep unauthorized personnel away. Stay upwind. Ventilate closed spaces before entering.
Environmental Precautions:
Avoid run off to waterways and sewers.
Methods and material for containment and cleaning up
Small Spills:
Stop leak if you can do it without risk. Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers for later disposal.
Large Spills:
Dike far ahead of liquid spill and prevent entry into waterways, sewers, basements or confined spaces. Neutralize with Sodium Sulfite (1 teaspoon in 2.5 gallons material) or dilute Hydrogen Peroxide (1 cup in1 gal of water then use on spill). May also neutralize using ¼ teaspoon Ascorbic acid for each gallon of liquid. DO NOT use vinegar or acidic solutions on spill, this will produce dangerous gases.

Section 7 – Handling and Storage

Wear all appropriate Personal Protective Equipment (PPE). Wear respiratory protection or ensure adequate ventilation at all times as vapors can accumulate in confined or poorly ventilated areas. Use the product in a manner which minimizes splashes. Keep containers closed when not in use. Do not mix with water without dilution and agitation to prevent potentially violent reaction. Do not mix with acids, ammonia, alcohol, ethers or hydrocarbons.

Storage:

Prevent material from freezing. Store at room temperatures, i.e., 40 to 95°F (4 - 35°C). Store away from direct sunlight and heat to slow normal decomposition. Do not handle or store material near heat, sparks, open flames or other sources of ignition.

Section 8 – Exposure Control and Personal Protection

Chemical Name/CAS No.	OSHA Exposure Limits	ACGIH Exposure Limits	Other Exposure Limits
Sodium Hypochlorite 7681-52-9	NA	NA	STEL 2 mg/m³ (AIHA)
Sodium Hydroxide 1310-73-2	2 mg/m³ TWA	2 mg/m³ (Ceiling)	NA

Engineering Controls:

Ensure that eyewashes and safety showers are close to the workstation.

Ventilation Controls:

Provide adequate ventilation to control airborne concentrations below the exposure guidelines.

Administrative Controls:

No Data Available

Personal Protection:

As prescribed in the OSHA Standard for Personal Protective Equipment (29CFR 1910.132), employers must perform a hazard assessment of the workplace to determine the need for proper PPE for each employee.

Eye Protection:

Normal industrial eye protection of safety glasses with side shields/goggles and face shield.

Skin Protection:

Avoid contact with skin. Wear long sleeved protective clothing. Wash hands before breaks and immediately after handling product. Wear chemical resistant gloves and chemical resistant boots.

Respiratory Protection:

If airborne concentration limits are exceeded, an approved respirator must be worn.

Contaminated Equipment:

Decontaminate equipment with a water wash-down.

SAFETY DATA SHEET

Section 9 – Physical and Chemical Properties

Density: 1.084 - 1.226 @ 20°C/68°F	**Viscosity: 2.15 @23°C for 12.5% NaOCL by wt.**
Freezing Point: -11°F/-24°C for 12.5% NaOCL by wt.	**Melting Point: -11°F/-24°C** for 12.5% NaOCL by wt.
Boiling Point: 219°F/104°C for 12.5% NaOCL by wt.	**Vapor Density: 2.6 g/cm³ (21.697 lbs./gal)**
Solubility: Complete	**Vapor Pressure: 12mmHg for 12.5% NaOCL by wt.**
Evaporation Rate: Not Available	**Flammability: Not Flammable**
Appearance: Clear, yellow liquid	**Flash Point: Not Flammable**
Physical State: Liquid	**Decomposition Temperature: Not Available**
pH: Strong Base >12	**Autoignition Temperature: Not Flammable**
Odor/Odor Threshold: Chlorine/0.9 mg/m³	**Explosive Limits: Not Explosive**
Partition Coefficient (n-octanol/water): Not Available	

Section 10 – Stability and Reactivity

Stability:

Solution decomposes slowly. Decomposition rate increases in temperature >40°C/104°F and sunlight.

Incompatibilities:

Avoid contact with strong acids which releases chlorine gas, Nitrogen compounds, Ammonium salts, Methanol or metals.

Hazardous Decomposition Products:

Hydrogen chloride, Chlorine, oxides of Chlorine, oxygen, Sodium Chlorate

Hazardous Polymerization:

Will not occur.

Section 11 – Toxicological Information

Component Toxicity:

Compound	LD50 Mode, species, level	LD50 Mode, species, level	LC50 Mode, species, level	Other Mode, species, level
Sodium Hypochlorite	oral, mouse, 5.81 g/kg	Dermal, rabbit, >20g/kg	NA	NA
Sodium Hydroxide	Intraperitoneal, mouse, 40 mg/kg	LDLO, oral, rabbit, 500 mg/kg	NA	NA

Routes of Entry:

Ingestion, Inhalation, Skin, Eyes

Target Organs:

No Data Found

Effects of Overexposure:

Causes severe skin burns and eye damage. Harmful if swallowed or absorbed through skin. May cause respiratory irritation, coughing, dizziness, nausea, or unconsciousness. Mucosal damage, vomiting.

Section 12 – Ecological Information

Product Ecotoxicity:
Toxic to aquatic life.

Component Ecotoxicity:

Component	Ecotoxicity values
Sodium Hypochlorite	96 Hr LC50 Pimephales promelas; 0.06 - 0.11 mg/L [flow-through]; 96 Hr LC50 Pimephales promelas; 4.5 - 7.6 mg/L [static]; 96 Hr LC50 Lepomis macrochirus; 0.4 - 0.8 mg/L [static]; 96 Hr LC50 Lepomis macrochirus: 0.28 -1 mg/L [flow-through]; 96 Hr LC50 Oncorhynchus mykiss: 0.05 - 0.771 mg/L [flow-through]; 96 Hr LC50 Oncorhynchus mykiss: 0.03 - <0.19 mg/L [semi-static]; 96 Hr LG50 Oncorhynchus mykiss: 0.18 - 0.22 mg/L [static] 48 Hr EC50 Daphnia magna: 0.033 - 0.044 mg/L [Static]
Sodium Hydroxide	100 mg/l, Daphnia, minnows, lethal; 40 - 240 mg/l, Daphnia magna, toxicity threshold; 125 - 1000 mg/l, various insect larvae, lethal; 25 mg/l, 24hr, brook trout, lethal; 70 mg/l, 5hr, fish, crabs, lethal; 90 mg/l, 4.5hr, oysters, lethal, salt water; 180 mg/l, 23hr, oysters, lethal, salt water (Sax 1986).

Section 13 – Disposal

Product Disposal:
Pesticide wastes may be hazardous. Improper disposal of excess pesticide, spray mixture or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to the label instructions, contact your State Pesticide, Environmental Control Agency or the Hazardous Waste Representative at the nearest EPA Regional Office for guidance.

Container Disposal:
Clean the container according to label instructions before final disposal.

Section 14 – Transportation Information

The following is for US DOT Highway transportation. Other modes/jurisdictions may have different classifications.
US DOT: Hypochlorite Solutions, UN 1791, III, 8, Marine Pollutant

SAFETY DATA SHEET

Section 15 – Regulatory Information

This listing is to highlight federal level regulation of the product. Individual States and other nations may have further regulations not listed below.

US DOT List of Marine Pollutants (172.101 - Appendix B)

7681-52-9 Sodium hypochlorite

US DOT List of Hazardous Substances and Reportable Quantities (172.101 Appendix A)

7681-52-9 Sodium hypochlorite 12.5%

1310-73-2 Sodium Hydroxide 15.0%

US DOT List of Severe Marine Pollutants (172.101 - Appendix B)

- None

SARA Section 302 Extremely Hazardous Substances (40 CFR 355):

- None

Sara Section 302 Threshold Planning Quantity.

- None

SARA Section 313, Toxic Chemicals (40 CFR 372.65):

- None

SARA Reportable Quantity.

7681-52-9 Sodium hypochlorite 12.5%

1310-73-2 Sodium Hydroxide 15.0%

Toxic Substances Control Act (TSCA):

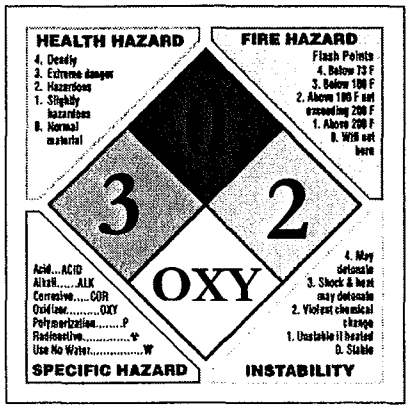
All components are listed or exempt from the Toxic Substances Control Act except those listed below.

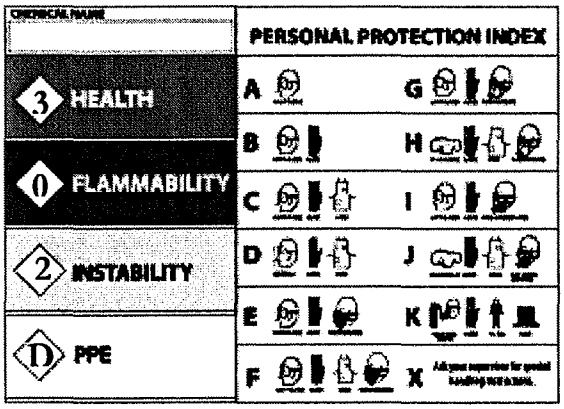
- None

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1985 (SARA):

This product contains a chemical or chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, part 372.

Section 16 – Other Information





Date Prepared: 01/16/2018 Reviewer Revision: 5.0

The information contained herein is offered only as a guide to the handling of this specific material and has been prepared in good faith by Rowell Chemical Corporation. It is not intended to be all-inclusive and the manner and conditions of use and handling may involve other and additional considerations. No warranty of

any kind is given or implied and Rowell Chemical Corporation will not be liable for any damages, losses, injuries or consequential damages which may result from the use or reliance on any information contained herein.

Safety Data Sheet

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name	Sodium Bisulfite 38-42% Solution
UN/ID No.	UN2693
Synonyms	No information available
Recommended Use	Reserved for industrial and professional use
Uses advised against	Consumer uses: Private households (= general public = consumers).

Company Name
PVS Chemical Solutions Inc.
10900 Harper Ave.
Detroit, MI 48213
313-921-1200

24 Hour Emergency Phone Number CHEMTREC 1-800-424-9300

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

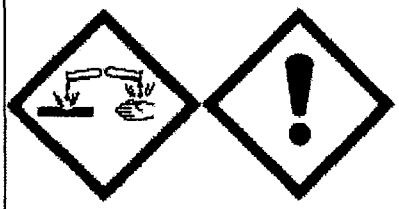
Acute toxicity - Oral	Category 4
Skin corrosion/irritation	Category 1 Sub-category C
Serious eye damage/eye irritation	Category 1

Emergency Overview

DANGER

Hazard statements
Causes severe skin burns and eye damage
Causes serious eye damage
Harmful if swallowed

Physical hazards
Do not handle until all hazard precautions have been read and understood



Precautionary statements

Prevention
- Wear protective gloves/protective clothing/eye protection/face protection
- Do not breathe dust/fume/gas/mist/vapors/spray
- Wash face, hands and any exposed skin thoroughly after handling
- Do not eat, drink or smoke when using this product

Response
- Immediately call a POISON CENTER or doctor/physician
- IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
- IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower
- IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
- IF SWALLOWED: Rinse mouth. DO NOT induce vomiting
- Wash contaminated clothing before reuse

Storage
- Store in a well-ventilated place. Keep container tightly closed
- Store in a secure area

Disposal • Dispose of in accordance with federal, state and local regulations

Hazards not otherwise classified (HNOC) None known.

Other Information

Other hazards • May be harmful if swallowed

Unknown Acute Toxicity 0% of the mixture consists of ingredient(s) of unknown toxicity

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	EC No.	Weight-% *
Water	7732-18-5	231-791-2	58-62
Sodium bisulfite	7631-90-5	231-548-0	38-42

4. FIRST AID MEASURES

General advice If symptoms persist, call a physician Do not breathe dust/fume/gas/mist/vapors/spray Do not get in eyes, on skin, or on clothing

Eye contact
- Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes
- Keep eyes wide open while rinsing
- If symptoms persist, call a physician

Skin Contact
- Consult a physician if necessary
- Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes
- Wash contaminated clothing before reuse

-Inhalation
- Remove to fresh air
- If breathing is irregular or stopped, administer artificial respiration
- If breathing is difficult, give oxygen
- If symptoms persist, call a physician

Ingestion
- Call a physician or poison control center immediately
- Do NOT induce vomiting
- Rinse mouth
- Drink 1 or 2 glasses of water
- Never give anything by mouth to an unconscious person

Note to physician • Treat symptomatically

Self-protection for first aid personnel • Use personal protective equipment as required

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media
- Dry chemical, CO2, water spray or alcohol-resistant foam
- Use extinguishing measures that are appropriate to local circumstances and the surrounding environment

Unsuitable extinguishing media • No information available

Specific hazards arising from the chemical
- Thermal decomposition can lead to release of irritating and toxic gases and vapors
- Sulfur Oxides (SOx)

Protective equipment and precautions for firefighters • Wear a self-contained breathing apparatus and chemical protective clothing

Flammable properties • Not flammable

Explosive properties • No information available

6. ACCIDENTAL RELEASE MEASURES

Personal precautions
- Evacuate personnel to safe areas
- Use personal protective equipment as required
- Keep people away from and upwind of spill/leak

Environmental precautions
- For small spills, absorb material with clay absorbent or other compatible material. Dispose of the waste material according to local, state and governmental requirements.
- For large spills, contain the material using barriers of absorbent pigs, clay absorbent or earth dams.

Methods for cleaning up
- Cover liquid spill with sand, earth or other non-combustible absorbent material
- Pick up and transfer to properly labeled containers
- Cover powder spill with plastic sheet or tarp to minimize spreading

Other Information
- No information available

7. HANDLING AND STORAGE

Advice on safe handling
- Avoid contact with skin, eyes or clothing
- Use personal protective equipment as required
- Wash contaminated clothing before reuse
- Do not breathe dust/fume/gas/mist/vapors/spray
- Do not eat, drink or smoke when using this product

Storage Conditions
- Keep container tightly closed in a dry and well-ventilated place
- Keep out of the reach of children

Incompatible materials
Acids, Oxidizers

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Sodium bisulfite 7631-90-5	TWA: 5 mg/m³	TWA 5 mg/m³	

Exposure Guidelines

Engineering Controls
Ensure adequate ventilation, especially in confined areas.

Individual protection measures, such as personal protective equipment

Respiratory protection
- A respiratory protection program that meets OSHA 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant the use of a respirator.

Eye/Face protection
- Tight sealing safety goggles

Skin and body protection
- Wear suitable protective clothing
- Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact

General Hygiene Considerations
- Handle in accordance with good industrial hygiene and safety practice
- Do not eat, drink or smoke when using this product

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state Liquid
Appearance clear
Color colorless or slight yellow
Odor Sulfur dioxide
Odor threshold No information available

Sodium Bisulfite 38-42% Solution

Property	Values	Remarks • Method
pH	3-5	
Melting point/Freezing Point	No information available	
Boiling point / boiling range	No information available	
Flash point	No information available	
Evaporation rate	No information available	
Flammability (solid, gas)	No information available	
Flammability Limit in Air		
Upper flammability limit (%)	No information available	
Lower flammability limit (%):	No information available	
Vapor pressure	78 mm Hg	@ 37.7 °C
Vapor density	No information available	
Specific Gravity	1.3-1.37	
Water solubility	Miscible in water	
Solubility in other solvents	No information available	
Partition coefficient	No information available	
Autoignition temperature	No information available	
Decomposition temperature	No information available	
Kinematic viscosity	No information available	
Dynamic viscosity	No information available	
Explosive properties	No information available	
Oxidizing properties	No information available	
Other Information		
Softening point °C	No information available	
Molecular weight	No information available	
VOC Content (%)	No information available	
Density	No information available	
Bulk density	10.8-11.4 Pounds per gallon (lb/gal)	

10. STABILITY AND REACTIVITY

Stability • Stable under recommended storage conditions

Conditions to avoid • Elevated temperature

Incompatible materials
- Acids
- Oxidizers

Hazardous Decomposition Products
- Reacts with acids to liberate corrosive and toxic sulfur dioxide
- Thermal decomposition can lead to release of irritating and toxic gases and vapors
- Sulfur Oxides (SOx)
- Carbon oxides (COx)

Possibility of Hazardous Reactions • None under normal processing and storage

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Principle Routes of Exposure	-Inhalation, Skin Contact, Eye contact
-Inhalation	May cause irritation of respiratory tract. Avoid breathing vapors or mists.
Ingestion	May be harmful if swallowed.
Skin Contact	Contact with moist skin may cause skin burns.
Eye contact	Risk of serious damage to eyes.

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Water 7732-18-5	> 90 mL/kg (Rat)		
Sodium bisulfite 7631-90-5	= 1310 mg/kg (Rat)		

Information on toxicological effects

Symptoms No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Sensitization No information available.
Germ cell mutagenicity No information available.
Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Chemical Name	ACGIH	IARC	NTP	OSHA
Sodium bisulfite 7631-90-5		Group 3		

IARC (International Agency for Research on Cancer)
Not classifiable as a human carcinogen

Reproductive toxicity No information available.
STOT - single exposure No information available.
STOT - repeated exposure No information available.
Target Organ Effects Eyes, Respiratory system, Skin.
Aspiration hazard No information available.

Numerical measures of toxicity - Product Information

Unknown Acute Toxicity 0% of the mixture consists of ingredient(s) of unknown toxicity
The following values are calculated based on chapter 3.1 of the GHS document .

12. ECOLOGICAL INFORMATION

Ecotoxicity

0% of the mixture consists of components(s) of unknown hazards to the aquatic environment

Chemical Name	Algae/aquatic plants	Fish	Crustacea
Sodium bisulfite 7631-90-5			119: 48 h Daphnia magna mg/L EC50

Persistence and degradability No information available.
Bioaccumulation No information available

Other adverse effects No information available

13. DISPOSAL CONSIDERATIONS

Disposal of wastes
- Dispose of in accordance with federal, state and local regulations
- Dispose of hazardous waste in a RCRA licensed facility

Contaminated packaging
- Do not reuse container

US EPA Waste Number
- D002

14. TRANSPORT INFORMATION

DOT

Proper shipping name Bisulfites, aqueous solution, n.o.s.
Hazard Class 8
UN/ID No. UN2693
Packing Group III
RQ (lbs)(dry) 5000
RQ as is (lbs)(wet) 13157
Technical Name Description SODIUM BISULFITE
Description UN2693, Bisulfites, aqueous solution, n.o.s., 8, III, RQ
Special Provisions IB3, T7, TP1, TP28
Emergency Response Guide Number 154

Transport Canada

UN/ID No. UN2693
Proper shipping name Bisulfites, aqueous solution, n.o.s.
Hazard Class 8

Sodium Bisulfite 38-42% Solution

Packing Group	III
Description	UN2693, Bisulfites, aqueous solution, n.o.s., 8, III

IATA

UN/ID No.	UN2693
Proper shipping name	Bisulphites, aqueous solution, n.o.s.
Hazard Class	8
Packing Group	III
ERG Code	8L

IMDG

UN/ID No.	UN2693
Proper shipping name	Bisulphites, aqueous solution, n.o.s.
Hazard Class	8
Packing Group	III
EmS-No.	F-A, S-B
Special Provisions	274

15. REGULATORY INFORMATION

US Federal Regulations

SARA 311/312 Hazard Categories

Acute health hazard	Yes
Chronic Health Hazard	No
Fire hazard	No
Sudden release of pressure hazard	No
Reactive Hazard	No

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

U.S. - TSCA (Toxic Substances Control Act) - Section 5(a)(2) - Chemicals with Significant New Use Rules (SNURs)

CWA (Clean Water Act)

This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

Chemical Name	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants	CWA - Hazardous Substances
Sodium bisulfite 7631-90-5	5000 lb			X

CERCLA

This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Chemical Name	Hazardous Substances RQs	CERCLA/SARA RQ	RQ (lbs)(dry)
Sodium bisulfite 7631-90-5	5000 lb		RQ 5000 lb final RQ RQ 2270 kg final RQ

Canada

WHMIS Classification

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Classification

E - Corrosive material

D2B - Toxic materials

US State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals

Sodium Bisulfite 38-42% Solution

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania
Water 7732-18-5			X
Sodium bisulfite 7631-90-5	X	X	X

International Inventories

TSCA	Complies
DSL/NDSL	Complies
EINECS/ELINCS	Complies
ENCS	Does not comply
IECSC	Complies
KECL	Complies
PICCS	Complies
AICS	Complies

Legend:

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
AICS - Australian Inventory of Chemical Substances

16. OTHER INFORMATION

NFPA	**Health hazards** 2	**Flammability** 0	**Instability** 0	**Physical and Chemical Properties**
HMIS	**Health hazards** 2	**Flammability** 0	**Physical hazards** 0	**Personal protection** B

Item #	**10592**
Safety Data Sheet	**0599**
Revision Date	May-22-2017
Issue Date	May-22-2017
Version	1.05
Revision Note	*** Updated value on SDS.

Disclaimer

All information, statements, data, advice, and/or recommendations, including, without limitation, those relating to storage, loading/unloading, piping, and transportation (collectively referred to herein as "information") are believed to be accurate, reliable, and based on reliable industry and regulatory references. However, no representation or warranty, express or implied, is made as to its completeness, accuracy, fitness for a particular purpose or any other matter, including, without limitation, that the practice or application of any such information is free of patent infringement or other intellectual property misappropriation. The Company providing this SDS is not engaged in the business of providing technical, operational, engineering, or safety information for a fee, and therefore, any such information provided herein has been furnished as an accommodation and without charge. All information provided herein is intended for use by persons having requisite knowledge, skill, and experience in the chemical industry. The Company providing this SDS shall not be responsible or liable for the use, application, or implementation of the information provided herein, and all such information is to be used at the risk, and in the sole judgment and discretion of such persons, their employees, advisors, and agents. This safety data sheet (SDS) is offered for your information, consideration, and investigation as required by federal hazardous products act and related legislation.

End of Safety Data Sheet

NALCO Water
An Ecolab Company

SAFETY DATA SHEET

C-9

Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	C-9
Other means of identification	:	Not applicable.
Recommended use	:	CORROSION INHIBITOR
Restrictions on use	:	Refer to available product literature or ask your local Sales Representative for restrictions on use and dose limits.
Company	:	Nalco Company 1601 W. Diehl Road Naperville, Illinois 60563-1198 USA TEL: (630)305-1000
Emergency telephone number	:	(800) 424-9300 (24 Hours) CHEMTREC
Issuing date	:	08/22/2016

Section: 2. HAZARDS IDENTIFICATION

GHS Classification

Corrosive to metals	:	Category 1
Acute toxicity (Oral)	:	Category 4
Acute toxicity (Inhalation)	:	Category 4
Skin corrosion	:	Category 1
Serious eye damage	:	Category 1

GHS Label element

Hazard pictograms :

Signal Word : Danger
Danger

Hazard Statements : Harmful if swallowed.
Causes severe skin burns and eye damage.
Toxic if inhaled.
May be corrosive to metals.
Harmful if swallowed or if inhaled
Causes severe skin burns and eye damage.

Precautionary Statements : **Prevention:**

Do not mix with bleach or other chlorinated products – will cause chlorine gas. Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray. Wash skin thoroughly after handling. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area. Wear protective gloves/ protective clothing/ eye protection/ face protection.
Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray. Wash skin thoroughly after handling. Use only outdoors or in a well-ventilated area. Wear protective gloves/ protective clothing/ eye protection/ face protection.
Response:
IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician. Wash contaminated clothing before reuse.
IF SWALLOWED: Call a POISON CENTER or doctor/ physician if you feel unwell. Rinse mouth.IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER/doctor.IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.
Wash contaminated clothing before reuse.
Storage:
Store in a well-ventilated place. Keep container tightly closed. Store locked up.
Disposal:
Dispose of contents/ container to an approved waste disposal plant.

Other hazards : Do not mix with bleach or other chlorinated products – will cause chlorine gas.

Section: 3. COMPOSITION/INFORMATION ON INGREDIENTS

Pure substance/mixture : Mixture

Chemical Name	CAS-No.	Concentration: (%)
Phosphoric Acid	7664-38-2	30 - 60
Zinc Chloride	7646-85-7	10 - 30

Section: 4. FIRST AID MEASURES

In case of eye contact : Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.

In case of skin contact : Wash off immediately with plenty of water for at least 15 minutes. Use a mild soap if available. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

If swallowed : Rinse mouth with water. Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Get medical attention immediately.

If inhaled	:	Remove to fresh air. Treat symptomatically. Get medical attention immediately.
Protection of first-aiders	:	In event of emergency assess the danger before taking action. Do not put yourself at risk of injury. If in doubt, contact emergency responders. Use personal protective equipment as required.
Notes to physician	:	Treat symptomatically.
Most important symptoms and effects, both acute and delayed	:	See Section 11 for more detailed information on health effects and symptoms.

Section: 5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable extinguishing media	:	None known.
Specific hazards during firefighting	:	Not flammable or combustible.
Hazardous combustion products	:	Decomposition products may include the following materials: Carbon oxides nitrogen oxides (NOx) Sulphur oxides Oxides of phosphorus
Special protective equipment for firefighters	:	Use personal protective equipment.
Specific extinguishing methods	:	Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations. In the event of fire and/or explosion do not breathe fumes.

Section: 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Ensure adequate ventilation. Keep people away from and upwind of spill/leak. Avoid inhalation, ingestion and contact with skin and eyes. When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. Ensure clean-up is conducted by trained personnel only. Refer to protective measures listed in sections 7 and 8.
Environmental precautions	:	Do not allow contact with soil, surface or ground water.
Methods and materials for containment and cleaning up	:	Stop leak if safe to do so. Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). For large spills, dike spilled material or otherwise contain material to ensure runoff does not reach a waterway. Flush away traces with water.

Section: 7. HANDLING AND STORAGE

Advice on safe handling	:	Do not ingest. Do not breathe dust/fume/gas/mist/vapours/spray. Do not get in eyes, on skin, or on clothing. Wash hands thoroughly after handling. Use only

with adequate ventilation. Do not mix with bleach or other chlorinated products – will cause chlorine gas.

Conditions for safe storage : Keep away from strong bases. Keep out of reach of children. Keep container tightly closed. Store in suitable labelled containers.

Suitable material : The following compatibility data is suggested based on similar product data and/or industry experience: Compatibility with Plastic Materials can vary; we therefore recommend that compatibility is tested prior to use.

Unsuitable material : not determined

Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Form of exposure	Permissible concentration	Basis
Phosphoric Acid	7664-38-2	TWA	1 mg/m3	ACGIH
		STEL	3 mg/m3	ACGIH
		TWA	1 mg/m3	NIOSH REL
		STEL	3 mg/m3	NIOSH REL
		TWA	1 mg/m3	OSHA Z1
Zinc Chloride	7646-85-7	TWA (Fumes)	1 mg/m3	OSHA Z1
		TWA (Fumes)	1 mg/m3	ACGIH
		STEL (Fumes)	2 mg/m3	ACGIH
		TWA (Fumes)	1 mg/m3	NIOSH REL
		STEL (Fumes)	2 mg/m3	NIOSH REL

Engineering measures : Effective exhaust ventilation system. Maintain air concentrations below occupational exposure standards.

Personal protective equipment

Eye protection : Safety goggles
Face-shield

Hand protection : Wear the following personal protective equipment:
Standard glove type.
Gloves should be discarded and replaced if there is any indication of degradation or chemical breakthrough.

Skin protection : Personal protective equipment comprising: suitable protective gloves, safety goggles and protective clothing

Respiratory protection : When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. Remove and wash contaminated clothing before re-use. Wash face, hands and any exposed skin thoroughly after handling. Provide suitable facilities for quick drenching or flushing of the eyes and body in case of contact or splash hazard.

Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Liquid
Colour	:	colourless
Odour	:	odourless
Flash point	:	> 93.3 °C
pH	:	< 1.0, 100 %, (25 °C)
Odour Threshold	:	no data available
Melting point/freezing point	:	FREEZING POINT: -20 °C, ASTM D-1177
Initial boiling point and boiling range	:	> 100 °C
Evaporation rate	:	no data available
Flammability (solid, gas)	:	no data available
Upper explosion limit	:	no data available
Lower explosion limit	:	no data available
Vapour pressure	:	similar to water
Relative vapour density	:	no data available
Relative density	:	1.56 - 1.6, (25 °C),
Density	:	13.3 lb/gal
Water solubility	:	completely soluble
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available
Auto-ignition temperature	:	no data available
Thermal decomposition temperature	:	no data available
Viscosity, dynamic	:	no data available
Viscosity, kinematic	:	no data available
Molecular weight	:	no data available
VOC	:	0 %, EPA Method 24

Section: 10. STABILITY AND REACTIVITY

Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	Do not mix with bleach or other chlorinated products – will cause chlorine gas.
		Do not mix with bleach or other chlorinated products – will cause chlorine gas.
Conditions to avoid	:	None known.

Incompatible materials	:	Strong bases
Hazardous decomposition products	:	Decomposition products may include the following materials: Carbon oxides nitrogen oxides (NOx) Sulphur oxides Oxides of phosphorus

Section: 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	:	Inhalation, Eye contact, Skin contact

Potential Health Effects

Eyes	:	Causes serious eye damage.
Skin	:	Causes severe skin burns.
Ingestion	:	Harmful if swallowed. Causes digestive tract burns.
Inhalation	:	Toxic if inhaled. Harmful if inhaled. May cause nose, throat, and lung irritation.
Chronic Exposure	:	Health injuries are not known or expected under normal use.

Experience with human exposure

Eye contact	:	Redness, Pain, Corrosion
Skin contact	:	Redness, Pain, Corrosion
Ingestion	:	Corrosion, Abdominal pain
Inhalation	:	Respiratory irritation, Cough

Toxicity

Product

Acute oral toxicity	:	LD50 rat: 1,530 mg/kg Test substance: Hazardous component LD50 rat: 350 mg/kg
Acute inhalation toxicity	:	Acute toxicity estimate: 2.55 mg/l Exposure time: 4 h
Acute dermal toxicity	:	Acute toxicity estimate: > 5,000 mg/kg
Skin corrosion/irritation	:	no data available
Serious eye damage/eye irritation	:	no data available
Respiratory or skin sensitization	:	no data available

Carcinogenicity	:	no data available
Reproductive effects	:	no data available
Germ cell mutagenicity	:	no data available
Teratogenicity	:	no data available
STOT - single exposure	:	no data available
STOT - repeated exposure	:	no data available
Aspiration toxicity	:	no data available

Section: 12. ECOLOGICAL INFORMATION

Ecotoxicity

Environmental Effects : Very toxic to aquatic life.
Very toxic to aquatic life with long lasting effects.

Product

Toxicity to fish : LC50 Lepomis macrochirus (Bluegill sunfish): 2.86 - 3.78 mg/l
Exposure time: 96 hrs

LC50 Inland Silverside: > 5,000 mg/l
Exposure time: 96 hrs
Test substance: Product

LC50 Lepomis macrochirus (Bluegill sunfish): 3.8 - 8.8 mg/l
Exposure time: 96 hrs
Test substance: Hazardous component

LC50 Zebra Danio: 18.18 mg/l
Exposure time: 96 hrs
Test substance: Hazardous component

LC50 Pimephales promelas (fathead minnow): 27 mg/l
Exposure time: 96 hrs
Test substance: Product
Test Type: Static

NOEC Pimephales promelas (fathead minnow): 3.1 mg/l
Exposure time: 96 hrs
Test substance: Product
Test Type: Static

Toxicity to daphnia and other aquatic invertebrates : LC50 Mysid Shrimp (Mysidopsis bahia): 4.8 mg/l
Exposure time: 96 hrs
Test substance: Product

LC50 Daphnia magna (Water flea): 0.158 mg/l
Exposure time: 48 hrs
Test substance: Hazardous component

LC50 Daphnia magna (Water flea): 10.3 mg/l
Exposure time: 48 hrs

Test substance: Product
Test Type: Static

NOEC Daphnia magna (Water flea): 1.3 mg/l
Exposure time: 48 hrs
Test substance: Product
Test Type: Static

Components

Toxicity to algae : Phosphoric Acid
EC50 Desmodesmus subspicatus (green algae): > 100 mg/l
Exposure time: 72 h

Persistence and degradability

no data available

Mobility

no data available

Bioaccumulative potential

no data available

Other information

no data available

Section: 13. DISPOSAL CONSIDERATIONS

If this product becomes a waste, it could meet the criteria of a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Before disposal, it should be determined if the waste meets the criteria of a hazardous waste.

Hazardous Waste: : D002

Disposal methods : The product should not be allowed to enter drains, water courses or the soil. Where possible recycling is preferred to disposal or incineration. If recycling is not practicable, dispose of in compliance with local regulations. Dispose of wastes in an approved waste disposal facility.

Disposal considerations : Dispose of as unused product. Empty containers should be taken to an approved waste handling site for recycling or disposal. Do not re-use empty containers.

Section: 14. TRANSPORT INFORMATION

The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport.

The presence of an RQ component (Reportable Quantity for U.S. DOT) in this product causes it to be regulated with an additional description of RQ for road, or as Environmentally hazardous for road and air, ONLY when the net weight in the package exceeds the calculated RQ for the product.

Land transport (DOT)

Proper shipping name	:	CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S.
Technical name(s)	:	ZINC CHLORIDE, PHOSPHORIC ACID
UN/ID No.	:	UN 3264
Transport hazard class(es)	:	8
Packing group	:	III
Reportable Quantity (per package)	:	3,730 lbs
RQ Component	:	ZINC CHLORIDE

Air transport (IATA)

Proper shipping name	:	CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S.
Technical name(s)	:	Zinc Chloride, Phosphoric Acid
UN/ID No.	:	UN 3264
Transport hazard class(es)	:	8
Packing group	:	III
Reportable Quantity (per package)	:	3,730 lbs
RQ Component	:	ZINC CHLORIDE

Sea transport (IMDG/IMO)

Proper shipping name	:	CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S.
Technical name(s)	:	ZINC CHLORIDE, PHOSPHORIC ACID
UN/ID No.	:	UN 3264
Transport hazard class(es)	:	8
Packing group	:	III
*Marine pollutant	:	ZINC CHLORIDE

*Note: This product is regulated as a Marine Pollutant when shipped by Rail, Highway (in bulk quantities), or Air (if no other hazard class applies), and when shipped by water in all quantities.

Section: 15. REGULATORY INFORMATION

EPCRA - Emergency Planning and Community Right-to-Know Act

CERCLA Reportable Quantity

Components	CAS-No.	Component RQ (lbs)	Calculated product RQ (lbs)
Zinc Chloride	7646-85-7	1000	3734

SARA 304 Extremely Hazardous Substances Reportable Quantity

This material does not contain any components with a section 304 EHS RQ.

SARA 311/312 Hazards : Acute Health Hazard

SARA 302 : No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 : The following components are subject to reporting levels established by SARA Title III, Section 313:

Zinc Chloride	7646-85-7	10 - 30 %

California Prop 65
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

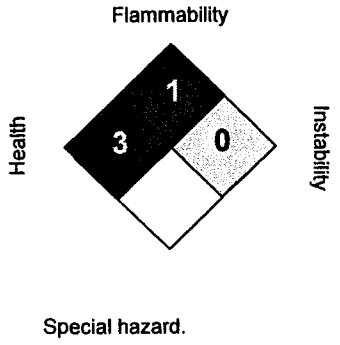
INTERNATIONAL CHEMICAL CONTROL LAWS :

TOXIC SUBSTANCES CONTROL ACT (TSCA)
The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

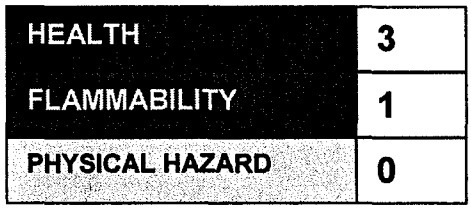
CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA)
The substance(s) in this preparation are included in or exempted from the Domestic Substance List (DSL).

Section: 16. OTHER INFORMATION

NFPA:



HMIS III:



0 = not significant, 1 =Slight,
2 = Moderate, 3 = High
4 = Extreme, * = Chronic

Revision Date	:	08/22/2016
Version Number	:	1.1
Prepared By	:	Regulatory Affairs

REVISED INFORMATION: Significant changes to regulatory or health information for this revision is indicated by a bar in the left-hand margin of the SDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.
For additional copies of an SDS visit www.nalco.com and request access.

NALCO
An Ecolab Company

SAFETY DATA SHEET

NALCO® 1393

Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	NALCO® 1393
Other means of identification	:	Not applicable.
Recommended use	:	SCALE INHIBITOR
Restrictions on use	:	Refer to available product literature or ask your local Sales Representative for restrictions on use and dose limits.
Company	:	Nalco Company 1601 W. Diehl Road Naperville, Illinois 60563-1198 USA TEL: (630)305-1000
Emergency telephone number	:	(800) 424-9300 (24 Hours) CHEMTREC
Issuing date	:	11/11/2015

Section: 2. HAZARDS IDENTIFICATION

GHS Classification

Skin corrosion	:	Category 1A
Serious eye damage	:	Category 1

GHS Label element

Hazard pictograms :

Signal Word : Danger

Hazard Statements : Causes severe skin burns and eye damage.

Precautionary Statements :

Prevention:
Wash skin thoroughly after handling. Wear protective gloves/ protective clothing/ eye protection/ face protection. Do not mix with bleach or other chlorinated products – will cause chlorine gas.

Response:
IF SWALLOWED: rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician. Wash contaminated clothing before reuse.

Storage:
Store locked up.

Disposal:

Dispose of contents/ container to an approved waste disposal plant.

Other hazards : None known.

Section: 3. COMPOSITION/INFORMATION ON INGREDIENTS

Pure substance/mixture : Mixture

Chemical Name	CAS-No.	Concentration: (%)
Hydroxyethylidenediphosphonic Acid	2809-21-4	60 - 100
Phosphonic Acid	13598-36-2	1 - 5
Phosphoric Acid	7664-38-2	1 - 5

Section: 4. FIRST AID MEASURES

In case of eye contact : Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.

In case of skin contact : Wash off immediately with plenty of water for at least 15 minutes. Use a mild soap if available. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

If swallowed : Rinse mouth with water. Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Get medical attention immediately.

If inhaled : Remove to fresh air. Treat symptomatically. Get medical attention if symptoms occur.

Protection of first-aiders : In event of emergency assess the danger before taking action. Do not put yourself at risk of injury. If in doubt, contact emergency responders. Use personal protective equipment as required.

Notes to physician : Treat symptomatically.

Most important symptoms and effects, both acute and delayed : See Section 11 for more detailed information on health effects and symptoms.

Section: 5. FIREFIGHTING MEASURES

Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media : None known.

Specific hazards during firefighting : Not flammable or combustible.

Hazardous combustion products : Carbon oxides

Special protective equipment : Use personal protective equipment.

for firefighters

Specific extinguishing methods	:	Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations. In the event of fire and/or explosion do not breathe fumes.

Section: 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Ensure adequate ventilation. Keep people away from and upwind of spill/leak. Avoid inhalation, ingestion and contact with skin and eyes. When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. Ensure clean-up is conducted by trained personnel only. Refer to protective measures listed in sections 7 and 8.
Environmental precautions	:	Do not allow contact with soil, surface or ground water.
Methods and materials for containment and cleaning up	:	Stop leak if safe to do so. Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). Flush away traces with water. For large spills, dike spilled material or otherwise contain material to ensure runoff does not reach a waterway.

Section: 7. HANDLING AND STORAGE

Advice on safe handling	:	Do not ingest. Do not mix with bleach or other chlorinated products – will cause chlorine gas. Do not breathe dust/fume/gas/mist/vapours/spray. Do not get in eyes, on skin, or on clothing. Wash hands thoroughly after handling. Use only with adequate ventilation.
Conditions for safe storage	:	Keep away from strong bases. Keep out of reach of children. Keep container tightly closed. Store in suitable labeled containers.
Suitable material	:	The following compatibility data is suggested based on similar product data and/or industry experience: Buna-N, EPDM, HDPE (high density polyethylene), Polyurethane, Chlorosulfonated polyethylene rubber, Fluoroelastomer, Neoprene, Polypropylene, Polyethylene, PVC, Stainless Steel 316L The following compatibility data is suggested based on similar product data and/or industry experience: Compatibility with Plastic Materials can vary; we therefore recommend that compatibility is tested prior to use.
Unsuitable material	:	The following compatibility data is suggested based on similar product data and/or industry experience: Brass, Epoxy phenolic resin, Mild steel, Stainless Steel 304The following compatibility data is suggested based on similar product data and/or industry experience:

Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Form of exposure	Permissible concentration	Basis

Phosphoric Acid	7664-38-2	TWA	1 mg/m3	ACGIH
		STEL	3 mg/m3	ACGIH
		TWA	1 mg/m3	NIOSH REL
		STEL	3 mg/m3	NIOSH REL
		TWA	1 mg/m3	OSHA Z1

Engineering measures : Effective exhaust ventilation system. Maintain air concentrations below occupational exposure standards.

Personal protective equipment

Eye protection : Safety goggles
Face-shield

Hand protection : Wear the following personal protective equipment:
Standard glove type.
Gloves should be discarded and replaced if there is any indication of degradation or chemical breakthrough.

Skin protection : Personal protective equipment comprising: suitable protective gloves, safety goggles and protective clothing

Respiratory protection : When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice. Remove and wash contaminated clothing before re-use. Wash face, hands and any exposed skin thoroughly after handling. Provide suitable facilities for quick drenching or flushing of the eyes and body in case of contact or splash hazard.

Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance : Liquid

Colour : Clear
Light yellow

Odour : None

Flash point : Not applicable.

pH : < 2, 1 %
(25 °C)

Odour Threshold : no data available

Melting point/freezing point : FREEZING POINT: -25 °C

Initial boiling point and boiling range : 108 °C

Evaporation rate : similar to water

Flammability (solid, gas) : no data available

Upper explosion limit : no data available

Lower explosion limit : no data available

Vapour pressure	:	17 mm Hg (20 °C)
Relative vapour density	:	no data available
Relative density	:	1.420 - 1.47 (25 °C)
Density	:	11.7 - 12.2 lb/gal
Water solubility	:	completely soluble
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available
Auto-ignition temperature	:	no data available
Thermal decomposition temperature	:	no data available
Viscosity, dynamic	:	40 mPa.s (25 °C)
Viscosity, kinematic	:	no data available
Molecular weight	:	no data available
VOC	:	no data available

Section: 10. STABILITY AND REACTIVITY

Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	Do not mix with bleach or other chlorinated products – will cause chlorine gas.
Conditions to avoid	:	None known.
Incompatible materials	:	Contact with strong alkalies (e.g. ammonia and its solutions, carbonates, sodium hydroxide (caustic), potassium hydroxide, calcium hydroxide (lime), cyanide, sulfide, hypochlorites, chlorites) may generate heat, splattering or boiling and toxic vapors. Contact with reactive metals (e.g. aluminum) may result in the generation of flammable hydrogen gas. Contact with strong oxidizers (e.g. chlorine, peroxides, chromates, nitric acid, perchlorate, concentrated oxygen, permanganate) may generate heat, fires, explosions and/or toxic vapors.
Hazardous decomposition products	:	Oxides of carbon Oxides of phosphorus

Section: 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	:	Inhalation, Eye contact, Skin contact

Potential Health Effects

Eyes	:	Causes serious eye damage.

Skin	:	Causes severe skin burns.
Ingestion	:	Causes digestive tract burns.
Inhalation	:	May cause nose, throat, and lung irritation.
Chronic Exposure	:	Health injuries are not known or expected under normal use.

Experience with human exposure

Eye contact	:	Redness, Pain, Corrosion
Skin contact	:	Redness, Pain, Corrosion
Ingestion	:	Corrosion, Abdominal pain
Inhalation	:	Respiratory irritation, Cough

Toxicity

Product

Acute oral toxicity	:	LD50 rat: 2,400 mg/kg Test substance: Product
Acute inhalation toxicity	:	Acute toxicity estimate : > 40 mg/l Exposure time: 4 h
Acute dermal toxicity	:	LD50 rabbit: > 7,940 mg/kg Test substance: Product
Skin corrosion/irritation	:	Result: 0.0 Method: Draize Test Test substance:Product
Serious eye damage/eye irritation	:	Result: 39.0 Method: Draize Test Test substance: Product
Respiratory or skin sensitization	:	no data available
Carcinogenicity	:	no data available
Reproductive effects	:	no data available
Germ cell mutagenicity	:	no data available
Teratogenicity	:	no data available
STOT - single exposure	:	no data available

STOT - repeated exposure : no data available

Aspiration toxicity : no data available

Section: 12. ECOLOGICAL INFORMATION

Ecotoxicity

Environmental Effects : This product has no known ecotoxicological effects.

Product

Toxicity to fish : LC50 Fathead Minnow: > 1,000 mg/l
Exposure time: 96 hrs
Test substance: Product

LC50 Bluegill Sunfish: 868 mg/l
Exposure time: 96 hrs
Test substance: Product

LC50 Rainbow Trout: 368 mg/l
Exposure time: 96 hrs
Test substance: Product

LC50 Channel Catfish: 695 mg/l
Exposure time: 96 hrs
Test substance: Product

LC50 Sheepshead Minnow: 2,180 mg/l
Exposure time: 96 hrs
Test substance: Product

Toxicity to daphnia and other aquatic invertebrates : LC50 Daphnia magna: 527 mg/l
Exposure time: 48 hrs
Test substance: Product

LC50 Grass Shrimp: 1,770 mg/l
Exposure time: 96 hrs
Test substance: Product

EC50 Ceriodaphnia dubia: 854 mg/l
Exposure time: 48 hrs
Test substance: Product

LC50 Ceriodaphnia dubia: 854 mg/l
Exposure time: 48 hrs
Test substance: Product

NOEC Ceriodaphnia dubia: 313 mg/l
Exposure time: 48 hrs
Test substance: Product

Components

Toxicity to algae : Phosphoric Acid

EC50 Desmodesmus subspicatus (green algae): > 100 mg/l
Exposure time: 72 h

Persistence and degradability

The product is not biodegradable

Total Organic Carbon (TOC) : 91,000 mg/l

Chemical Oxygen Demand (COD): 450,000 mg/l

Biochemical Oxygen Demand (BOD):

Incubation Period	Value	Test Descriptor
5 d	< 160 mg/l	Product

Mobility

The environmental fate was estimated using a level III fugacity model embedded in the EPI (estimation program interface) Suite TM, provided by the US EPA. The model assumes a steady state condition between the total input and output. The level III model does not require equilibrium between the defined media. The information provided is intended to give the user a general estimate of the environmental fate of this product under the defined conditions of the models.
If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages;

Air	:	<5%
Water	:	30 - 50%
Soil	:	30 - 50%

The portion in water is expected to be soluble or dispersible.

Bioaccumulative potential

This preparation or material is not expected to bioaccumulate.

Other information

no data available

Section: 13. DISPOSAL CONSIDERATIONS

If this product becomes a waste, it could meet the criteria of a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261. Before disposal, it should be determined if the waste meets the criteria of a hazardous waste.

Hazardous Waste:	:	D002
Disposal methods	:	Where possible recycling is preferred to disposal or incineration. If recycling is not practicable, dispose of in compliance with local regulations. Dispose of wastes in an approved waste disposal facility.
Disposal considerations	:	Dispose of as unused product. Empty containers should be taken to an approved waste handling site for recycling or disposal. Do not re-use empty containers.

Section: 14. TRANSPORT INFORMATION

The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport.

Land transport (DOT)

Proper shipping name	: CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.
Technical name(s)	: Phosphonic acid ester, Phosphonic Acid
UN/ID No.	: UN 3265
Transport hazard class(es)	: 8
Packing group	: III

Air transport (IATA)

Proper shipping name	: CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.
Technical name(s)	: Phosphonic acid ester, Phosphonic Acid
UN/ID No.	: UN 3265
Transport hazard class(es)	: 8
Packing group	: III

Sea transport (IMDG/IMO)

Proper shipping name	: CORROSIVE LIQUID, ACIDIC, ORGANIC, N.O.S.
Technical name(s)	: Phosphonic acid ester, Phosphonic Acid
UN/ID No.	: UN 3265
Transport hazard class(es)	: 8
Packing group	: III

Section: 15. REGULATORY INFORMATION

EPCRA - Emergency Planning and Community Right-to-Know Act

CERCLA Reportable Quantity

This material does not contain any components with a CERCLA RQ.

SARA 304 Extremely Hazardous Substances Reportable Quantity

This material does not contain any components with a section 304 EHS RQ.

SARA 311/312 Hazards	: Acute Health Hazard
SARA 302	: No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.
SARA 313	: This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

California Prop 65

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

INTERNATIONAL CHEMICAL CONTROL LAWS :

TOXIC SUBSTANCES CONTROL ACT (TSCA)
The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA)
The substance(s) in this preparation are included in or exempted from the Domestic Substance List (DSL).

AUSTRALIA
All substances in this product comply with the National Industrial Chemicals Notification & Assessment Scheme (NICNAS).

CHINA
All substances in this product comply with the Provisions on the Environmental Administration of New Chemical Substances and are listed on or exempt from the Inventory of Existing Chemical Substances China (IECSC).

JAPAN
All substances in this product comply with the Law Regulating the Manufacture and Importation Of Chemical Substances and are listed on the Existing and New Chemical Substances list (ENCS).

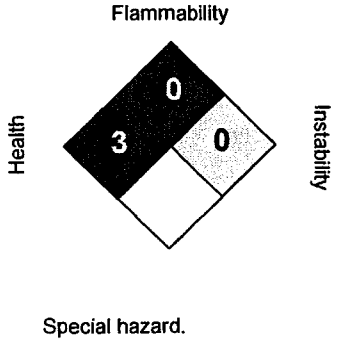
KOREA
All substances in this product comply with the Toxic Chemical Control Law (TCCL) and are listed on the Existing Chemicals List (ECL)

NEW ZEALAND
All substances in this product comply with the Hazardous Substances and New Organisms (HSNO) Act 1996,and are listed on or are exempt from the New Zealand Inventory of Chemicals.

PHILIPPINES
All substances in this product comply with the Republic Act 6969 (RA 6969) and are listed on the Philippines Inventory of Chemicals & Chemical Substances (PICCS).

Section: 16. OTHER INFORMATION

NFPA:



HMIS III:

HEALTH	3
FLAMMABILITY	0
PHYSICAL HAZARD	0

0 = not significant, 1 =Slight,
2 = Moderate, 3 = High
4 = Extreme, * = Chronic

Revision Date : 11/11/2015

Version Number : 1.1
Prepared By : Regulatory Affairs

REVISED INFORMATION: Significant changes to regulatory or health information for this revision is indicated by a bar in the left-hand margin of the SDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.
For additional copies of an SDS visit www.nalco.com and request access.

NALCO Water
An Ecolab Company

SAFETY DATA SHEET

pHreeGUARD™ 4500

Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	pHreeGUARD™ 4500
Other means of identification	:	Not applicable.
Recommended use	:	SCALE/DEPOSIT INHIBITOR
Restrictions on use	:	Refer to available product literature or ask your local Sales Representative for restrictions on use and dose limits.
Company	:	Nalco Company 1601 W. Diehl Road Naperville, Illinois 60563-1198 USA TEL: (630)305-1000
Emergency telephone number	:	(800) 424-9300 (24 Hours) CHEMTREC
Issuing date	:	06/26/2017

Section: 2. HAZARDS IDENTIFICATION

GHS Classification

Not a hazardous substance or mixture.

GHS Label element

Precautionary Statements	:	**Prevention:** Wash hands thoroughly after handling. **Response:** Specific measures: consult SDS Section 4. **Storage:** Store in accordance with local regulations. Protect product from freezing.
Other hazards	:	None known.

Section: 3. COMPOSITION/INFORMATION ON INGREDIENTS

No hazardous ingredients

Section: 4. FIRST AID MEASURES

In case of eye contact	:	Rinse with plenty of water. Get medical attention if symptoms occur.
In case of skin contact	:	Wash off with soap and plenty of water. Get medical attention if symptoms occur.
If swallowed	:	Rinse mouth. Get medical attention if symptoms occur.
If inhaled	:	Get medical attention if symptoms occur.
Protection of first-aiders	:	In event of emergency assess the danger before taking action. Do not put

		yourself at risk of injury. If in doubt, contact emergency responders. Use personal protective equipment as required.
Notes to physician	:	Treat symptomatically.
Most important symptoms and effects, both acute and delayed	:	See Section 11 for more detailed information on health effects and symptoms.

Section: 5. FIREFIGHTING MEASURES

Suitable extinguishing media	:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Unsuitable extinguishing media	:	None known.
Specific hazards during firefighting	:	Not flammable or combustible.
Hazardous combustion products	:	Decomposition products may include the following materials: Carbon oxides nitrogen oxides (NOx) Sulphur oxides Oxides of phosphorus
Special protective equipment for firefighters	:	Use personal protective equipment.
Specific extinguishing methods	:	Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.

Section: 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Refer to protective measures listed in sections 7 and 8.
Environmental precautions	:	No special environmental precautions required.
Methods and materials for containment and cleaning up	:	Stop leak if safe to do so. Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13). For large spills, dike spilled material or otherwise contain material to ensure runoff does not reach a waterway. Flush away traces with water.

Section: 7. HANDLING AND STORAGE

Advice on safe handling	:	For personal protection see section 8. Wash hands after handling.
Conditions for safe storage	:	Keep out of reach of children. Keep container tightly closed. Store in suitable labelled containers. Protect product from freezing.

Suitable material	:	The following compatibility data is suggested based on similar product data and/or industry experience: Compatibility with Plastic Materials can vary; we therefore recommend that compatibility is tested prior to use.
Unsuitable material	:	The following compatibility data is suggested based on similar product data and/or industry experience: Brass, Neoprene, Stainless Steel 304, EPDM, Fluoroelastomer, Chlorosulfonated polyethylene rubber

Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Contains no substances with occupational exposure limit values.

Engineering measures	:	Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Personal protective equipment

Eye protection	:	Safety glasses
Hand protection	:	Wear protective gloves. Gloves should be discarded and replaced if there is any indication of degradation or chemical breakthrough.
Skin protection	:	Wear suitable protective clothing.
Respiratory protection	:	No personal respiratory protective equipment normally required.
Hygiene measures	:	Wash hands before breaks and immediately after handling the product.

Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Viscous liquid
Colour	:	amber
Odour	:	Mild
Flash point	:	> 93.3 °C, Method: ASTM D 93, Pensky-Martens closed cup
pH	:	2.3 - 3.5,(100 %), (25 °C)
Odour Threshold	:	no data available
Melting point/freezing point	:	no data available
Initial boiling point and boiling range	:	no data available
Evaporation rate	:	no data available
Flammability (solid, gas)	:	no data available
Upper explosion limit	:	no data available
Lower explosion limit	:	no data available
Vapour pressure	:	similar to water
Relative vapour density	:	no data available

Relative density	:	1.225, (25 °C),
Density	:	no data available
Water solubility	:	completely soluble
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available
Auto-ignition temperature	:	no data available
Thermal decomposition	:	no data available
Viscosity, dynamic	:	400 - 2,000 mPa.s (25 °C)
Viscosity, kinematic	:	no data available
Molecular weight	:	no data available
VOC	:	0 %, Calculation method

Section: 10. STABILITY AND REACTIVITY

Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	No dangerous reaction known under conditions of normal use.
Conditions to avoid	:	Freezing temperatures.
Incompatible materials	:	Contact with strong oxidizers (e.g. chlorine, peroxides, chromates, nitric acid, perchlorate, concentrated oxygen, permanganate) may generate heat, fires, explosions and/or toxic vapors.
Hazardous decomposition products	:	Decomposition products may include the following materials: Carbon oxides nitrogen oxides (NOx) Sulphur oxides Oxides of phosphorus

Section: 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	:	Inhalation, Eye contact, Skin contact

Potential Health Effects

Eyes	:	Health injuries are not known or expected under normal use.
Skin	:	Health injuries are not known or expected under normal use.
Ingestion	:	Health injuries are not known or expected under normal use.
Inhalation	:	Health injuries are not known or expected under normal use.
Chronic Exposure	:	Health injuries are not known or expected under normal use.

Experience with human exposure

Eye contact	:	No symptoms known or expected.
Skin contact	:	No symptoms known or expected.
Ingestion	:	No symptoms known or expected.
		No symptoms known or expected.
Inhalation	:	No symptoms known or expected.

Toxicity

Product

Acute oral toxicity	:	LD50 rat: > 5,000 mg/kg Test substance: Similar Product
Acute inhalation toxicity	:	no data available
Acute dermal toxicity	:	LD50 rabbit: > 2,000 mg/kg Test substance: Similar Product
Skin corrosion/irritation	:	no data available
Serious eye damage/eye irritation	:	no data available
Respiratory or skin sensitization	:	no data available
Carcinogenicity	:	no data available
Reproductive effects	:	no data available
Germ cell mutagenicity	:	no data available
Teratogenicity	:	no data available
STOT - single exposure	:	no data available
STOT - repeated exposure	:	no data available
Aspiration toxicity	:	no data available

Section: 12. ECOLOGICAL INFORMATION

Ecotoxicity

Environmental Effects	:	This product has no known ecotoxicological effects.

Product

Toxicity to fish	:	LC50 Lepomis macrochirus (Bluegill sunfish): > 1,000 mg/l Exposure time: 96 hrs Test substance: Similar Product LC50 Oncorhynchus mykiss (rainbow trout): 2,387 mg/l Exposure time: 96 hrs Test substance: Product Test Type: Static

NOEC Oncorhynchus mykiss (rainbow trout): 1,250 mg/l
Exposure time: 96 hrs
Test substance: Product
Test Type: Static

Toxicity to daphnia and other aquatic invertebrates : LC50 Daphnia magna (Water flea): 884 mg/l
Exposure time: 48 hrs
Test substance: Product
Test Type: Static

NOEC Daphnia magna (Water flea): 625 mg/l
Exposure time: 48 hrs
Test substance: Product
Test Type: Static

Persistence and degradability

The organic portion of this preparation is expected to be poorly biodegradable.

Total Organic Carbon (TOC) : 128,000 mg/l

Chemical Oxygen Demand (COD): 310,000 mg/l

Biochemical Oxygen Demand (BOD):

Incubation Period	Value	Test Descriptor
	< 5,000 mg/l	Similar Product

Mobility

The environmental fate was estimated using a level III fugacity model embedded in the EPI (estimation program interface) Suite TM, provided by the US EPA. The model assumes a steady state condition between the total input and output. The level III model does not require equilibrium between the defined media. The information provided is intended to give the user a general estimate of the environmental fate of this product under the defined conditions of the models.
If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages;

Air : <5%
Water : 10 - 30%
Soil : 70 - 90%

The portion in water is expected to be soluble or dispersible.

Bioaccumulative potential

This preparation or material is not expected to bioaccumulate.

Other information

no data available

Section: 13. DISPOSAL CONSIDERATIONS

If this product becomes a waste, it is not a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261, since it does not have the characteristics of Subpart C, nor is it listed under Subpart D.

Disposal methods : Where possible recycling is preferred to disposal or incineration. If recycling is not practicable, dispose of in compliance with local regulations. Dispose of wastes in an approved waste disposal facility.

Disposal considerations : Dispose of as unused product. Empty containers should be taken to an approved waste handling site for recycling or disposal. Do not re-use empty containers.

Section: 14. TRANSPORT INFORMATION

The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport.

Land transport (DOT)

Proper shipping name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Air transport (IATA)

Proper shipping name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Sea transport (IMDG/IMO)

Proper shipping name : PRODUCT IS NOT REGULATED DURING TRANSPORTATION

Section: 15. REGULATORY INFORMATION

EPCRA - Emergency Planning and Community Right-to-Know Act

CERCLA Reportable Quantity

This material does not contain any components with a CERCLA RQ.

SARA 304 Extremely Hazardous Substances Reportable Quantity

This material does not contain any components with a section 304 EHS RQ.

SARA 311/312 Hazards : No SARA Hazards

SARA 302 : No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 : This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

California Prop 65

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

INTERNATIONAL CHEMICAL CONTROL LAWS :

United States TSCA Inventory

The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

Australia. Industrial Chemical (Notification and Assessment) Act
All substances in this product comply with the National Industrial Chemicals Notification & Assessment Scheme (NICNAS).

Canadian Domestic Substances List (DSL)
The substance(s) in this preparation are included in or exempted from the Domestic Substance List (DSL).

Japan. ENCS - Existing and New Chemical Substances Inventory
All substances in this product comply with the Law Regulating the Manufacture and Importation Of Chemical Substances and are listed on the Existing and New Chemical Substances list (ENCS).

Korea. Korean Existing Chemicals Inventory (KECI)
All substances in this product comply with the Chemical Control Act (CCA) and are listed on the Existing Chemicals List (ECL)

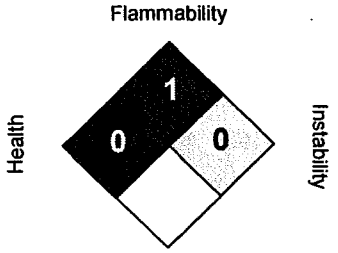
Philippines Inventory of Chemicals and Chemical Substances (PICCS)
All substances in this product comply with the Republic Act 6969 (RA 6969) and are listed on the Philippines Inventory of Chemicals & Chemical Substances (PICCS).

China Inventory of Existing Chemical Substances
All substances in this product comply with the Provisions on the Environmental Administration of New Chemical Substances and are listed on or exempt from the Inventory of Existing Chemical Substances China (IECSC).

Taiwan Chemical Substance Inventory
All substances in this product comply with the Taiwan Existing Chemical Substances Inventory (ECSI).

Section: 16. OTHER INFORMATION

NFPA:



Special hazard.

HMIS III:

HEALTH	0
FLAMMABILITY	1
PHYSICAL HAZARD	0

0 = not significant, 1 =Slight,
2 = Moderate, 3 = High
4 = Extreme, * = Chronic

Revision Date	:	06/26/2017
Version Number	:	1.2
Prepared By	:	Regulatory Affairs

REVISED INFORMATION: Significant changes to regulatory or health information for this revision is indicated by a bar in the left-hand margin of the SDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use,

processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.
For additional copies of an SDS visit www.nalco.com and request access.

Dry Alum

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Revision Date: 05/01/15 Date of Issue: 05/01/15 Version: 1.0

SECTION 1: IDENTIFICATION

Product Identifier

Product Form: Mixture

Product Name: Dry Alum

CAS No: 16828-12-9

Formula: $Al_2(SO_4)_3 \bullet 14H_2O$

Intended Use of the Product

Alum is used as a coagulating agent in municipal and industrial water and wastewatertreatment and as an additive in papermaking.

Name, Address, and Telephone of the Responsible Party

Manufacturer

CHEMTRADE LOGISTICS INC.
155 Gordon Baker Road
Suite 300
Toronto, Ontario M2H 3N5
For MSDS Info: (416) 496-5856
www.chemtradelogistics.com

Emergency Telephone Number

Emergency number : Canada: CANUTEC +1-613-996-6666 / US: CHEMTREC +1-800-424-9300
Chemtrade Emergency Contact: (866) 416-4404
For Chemical Emergency, Spill, Leak, Fire, Exposure, or Accident, call CHEMTREC – Day or Night

SECTION 2: HAZARDS IDENTIFICATION

Classification of the Substance or Mixture

Classification (GHS-US)

Skin Irrit. 2 H315
Eye Irrit. 2B H320

Label Elements

GHS-US Labeling

Hazard Pictograms (GHS-US) :

GHS07

Signal Word (GHS-US) : Warning

Hazard Statements (GHS-US) : H315 - Causes skin irritation
H320 - Causes eye irritation

Precautionary Statements (GHS-US) : P264 - Wash ... thoroughly after handling
P280 - Wear protective gloves/protective clothing/eye protection/face protection
P302+P352 - IF ON SKIN: Wash with plenty of soap and water
P305+P351+P338 - If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P321 - Specific treatment (see Section 4)
P332+P313 - If skin irritation occurs: Get medical advice/attention
P337+P313 - If eye irritation persists: Get medical advice/attention
P362 - Take off contaminated clothing and wash before reuse

Other Hazards

Other Hazards Not Contributing to the Classification: Exposure may aggravate those with pre-existing eye, skin, or respiratory conditions.

Unknown Acute Toxicity (GHS-US) Not available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Substances

Name	Product identifier	% (w/w)	Classification (GHS-US)
Aluminum Sulfate	(CAS No) 16828-12-9	100	Skin Irrit. 2, H315 Eye Irrit. 2B, H320

Full text of H-phrases: see section 16

SECTION 4: FIRST AID MEASURES

Description of First Aid Measures

General: Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label if possible).

Inhalation: Remove to fresh air and keep at rest in a position comfortable for breathing. Obtain medical attention if breathing difficulty persists.

Skin Contact: Rinse immediately with plenty of water. Obtain medical attention if irritation develops or persists.

Eye Contact: Rinse cautiously with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Obtain medical attention.

Ingestion: Do NOT induce vomiting. Rinse mouth. Immediately call a POISON CENTER or doctor/physician.

Most Important Symptoms and Effects Both Acute and Delayed

General: Causes serious eye irritation. Causes skin irritation.

Inhalation: May cause respiratory irritation.

Skin Contact: Causes skin irritation.

Eye Contact: Causes serious eye irritation.

Ingestion: Ingestion is likely to be harmful or have adverse effects.

Chronic Symptoms: None expected under normal conditions of use.

Indication of Any Immediate Medical Attention and Special Treatment Needed

If you feel unwell, seek medical advice (show the label where possible).

SECTION 5: FIRE-FIGHTING MEASURES

Extinguishing Media

Suitable Extinguishing Media: Use extinguishing media appropriate for surrounding fire.

Unsuitable Extinguishing Media: Do not use a heavy water stream. Use of heavy stream of water may spread fire.

Special Hazards Arising From the Substance or Mixture

Fire Hazard: Not considered flammable but may burn at high temperatures.

Explosion Hazard: Product is not explosive.

Reactivity: Hazardous reactions will not occur under normal conditions.

Advice for Firefighters

Precautionary Measures Fire: Not available

Firefighting Instructions: Use water spray or fog for cooling exposed containers. In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.

Protection During Firefighting: Do not enter fire area without proper protective equipment, including respiratory protection.

Hazardous Combustion Products: Forms aluminum oxide, sulfur dioxide and/or sulfur trioxide at temperatures above 760°C (1400°F) or when dry alum is encompassed in a fire involving other burning materials.

Other information: Refer to Section 9 for flammability properties.

Reference to Other Sections

Refer to section 9 for flammability properties.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures

General Measures: Avoid all contact with skin, eyes, or clothing. Avoid breathing (dust, vapor, mist, gas).

For Non-Emergency Personnel

Protective Equipment: Use appropriate personal protection equipment (PPE).

Emergency Procedures: Evacuate unnecessary personnel.

For Emergency Personnel

Protective Equipment: Equip cleanup crew with proper protection.

Emergency Procedures: Stop leak if safe to do so. Eliminate ignition sources. Ventilate area.

Environmental Precautions

Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters.

Methods and Material for Containment and Cleaning Up

For Containment: Contain and collect as any solid.

Methods for Cleaning Up: Avoid generation of dust during clean-up of spills. Vacuum clean-up is preferred. If sweeping is required use a dust suppressant.

Reference to Other Sections

See Heading 8. Exposure controls and personal protection.

SECTION 7: HANDLING AND STORAGE

Precautions for Safe Handling

Hygiene Measures: Handle in accordance with good industrial hygiene and safety procedures. Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Good housekeeping is needed during storage, transfer, handling, and use of this material to avoid excessive dust accumulation. Protect from moisture.

Conditions for Safe Storage, Including Any Incompatibilities

Technical Measures: Comply with applicable regulations.

Storage Conditions: Store in a dry, cool and well-ventilated place. Keep container closed when not in use. Keep/Store away from direct sunlight, extremely high or low temperatures and incompatible materials.

Incompatible Materials: Strong bases.

Specific End Use(s)

Alum is used as a coagulating agent in municipal and industrial water and wastewatertreatment and as an additive in papermaking.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Control Parameters

No Occupational Exposure Limits (OELs) have been established for this product or its chemical components.

Exposure Controls

Appropriate Engineering Controls: Ensure adequate ventilation, especially in confined areas. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Ensure all national/local regulations are observed.

Personal Protective Equipment: Protective goggles. Gloves. Protective clothing.

Materials for Protective Clothing: Chemically resistant materials and fabrics.

Hand Protection: Wear chemically resistant protective gloves.

Eye Protection: Chemical goggles or safety glasses.

Skin and Body Protection: Wear suitable protective clothing.

Respiratory Protection: Use NIOSH-approved dust mask if dust has the potential to become airborne.

Environmental Exposure Controls: Do not allow the product to be released into the environment.

Consumer Exposure Controls: Do not eat, drink or smoke during use

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on Basic Physical and Chemical Properties

Physical State	:	Solid
Appearance	:	White to off-white powder or granules
Odor	:	Not available
Odor Threshold	:	Not available
pH	:	> 2.9 @ 5%
Relative Evaporation Rate (butylacetate=1)	:	Not available
Melting Point	:	86 °C (186.8°F)
Freezing Point	:	Not available
Boiling Point	:	117 °C (242.6°F)
Flash Point	:	Not available
Auto-ignition Temperature	:	Not available
Decomposition Temperature	:	Not available
Flammability (solid, gas)	:	Not available
Lower Flammable Limit	:	Not available

Upper Flammable Limit	:	Not available
Vapor Pressure	:	Not available
Relative Vapor Density at 20 °C	:	Not available
Relative Density	:	Not available
Specific Gravity	:	Not available
Solubility	:	Water: Complete
Partition coefficient: n-octanol/water	:	Not available
Viscosity	:	Not available
Explosion Data – Sensitivity to Mechanical Impact	:	Not expected to present an explosion hazard due to mechanical impact.
Explosion Data – Sensitivity to Static Discharge	:	Not expected to present an explosion hazard due to static discharge.

SECTION 10: STABILITY AND REACTIVITY

Reactivity: Hazardous reactions will not occur under normal conditions.

Chemical Stability: Stable under recommended handling and storage conditions (see section 7).

Possibility of Hazardous Reactions: Hazardous polymerization will not occur.

Conditions to Avoid: Direct sunlight. Extremely high or low temperatures. Ignition sources. Incompatible materials. Moisture.

Incompatible Materials: Strong bases.

Hazardous Decomposition Products: Oxides of aluminum. The decomposition products are corrosive and hazardous to health.

SECTION 11: TOXICOLOGICAL INFORMATION

Information on Toxicological Effects - Product

Acute Toxicity: Not classified

LD50 and LC50 Data: Not available

Skin Corrosion/Irritation: Causes skin irritation.

pH: > 2.9 @ 5%

Serious Eye Damage/Irritation: Causes eye irritation.

pH: > 2.9 @ 5%

Respiratory or Skin Sensitization: Not classified

Germ Cell Mutagenicity: Not classified

Teratogenicity: Not available

Carcinogenicity: Not classified

Specific Target Organ Toxicity (Repeated Exposure): Not classified

Reproductive Toxicity: Not classified

Specific Target Organ Toxicity (Single Exposure): Not classified

Aspiration Hazard: Not classified

Symptoms/Injuries After Inhalation: May cause respiratory irritation.

Symptoms/Injuries After Skin Contact: Causes skin irritation.

Symptoms/Injuries After Eye Contact: Causes serious eye irritation.

Symptoms/Injuries After Ingestion: Ingestion is likely to be harmful or have adverse effects.

Chronic Symptoms: None expected under normal conditions of use.

Information on Toxicological Effects - Ingredient(s)

LD50 and LC50 Data: Not available

SECTION 12: ECOLOGICAL INFORMATION

Toxicity Not classified

Persistence and Degradability Not available

Bioaccumulative Potential Not available

Mobility in Soil Not available

Other Adverse Effects

Other Information: Avoid release to the environment.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal Recommendations: Dispose of waste material in accordance with all local, regional, national, and international regulations.

Ecology – Waste Materials: Avoid release to the environment.

SECTION 14: TRANSPORT INFORMATION

14.1 In Accordance with DOT Not regulated for transport

14.2 In Accordance with IMDG Not regulated for transport

14.3 In Accordance with IATA Not regulated for transport

14.4 In Accordance with TDG Not regulated for transport

SECTION 15: REGULATORY INFORMATION

US Federal Regulations

Neither this product nor its chemical components appear on any US federal lists.

US State Regulations

Dry Alum(16828-12-9)
Neither this product nor its chemical components appear on any state lists.

Canadian Regulations

Dry Alum (16828-12-9)	
WHMIS Classification	Class D Division 2 Subdivision B - Toxic material causing other toxic effects

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the SDS contains all of the information required by CPR.

SECTION 16: OTHER INFORMATION, INCLUDING DATE OF PREPARATION OR LAST REVISION

Revision date : 05/01/15

Other Information : This document has been prepared in accordance with the SDS requirements of the OSHA Hazard Communication Standard 29 CFR 1910.1200.

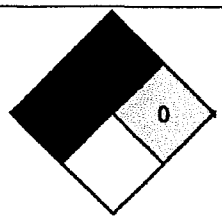
GHS Full Text Phrases:

Eye Irrit. 2B	Serious eye damage/eye irritation Category 2B
Skin Irrit. 2	Skin corrosion/irritation Category 2
H315	Causes skin irritation
H320	Causes eye irritation

NFPA Health Hazard : 2 - Intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical attention is given.

NFPA Fire Hazard : 1 - Must be preheated before ignition can occur.

NFPA Reactivity : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



Party Responsible for the Preparation of This Document

CHEMTRADE LOGISTICS, INC.

For MSDS Info: (416) 496-5856

Handle product with due care and avoid unnecessary contact. This information is supplied under U.S. OSHA'S "Right to Know" (29 CFR 1910.1200) and Canada's WHMIS regulations. Although certain hazards are described herein, we cannot guarantee these are the only hazards that exist. The information contained herein is based on data available to us and is believed to be true and accurate but it is not offered as a product specification. No warranty, expressed or implied, regarding the accuracy of this data, the hazards connected with the use of the product, or the results to be obtained from the use thereof, is made and Chemtrade and its affiliates assume no responsibility. Chemtrade is a member of the CIAC (Chemistry Industry Association of Canada) and adheres to the codes and principles of Responsible Care™.

Chemtrade North America SDS Template

NALCO Water
An Ecolab Company

SAFETY DATA SHEET

NALCLEAN 2568 PULV

Section: 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	NALCLEAN 2568 PULV
Other means of identification	:	Not applicable.
Recommended use	:	SCALE REMOVER
Restrictions on use	:	Refer to available product literature or ask your local Sales Representative for restrictions on use and dose limits.
Company	:	Nalco Company 1601 W. Diehl Road Naperville, Illinois 60563-1198 USA TEL: (630)305-1000
Emergency telephone number	:	(800) 424-9300 (24 Hours) CHEMTREC
Issuing date	:	10/20/2017

Section: 2. HAZARDS IDENTIFICATION

GHS Classification

Skin corrosion	:	Category 1A
Serious eye damage	:	Category 1
Skin sensitization	:	Category 1

GHS Label element

Hazard pictograms :

Signal Word : Danger

Hazard Statements : Causes severe skin burns and eye damage.
May cause an allergic skin reaction.

Precautionary Statements :

Prevention:
Do not breathe dusts or mists. Wash skin thoroughly after handling. Contaminated work clothing should not be allowed out of the workplace. Wear protective gloves/ protective clothing/ eye protection/ face protection.

Response:
IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower. IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician. If skin irritation or rash occurs: Get medical advice/ attention. Wash contaminated clothing before reuse.

Storage:
Store locked up.
Disposal:
Dispose of contents/ container to an approved waste disposal plant.

Other hazards : None known.

Section: 3. COMPOSITION/INFORMATION ON INGREDIENTS

Pure substance/mixture : Mixture

Chemical Name	CAS-No.	Concentration: (%)
Sulfamic Acid	5329-14-6	60 - 100
Disodium Pyrophosphate	7758-16-9	10 - 30
Mercaptobenzothiazole	149-30-4	1 - 5

Section: 4. FIRST AID MEASURES

In case of eye contact : Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.

In case of skin contact : Wash off immediately with plenty of water for at least 15 minutes. Use a mild soap if available. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

If swallowed : Rinse mouth with water. Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Get medical attention immediately.

If inhaled : Remove to fresh air. Treat symptomatically. Get medical attention if symptoms occur.

Protection of first-aiders : In event of emergency assess the danger before taking action. Do not put yourself at risk of injury. If in doubt, contact emergency responders. Use personal protective equipment as required.

Notes to physician : Treat symptomatically.

Most important symptoms and effects, both acute and delayed : See Section 11 for more detailed information on health effects and symptoms.

Section: 5. FIREFIGHTING MEASURES

Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media : None known.

Specific hazards during firefighting : Not flammable or combustible.

Hazardous combustion : Decomposition products may include the following materials: Carbon oxides

products		nitrogen oxides (NOx) Sulphur oxides Oxides of phosphorus
Special protective equipment for firefighters	:	Use personal protective equipment.
Specific extinguishing methods	:	Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations. In the event of fire and/or explosion do not breathe fumes.

Section: 6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	:	Ensure adequate ventilation. Keep people away from and upwind of spill/leak. Avoid inhalation, ingestion and contact with skin and eyes. When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. Ensure clean-up is conducted by trained personnel only. Refer to protective measures listed in sections 7 and 8.
Environmental precautions	:	Do not allow contact with soil, surface or ground water.
Methods and materials for containment and cleaning up	:	Sweep up and shovel into suitable containers for disposal.

Section: 7. HANDLING AND STORAGE

Advice on safe handling	:	Do not ingest. Do not breathe dust/fume/gas/mist/vapours/spray. Do not get in eyes, on skin, or on clothing. Wash hands thoroughly after handling. Use only with adequate ventilation.
Conditions for safe storage	:	Keep away from strong bases. Keep out of reach of children. Keep container tightly closed. Store in suitable labelled containers.
Suitable material	:	The following compatibility data is suggested based on similar product data and/or industry experience: Compatibility with Plastic Materials can vary; we therefore recommend that compatibility is tested prior to use.
Unsuitable material	:	not determined

Section: 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Form of exposure	Permissible concentration	Basis
Mercaptobenzothiazole	149-30-4	TWA	5 mg/m3	AIHA WEEL

Engineering measures	:	Effective exhaust ventilation system. Maintain air concentrations below occupational exposure standards.

Personal protective equipment

Eye protection	:	Safety goggles Face-shield
Hand protection	:	Wear the following personal protective equipment:

		Standard glove type. Gloves should be discarded and replaced if there is any indication of degradation or chemical breakthrough.
Skin protection	:	Personal protective equipment comprising: suitable protective gloves, safety goggles and protective clothing
Respiratory protection	:	When workers are facing concentrations above the exposure limit they must use appropriate certified respirators.
Hygiene measures	:	Handle in accordance with good industrial hygiene and safety practice. Remove and wash contaminated clothing before re-use. Wash face, hands and any exposed skin thoroughly after handling. Provide suitable facilities for quick drenching or flushing of the eyes and body in case of contact or splash hazard.

Section: 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Powder
Colour	:	Violet
		Light blue
Odour	:	Sulfurous
Flash point	:	does not flash
pH	:	0 - 2.0,(3 %)
Odour Threshold	:	no data available
Melting point/freezing point	:	MELTING POINT: 205 °C
Initial boiling point and boiling range	:	no data available
Evaporation rate	:	no data available
Flammability (solid, gas)	:	no data available
Upper explosion limit	:	no data available
Lower explosion limit	:	no data available
Vapour pressure	:	no data available
Relative vapour density	:	no data available
Relative density	:	no data available
Density	:	no data available
Water solubility	:	no data available
Solubility in other solvents	:	no data available
Partition coefficient: n-octanol/water	:	no data available
Auto-ignition temperature	:	no data available
Thermal decomposition	:	no data available
Viscosity, dynamic	:	no data available
Viscosity, kinematic	:	no data available

Molecular weight	:	no data available
VOC	:	no data available

Section: 10. STABILITY AND REACTIVITY

Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	No dangerous reaction known under conditions of normal use.
Conditions to avoid	:	None known.
Incompatible materials	:	Strong bases
Hazardous decomposition products	:	Decomposition products may include the following materials: Carbon oxides nitrogen oxides (NOx) Sulphur oxides Oxides of phosphorus

Section: 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure	:	Eye contact, Skin contact

Potential Health Effects

Eyes	:	Causes serious eye damage.
Skin	:	Causes severe skin burns. May cause allergic skin reaction.
Ingestion	:	Causes digestive tract burns.
Inhalation	:	May cause nose, throat, and lung irritation.
Chronic Exposure	:	Health injuries are not known or expected under normal use.

Experience with human exposure

Eye contact	:	Redness, Pain, Corrosion
Skin contact	:	Redness, Pain, Irritation, Corrosion, Allergic reactions
Ingestion	:	Corrosion, Abdominal pain
Inhalation	:	Respiratory irritation, Cough

Toxicity

Product

Acute oral toxicity	:	LD50 rat: 3,160 mg/kg Test substance: Product
Acute inhalation toxicity	:	Acute toxicity estimate: > 10 mg/l Exposure time: 4 h Test atmosphere: dust/mist
Acute dermal toxicity	:	no data available
Skin corrosion/irritation	:	no data available
Serious eye damage/eye irritation	:	no data available
Respiratory or skin sensitization	:	no data available
Carcinogenicity	:	no data available
Reproductive effects	:	no data available
Germ cell mutagenicity	:	no data available
Teratogenicity	:	no data available
STOT - single exposure	:	no data available
STOT - repeated exposure	:	no data available
Aspiration toxicity	:	no data available

Components

Acute dermal toxicity	:	Sulfamic Acid LD50 rat: > 2,000 mg/kg Disodium Pyrophosphate LD50 rat: > 2,000 mg/kg

Section: 12. ECOLOGICAL INFORMATION

Ecotoxicity

Environmental Effects	:	Harmful to aquatic life with long lasting effects.

Product

Toxicity to fish	:	LC50 Lepomis macrochirus (Bluegill sunfish): > 10 - 100 mg/l Exposure time: 96 hrs Test substance: Product LC50 Oncorhynchus mykiss (rainbow trout): > 10 - 100 mg/l Exposure time: 96 hrs Test substance: Product
Toxicity to daphnia and other aquatic invertebrates	:	LC50 Daphnia magna (Water flea): 12 mg/l Exposure time: 48 hrs Test substance: Product LC50 Acartia tonsa: 12 mg/l Exposure time: 48 hrs Test substance: Product

LC50 Corophium volutator: 2,826 mg/l
Exposure time: 240 hrs
Test substance: Product

NOEC Corophium volutator: 705 mg/l
Exposure time: 240 hrs
Test substance: Product

Toxicity to algae : EC50 Marine Algae (Skeletonema costatum): 0.99 mg/l
Exposure time: 72 hrs
Test substance: Product

NOEC Marine Algae (Skeletonema costatum): 0.25 mg/l
Exposure time: 72 hrs
Test substance: Product

Persistence and degradability

Chemical Oxygen Demand (COD): 44,800 mg/l

Mobility

The environmental fate was estimated using a level III fugacity model embedded in the EPI (estimation program interface) Suite TM, provided by the US EPA. The model assumes a steady state condition between the total input and output. The level III model does not require equilibrium between the defined media. The information provided is intended to give the user a general estimate of the environmental fate of this product under the defined conditions of the models.
If released into the environment this material is expected to distribute to the air, water and soil/sediment in the approximate respective percentages;

Air	:	5 - 10%
Water	:	30 - 50%
Soil	:	> 90%

The portion in water is expected to be soluble or dispersible.

Bioaccumulative potential

This preparation or material is not expected to bioaccumulate.

Other information

no data available

Section: 13. DISPOSAL CONSIDERATIONS

If this product becomes a waste, it is not a hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) 40 CFR 261, since it does not have the characteristics of Subpart C, nor is it listed under Subpart D.

Disposal methods : The product should not be allowed to enter drains, water courses or the soil. Where possible recycling is preferred to disposal or incineration. If recycling is not practicable, dispose of in compliance with local regulations. Dispose of wastes in an approved waste disposal facility.

Disposal considerations : Dispose of as unused product. Empty containers should be taken to an approved waste handling site for recycling or disposal. Do not re-use empty containers.

Section: 14. TRANSPORT INFORMATION

The shipper/consignor/sender is responsible to ensure that the packaging, labeling, and markings are in compliance with the selected mode of transport.

Land transport (DOT)

Proper shipping name	: SULFAMIC ACID, MIXTURE, SOLID
Technical name(s)	:
UN/ID No.	: UN 2967
Transport hazard class(es)	: 8
Packing group	: III

Air transport (IATA)

Proper shipping name	: SULPHAMIC ACID, MIXTURE, SOLID
Technical name(s)	:
UN/ID No.	: UN 2967
Transport hazard class(es)	: 8
Packing group	: III

Sea transport (IMDG/IMO)

Proper shipping name	: SULPHAMIC ACID, MIXTURE, SOLID
Technical name(s)	:
UN/ID No.	: UN 2967
Transport hazard class(es)	: 8
Packing group	: III

*Marine pollutant : Mercaptobenzothiazole

*Note: This product is regulated as a Marine Pollutant when shipped by Rail, Highway (in bulk quantities), or Air (if no other hazard class applies), and when shipped by water in all quantities.

Section: 15. REGULATORY INFORMATION

EPCRA - Emergency Planning and Community Right-to-Know Act

CERCLA Reportable Quantity

This material does not contain any components with a CERCLA RQ.

SARA 304 Extremely Hazardous Substances Reportable Quantity

This material does not contain any components with a section 304 EHS RQ.

SARA 311/312 Hazards : Acute Health Hazard

SARA 302 : No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 : The following components are subject to reporting levels established by SARA Title III, Section 313:

Mercaptobenzothiazole	149-30-4	1 - 5 %

California Prop 65
This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

INTERNATIONAL CHEMICAL CONTROL LAWS :

United States TSCA Inventory
The substances in this preparation are included on or exempted from the TSCA 8(b) Inventory (40 CFR 710)

Canadian Domestic Substances List (DSL)
The substance(s) in this preparation are included in or exempted from the Domestic Substance List (DSL).

Korea. Korean Existing Chemicals Inventory (KECI)
All substances in this product comply with the Chemical Control Act (CCA) and are listed on the Existing Chemicals List (ECL)

Philippines Inventory of Chemicals and Chemical Substances (PICCS)
All substances in this product comply with the Republic Act 6969 (RA 6969) and are listed on the Philippines Inventory of Chemicals & Chemical Substances (PICCS).

China Inventory of Existing Chemical Substances
All substances in this product comply with the Provisions on the Environmental Administration of New Chemical Substances and are listed on or exempt from the Inventory of Existing Chemical Substances China (IECSC).

Japan. ENCS - Existing and New Chemical Substances Inventory
All substances in this product comply with the Law Regulating the Manufacture and Importation Of Chemical Substances and are listed on the Existing and New Chemical Substances list (ENCS).

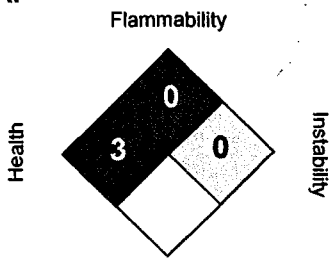
New Zealand. Inventory of Chemicals (NZIoC), as published by ERMA New Zealand
All substances in this product comply with the Hazardous Substances and New Organisms (HSNO) Act 1996,and are listed on or are exempt from the New Zealand Inventory of Chemicals.

Taiwan Chemical Substance Inventory
All substances in this product comply with the Taiwan Existing Chemical Substances Inventory (ECSI).

Australia. Industrial Chemical (Notification and Assessment) Act
All substances in this product comply with the National Industrial Chemicals Notification & Assessment Scheme (NICNAS).

Section: 16. OTHER INFORMATION

NFPA:



Special hazard.

HMIS III:

HEALTH	3*
FLAMMABILITY	0
PHYSICAL HAZARD	0

0 = not significant, 1 =Slight,
2 = Moderate, 3 = High
4 = Extreme, * = Chronic

Revision Date	:	10/20/2017
Version Number	:	1.2
Prepared By	:	Regulatory Affairs

REVISED INFORMATION: Significant changes to regulatory or health information for this revision is indicated by a bar in the left-hand margin of the SDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.
For additional copies of an SDS visit www.nalco.com and request access.