BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:)
)
WATER QUALITY STANDARDS AND) R08-9
EFFLUENT LIMITATIONS FOR THE) (Rulemaking – Water)
CHICAGO AREA WATERWAY SYSTEM)
AND LOWER DES PLAINES RIVER)
PROPOSED AMENDMENTS TO 35 ILL.)
ADM. CODE 301, 302, 303, and 304)

NOTICE OF FILING

TO:

John Therriault, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street, Suite 11-500
Chicago, IL 60601

Marie Tipsord, Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street, Suite 11-500
Chicago, IL 60601

Deborah J. Williams, Assistant Counsel
Stefanie N. Diers, Assistant Counsel
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Persons included on the attached
SERVICE LIST

PLEASE TAKE NOTICE that I have electronically filed today with the Office of the Clerk of the Pollution Control Board PRE-FILED TESTIMONY OF G. ALLEN BURTON AND GREG SEEGERT, by Midwest Generation, a copy of which is herewith served upon you.

MIDWEST GENERATION, L.L.C.

Susan M. Franzetti

Date: September 8, 2008

Exhibit
1110

Susan M. Franzetti
Nijman Franzetti LLP
10 S. LaSalle St., Suite 3600
Chicago, IL 60603
(312) 251-5590 (phone)
(312) 251- 4610 (fax)

Kristy A. N. Bulleit
Brent Fewell
Hunton & Williams, LLP
1900 K. Street, NW
Washington, DC 20006
(202) 855-1500 (phone)
(202) 778-7411 (fax)

CERTIFICATE OF SERVICE

I, the undersigned, certify that on this 8th day of September, 2008, have caused to be filed electronically the attached PRE-FILED TESTIMONY OF G. ALLEN BURTON AND GREG SEEGERT, by Midwest Generation, and NOTICE OF FILING upon the following person:

John Therriault, Clerk
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street, Suite 11-500
Chicago, IL 60601

by personal delivery to the following person:

Marie Tipsord, Hearing Officer
Illinois Pollution Control Board
James R. Thompson Center
100 West Randolph Street, Suite 11-500
Chicago, IL 60601

by U.S. Mail, first class postage prepaid, to the following persons:

Deborah J. Williams, Assistant Counsel
Stefanie N. Diers, Assistant Counsel
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

AND the participants listed on the attached SERVICE LIST via CD Disc.

Susan M. Franzetti

SERVICE LIST

Frederick M. Feldman
Ronald M. Hill
Margaret T. Conway
Metropolitan Water Reclamation District
of Greater Chicago
111 East Erie Street
Chicago, IL 60611

Matthew Dunn, Chief
Environmental Bureau
Office of the Attorney General
100 West Randolph, 12th Floor
Chicago, IL 60601

Bill Richardson, Chief Legal Counsel
Illinois Department of Natural Resources
One Natural Resources Way
Springfield, IL 62702-1271

Ann Alexander
Natural Resources Defense Counsel
101 N. Wacker Dr., Ste. 609
Chicago, IL 60606

Keith Harley
Elizabeth Schenkier
Chicago Legal Clinic, Inc.
205 West Monroe, 4th Floor
Chicago, IL 60606

Thomas V. Skinner
Thomas W. Dimond
Kevin Desharnais
Jennifer A. Simon
Mayer Brown LLP
71 South Wacker Drive
Chicago, Illinois 60606-4637

Katherine D. Hodge
Monica T. Rios
Hodge Dwyer Zeman
3150 Roland Avenue
P.O. Box 5776
Springfield, IL 62705-5776

Albert Ettinger
Jessica Dexter
Environmental Law & Policy Center
35 E. Wacker Dr., Suite 1300
Chicago, IL 60601

Dennis Duffield
Director of Public Works & Utilities
City of Joliet
921 E. Washington St
Joliet, IL 60431

Richard Kissel
Roy Harsch
DrinkerBiddle
191 N. Wacker Dr., Suite 3700
Chicago, IL 60606-1698

Claire Manning
Brown Hay& Stephens LLP
700 First Mercantile Bank Bldg
205 S. Fifth St
Springfield, IL 62705-2459

Charles Wesselhoft
James Harrington
Ross& Hardies
150 N. Michigan Ave
Chicago, IL 60601-7567

Frederick Keady
Vermillion Coal Company
1979 Jolms Drive
Glenview, IL 60025
Chicago, IL 60614

Dr. Thomas J. Murphy
2325 N. Clifton Street
Chicago, IL 60614

Georgia Vlahos
Naval Training Center
2601A Paul Jones St
Great Lakes, IL 60088-2845

W.C. Blanton
Blackwell Sanders LLP
4801 Main St, Suite 1000
Kansas City, MO 64112

Jerry Paulsen
Cindy Skukrud
McHenry County Defenders
132 Cass Street
Woodstock, IL 60098

Bernard Sawyer
Thomas Granto
Metropolitan Water Reclamation District
6001 W. Pershing Rd
Cicero, IL 60650-4112

Fredric Andes
Erika Powers
Bames & Thornburg
1 North Wacker Dr
Suite 4400
Chicago, IL 60606

Bob Carter
Bloomington Normal Water Reclamation
PO Box 3307
Bloomington, IL 61702-3307

Kenneth W. Liss
Andrews Environmental Engineering
3300 Ginger Creek Drive
Springfield, IL 62711

Marc Miller
Jamie S. Caston
Office of Lt. Governor Pat Quinn
Room 414 State House
Springfield, IL 62706

Kay Anderson
American Bottoms
One American Bottoms Road
Sauget, IL 62201

Robert VanGyseghem
City of Geneva
1800 South St
Geneva, IL 60134-2203

Lisa Frede
Chemical Industry Council of Illinois
1400 E. Touhy Ave., Suite 110
Des Plaines, IL 60018

Jack Darin
Sierra Club
70 E. Lake St
Chicago, IL 60601-7447

Tom Muth
Fox Metro Water Reclamation District
628 State Route 31
Oswego, IL 60543

Vicky McKinley
Evanston Environmental Board
223 Grey Avenue
Evanston, IL 60202

James L. Daugherty
Thorn Creek Basin Sanitary District
700 West End Avenue
Chicago Heights, IL 60411

Tracy Elzemeyer
American Water Company
727 Craig Road
St. Louis, MO 63141

Irwin Polls
Ecological Monitoring and Assessment
3206 Maple Leaf Drive
Glenview, IL 60025

Jeffrey C. Fort
Ariel J. Tesher
Sonnenschein Nath & Rosenthal LLP
7800 Sears Tower
233 S. Wacker Drive
Chicago, IL 60606-6404

Cathy Hudzik
City of Chicago
Mayor's Office of Intergovernmental Affairs
121 North LaSalle Street, Room 406
Chicago, IL 60602

Sharon Neal
Commonwealth Edison
125 South Clark Street
Chicago, IL 60603

Beth Steinhorn
2021 Timberbrook
Springfield, IL 62702

Traci Barkley
Prairie Rivers Networks
1902 Fox Drive, Suite 6
Champaign, IL 61820

Susan Hedman
Andrew Armstrong
Environmental Counsel
Environmental Bureau
Suite 1800
69 West Washington Street
Chicago, IL 60602

Stacy Meyers-Glen
Openlands
Suite 1650
25 East Washington
Chicago, IL 60602

James Huff
Huff & Huff, Inc.
915 Harger Road, Suite 330
Oak Brook, IL 60523

Alec M. Davis
Illinois Environmental Regulatory Group
215 East Adams Street
Springfield, IL 62701

BEFORE THE ILLINOIS POLLUTION CONTROL BOARD

IN THE MATTER OF:	)	
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WATER QUALITY STANDARDS AND	)	
EFFLUENT LIMITATIONS FOR THE	)	R08-9
CHICAGO AREA WATERWAY SYSTEM	)	(Rulemaking - Water)
AND THE LOWER DES PLAINES RIVER:	)	
PROPOSED AMENDMENTS TO 35 Ill.	)	
Adm. Code Parts 301, 302, 303 and 304	)	

PRE-FILED TESTIMONY OF G. ALLEN BURTON

Good morning, my name is Allen Burton. I currently serve as the Director of NOAA's Cooperative Institute for Limnology and Ecosystems Research and a Professor in the School of Natural Resources and Environment at the University of Michigan. Prior to joining the University of Michigan in August of this year, I was a Professor and Chair of the Department of Earth and Environmental Sciences at Wright State University in Columbus, Ohio. Over the past 30 years, my research has focused on developing effective methods for identifying significant effects and stressors in aquatic systems where sediment and storm water contamination is a concern. I serve on the U.S. EPA Science Advisory Board committees, a National Research Council committee (in 2007), and am the "Immediate Past President" of the Society of Environmental Toxicology & Chemistry, and have served on numerous national and international scientific committees, review panels, councils and editorial boards with more than 200 publications. I have an M.S. and Ph.D. from the University of Texas, where I focused on aquatic toxicology. My resume can be found at Attachment 1, Appendix A.

I have been retained by Midwest Generation ("MWGen") to provide technical support in the evaluation of the Illinois EPA Water Quality Standards and Effluent Limitations for the Chicago Area Waterway System and the Lower Des Plaines River: Proposed Amendments to 35 Ill. Adm. Code Parts 301, 302, 303 and 304 (the "Proposed UAA Rules") and supporting documentation provided to the Illinois Pollution Control Board (the "Board") in the rule-making docketed as R08-09. The focus of my testimony is contained in my written report and assessment of the Illinois EPA's Proposed UAA Rules attached hereto as Attachment 1, which includes supporting tables, citations, and appendices.

My area of expertise is in the evaluation of freshwater ecosystem stressor effects, particularly focusing on the role of sediment and storm water quality. In the mid-1990's, on behalf of Commonwealth Edison (the former owner of the MWGen electric generating stations), I was asked to lead an evaluation of sediment quality on the Des Plaines River in support of the Upper Illinois Waterway ("UIW") Task Force process. My work entailed, among other things, an evaluation of sediment contamination and toxicity, review of the literature on temperature, turbidity and barge traffic effects, *in situ* toxicity evaluations around MWGen's Joliet generating stations, and laboratory evaluations of temperature effects.

My testimony will focus on the chemical, biological, and physical stressors in the UIW, the role of these stressors in biological impairment, and the interrelationship with other key watershed factors that affect heavily human-dominated, effluent dominant waterway such as the UIW. My testimony will also identify what I consider to be fundament flaws relating to the Illinois Environmental Protection Agency's ("Illinois EPA") overall approach to the Proposed UAA Rules, including the Agency's failure to consider the dominant physical, chemical, and biological factors affecting the UIW and the interplay of those stressors with indigenous populations, and the Agency's failure to rely upon peer-reviewed and quantitative approaches that would support the proposal. Unfortunately, as I have concluded, and as set forth more fully below and in my detailed report, it is my position that these flaws are fatal to certain aspects of the aquatic life use designations in the Illinois EPA's Proposed UAA Rules, particularly for the proposed Upper Dresden Island Pool aquatic life use designation, which are not supported by the facts or weight of evidence in this proceeding.

1. The Des Plaines Watershed Is One Of The Most Heavily Urbanized And Polluted Rivers In The State And, Due To The Many Significant Stressors, Certain Segments Will Not Achieve CWA Aquatic Life Goals.

The Des Plaines River is like many watersheds in highly urbanized areas in that it is heavily dominated by human activities that result in significant stressors on the aquatic ecosystem. The river flow itself is dominated by discharges of municipal wastewater, which account for more than 70% of the flow during low flow periods. As documented by the Illinois EPA in its recent integrated water quality assessment reports submitted to the U.S. Environmental Protection Action ("U.S. EPA"), the Des Plaines River is heavily polluted and ranks among the most impaired water bodies in Illinois. Pollutants such as organic chemicals, nutrients, metals, pathogens, ammonia, sedimentation/siltation, total dissolved and suspended solids, chlorides, and dissolved oxygen, are ubiquitous. In 2004, Illinois EPA identified more than 800 causes and sources of impairments. The most common sources of impairment are municipal point source discharges, combined sewer overflows ("CSO"), urban runoff/storm sewers, contaminated sediments, channelization, flow regulation, hydro-modification, and habitat alteration. Importantly, thermal modification has never been identified by the Illinois EPA as a cause of impairment.

The upper part of the UIW, known as the Chicago Area Waterway System ("CAWS"), consists of 78 miles of engineered canals and modified river channels, and flow has been significantly altered by a series of regulated locks and dams. The CAWS was created to drain urban runoff, treated wastewater and support commercial navigation. The heavily human-dominated nature of this waterway and the attendant stressors that shape the aquatic ecosystem will not change. Until the stressors causing the beneficial use impairments are reduced significantly, there will be ongoing risks to the aquatic biota and to humans that consume fish in the CAWS and Des Plaines River.

The Upper Dresden Pool ("UDP") area just like many areas in the Des Plaines watershed has multiple causes and sources of use impairment. Dominant stressors for the UDP include contaminated sediments, metals, nutrients, synthetic organics (*e.g.,* pesticides, carcinogenic polycyclic aromatic hydrocarbons ("PAHs"), pharmaceuticals and personal care products ("PPCPs")), and flow regime alteration and degraded habitats. The lower area of Hickory Creek, nearest to the Brandon tailwaters, does not support aquatic life or primary recreation uses due to impairments such as fecal coliforms, chloride, alteration to streamside or littoral vegetation, flow alterations, sedimentation/siltation, total dissolved and suspended solids, zinc, nitrogen, phosphorus and algae. It is important to understand that with many urbanized watersheds, such as the Des Plaines, the removal of one stressor alone will not be sufficient to restore a watershed to beneficial use attainment.

2. Wet Weather Impacts In The UIW Are Significant And Will Continue To Cause Significant Loadings From Sewage And Other Contaminants.

Although water quality in the UIW has improved somewhat since the 1970s, there is no documented evidence of significant improvement in beneficial use attainment. Despite reductions of untreated discharges of sewage from the Metropolitan Water Reclamation District of Greater Chicago's ("MWRDGC") tunnel and reservoir plan ("TARP"), significant loadings of raw sewage with associated solids, nutrients and chemical contaminants will continue into the foreseeable future. In addition, significant loadings and associated pollutants from both urban characterization. The extensive EA 2008 Sediment Survey conducted this past May (2008) documented exceedances of sediment guidelines for metals, PAHs and PCBs at almost every sample location. Table 11 of the 2008 Sediment Survey provides a comparison of sediment concentrations for organics and metals for samples collected this year with those collected by me in 1994 and 1995. The organic contaminants for the vast majority of sediments sampled between 1994 and 2008 in the UIW (CSSC to the Dresden Pool) exceed sediment quality guidelines ("SQGs") for probable adverse biological effects.[1] The fact that both the Upper Dresden and the Lower Brandon Pools had high concentrations of both metals and organic constituents indicates that large portions of these pools are of poor sediment quality and include the higher quality habitats of the Brandon Lock & Dam tailwaters.

Although some of the sediment contamination of the Des Plaines River is attributable to historical discharges and human activities, much of it is on-going and will continue to persist due to the existing point and nonpoint sources discussed above. There are no known plans to remove contaminated sediments in the UDP area. Such a removal would be one of the largest in the United States, likely costing hundreds of millions of dollars due to the spatial extent of the extreme contamination. However, even the removal of significantly contaminated and acutely toxic sediments from depositional areas identified would only provide temporary improvement, as the continued loadings of a broad array of chemicals from point and nonpoint sources would result in the re-accumulation of contaminated sediments. Further, the fact that the 2008 Sediment Survey reveals highly contaminated sediments similar to what I observed in the mid-90's, strongly suggests that depositional sediments remain significantly degraded and are not

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[1] SQGs are commonly accepted benchmarks and have been widely used in the U.S. for many years to establish "clean-up" levels for federal and state remediation activities and to determine which sediments are toxic and thus represent a threat to aquatic biota.

being reduced, contrary to the Illinois EPA's assumption that sediment quality in the CSSC and UDP is improving.

Based on my experience, most depositional sediments that are acutely toxic are located in areas suitable as fish habitat, not in high current areas, such as the main channel. Indeed, the prime habitat for spawning in this study area are the shallow waters below Brandon Lock & Dam where sediments are contaminated and exceed sediment quality guidelines. Shallow waters, including those throughout the UIW, are prone to a phenomenon known as photoinduced-toxicity due to the presence of even ug/L (ppb) levels of PAHs, which is toxic to zooplankton, benthic macroinvertebrates, fish and amphibians in surficial layers of waters. In addition to photoinduced PAH toxicity in overlying waters, the concentrations of PAHs found in the sediments (parts per million) are high enough to cause acute toxicity without UV stimulation and exceed Probable Effect Concentrations ("PECs") by up to 30-fold.

A recent study by the U.S. Geological Survey ("USGS") found that total PAHs in the sediments of the Upper Illinois River Basin are among the highest for sites nationwide, and nearby sites in Western Springs and Riverside, tributaries upstream from the UDP, are among the highest 5% in the nation, exceeding probable effect levels for adverse effects on aquatic life. The USGS study also revealed that concentrations of DDT, PCBs, methyl mercury, and dieldrin in fish and sediments in the Upper Des Plaines and its tributaries are among the highest concentrations observed nationwide. The USGS findings are consisting with the results of the 2008 Sediment Survey, which revealed significant concentrations of PAHs throughout the Dresden and Lower Brandon Pools. *See* Tables 7 – 10, 2008 Sediment Survey.

4. Suspended Sediments And Turbidity Are Significant Stressors.

Studies have shown that turbidity is a major stressor in both the CSSC and the UDP. Turbidity is due to eroded soils and resuspended sediments, both of which contribute during high flow events. Turbidity during low flow events is primarily a result of resuspension of bedded sediments, which in the UIW often occurs from barge traffic. A study that I conducted in 1998 showed that *Ceriodaphnia dubia* survival was affected by turbidity. As well, filter feeding zooplankton are known to be sensitive to suspended solids at levels of 50-100 mg/L (*e.g.*, IEQ 1995). This dominant stressor of the UIW, aggravated by barge and navigation traffic, is likely to impact zooplankton populations throughout the waterway.

5. Nutrient Enrichment And Ammonia Are Significant Stressors.

Nutrients, such as nitrogen and phosphorus, are a common pollutant of human dominated watersheds, disrupting aquatic ecosystems by increasing biological productivity, leading to increased bacterial respiration (and thus anoxia), increased algae and nuisance weeds, and thus a switch to less desirable fish and invertebrate species. Nutrient loading from sources such as municipal sewage and agricultural runoff contribute to eutrophic conditions, impair beneficial uses, and reduce oxygen levels that favor pollution tolerant species. As documented in the Lower Des Plaines UAA Report and elsewhere, the waters of the UIW from above Chicago through the Dresden Pool exhibit high levels of nitrogen and phosphorus. When nitrogen is elevated, another stressor of particular concern is ammonia, which can be particularly toxic to certain aquatic species. In fact, studies have found ammonia to be a primary sediment stressor in the UIW and Brandon Pool area, and it is significantly correlated with sediment acute toxicity, particle size and organic contaminants.

Recent USGS studies have documented phosphorus concentrations exceeding U.S. EPA desired goals to prevent excessive growth of algae and other nuisance plants in every water sample collected from urban or mixed land-use watersheds in the UIW. These studies have also found the concentration of ammonia in the CSSC at Romeoville as the highest measured in the Upper Illinois River Basin, the fourth highest of 109 streams and rivers measured nationwide by the USGS, and among the highest in the Mississippi River basin. The USGS has attributed the primary degradation of the UIW to elevated concentrations of ammonia and phosphorus, and the presence of organic wastewater contaminants such as disinfectants, pharmaceuticals and steroids, insecticides, and organochlorines. These USGS studies also found that water quality conditions in the UIW have resulted in decreased numbers and diversity of pollution-sensitive species of fish and benthic invertebrates.

6. Municipal Wastewater Plants Will Continue To Discharge Endocrine Disruptors And Other Emerging Contaminants.

The UIW and the UDP are also adversely impacted by organic compounds collectively referred to as "emerging contaminants," which include endocrine-disrupting compounds (EDCs) found in many pharmaceutical and personal care products (PPCPs) and veterinarian and livestock operations. Numerous studies have found that fish downstream of municipal wastewaters suffer from exposures to estrogenic chemicals with extreme reproductive disruption and feminization.

Recent studies by U.S. EPA of effluent dominated streams and other water bodies, including the North Shore Channel in Chicago, identified numerous pharmaceutical compounds in fish tissues, of which antihistamines and antidepressants were most frequent. A recent lake study conducted in Canada found that fish exposed to levels commonly found in both untreated and treated municipal wastewaters (5 – 6 ng/L) resulted in feminization of males and ultimately a near extinction of the fathead minnow species from the lake. Other studies, including segments of the Potomac River Basin, where 80 to 100% of the male smallmouth bass are intersex, have identified EDCs at concentrations significantly in excess of those that can result in male feminization. These finding are of serious concern for the sustainability of wild fish populations in waterways receiving municipal wastewaters, such as the UIW.

7. The Illinois EPA Has Never Identified Temperature As A Limiting Factor To Attainment of Beneficial Uses.

As noted earlier, despite the many causes of impairment to the Des Plaines River, thermal modification has never been identified by the Illinois EPA as a cause of impairment. While temperature in some cases can be a stressor, studies have shown that warm and cold temperatures can be both advantageous and detrimental to aquatic biota. Although it was not discussed in the Lower Des Plaines River UAA Report (hereafter referred to as the "LDR UAA Report"), another concern regarding temperature is that there are winter maximum temperatures which are impacted by municipal wastewater effluents and may impede some fish reproductive processes. The sections of the LDR UAA Report titled "Selection of the Temperature Standard" and "Critique of the Current Secondary Contact and Indigenous Aquatic Life Standard" contain inaccurate statements regarding temperature effects on riverine species and ecosystem processes. High and low temperatures may or may not be detrimental to aquatic life that reside in the UIW. The authors of the LDR UAA Report incorrectly imply and over-generalize that high temperatures are always detrimental. Moreover, as discussed below, the LDR UAA Report inaccurately presents my prior work on the UIW in several ways. Contrary to the LDR UAA Report, there is no simple relationship between temperature and aquatic toxicity. Both low and high temperatures can increase and decrease toxicity due to exposures from other chemical stressors, such as those found in the UIW. Toxicity is dependent upon species, presence of other toxicants, toxicant type and concentration. The LDR UAA Report's over-simplification that high temperatures increase toxicity is simply incorrect and misleading. Nitrification is also inhibited by cold temperatures and ammonia is not always consumed in the upper sediment layers. Nitrification, which is the biological oxidation of ammonia, is very sensitive to toxicants, which abound in the UIW's depositional sediments.

The former study that I directed while at Wright State University (the "Wright State Study") did not attempt to establish temperature limits for the UIW. The LDR UAA Report's discussion of the Wright State Study is misleading, leaving out key portions of the conclusions and misinterpreting others. The Wright State Study findings substantiated previous studies by my laboratory and others. These key findings documented that acute toxicity exists in short-term exposures for multiple species in waters and sediments of the UIW without any water temperature elevation. Toxic sediments abound in most tributary mouth, tailwater, and pool depositional areas, which generally provide better habitats for fish. These same habitats are typically shallow waters which are subject to rapid mortality as a result of photoinduced toxicity of PAHs, as discussed above. Both cold and hot temperatures accentuate toxicity originating from UIW waters and sediments. Statistically significant correlations between sediment ammonia and fluorene concentrations and toxicity were also observed. Ammonia was also significantly correlated to depositional sediments and the presence of high concentrations of organics. These correlations were based on sediment data collected from throughout the UIW. Outside the thermal discharge plume, temperature was not observed as a factor of *in situ* toxicity.

The laboratory toxicity test results produced by the Wright State Study further document the role of sediment toxicity and how it increases in the presence of temperature extremes. The Toxicity Identification Evaluation Phase I experiments further substantiate the findings of the Chemical Screening Risk Assessment and the ammonia correlations with toxicity, suggesting that ammonia is a primary system stressor to benthic and epibenthic species. However, these seven day, static renewal experiments do not adequately mimic dynamic, *in situ* conditions where light, temperature, turbidity, water quality and food conditions change over minutes to hours. The most reliable indicator of *in situ* conditions are the indigenous communities actually present in the waterway. These are the most reliable data for evaluations of thermal impacts.

8. Several UAA Factors Are Met, Based On Severity And Prevalence Of Sediment Contamination And Continued Chemical And Biological Stressors From Human Dominated Activities.

Based on my professional opinion, at least three of the six UAA Factors set forth at 40 C.F.R. 131.10 apply in the present case, demonstrating that the UIW (including the CSSC and UDP) does not meet CWA aquatic life goals. I did not evalute UAA Factor 2, as flow alterations were not part of my evaluation. Moreover, it is my opinion that it is not feasible to correct these factors or limitations sufficient to attain CWA goals.[2] The application of these three UAA Factors does not support the upgrading of use designations under the Proposed UAA Rules. Moreover, under U.S. EPA's rules, a determination that any one of these Factors applies would support the downgrading of the use designations. The UAA factors that apply include:

Factor 3. *Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave*

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[2] An evaluation of the potential applicability of the other UAA Factors, such as Factor 2 related to flow conditions, was outside the scope of my review.

in place. Human caused conditions or sources of pollution prevent both the CSSC and the Lower Des Plaines River from attaining the Clean Water Act's aquatic life goals. It is the primary reason supporting not upgrading the use designation for either waterway to Clean Water Act "fishable" use designations. The evidence of excessive impairments is clear from the results of sediment surveys, including the 2008 Sediment Survey. A multitude of physical and chemical impairment causes and sources exist throughout the watershed as discussed and documented above. The sources will not be removed due to the human dominated nature of the watershed and the connectivity between the UDP and the UIW. *In-situ* remediation of contaminated sediments would likely cost hundreds of millions of dollars or more based on the costs of remediating other similar systems.

Factor 4. *Dams, diversions or other hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original conditions or to operate such modifications in a way that would result in the attainment of the use.* The UIW habitat is heavily and permanently modified. Barge traffic is a major protected use and will continue to result in degraded habitat and resuspended contaminated sediments.

Factor 5. *Physical conditions associated with the natural features of the water body, such as the lack of proper substrate, cover, flow, depth, pools, riffles and the like, unrelated to quality preclude attainment of aquatic life protection uses.* The rationale for Factor 4 above applies here as well. Due to the many stressors, habitat is of poor quality throughout most of the UIW and cannot be feasibly corrected.

Conclusion

The rationales used and conclusions reached by the Illinois EPA to support its Proposed UAA Rules are in my view detrimentally flawed. Illinois EPA's presentation of data, data interpretation, and supporting statements are often biased, and fail to provide a scientifically-balanced representation of previous UIW studies, peer-reviewed literature, and accepted approaches that reflect state-of-the-science. Multiple lines of evidence clearly establish that the CSSC, as well as the UDP, is a highly modified, effluent-dominated waterway that receives massive amounts of pollutants from various regulated and unregulated discharges and is generally poor habitat. Acute toxicity of water and sediments, unrelated to temperature, is and will remain a major limitation on the potential of this water body to achieve CWA aquatic life goals. Major nonpoint source loadings of solids, nutrients, metals, and organics will continue from growing urban areas, sewers, construction, and agriculture in this human-dominated watershed and therefore will continue to contaminate waters, sediments, and the food of aquatic biota throughout the UIW. Modified and limited habitats (channelization, barge traffic, lock and dams), extreme turbidity and siltation, and stressor loadings will not improve in the foreseeable future and will continue to dominate water quality conditions and use impairments. Consequently, development of new, modified standards, including thermal standards, will not address the key issue of excessive and pervasive pollution sources, excessive use impairments and limited habitats in this watershed.

Thank for the opportunity to testify before the Board.

G. A. Burton

BY: ______________________________
G. Allen Burton, Ph.D.

Attachment 1

Review of the Illinois EPA Water Quality Standards and Effluent Limitations for the Chicago Area Waterway System and the Lower Des Plaines River: Proposed Amendments to 35 Ill. Adm. Code Parts 301, 302, 303, and 304

Review of the Illinois EPA Water Quality Standards and Effluent Limitations for the Chicago Area Waterway System and the Lower Des Plaines River: Proposed Amendments to 35 Ill. Adm.Code Parts 301, 302, 303 and 304.

by

G. Allen Burton, Jr., Professor and Director
Cooperative Institute of Limnology & Ecosystem Research
School of Natural Resources & Environment
University of Michigan
Ann Arbor, MI

September 4, 2008

Table of Contents

I. Introduction

I have been asked by Midwest Generation to review and comment on the Illinois EPA Water Quality Standards and Effluent Limitations for the Chicago Area Waterway System and the Lower Des Plaines River: Proposed Amendments to 35Ill. Adm. Code Parts 301, 302, 303 and 304 (the "Proposed UAA Rules") and supporting documentation provided to the Illinois Pollution Control Board (the "IPCB") in the rule-making docketed as R08-09.

In the mid-1990's, I lead evaluations of sediment quality on the Des Plaines River for Commonwealth Edison in support of the Upper Illinois Waterway (UIW) Task Force process (Burton, 1995, 1998; Burton and Brown 1995). These studies involved evaluations of sediment contamination and toxicity on the upper ~55 miles of the UIW, reviews of the literature on temperature, turbidity and barge traffic effects, *in situ* toxicity evaluations around the Joliet power stations, and laboratory evaluations of temperature effects. My area of expertise is in the evaluation of freshwater ecosystem stressor effects, particularly focusing on the role of sediment and storm water quality (Appendix A). Therefore, this review deals with the stressors in the UIW, their role in biological impairment, and interrelationships with other key watershed factors.

Effective management of aquatic ecosystem quality requires a comprehensive, watershed based framework, because upstream inputs affect downstream ecosystems. This process is well understood and was the foundation for the U.S. EPA's TMDL approach. Each aquatic ecosystem is both unique and complex. Protective management approaches such as NPDES permit limits, water and sediment quality standards, and Best Management Practices have numerous assumptions and uncertainties that confound the ability to ensure they are effective. Determining what will be effective requires an interdisciplinary approach and understanding of how dominant physical, chemical and biological factors interact. This dictates that state-of-the-science approaches be used that generate an adequate level of quality data and that the associated uncertainties and assumptions be clearly understood and stated. The current consensus is that reliable "weight-of-evidence" based approaches are necessary in environmental quality assessments, providing for sound decision-making (*e.g.,* Burton *et al.* 2002ab; Wenning *et al.* 2005, USEPA 2000). These approaches should characterize *and link* the key "exposure" (*i.e.,* stressor) components with indigenous biological "effect" components using reliable, peer-reviewed, and quantitative approaches where reference conditions, dominant stressors (including their spatial and temporal patterns), and, finally, associated risk is clearly defined. Unfortunately, this important process has not been followed in the supporting documentation for the Proposed UAA Rules, as explained below.

II. Overview of the Des Plaines Watershed and its Impairments

A wealth of information exists on the Des Plaines River and its watershed. It is clearly a watershed that is heavily dominated by human activities, with no pristine waters. It drains nearly 855,000 acres in Lake, Cook, DuPage and Will counties (Appendix B). The majority of Chicago's metropolitan area drains into the Des Plaines River and its tributaries. Much of the current data has been summarized by the Illinois EPA (IEPA 2004, 2008). This human-dominated watershed is characterized primarily by urban and agricultural land uses (AquaNova

& Hey 2003; CDM 2007; Groschen *et al.* 2004). The river is effluent dominated, receiving municipal wastewaters from many cities, including the 3rd largest in the nation. Municipal wastewater constitutes more than 70% of the flow during low flow periods (CDM 2007 – Attachment B to Illinois EPA Statement of Reasons). The Illinois EPA 2004 303(d) List report on Illinois water quality for 2004 identified a large number of possible causes of beneficial use impairment in this system (IEPA 2004). The 2004 303(d) List included the following list of causes of impairments: organic chemicals, nutrients, metals, pathogens, ammonia, sedimentation/siltation, total dissolved and suspended solids, chlorides, flow alterations, dissolved oxygen, flow and habitat alteration, combined sewer overflow, urban runoff/storm sewers, and fish consumption advisories. Surprisingly, in the Illinois EPA 2008 Integrated Water Quality Report and Section 303(d) List, Final Draft dated June 30, 2008, many of the 2004 303(d) List causes and sources of impairment were deleted from this most recent Illinois EPA report (IEPA 2008). While the Illinois EPA's reasons for deleting certain of the 2004-listed causes and sources of impairments are not explained in the 2008 Final Draft Integrated Report, some of its reasons are provided and show that the deletion of the causes and sources of impairments is not due to their having ceased being impairments to the system. Rather, these deletions are due to changes in the "criteria" that the Illinois EPA uses to identify such impairments. For example, with respect to total nitrogen and dissolved oxygen causes of impairments, the Illinois EPA states:

> *We have stopped using total nitrogen, as a cause of impairment for aquatic life use. Total nitrogen appeared as nitrogen (total) on previous 303(d) lists. We do not have a standard for total nitrogen related to aquatic life. In streams, we typically do not have total nitrogen data. The methods, criteria and the manner in which nitrogen was reported as a cause of impairment of aquatic life use have changed many times over previous assessment cycles. These criteria had never been shown to be related to aquatic life use impairment in any scientific study and had never been used or proposed as water quality standards. Illinois now believes that the criteria by which it placed total nitrogen on previous 303(d) lists were not scientifically valid. Illinois does not believe that a scientifically valid criterion currently exists for determining when nitrogen is causing an impairment of aquatic life use in this state.*
>
> *Dissolved oxygen (which is a cause of impairment used to indicate low dissolved oxygen) has been changed from a pollutant to a nonpollutant cause of impairment. Although low dissolved oxygen may be caused by pollutants, the impairment does not result from the discharge of dissolved oxygen into the water. Furthermore, federal regulations in CWA Section 502(6) do not define dissolved oxygen or low dissolved oxygen as a pollutant. Because only pollutant causes of impairment appear on the 303(d) List this means that all entries of dissolved oxygen have been delisted.*

Thus, while the Illinois EPA's 2008 draft list of causes and sources of impairments may be shorter than the UIW 2004 list of impairments, it does not appear to reflect any real improvements in the quality of the subject waterway.

The quality of the Des Plaines River ranks among the worst in the state (and likely the nation), in number of impaired reaches (USEPA 303d Fact Sheet). Every reach of the Des Plaines River reported in the Illinois EPA 2008 Integrated Report had multiple causes (*i.e.*, stressors) and sources that contributed to non-attainment of beneficial uses. (In the 2004 303(d) List, a total of more than 800 causes and sources of impairments were identified). Of the Illinois EPA-identified impairments, the most common sources of impairment on many reaches are municipal point sources, contaminated sediments, channelization, flow regulation, hydro-modification, combined sewer overflow (CSO), and urban runoff/storm sewers. In the Illinois EPA 2002 305b Report, "thermal modification" was listed as a possible cause of impairment, although it was not identified as a stressor for the Des Plaines River in 2002. The more recent Illinois EPA 2004, 2006 and 2008, Integrated 305b/303d reports do not list thermal modification as a possible cause of impairment in the Des Plaines River. The Upper Dresden Pool (UDP) area has multiple causes and sources of use impairment identified by the Illinois EPA (Appendix B-1 of IEPA 2006 305(b) Report). The causes include: DDT, flow regime alterations, phosphorus, mercury, PCBs, total suspended solids, and sedimentation/siltation. The sources of impairment identified include: urban runoff, municipal point sources, contaminated sediments, and impacts from hydrostructure/flow regulation/modification.

The upper part of the UIW is known as the Chicago Area Waterway System (CAWS) consisting of 78 miles of man-made canals and modified river channels. These were created to drain urban runoff, treated wastewater and support commercial navigation (CDM 2007). All of this artificial and modified system is further altered by five structures (*i.e.*, engineered locks) that control flow. With no high quality habitat and the continual presence of contaminants that spike to high levels during periodic events, no pollution sensitive aquatic life is expected. Unfortunately, water flows downstream and the contaminants identified as causes of impairment also travel great distances affecting downstream areas. Indeed, the growing incidence of hypoxia in the Gulf of Mexico is largely due to nitrogen inputs from agricultural runoff in the upper Midwest (*e.g.*, Scavia and Donnelly 2007), while the UDP area is only a few miles downstream of the CAWS. The Illinois EPA has found the Chicago Sanitary and Ship Canal (CSSC) has 7 causes of impairments originating from 8 major source categories (IEPA 2006, 2008). Because most of the water (approximately 70%) is municipal wastewater effluent (with additional contributions from urban runoff) it contains significant loadings of stressors that will impact the lower reaches. In addition, the flow alterations upstream will impact downstream flows. Some of the stressors are more likely to be transported long distances downstream, such as fine solids, metals, and the more problematic organic chemicals (such as, larger polycyclic aromatic hydrocarbons, pyrethroid and chlorinated pesticides). This is evidenced by the high levels of contaminants in depositional sediments in the UDP, as discussed further below.

Further downstream from the CSSC, there are four significant tributaries that empty into the upper Des Plaines River. Each of these key tributaries provide the potential for a refuge for fish from the Des Plaines, a source of aquatic life, and correspondingly a source of pollution. Unfortunately, these waterways have several causes and sources of impairment. Hickory Creek discharges directly into the Brandon Road Lock & Dam tailwaters which have good quality habitat. However, according to the Illinois EPA's Integrated Reports, the lower areas nearest to the Brandon tailwaters (GG02 and 06) do not support aquatic life or primary recreation uses due to the following impairments: fecal coliforms, chloride, alteration to streamside or littoral vegetation, flow alterations, sedimentation/siltation, total dissolved and suspended solids, zinc, nitrogen, phosphorus and algae. The sources of these 11 causes of impairments are thought to be combined sewer overflows, municipal point source discharges, urban runoff, channelization, flow regulation structures and land development (IEPA 2006, 2008). Grant Creek does not support aquatic life due to unknown impairment sources (IEAP 2006, 2008). Jackson Creek does not support aquatic life due to altered flow, phosphorus and aquatic plants (IEPA 2006, 2008). Finally, DuPage River segments do not support aquatic life, fish consumption and primary contact beneficial uses due to altered flow, sedimentation/siltation, silver, phosphorus, aquatic plants, PCBs, chloride, DDT, hexachlorobenzene, nitrogen, fecal coliforms, and dissolved oxygen. These 12 causes of impairment were stated to originate from 6 sources, including hydrostructures, land development, upstream impoundments, urban runoff, municipal point sources, and contaminated sediments (IEPA 2006, 2008) which are documented to be accumulating at the mouth of the DuPage River in the Des Plaines River (see below).

The high degree of impairment and the multiple causes and sources are to be expected, based on the dominance of human activities and the limited nonpoint source runoff controls in the watershed. In fact, these dominant stressors and the resulting biological impairments are similar to other waterways that are human dominated (*e.g.*, Burton *et al.* 2000; Burton and Pitt 2001).

The unique, human-dominated nature of this watershed makes the critically important issue of reference waterway selection difficult. The reality is that the Des Plaines watershed is one of the most heavily human-dominated waterways in the nation. This will not change. While the quality of the Des Plaines can be improved via a comprehensive watershed management program, it will always be a heavily modified waterway. Until the stressors that dominate as causes of the beneficial use impairments (identified above) are reduced significantly, there will be risks to the aquatic biota and to humans that consume fish and recreate in the UDP.

In the following discussion, evidence will be presented that supports the findings of the recent Illinois EPA 305(b) Reports on the primary causes of beneficial use impairments in the UDP and why these stressors and impairments will persist in the foreseeable future. These dominant stressors include: contaminated sediments, metals, synthetic organic chemicals (including pesticides, PAHs and pharmaceuticals and personal care products (PPCPs), nutrients, flow regime alteration and degraded habitats. Unless the great majority of these stressors (and their sources) are removed, the CSSC and UDP will continue to be impaired.

III. Wet Weather Impacts in the UIW

While water quality in the UIW has improved since the 1970s, the recent Illinois EPA 305(b) Reports found no significant changes in beneficial use attainment. This is despite the MWRDGC improvements (including TARP) to reduce the impacts from wet weather events to the waterway. The lack of improvement is likely the result of two key factors. First, there will be continuing, significant inputs from many large CSOs (Appendix B) that provide large loadings of raw sewage with associated solids, nutrients and chemical contaminants. Based on MWRDGC data, during the period from January 1, 2007 through August 6, 2008, there were 117 CSO events at 4 major CSO stations (www.mwrdgc.dst.il.us/CSO/display_only.aspx). Second, there will continue to be significant nonpoint source inputs from both urban and, to a lesser extent, agricultural runoff given the nature of the watershed and its continued development (Appendix B). A press release by the University of Illinois –Urbana Champaign (August 1, 2007) reported that "flood peaks in the Chicago metropolitan area are higher than they used to be, and they are also higher than estimates currently used by water managers, according to an Illinois-Indiana Sea Grant study….the steady increase in flood discharges in small streams over the past 100 years is due to increases in urbanization and precipitation, with urbanization playing the major role…Between 1954 and 1999, urbanization, on average, increased from about 11 percent to 52 percent in the 12 Chicago watersheds… the 10 largest historical storms have occurred since 1950, and these storms were much larger than any in the previous 50 years." These urbanization trends are also reflected in data through 2006 shown in Appendix B, showing changes in land use, development, population, and housing from the USGS, Chicago Metropolitan Agency for Planning, and U.S. Census Bureau. It is apparent that the Des Plaines watershed's trait of being human dominated is increasing steadily with time and will likely continue long-term, despite the recent economic slow-down. This finding is also reflected in the recent comprehensive USGS study and US Census Bureau data (Groschen et al 2004). Growth has been greatest in the counties surrounding Chicago (ranging from 14 to 42 percent: Du Page 16%, Grundy 25%, Lake 25%, Kane 27%, Kendall 38%, McHenry 42%, Will 41%).

Agricultural runoff is contributing four groups of stressors: clay/silt sediments, nutrients (from fertilizers and livestock), metals (a common contaminant of fertilizers), pathogens (from livestock), pesticides, and pharmaceuticals (from livestock). The recently banned insecticide Diazinon (toxic in the part per trillion range) is still being marketed and used. It was frequently found in the Des Plaines River watershed (93% of samples). In agricultural parts of the watershed, Atrazine was found in every sample (Groschen *et al.* 2004).

While the recent and near-future improvements from TARP are noteworthy, this will continue to be a highly impacted waterway, being effluent-dominated and receiving large amounts of untreated nonpoint source (NPS) runoff containing a wide range of nutrients, pathogens, metals, petroleum products, "new-age" pesticides and pharmaceutical and personal care products (PPCP) which are often referred to as emerging contaminants. Many of these chemicals are known to be toxic at the part-per-trillion level and/or hormone disruptors (Burton and Pitt 2001; Burton *et al.* 2000). Urban and agricultural storm waters in streams are often acutely toxic (Burton *et al.* 2000; Burton and Pitt 2001; Hatch and Burton 1999; Tucker and Burton 1999). In addition to the chemicals, solids erode from urban, construction and agricultural lands and constitute the number one pollutant of river systems (USEPA 2002; Burton and Pitt 2001). Many of the above stressors have been identified by the Illinois EPA as the primary causes of impairment on the Des Plaines (IEPA 2004, 2006, 2008); the others are known to be common in human-dominated waterways as discussed above and below.

The above NPS inputs will continue for many years, likely decades, and will continue to adversely impact the downstream ecosystems. The sheer magnitude of urbanization and agriculture in the watershed (Appendix B) and lack of effective NPS controls dictates that NPS-related degradation will be the dominant source of impairment for the foreseeable future. This is not surprising, because NPS runoff is the leading cause of water quality problems in the U.S. (USEPA 2002).

IV. Sediment Quality

It is well known that chemicals (nutrients, synthetic organics and metals) and pathogens tend to associate with solids due to polar and non-polar binding affinities (Burton 1992). Therefore, those sediments that have greatest surface areas (clays, silts, colloids) will accumulate the greatest concentrations, and thus serve as both a sink and a source of contamination. Indeed, contaminated sediments are the cause of use impairment of 41 of 42 Great Lakes Areas of Concern and the dominant cause for Superfund site designation in our waterways. Depositional sediments are not stationary and continue to contaminate resident organisms and downstream waters *via* common fate processes, such as resuspension, advection, bioturbation and diffusion. All of these fate processes exist on the Des Plaines River and vary spatially and temporally. In cases, for example, where overlying water quality may be relatively good (*i.e.*, meet water quality standards), contaminant concentrations will steadily increase in depositional sediments and provide an environment for bioaccumulation in benthic organisms (*e.g.*, Burton *et al.* 1992; Wenning *et al.* 2005). The U.S. Environmental Protection Agency (USEPA) has shown dramatic correlations between fish tissue consumption advisories and the levels of sediment contamination. On the Des Plaines, most of the reaches assessed in the Illinois EPA 305(b) Reports have fish consumption advisories and the levels of mercury and PCBs found in sediments suggest a substantial risk exists to those consuming fish from the Des Plaines River.

There have been several studies of sediment chemical contamination and toxicity in the UIW, from the CSSC downstream through the Dresden Pool since the 1990s (Burton *et al.* 1995; Groschen *et al.* 2004; MWRDGC 2008, EA Engineering, Science, and Technology 2008). The most recent study by EA (2008) was conducted in the Dresden Pool and the lower portion of the Brandon Pool between May 6 -9, 2008. This extensive physical and chemical survey included 35 sediment samples (31 in the Dresden Pool and four in the Lower Brandon Pool). Analyses included total organic carbon, total solids (percent moisture), grain size (sieve and hydrometer), arsenic, silver, cadmium, chromium, copper, lead, mercury, nickel, zinc, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCB congeners).

These studies have documented that the depositional sediments (clays and silts) have been and continue to be severely contaminated with metals, synthetic organics and nutrients throughout the UIW (from northern Chicago to the Dresden Island Lock and Dam). The depositional sediments are often acutely or chronically toxic to benthic invertebrates (Table 1 below; Tables 9-11 Appendix C). All have shown typical high degrees of riverine spatial heterogeneity (*i.e.*, natural variation across the river and longitudinally). This high degree of spatial heterogeneity makes determinations of improvement through time extremely difficult. Indeed, high levels of sediment contamination and exceedances of internationally accepted sediment quality guidelines (SQGs) are as common now as in the early 1990s.

Contamination of the Des Plaines River sediments is not only historical but is on-going due to the point and nonpoint sources discussed above. Nutrients, metals, pathogens and synthetic organics (primarily polycyclic aromatic hydrocarbons (PAHs) and new age pesticides such as pyrethroids) are common constituents today of both point and nonpoint source loadings in waterways such as the Des Plaines (Burton and Pitt 2002; USGS 1999). Although there are no known plans to dredge sediment locations in the UPD area, even the removal of significantly contaminated and acutely toxic sediments from depositional areas identified throughout the UIW (Burton 1995) would provide but a temporary improvement. The hydrologic conditions and continued point and nonpoint source loadings would eventually result in contaminated sediments re-accumulating because the myriad of sources will not be removed. The Illinois EPA-identified problems associated with TSS, siltation and contaminated sediments (IEPA 2004, 2008) suggest widespread watershed sources of these major stressors.

Indeed, sediment sampling in the UIW (CSSC to Dresden Island Lock and Dam) between 1994 and 2008 showed that the concentrations of organic contaminants in the depositional sediments of the UIW exceed widely used sediment quality guidelines (SQGs) for probable adverse biological effects (Appendix C) (Burton 1995, USEPA 2001, MWRDGC 2008, EA Engineering, Science, and Technology 2008). SQGs are widely used to determine which sediments are toxic and thus represent a threat to the aquatic biota (Wenning *et al.* 2005). They have been used in Superfund, RCRA and State investigations for many years and are frequently used to establish "clean-up" levels for remediation activities (Wenning *et al.* 2005). One of the biological-effects approaches that has been widely used to assess sediment quality relative to the potential for adverse effects on benthic organisms in freshwater ecosystems is the Threshold Effects Concentration (TEC)/Probable Effects Concentration (PEC) (MacDonald *et al.* 1996) approach. TECs typically represent concentrations below which adverse biological effects are not expected to occur, while PECs typically represent concentrations in the middle of the effects range and above which effects are expected to occur more often than not. (MacDonald *et al.* 2000).

Comparing the analytical results of sediment sampling to the SQGs, the Burton, U.S. EPA, and MWRDGC surveys all document that these sediments are highly contaminated and are likely to cause adverse biological effects (*e.g.*, Buchman 1999; McDonald *et al.* 2000ab, Wenning *et al.* 2005). Recent studies by the MWRDGC (2007) and EA Engineering, Science, and Technology (2008) found that Brandon Road and both upper and lower Dresden Pool sediments continue to be highly contaminated with nutrients, cyanide, metals, and synthetic organic chemicals. Sediments from a majority of the sampling locations had both an odor and a sheen indicative of petroleum products.

A sediment survey was conducted in the Upper Dresden Pool and the lower portion of the Brandon Pool between May 6 -9, 2008 by EA Engineering, Science & Technology ("EA 2008 Sediment Survey"). A copy of the report prepared by EA on the EA 2008 Sediment Survey is attached as Appendix C. In the EA 2008 Sediment Survey, 35 sediment samples, 31 in the Upper Dresden Pool and four in the Lower Brandon Pool, were collected for physical and chemical characterization. The physical composition of the sediment was determined by total organic carbon, total solids (percent moisture) and grain size (sieve and hydrometer) analysis.

The target analytes for identifying the chemical composition of the sediments included arsenic, silver, cadmium, chromium, copper, lead, mercury, nickel, zinc, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCB congeners). The extensive EA 2008 Sediment Survey conducted this past May (2008) documented exceedances of sediment guidelines for metals, PAHs and PCBs at almost every sample location (Tables 9 and 10, Appendix C). A majority of the sampling locations had both an odor and a sheen, both of which are indications of sediment contamination. (Appendix C at p. 10).

As explained in the EA 2008 Sediment Survey report (Appendix C at p. 9), one of the biological-effects approaches that have been used to assess sediment quality relative to the potential for adverse effects on benthic organisms in freshwater ecosystems is the Threshold Effects Concentration (TEC)/Probable Effects Concentration (PEC) (MacDonald et al. 1996) approach. The TEC and PEC concentrations are sediment guidelines used to identify potential adverse biological effects associated with contaminated sediments. TECs typically represent concentrations below which adverse biological effects are not expected to occur, while PECs typically represent concentrations in the middle of the effects range and above which effects are expected to occur more often than not. (MacDonald et. al. 2000)

In the Lower Brandon Pool, metals concentrations of the sediments, with limited exceptions, exceeded the PEC values. The total PAH and PCB concentrations exceeded the PEC values in all four samples (Appendix C at p.11). In the UDP, concentrations of metals, PAHs and PCB congeners were elevated. Metals concentrations exceeded the PEC values at several locations. Total PAH concentrations exceeded PEC concentrations at 61% of the locations sampled (19 locations) and total PCB concentrations exceeded PEC values at 29% of the locations sampled (8 locations). (Figures 2 and 3, Appendix C). The fact that both the Upper Dresden and the Lower Brandon Pools had high concentrations of both metals and organic constituents indicates that large portions of these pools are of poor sediment quality. This includes the higher quality habitats of the Brandon Road Lock & Dam tailwaters.

Many of these areas had extremely high levels of sediment contamination, greatly exceeding SQGs. For example, at the lower end of the Dresden Pool, near Bay Hill Marina, 96% of the metal and organic SQGs were exceeded with 75% exceeding the PECs (Appendix C, Table 9); while upstream near the DuPage River, I-55 and Jackson Creek Dam (stations DR-13, 15, and 16) between 79 and 100% of the PECs were exceeded. Remarkably at DR-13 the PAH PEC was exceeded by nearly 30 fold and Benzo-a-pyrene (a potent human carcinogen) exceeded the PEC by 50-fold. All 35 stations exceeded the SQGs for total PAHs, showing pervasive and extreme sediment contamination indicative of urban-dominated watersheds. Of the 35 stations, 80% exceeded the PECs (up to 30-fold).

Because the U.S. EPA's 2001 sediment survey and recent surveys by MWRDGC (2007) and the EA 2008 Sediment Survey all found highly contaminated depositional sediments similar to the levels we found in the mid-90's UIW work (Burton 1995), it is likely that depositional sediments are not being cleaned out, capped, or significantly degraded. Further, contrary to statements made by Illinois EPA that sediment quality is improving, there are no reliable data establishing a trend of improving sediment quality. In fact, it appears that there has been no improvement in sediment contaminant levels, as evidenced by the recent 2008 EA Sediment Survey (Appendix

C). The 2008 EA Sediment Survey results were compared to the results of sediment sampling from the same study area in 1994-1995 (Burton 1995) and to metals data compiled previously by the MWRDGC (2007). Eighteen of the 1994-95 sediment study locations were re-sampled in the EA 2008 Sediment Survey. For the detected metals, the majority of the detected concentrations from the 2008 EA Sediment Survey are either higher or within a factor of two or less, indicating that overall, the sediment quality has remained the same or has degraded in several areas (*see* Table 11 to EA 2008 Sediment Study Report). A comparison of the results for PAHs and PCBs was more difficult because the 1994-95 study generally had higher detection limits than did the EA 2008 study. However, concentrations of both total PAHs and total PCBs were elevated in both studies, indicating no basis to support the Illinois EPA opinion that sediment quality is improving. The results indicate that sediment quality remains poor in both the Dresden and Brandon Pools.

As discussed above, surficial sediments are being routinely contaminated from urban, residential, transportation and agricultural runoff and a wide variety of small to large point sources. These sources will continue to contaminate the depositional sediments and, as these sediments are resuspended, they will continue to contaminate the more biologically sensitive and productive lower reaches of the UIW system along with the Brandon tailwaters and UDP.

The main channel of the UDP, a relatively well scoured area, contains large grained sediments that are non-toxic (Burton 1995). However, most depositional sediments showed acute toxicity and lie in the limited habitat areas for fish (Burton 1995). The main channel is not primary habitat and not suitable for spawning. Indeed, one of the prime habitat for spawning in this study area is the tail waters below Brandon Road Lock & Dam where sediments are contaminated (Burton 1995, EA 2008). PAH SQGs were exceeded and greatly exceed levels known to be acutely toxic to aquatic life, particularly in the presence of sunlight. These shallow areas allow for photoinduced-toxicity of low ug/L (ppb) levels of PAHs. The photoinduced PAHs will be toxic to zooplankton, benthic macroinvertebrates, fish and amphibians in surficial layers of waters throughout the UIW. This phenomenon is well established in the peer-reviewed literature (*e.g.,* Hatch and Burton 1998, 1999; Ireland *et al.* 1996). Portions of the UIW have significant areas that are shallow (<1m depth) and thus subject to photoinduced PAH toxicity. In addition, the levels found in the sediments (parts per million) are high enough to cause acute toxicity without UV stimulation, with or without carbon loadings, based on accepted SQGs (EA 2008). Station DR-29 at the end of the tailwaters even exceeded the PEC guidelines.

A recent USGS study (Groschen *et al.* 2004) did an extensive water quality evaluation of the Upper Illinois River Basin. It found that total PAHs in the sediments of the upper Illinois River Basin were among the highest 25% of all sites nationwide and sites in Western Springs and Riverside were among the highest 5% of the nation, exceeding probable effect levels for adverse effects on aquatic life. The lowest concentrations at Milford were still ranked in the top 55% of the nation (Groschen *et al.* 2004). These PAH loadings originate from nonpoint sources and will not decline as there are no management practices in place to reduce these nonpoint source loadings. Sediment concentrations of total DDT, PAHs and PCBs were related to urban sources in the Chicago metropolitan area. Concentrations of DDD and DDT in Western Springs were among the top 3% nationwide and concentrations in fish increase being among the highest concentrations found nationwide. Methyl mercury concentrations in fish and sediment were also the highest nationwide on the Des Plaines at Russell. Fish in this system also have exceedingly high levels of PCBs, DDT and dieldrin in fish tissue. Cadmium and nickel have also been implicated as causing fish impairment. (*See* Groschen *et al.* 2004 for additional information.) These recent findings soundly document that this is one of the most (if not the most) impaired watersheds in the nation. The Illinois EPA has not considered the important results and findings of the USGS Study. These study results demonstrate that the Illinios EPA has ignored these multiple chemical stressors that should be taken into account in determining the use designations for the CSSC and the UDP.

TABLE 1. Sediment Quality Guideline Exceedances in Des Plaines River (Brandon Road Pool to Dresden Pool) in 2006 (MWRDGC 2007)

Station 2 Brandon Road Pool RM 290.5

Date	Cd mg/Kg	Cr mg/Kg	Cu mg/Kg	Pb mg/Kg	Hg mg/Kg	Ni mg/Kg	Zn mg/Kg
Oct-84	27	263	226	299	4.9	216	1595
Oct-85	NA	NA	NA	NA	NA	NA	NA
Oct-86	3	18	35	127	<0.1	65	246
Oct-87	NA	NA	NA	NA	NA	NA	NA
Oct-88	NA	NA	NA	NA	NA	NA	NA
Oct-89	17	185	192	290	1	80	870
Oct-90	5	50	78	254	0.03	52	340
Oct-91	38	323	234	336	2.3	86	1196
Oct-92	5.1	75	79	205	0.6	32	383
Oct-93	2	20	42	170	0.02	23	168
Oct-94	4	36	62	292	<0.1	40	190
Oct-95	3	40	71	280	0.2	34	280
Oct-96	3.6	146	60	223	0.5	39	290
Oct-99	2.5	65	66	236	<0.1	45	242
Oct-00	2	26	57	106	0.3	19	178
Oct-02	11.6	180	161	536	0.64	214	719
Oct-03	23.6	234	233	465	1.78	258	1124
Oct-04	16.7	189	313	439	0.93	221	961
Oct-05	10.4	155	213	469	0.21	184	902
Oct-06	1.3	26	21	211	0.71	420	166
Oct-07	1.1	24	78	295	0.11	46	138

Station 5 Des Plaines River Upper Dresden Island Pool RM 285

Sep-83	2.8	16	25	49	0.6	47	163
Oct-84	4	23	37	66	<0.1	66	199
Oct-85	7	37	39	100	0.2	66	311
Oct-86	1	NA	NA	NA	<0.1	NA	NA
Oct-87	29	321	307	306	0.2	110	990
Oct-88	2	433	27	23	<0.1	40	170
Oct-89	10	93	81	154	0.6	70	540
Oct-90	4	55	19	51	<0.1	28	135
Oct-91	1	19	27	94	0.2	21	162
Oct-92	0.9	11	37	33	<0.1	18	107
Oct-93	2	15	14	28	<0.1	28	138
Oct-94	3	35	47	137	<0.1	40	200
Oct-95	5	72	74	101	0.3	36	383
Oct-96	2.2	106	51	77	0.4	28	215
Oct-99	1.1	31	27	70	0.5	27	149

Oct-00	0.5	19	23	180	<0.1	22	75
7-Oct-02	0.3	27	10	275	0.1	99	86
6-Oct-03	1.8	37	92	333	0.12	78	206
4-Oct-04	4.2	133	58	284	0.35	65	278
3-Oct-05	1.2	30	29	285	0.62	60	151
2-Oct-06	2.3	41	48	295	0.83	124	237
1-Oct-07	1.8	30	26	231	0.16	31	148

Station 8

Des Plaines River		Dresden Island Pool (to Lock)		RM 278			
Sep-83	5.1	32	46	67	3.4	63	309
Oct-84	4	28	38	38	0.1	73	262
Oct-85	3	23	20	32	0.2	53	253
Oct-86	5	41	69	132	0.3	42	300
Oct-87	3	25	21	45	0.1	50	220
Oct-88	48	10	430	15	6.9	110	1680
Oct-89	3	24	16	20	0.1	40	160
Oct-90	30	384	478	249	2.4	113	1747
Oct-91	1	29	91	284	2.6	26	375
Oct-92	7.6	90	99	101	0.7	36	494
Oct-93	5	61	66	226	0.5	42	474
Oct-94	6	60	84	102	0.1	40	380
Oct-95	3	49	62	74	0.2	46	399
Oct-96	17	211	158	217	3	44	784
Oct-99	2.5	41	44	82	0.7	40	322
Oct-00	5	65	82	105	0.5	30	407
7-Oct-02	1.4	50	38	361	0.39	47	219
6-Oct-03	1.5	30	20	290	0.19	34	201
4-Oct-04	0.8	28	37	226	0.13	22	110
3-Oct-05	6.3	98	135	546	0.67	118	555
2-Oct-06	2.2	35	38	385	1.97	64	222
1-Oct-07	5.7	84	104	530	0.85	103	474

	Cd	Cr	Cu	Pb	Hg	Ni	Zn	
Yellow = Threshold Effects Concentration	0.99	43.4	31.6	35.8	0.18	22.7	121	
Red = Probable Effects Concentration	5	111	149	128	1.1	49	459	

V. Suspended Sediments in the CSSC and UDP

Prior studies have shown that turbidity has and continues to be a stressor in both the CSSC and the UDP. Turbidity is due to eroded soils and resuspended sediments, both of which contribute during high flow events. Turbidity during low flow events is primarily a result of resuspension of bedded sediments, which in the UIW often occurs from barge traffic. *Ceriodaphnia dubia* survival was adversely affected by turbidity (86-100% mortality) as would be expected (Burton 1995). Filter feeding zooplankton are known to be sensitive to suspended solids at levels of 50-100 mg/L (*e.g.*, IEQ 1995). This dominant stressor of the UIW likely impacts zooplankton populations throughout the waterway and is aggravated by barge and navigation traffic.

VI. Nutrients

Nutrients are a common contaminant of human-dominated watersheds, disrupting aquatic ecosystems by increasing biological productivity, leading to increased bacterial respiration (thus anoxia), increased algae and nuisance weeds, and thus a switch to less desirable fish and invertebrate species. Nutrient rich waters become eutrophic, impair beneficial uses, and experience oxygen declines that favor pollution tolerant species. The waters of the UIW from above Chicago through the Dresden Pool have high levels of nitrogen and phosphorus (MWRDGC 2007). It is not until below Dresden Pool that levels drop significantly for nitrogen, ammonia, phosphorus and fecal coliforms. When nitrogen is elevated, a stressor of particular concern is ammonia. Ammonium is typically considered to be the ionic form, while the term ammonia is inclusive of both the ionic (dominant form) and unionized (NH_4OH) forms. The unionized form is more toxic to some species, such as rainbow trout, but not others (*e.g., Hyalella azteca*). The U.S. EPA is currently considering revising their ammonia criteria as recent evidence has found it is not protective of freshwater mussels and snails. Criteria continuous concentrations for chronic protection of unionid mussels were 0.3 to 1.0 mg/L (Augspurger *et al.* 2003). More than half the nearly 300 species of mussels are in decline in North America. These findings suggest that levels commonly found in the UIW are toxic and may explain their absence from the UDP.

Previous studies found ammonia to be a primary sediment stressor in the UIW and Brandon Pool area. It was significantly correlated with sediment acute toxicity, particle size and organic contaminants (Burton 1995; Groschen *et al.* 2004). The 1999-2001 USGS study found phosphorus concentrations exceeded U.S. EPA desired goals to prevent excessive growth of algae and other nuisance plants in every water sample collected from urban or mixed land-use watersheds in the UIW (Groschen *et al.* 2004).
In the recent USGS study (Groschen *et al.* 2004) of the Upper Illinois River Basin, the flow-weighted mean of ammonia in the Chicago Sanitary and Ship Canal (CSSC) at Romeoville was the highest measured in the Upper Illinois River Basin, the fourth highest of 109 streams and rivers measured nationwide by the USGS, and among the highest in the Mississippi River basin. The USGS study findings state that the primary causes of degradation of the UIW are elevated concentrations of ammonia and phosphorus and the presence of organic wastewater contaminants such as disinfectants, pharmaceuticals and steroids, insecticides, and organochlorines. The USGS Study also found that these water quality conditions have resulted in decreased numbers and diversity of pollution-sensitive species of fish and benthic invertebrates.

Recently, environmental groups from states bordering the Mississippi River have filed a petition with the U.S. EPA to take aggressive action (including numeric nutrient limits) to address the growing problem of hypoxia in the Gulf of Mexico that originates from nutrient loadings. It is believed that nitrogen and phosphorus pollution alone prevents waters from attaining "fishable-swimmable" goals. Illinois is the largest contributor to the Gulf dead zone with 16.8% of the total nitrogen and 12.9% of the phosphorus. "Toxic algal blooms in Illinois have closed lakes to swimming and fishing and burdened water suppliers with increased treatment costs. These blooms have killed livestock, pets and, tragically, a teenager in Wisconsin in 2002." (Environmental Lay & Policy Center 2008; National Research Council 2008). Despite the removal of nutrients by the Illinois EPA as a cause of impairment in its 2008 Integrated Report – it is obviously a major cause based on the above studies, and is not surprising given the high loadings from both point and nonpoint sources.

Toxicity Identification Evaluation (TIE) results (Lower Brandon Pool and Tailwaters) also suggested ammonia and PAHs as primary toxicants (Burton 1998). While ammonia is reduced by nitrification, this microbial process is greatly inhibited in undisturbed sediments because oxygen is typically low or absent (Wetzel 1983). So as long as there continues to be high loadings of natural organic compounds and suspended solids, there will be ideal environments in the UIW for ammonia production by heterotrophic bacteria. There are at least 3 lines of evidence (chemistry, TIE testing, laboratory toxicity tests) showing ammonia is a major stressor throughout the UIW.

VII. Emerging Contaminants

The term "emerging contaminants" has become common and refers to more recently identified organic compounds that have been found to be relatively common in the environment and are of concern because they accumulate in wildlife and humans, cause endocrine-hormone disruption resulting in loss of male species and population collapses (Ankley *et al.* 2007). Examples of these compounds include endocrine disrupting compounds (EDCs, such as 17 alpha-ethymylestradiol (EES) found in birth control pills), many pharmaceutical and personal care products (PPCPs) which have been identified often in waters below municipal wastewater outfalls and livestock operations, and some of the newer pesticides that have replaced banned pesticides in recent years. Numerous European and US studies have found that fish downstream of municipal wastewater plants suffer from exposures to estrogenic chemicals with extreme reproductive disruption and feminization (Vajda *et al.* 2008; http://toxics.usgs.gov/regional/emc/ estrogenicity.html and http://toxics.usgs.gov/highlights/wastewater-fish.html).

A 1999-2000 nationwide survey (139 streams in 30 states) by the USGS of pharmaceuticals, hormones, and other organic wastewater contaminants focused on streams downstream of intense urbanization and livestock production. These compounds were found in 80% of the streams. The compounds originate from a wide range of residential, industrial and agricultural sources with 82 of the 95 analyzed being detected. The most frequently detected were coprostanol (fecal steroid), cholesterol (plant and animal steroid), *N,N*-diethytoluamide (insect repellant), caffeine, triclosan (antimicrobial disinfectant), tri(20chloroethyl) phosphate (fire retardant), and 4-nonylphenol (nonionic detergent metabolite) (Kolpin *et al.* 2002). Some of these compounds are noted EDCs. A survey was also conducted by the U.S. EPA in 2006 of 5 states in effluent dominated streams (Stahl *et al.* 2007). Eight of 24 pharmaceutical compounds were detected in fish tissues, of which antihistamines and antidepressants were most frequent. One of these sites was the North Shore Channel in Chicago where 24 largemouth bass were sampled

A more recent similar study was conducted by the USGS in the UIW. It found 5 of 45 compounds typically found in domestic and industrial wastewater in waters that drained more than 25% urban areas (Groschen *et al.* 2004).

A recent 7 year whole lake study in Canada exposed fish to levels commonly found in both untreated and treated municipal wastewaters (5 – 6 ng/L). The chronic exposure resulted in feminization of males and ultimately a near extinction of the fathead minnow species from the lake. This finding is of grave concern for the sustainability of wild fish populations in waterways receiving municipal wastewaters. Levels in the Potomac Basin stormwaters of 90-370 ng estradiol/L have been detected from agricultural areas.

Levels as low a 1 ng/L can result in male feminization (Jobling *et al.* 2006). In the Potomac Basin 80 to 100% of the male smallmouth bass are intersex (www.mawaterquality.org).

For purposes of the UAA waterways at issue, these studies have shown that urban waters, like the Chicago Area Waterway System and the Lower Des Plaines River, are impacted by these "emerging contaminants." This is particularly true of highly urbanized waters, like the Chicago Sanitary and Ship Canal and the Upper Dresden Pool, which are effluent-dominated. The presence of these emerging contaminants is another stressor that will adversely affect the aquatic community.

VIII. Temperature

It is noteworthy that thermal modifications have not been identified as one of the 23 impairment causes on the Des Plaines River (IEPA 2002, 2006, 2008). While temperature can certainly be a stressor, a literature review found that warm temperatures can be both advantageous and detrimental to aquatic biota (IEQ 1995). Another concern not discussed in the Lower Des Plaines River UAA Report is that there are winter maximum temperatures which are impacted by municipal wastewater effluents and may impede some fish reproductive processes. The "Selection of the Temperature Standard" and "Critique of the Current Secondary Contact and Indigenous Aquatic Life Standard" sections have inaccurate statements regarding temperature effects on riverine species and ecosystem processes. High and low temperatures may or may not be detrimental to aquatic life that resides in the UIW. There is not a simple relationship, as noted from many past studies (*e.g.,* Cairns *et al.* 1973; Cairns *et al.* 1978; review by Burton and Brown 1995). Both low and high temperatures can increase and decrease toxicity due to exposures from other chemical stressors, such as found in the UIW, and these relationships are both species and toxicant type and concentration dependent. The Lower Des Plaines River UAA Report's over-simplification that high temperatures increase toxicity is simply incorrect. Nitrification is also inhibited by cold temperatures and ammonia is not always consumed in the upper sediment layers. Nitrification is very sensitive to toxicants, which abound in the UIW's depositional sediments. As further discussed below, the authors of the Lower Des Plaines River UAA Report incorrectly imply and over-generalize that high temperatures are always detrimental.

One of the negative effects of high temperatures cited in the Lower Des Plaines River Report is the creation of blue green algae blooms in waterways. However, the authors fail to note that blue green algae are not a concern on the UIW due to its flow conditions. Toxic cyanobacterial blooms do not apply to the UIW, yet their presentation in the Lower Des Plaines River UAA Report implies that they do.

Similarly, the Lower Des Plaines River UAA Report also inaccurately presents my prior work on the UIW. On p. 2-97 of the Report, the subsection title is "Experiments by Wright University to Establish Temperature Limits". This study, which I directed while at Wright State University, did not attempt to establish temperature limits for the UIW (the "Wright State Study"). The UAA Report's discussion of the Wright State Study is misleading, leaving out key portions of the conclusions and misinterpreting others. The Wright State Study findings substantiated previous studies by my laboratory and others. The key findings documented that acute toxicity exists in short-term exposures for multiple species in waters and sediments of the UIW without any water temperature elevation. Toxic sediments abound in most tributary mouth, tailwater, and pool depositional areas, which include the better (but limited) habitats for fish. These same habitats are typically shallow waters which are subject to rapid mortality as a result of photoinduced toxicity of PAHs, as discussed above. Both cold and hot temperatures accentuated toxicity originating from UIW waters and sediments. Statistically significant correlations between sediment ammonia and fluorene concentrations and toxicity were observed. Ammonia was also significantly correlated to depositional sediments and the presence of high concentrations of organics. These correlations were based on sediment data collected from throughout the UIW. *In situ* toxicity was not observed due to temperature outside the thermal discharge plume.

The laboratory toxicity test results produced by the Wright State Study further document the role of sediment toxicity and how it is increased in the presence of temperature extremes. The Toxicity Identification Evaluation Phase I experiments further substantiate the findings of the Chemical Screening Risk Assessment and the ammonia correlations with toxicity, suggesting that ammonia is a primary system stressor to benthic and epibenthic species. However, these 7 day, static renewal experiments do not adequately mimic dynamic, *in situ* conditions where light, temperature, turbidity, water quality and food conditions change over minutes to hours. The most reliable indicator of *in situ* conditions are the indigenous communities present in the waterway. These are the most reliable data to use for evaluations of thermal impacts.

IX. Review of the UAA Factors[1]

The current and future status of this watershed and the relevant data clearly show that several UAA factors are met in the CSSC and UDP. The rationale supporting the statements below are provided in the text above and literature citations; and through a weight-of-evidence based, decision-making process involving the following 12 lines-of-evidence: magnitude of SQG exceedances, prevalence of sediment contamination, likelihood of continuing sediment contamination, extreme degraded status of waterway compared to others in the nation, human dominance of watershed, profuse NPS inputs, excessive habitat modification and degradation, human risk from pathogens and fish consumption, toxicity levels in water and sediment, correlations of toxicity with chemical stressors, indigenous biotic indices, and excessive numbers of use impairments throughout the watershed.

A. UAA Factor 3. Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place:

Human caused conditions or sources of pollution prevent both the CSSC and the Upper Dresden Island Pool from attaining the Clean Water Act's aquatic life goals. It is the primary reason that upgrading the use designation for either waterway to Clean Water Act "fishable" use designations is not appropriate. The evidence of excessive impairments is clear from the results of recent Illinois EPA efforts (IEPA 305(b) and 303(d) reports) and surveys by the MWRDGC. A multitude of physical and chemical impairment causes and sources exist throughout the watershed as discussed and documented above. The sources will not be removed due to the human-dominated nature of the watershed and the connectivity between the UDP and the UIW. In-situ remediation of contaminated sediments would likely take hundreds of millions of dollars based on the costs of remediating other similar systems (NRC 2007).

B. UAA Factor 4. Dams, diversions or other hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original conditions or to operate such modifications in a way that would result in the attainment of the use.

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[1] UAA Factor 2 not considered as the impacts of altered regimes were not part of this review.

The CSSC and UDP habitat is heavily and permanently modified. Barge traffic will continue to be a protected use and will continue to result in degraded habitat, resuspended contaminated sediments and a physical hazard to recreational users.

C. UAA Factor 5. Physical conditions associated with the natural features of the water body, such as the lack of proper substrate, cover, flow, depth, pools, riffles and the like, unrelated to quality preclude attainment of aquatic life protection uses.

See rationale for Factor 4 above. Habitat is of poor quality through most of the UIW and cannot be feasibly corrected.

Conclusions

An extensive database exists on the UIW (including the CSSC and UDP) concerning its physical, chemical, biological and toxicity characteristics. These multiple lines-of-evidence clearly establish this is a highly modified waterway that has poor riverine habitat, is effluent dominated and receives significant amounts of untreated, nonpoint source runoff. Primary stressors to the aquatic biota in the CSSC and the UDP are: metal and synthetic organic chemical contaminated sediments, elevated nutrients and ammonia, pharmaceuticals and personal care products, unnaturally altered flow regimes, lack of pools and riffles and generally poor substrates and habitat conditions. These stressors have been documented via multiple studies that quantitatively measured their presence recently and showed adverse biological effects result through on-site studies and peer-reviewed literature. This included studies that documented acute toxicity of waters and sediments in the UDP unrelated to temperature. Other research by Cairns *et al.,* (1973, 1978) showed the complexity of temperature and chemical interactions in organisms which refute the simplistic conclusions of the UAA report. Laboratory-based results require extrapolation to field conditions and indigenous benthic and fish communities, which have been thoroughly characterized in the UIW and are the most important line-of-evidence. Depositional sediments throughout the UIW are contaminated with levels of multiple contaminants that, in many locations, pose a hazard to aquatic biota, wildlife and humans. Major nonpoint source loadings of solids, nutrients, metals, and organics will continue from small to major urban areas, sewers, construction, and agriculture in this human-dominated watershed and therefore will continue to contaminate waters, sediments and the food of aquatic biota throughout the UIW. Modified and limited habitats (channelization, barge traffic, lock and dams), extreme turbidity and siltation, and stressor loadings will not improve in the foreseeable future and will continue to dominate water quality conditions and use impairments. Development of new, modified standards will not address the key issue of excessive and pervasive pollution sources, excessive use impairments and limited habitats in this watershed.

The conclusions and the rationales used by Illinois EPA (*i.e.*, proposed Illinois EPA Water Quality Standards and Effluent Limitations for the Chicago Area Waterway System and the Lower Des Plaines River: Proposed Amendments to 35Ill. Adm. Code Parts 301, 302, 303 and 304) are flawed. The presentation of data, data interpretation, and supporting statements are often biased, and fail to provide a scientifically-balanced representation of previous Upper Illinois Waterway studies, peer-reviewed literature and accepted approaches that are the state-of-the-science.

References Cited

Ankley GT, Brooks BW, Huggett DB, Sumpter JP. 2007. Repeating history: pharmaceuticals in the environment. Environ. Sci. Technol. 8211-8217.

Augspurger T, Keller AE, Black MC, Cope WG, Dwyer FJ. 2003. Water quality guidance for protection of freshwater mussels (unionidae) from ammonia exposure. Environ. Toxicol. Chem. 22:2569-2575.

Booth DB, Karr JR, Schauman S, Konrad CP, Morley SA, Larson MG, Burges SJ. 2004. Reviving urban streams: land use, hydrology, biology, and human behavior. J Am Water Resources Assoc. no. 03187.

Brix KV, DeForest DK, Adams WJ. 2001. Assessing acute and chronic copper risks to freshwater aquatic life using species sensitivity distributions for different taxonomic groups. Environ Toxicol Chem 20:1846-1856.

Buchman MF. 1999. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1. Seattle WA.

Burton, G.A., Jr., D. Gunnison and G.R. Lanza. 1987. Survival of enteric pathogens in freshwater sediments. Appl. Environ. Microbiol. 53: 633-638.

Burton, G.A., Jr. 1991. Assessing freshwater sediment toxicity. Environ. Toxicol. Chem. 10: 1585-1627.

Burton, G.A., Jr. 1992. Sediment Toxicity Assessment. Lewis Publishers. Boca Raton, FL. 457 p

Burton, G.A., Jr. 1992. Sediment collection and processing: factors affecting realism. In, Sediment Toxicity Assessment. Lewis Publishers. Boca Raton, FL. pp. 37-66.

Burton, G.A., Jr. 1992. Assessing contaminated aquatic sediments (a two part feature series - Special Editor). Environ. Sci. Technol. Vol. 26:1862-1863.

Burton, G.A., Jr. 1995. The Upper Illinois Waterway Study, 1994-1995 Sediment Contamination Assessment Final Report. Commonwealth Edison, Co., Chicago, IL.

Burton, G.A. Jr. 1998. The Upper Illinois Waterway Ecological Survey: Continuous *In Situ* Toxicity Monitoring and Thermal Effect Characterization Tasks. Commonwealth Edison Corp. Chicago, IL.

Burton, G.A., Jr. 2002. Sediment quality criteria in use around the world. Limnology 3:65-76.

Burton, G.A., Jr. and H. Brown. 1995. Reviews of the Literature Concerning: 1) Effects of Temperature on Freshwater Fish, 2) Effects on Freshwater Biota from Interactions of Temperature and Chemicals, and 3) Effects of Turbidity and Barge-Traffic on Aquatic Ecosystems. Commonwealth Edison, Co. Chicago, IL.

Burton, G.A., Jr., and R. Pitt. 2001. Stormwater Effects Handbook: A Tool Box for Watershed Managers, Scientists and Engineers. CRC/Lewis Publishers, Boca Raton, FL, 924 pp.

Burton, G.A., Jr., R. Pitt, and S. Clark. 2000. The role of whole effluent toxicity test methods in assessing stormwater and sediment contamination. CRC Critical Reviews in Environmental Science & Technology 30: 413-447.

Burton, G.A., Jr., P. Chapman, and E. Smith. 2002. Weight of Evidence Approaches for Assessing Ecosystem Impairment. Human and Ecological Risk Assessment 8:1657-1673.

Burton, G.A., Jr., G. E. Batley, P.M. Chapman, V.E. Forbes, E.P. Smith, T. Reynoldson, C.E. Schlekat, P.J. den Besten, A.J. Bailer, A.S. Green and R.L. Dwyer. 2002. A Weight-of-Evidence Framework for

Assessing Sediment (Or Other) Contamination: Improving Certainty in the Decision-Making Process. Human and Ecological Risk Assessment 8:1675-1696.

Burton GA, Jr., Rowland CD, Greenberg MS, Lavoie DR, Nordstrom JF, Eggert LM. 2003. A tiered, weight-of-evidence approach for evaluating aquatic ecosystems, in, M. Munawar (ed.), Sediment Quality Assessment and Management: Insight and Progress, 2003 Ecovision World Monograph Series, Aquatic Ecosystem Health and Management Society Publ., Hamilton, Ontario. pp. 3-21.

Cairns JJ Jr, Buikema AL Jr, Heath AG, Parker BC. 1978. Effects of temperature on aquatic organism sensitivity to selected chemicals. Virginia Water Resources Research Center. Bulletin 106. Blacksburg, VA.

Cairns JJ Jr, Heath AG, Parker BC. 1973. The effects of temperature upon the toxicity of chemicals to aquatic organisms. Report to Congress by the Environmental Protection Agency. Part 3. Serial No. 93-14. Washington DC.

CDM. 2007. Chicago Area Waterway System Use Attainability Analysis--Final Report prepared for the Illinois Environmental Protection Agency by CDM. (211 pp.) August, 2007.

ComEd. 1996. Aquatic Ecological Study of the Upper Illinois Waterway. Final Report. Chicago, IL.

EA Engineering, Science and Technology. 2008. Sediment Chemistry Study Upper Illinois Waterway, Upper Dresden and Lower Brandon Pools. August 2008 report to Nijman Franzetti LLP. Chicago IL.

Greenberg, M.S., G.A. Burton, Jr., P.B. Duncan. 2000. Considering Groundwater-Surface Water Interactions in Sediment Toxicity Assessment. SETAC Globe. March, April, pp. 42-44.

Groschen GE, Arnold TL, Harris MA, Dupre DH, Fitzpatrich FA, Scudder BC, Morrow WS, Terrio PJ, Warner KL, Murphy EA. 2004. Water quality in the upper Illinois River basin, Illinois, Indiana and Wisconsin, 1999-2001. Resont VA, US Geological Survey Circular 1230. http://il.water.usgs.lgov/nawqa/uirb.

Gutreuter S, Dettmers JM, Wahl DH. 2003. Estimating mortality rates of adult fishes from entrainment through the propellers of river towboats. Trans Am Fisheries Soc 132:646-661.

Hart DD, Finelli CM. 1999. Physical-biological coupling in streams: the pervasive effects of flow on benthic organisms. Annu Rev Ecol Syst 30:363-395.

Hart DD, Clark BD, Jasentuliyana A. 1996. Fine-scale field measurement of benthic flow environments inhabited by stream invertebrates. Limnol. Oceanogr. 41:297-308.

Hart DD, Johnson TE, Bushaw-Newton KL, Horwitz RJ, Bednarek AT, Charles DF, Kreeger DA, Velinsky DJ. 2002. BioScience 52:669-681.

Hatch, A.C. and G.A. Burton, Jr. 1998. Effects of photoinduced toxicity of fluoranthene on amphibian embryos and larvae. Environ. Toxicol. Chem. 17:1777-1785.

Hatch, A.C. and G.A. Burton, Jr. 1999. Sediment toxicity and stormwater runoff in a contaminated receiving system: Consideration of different bioassays in the laboratory and field. Chemosphere 39:1001-1017.

Hatch, A.C. and G.A. Burton, Jr. 1999. Photoinduced toxicity of PAHs to *Hyalella azteca* and *Chironomus tentans*: Effects of mixtures and behavior. Environmental Pollution106:157-167.

IEQ (Institute for Environmental Quality) 1995. Reviews of the literature concerning: 1) Effects of temperature on freshwater fish, 2) Effects on freshwater biota from interactions of temperature and chemicals, and 3) Effects of turbidty and barge-traffic on aquatic ecosystems. Final report for Commonwealth Edison Co. Chicago, IL.

Illinois Environmental Protection Agency. 2002. Illinois Water Quality Report 2002. Bureau of Water. Springfield, IL.

Ireland, D.S., G.A. Burton, Jr., and G.G. Hess. 1996. *In Situ* toxicity evaluations of turbidity and photoinduction of polycyclic aromatic hydrocarbons. Environ. Toxicol. Chem. 15:574-581.

Kidd KA, Blanchfield PJ, Mills KH, Palace VP, Evans RE, Lazorchak JM, Flick RW. 2007. Collapse of a fish population after exposure to a synthetic estrogen. Proc. Nat. Acad. Sci. 104:8897-8901.

Kolpin DA, Furlong ET, Meyer MT, Thurman EM, Zaugg SD, Barber LB, Buxton HT. 2002. Pharmaceuticals, hormones, and other organic wasterwater contaminants in U.S. streams, 1999-2000: A national reconnaissance. Environ. Sci. Technol 32:1201-1211.

Lowery DDR, Pasch RW, Scott EM. 1987. Hydroacoustic survey of fish populations of the lower Cumberland River. US Amrmy Eng Distr, Nashville TN.

MacDonald DD, CG Ingersoll and TA Berger. 2000a. Development and evaluation of consensus based sediment quality guidelines for freshwater ecosystems. Arch Environ Contam Toxicol. 39:20-31.

MacDonald DD, LM DiPinto, J Field, CG Ingersoll, ER Long and RC Swartz. 2000b. Development and Evaluation of consensus-based sediment effect concentrations for polychlorinated biphenyls. Environ. Toxicol Chem. 19:1403-1413.

MWRDGC (Metropolitan Water Reclamation District of Great Chicago). 2007. Water and sediment quality along the Illinois waterway from the Lockport Lock to the Peoria Lock during 2006. Report No. 07-39. January 2008.

MWRDGC (Metropolitan Water Reclamation District of Great Chicago). 2008 Ambient water quality monitoring in the Chicago area waterway system: A summary of biological, habitat, and sediment quality data between 2001 and 2004. Report No. 08-2. January 2008.

National Research Council. 2007. Sediment dredging at Superfund megasites. National Academy of Science. Washington DC.

National Research Council. 2008. Mississippi River water quality and the Clean Water Act: Progress, Challenges and opportunities. National Academy of Science, Washington, DC.

Poff NL, Allen JD, Bain MB, Karr JR, Prestegaard KL, Richter BD, Sparks RE, Stromberg JC. 1997. The natural flow regime. BioScience 47:769-784

Santucci VJ, Gephard SR, Pescitelli SM. 2005. Effects of multiple low-head dams on fish, macroinvertebrates, habitat, and water quality in the Fox River, Illinois. N Am J Fisheries Mgmt 25:975-992.

Scavia D, Donnelly KA. 2007. Reassessing hypoxia forecasts for the Gulf of Mexico. Environ Sci Technol 41:8111-8117.

Stahl L, Wathen J, Snyder B, O'Donnel J, Pitt J. 2007. EPA pilot study of PPCPs in fish tissue. Abstr. Annu. Meeting Soc Environ Toxicol Chem. Milwaukee WI.

Todd BL, Rabeni CF. 1989. Movement and habitat use by stream-dwelling smallmouth bass. Trans Am Fish Soc 118:229-242.
Tucker, K.A. and G.A. Burton, Jr. 1999. Assessment of nonpoint source runoff in a stream using *in situ* and laboratory approaches. Environ. Toxicol. Chem. 18:2797-2803.

U.S. Environmental Protection Agency. 2000. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. 2nd Edition. EPA/600/R-99/064. Office of Research and Development and Office of Water. Washington, DC.

U.S. Environmental Protection Agency. 2001. Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. Office of Water. EPA-823-B-01-002. Washington, DC.

U.S. Environmental Protection Agency 2002. National Water Quality Inventory 2000 Report. Office of Water. Washington DC. EPA-841-R-02-001.

U.S. Environmental Protection Agency. 2000. Stressor Identification Guidance Document. Office of Water and Office of Research & Development. EPA/822/B-OO/025. Washington, DC.

U.S. Geological Survey. 1999. The Quality of Our Nation's Waters. Nutrients and Pesticides. USGS Circular 1225. Reston, VA.

Vajda AM, Barber LB, Gray JL, Lopez EM, Woodling JD, and Norris DO. 2008. Reproductive disruption in fish downstream from an estogenic wastewater effluent. Environ. Sci Technol. 42:3407-3414.

Wenning RJ, Batley GE, Ingersoll CG, Moore DW. 2005. Use of sediment quality guidelines and related tools for the assessment of contaminated sediments. Society of Environmental Toxicology and Chemistry. Pensacola, FL.

Wetzel RG. 1983. Limnology, 2nd ed. Saunders College Publ., Philadelphia.

Wolter C, Arlinghaus R. 2003. Navigation impacts on freshwater fish assemblages: the ecological relevance of swimming performance. Rev Fish Biol Fisheries 13:63-89.

APPENDIX A

Resume
G. Allen Burton

Dr. Burton recently began as Director of NOAA's Cooperative Institute of Limnology and Ecosystem Research, and is a Professor in the School of Natural Resources and Environment at the University of Michigan. Previously, he was Professor and Chair of the Earth & Environmental Sciences Department at Wright State University, in Dayton, Ohio. While at WSU he directed the Institute for Environmental Quality, started the PhD program in Environmental Sciences, and was the Brage Golding Distinguished Professor of Research. His research on aquatic ecosystem stressors has taken him to all seven continents and Visiting Scientist positions in New Zealand, Italy and Portugal. Recently he was the President of the international Society of Environmental Toxicology & Chemistry and served on National Research Council and U.S. EPA Science Advisory Board committees. He has served on numerous national and international boards and panels with over 200 publications.

Education

Ouachita Baptist University	B.S.	1976	Biology & Chemistry
Auburn University	M.S.	1978	Microbiology
University of Texas @ Dallas	M.S.	1981	Environmental Sciences
University of Texas @ Dallas	Ph.D.	1984	Env. Sci. (Aquatic Toxicology)

Professional Positions:

1980-1984. Life Scientist. U.S. Environmental Protection Agency, Dallas, Texas
1984-1985. Visiting Fellow. NOAA's Cooperative Institute for Research in Environmental Sciences, University of Colorado.
1985-1990. Assistant Professor, Dept. of Biological Sciences, Wright St. Univ.
1990-1996. Associate Professor, Dept. of Biological Sciences, Wright St. Univ.
1985-present. Coordinator, Environmental Health Sciences Program, WSU.
1994-2006, Director, Institute for Environmental Quality, WSU.
1996-present. Professor. Dept. of Biological Sciences, Wright St. Univ.
2000-2003. Brage Golding Distinguished Professor of Research, WSU.
2002-2003. Director, Environmental Sciences Ph.D. Program, WSU.
2003-2005. Associate Director, Environmental Sci. Ph.D. Program, WSU.
2005. Interim Chair, Geological Sciences Department, WSU.
2006-2008. Chair, Department of Earth & Environmental Sciences, WSU.
2008-present. Professor, School of Natural Resources & Environment, University of Michigan
Director, Cooperative Institute of Limnology & Ecosystem Research

Awards and Other Professional Activities (Select):

1992-1999. U.S. EPA National Freshwater Sediment Toxicity Methods Committee
1994, 2001. Visiting Senior Scientist, Italian Institute for Hydrobiology.
1994, 1995, 1998, 1999. External Review Panel. Environmental Biology Research Program. Exploratory Research. Office of Research and Development, U.S. EPA.
1996. Visiting Senior Scientist, New Zealand Inst. of Water and Atmospheric Research.
1994-1997. NATO Senior Research Fellow, University of Coimbra, Portugal.
1993-1996. Board of Directors, Soc. of Environmental Toxicology and Chemistry
2002. Meeting Chair. 5th International Symposium on Sediment Quality Assessment.
1999-2001. U.S. EPA Scientific Advisory Panel, Office of Pesticide Programs
2001-2004, Editorial Board, Aquatic Ecosystem Health & Management and Chemosphere.
2000-2003. Brage Golding Distinguished Professor of Research.
2003-2006. World Council, Society of Environmental Toxicology & Chemistry (SETAC)

2006. Vice President, World Council, SETAC
2007. President. Society of Environmental Toxicology & Chemistry
2005-2009. U.S. EPA Science Advisory Board Committees (2).
2006-2007. National Research Council Committee on Sediment Dredging at Superfund Megasites.
2008. Past President, Society of Environmental Toxicology and Chemistry.

Recent Research Projects ($7,655,912 total; Select since 2005):

1. U.S. Environmental Protection Agency STAR Grant Program. Defining and Predicting PCB Fluxes and Their Ecological Effects in River Systems for Risk Characterizations. March 2005- February 2008. $325,000.
2. City of Dayton. Great Miami River Water Quality vs. Stormwater Inputs. 2005. $56,382.
3. U.S. Environmental Protection Agency, Cooperative Research and Development Agreement. Toxicity Evaluation of Ground Water/Surface Water Interactions. EPA No. 304-04. 2005-2006. $56,090.
4. Bayer CropScience and BASF. An Assessment of Fipronil Effects on Benthic Invertebrates in Freshwater Ecosystems. 2005-2006. $325,295.
5. Copper Development Association, RioTinto, and International Copper Association. An Assessment of Copper Effects on Benthic Invertebrates in Freshwater Ecosystems. 2005-2007. $80,884.
6. RIVM, the Netherlands. Weight-of-Evidence based GIS System for Stressor Detection. QERAS Project. $10,000. 2006.
7. European Copper Association. 2006. An Assessment of Copper Effects on Benthic Invertebrates in Freshwater Ecosystems, Project Amendment. $36,575.
8. Nickel Producers Environmental Research Association. Comparison of Nickel Sensitivity in Cultured and Field Collected *Ceriodaphnia* spp. 2006-2007. $27,122.
9. Strategic Environmental Restoration and Demonstration Program (SERDP). USDOD, USDOE, USEPA. Sediment Ecosystem Assessment Protocol (SEAP): An Accurate and Integrated Weight-of-Evidence Based System. Feb 2007-Jan 2010. $903,000.
10. Copper Development Association. Copper and Sediments: Defining the State-of-the-Science and Key Data Gaps. $36,000. 2007.
11. International Copper Association, Dissolved Organic Carbon Dynamics in Brandenberg Pond, Ohio. $2,700. 2007.
12. International Zinc Association. Zinc and Sediments: Defining the State-of-the-Science and Key Data Gaps. $12,000. 2007.
13. City of Dayton. Stormwater Effects on the Mad River, Ohio. $66,997 ($50,000 to WSU). 2007.
14. Nickel Producers Environmental Research Association. Determining Realistic Sediment Toxicity Threshold Effect Levels for Freshwater Species. $131,206. 2007-2008
15. Wright State University Research Challenge. Seed grant for Center of Excellence: Nanoscale Science & Engineering of Multi-functional Materials. (Co-PI) 2007-2008. $60,000 (AB - $30,000)
16. International Copper Association and Copper Development Association. An Assessment of Copper Effects on Benthic Invertebrates in Freshwater Ecosystems, Project Amendment. $19,278. 2007-2008.
17. Environment Agency – United Kingdom. A Quantitative Approach for Scientifically-Based Decision Making: Linking Physical and Chemical Factors with Ecosystem Responses. $20,900. 2007-2008.

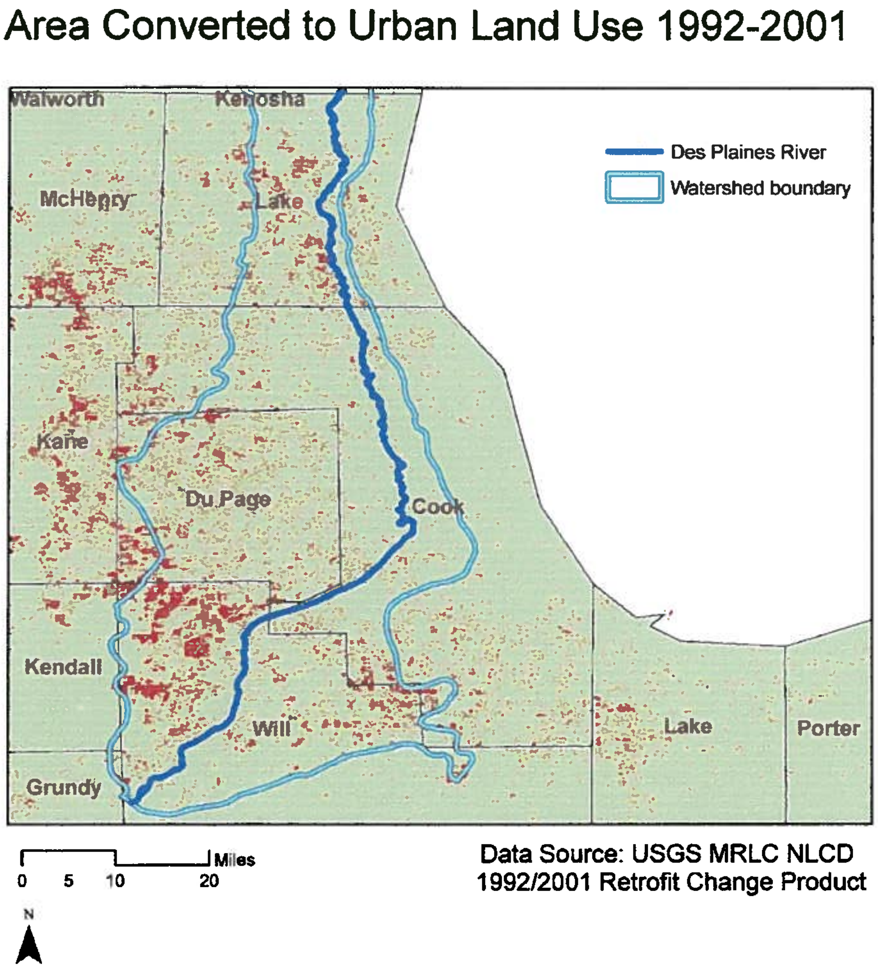
Publications (144 excluding technical reports; Select since 2005):

1. Burton GA Jr., Greenberg MS, Rowland CD, Irvine CA, Lavoie DR, Brooker JA, Eggert LM, Raymer DFN, McWilliam RA. 2005. *In situ* exposures using caged organisms: a multi-compartment approach to detect aquatic toxicity and bioaccumulation. Environ. Pollut. 134:133-144.
2. Burton GA Jr, Nguyen LTH, Janssen C, Baudo R, McWilliam R, Bossuyt B, Beltrami M, Green A. 2005. Field validation of sediment zinc toxicity. Environ Toxicol. Chem 24:541-553.
3. Kapo, K., Burton GA. 2006. A GIS based weight of evidence approach for identifying aquatic impairment. Environ. Toxicol. Chem. 25:2237-2249.
4. Custer KW, Burton GA, Coleho R, Smith P. 2006. Determining stressor presence in streams receiving urban and agriculture runoff: development of a benthic in situ toxicity identification evaluation (BiTIE) Method. Environ Toxicol Chem 25:2299-2305

5. Burton, GA,Green A, Baudo R, Forbes V, Nguyen LTH, Janssen CR, Kukkonen J, Leppanen M, Maltby L, Soares A, Kapo K, Smith P, Dunning J. 2007. Characterizing sediment acid volatile sulfide concentrations in European stream. Environ Toxicol Chem 26:1-12.
6. Baird, DJ, Burton GA, Culp JM, Maltby L. 2007. Summary and recommendations from a SETAC Pellston Workshop on in situ measures of ecological effects. Integr Environ Asseess Mgmt 3:275-278.
7. Crane M, G. Allen Burton, Joseph Culp, Marc S. Greenberg, Kelly R. Munkittrick, Rui G.L.G. Ribeiro, Michael H. Salazar and Sylvie D. St-Jean. 2007. Review of In Situ Approaches for Stressor and Effect Diagnosis. Integr Environ Assess Mgmt. 3:234-245.
8. Custer KW, Burton GA Jr. 2007. *Isonychia* spp. and macroinvertebrate community responses to stressors in streams utilizing the benthic in situ toxicity identification evaluation (BiTIE) method. Environ Pollut. 151:101-109.
9. National Research Council (A. Burton coauthor). 2007. Sediment Dredging at Superfund Megasites: Assessing the Effectiveness. National Academies Press. Washington DC.

APPENDIX B

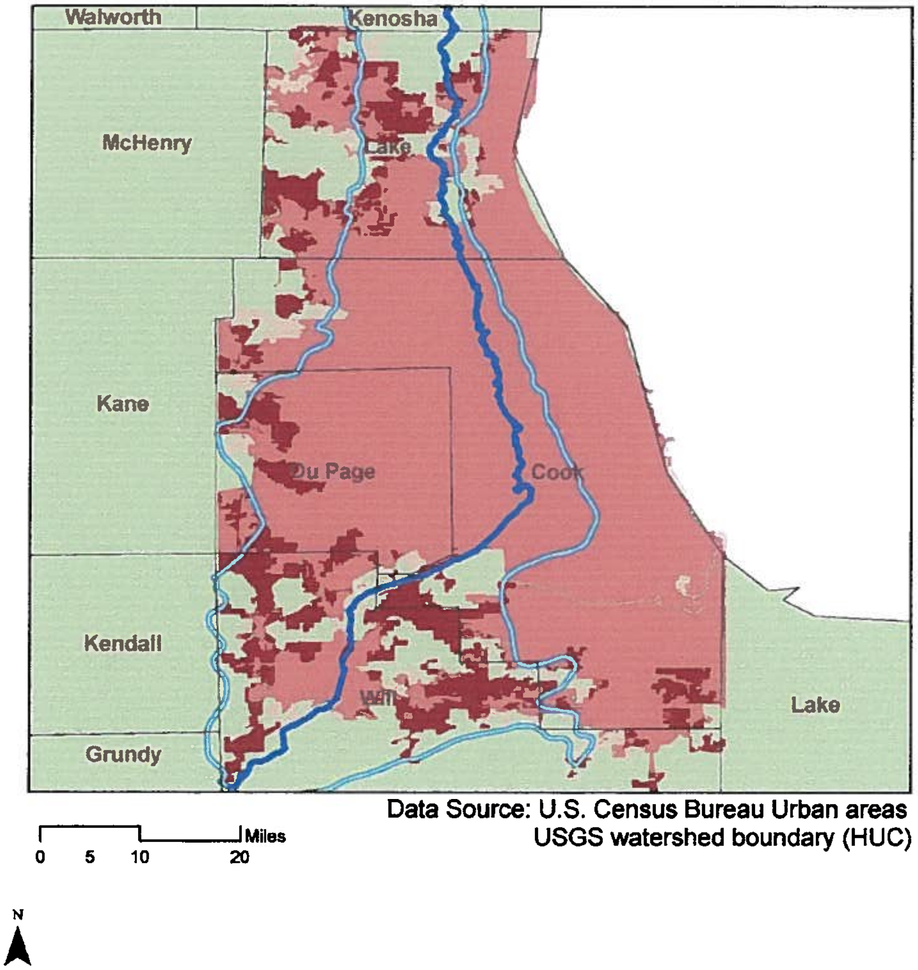
Land Use and Recent Development in the Des Plaines Watershed



Data Source: USGS MRLC NLCD 1992/2001 Retrofit Change Product

Figure B-1. Estimated land converted to urban land use between 1992 and 2001 based on a comparison of the NLCD 1992 and 2001 datasets (USGS, MRLC NLCD 1992/2001 Retrofit Change Product).

Urban Area Boundary Expansion 1990-2000
Cook, Dupage, Lake and Will Counties (IL)



Data Source: U.S. Census Bureau Urban areas
USGS watershed boundary (HUC)

Figure B-2. U.S. Census urban boundary change between 1990 and 2000 census for Cook, Du Page, Lake, and Will counties in Illinois.

The following three figures are from the Chicago Metropolitan Agency for Planning (CMAP) Data Bulletin: 2001 Land Use Inventory for Northeastern Illinois, September 2006 (www.cmap.illinois.gov).

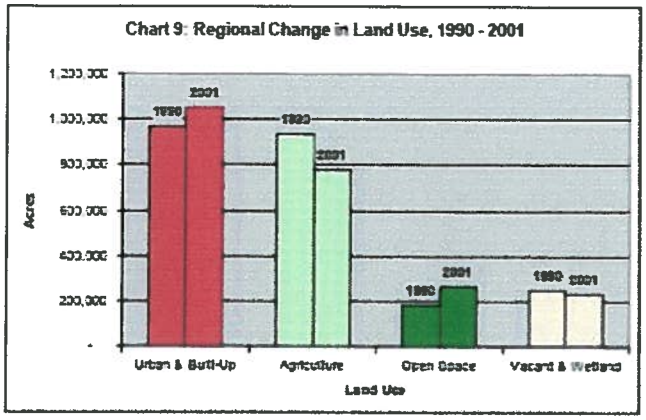


Figure B-3. Regional change in land use from 1990-2001.

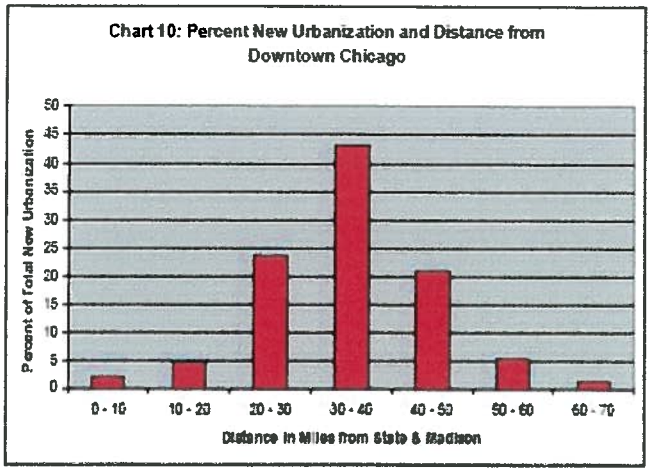


Figure B-4. Percent new urbanization and distance from downtown Chicago.

Map 10: "Urbanized" Lands (2001) Classified as "Agriculture" or "Vacant" in 1990

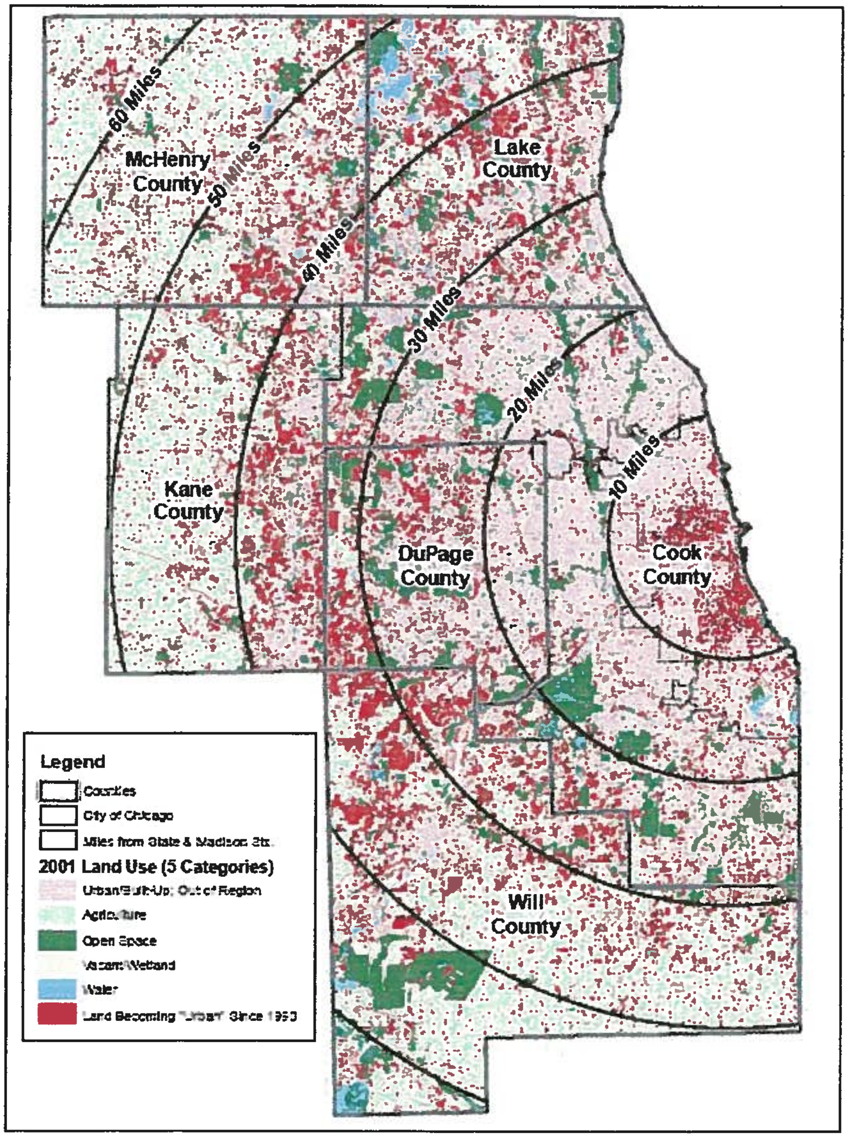
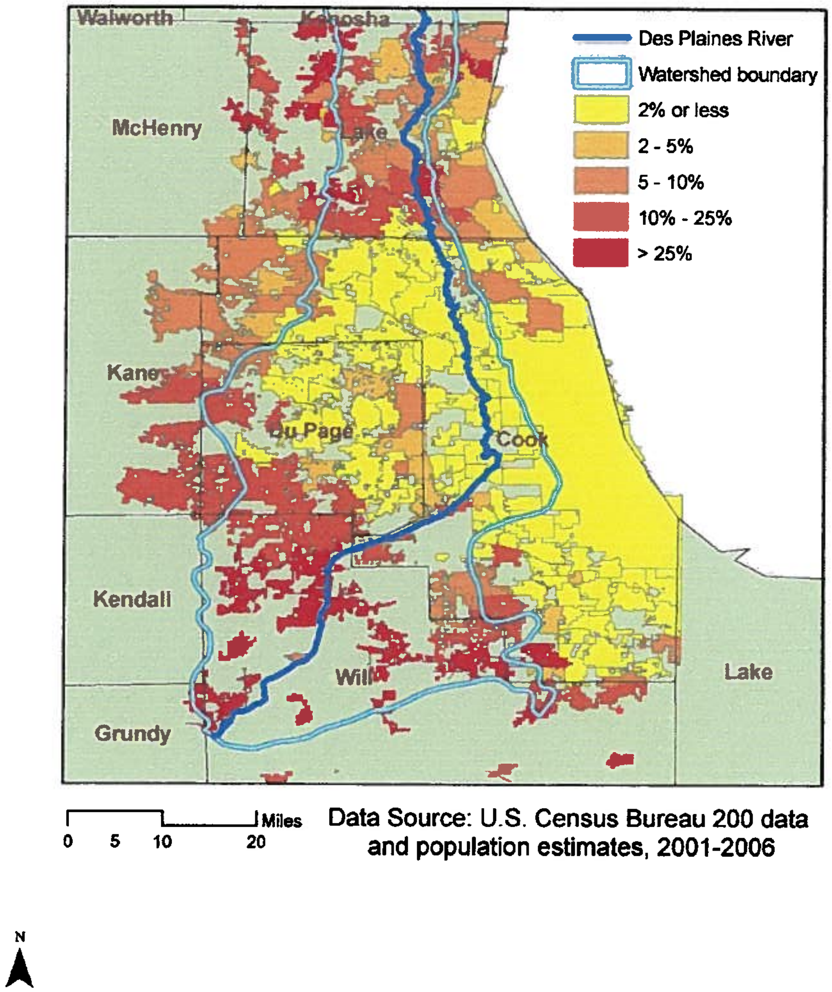


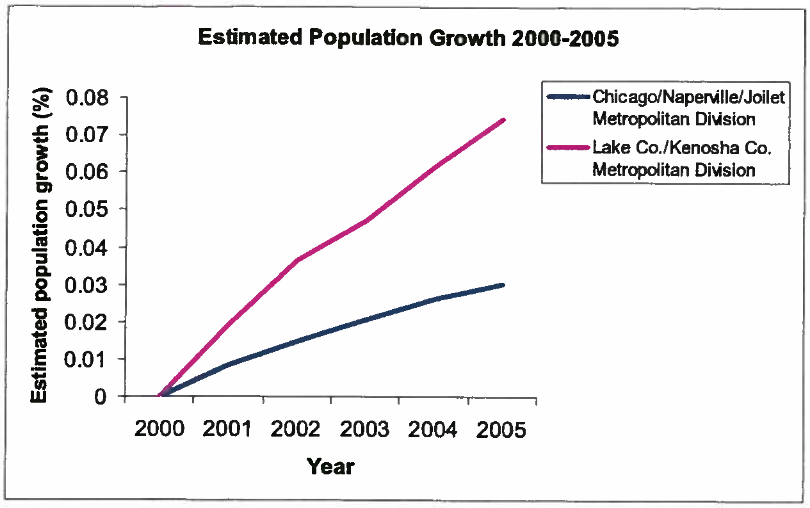
Figure B-5. Urban lands in 2001 that were agricultural or vacant in 1990. The 2001 land use data was compiled from interpretation of aerial photography and other sources).

% Population Increase in Municipalities 2000-2006



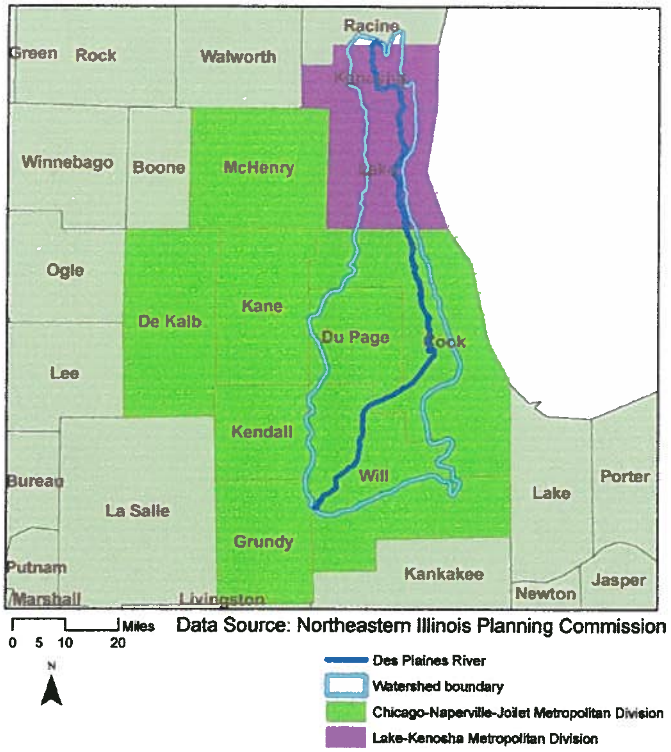
Data Source: U.S. Census Bureau 200 data and population estimates, 2001-2006

Figure B-6. U.S. Census estimated population increase (%) in municipalities from year 2000 to 2006.



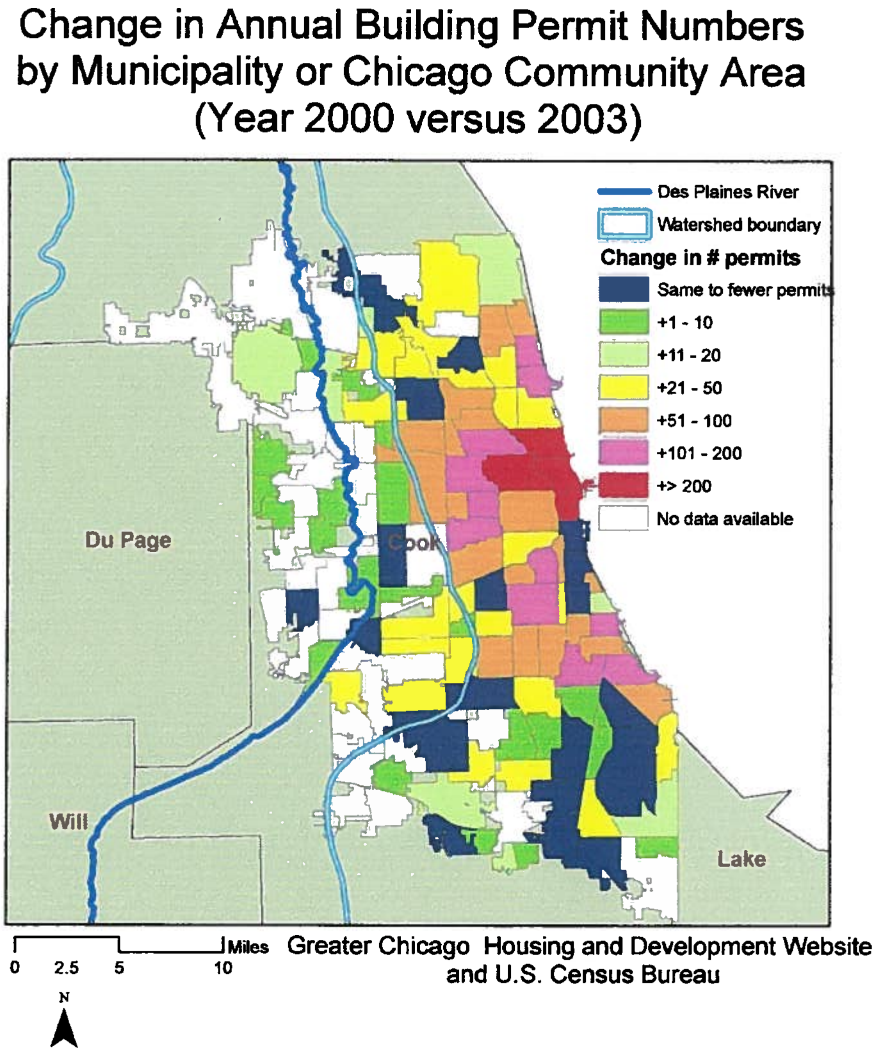
** See metropolitan divisions in figure below*

Metropolitan Division Areas



Data Source: Northeastern Illinois Planning Commission

Figure B-7 (a+b). Estimated population growth (2000-2005, U.S. Census Bureau) by Metropolitan Division (Northeastern Illinois Planning Commission).



Change in Annual Building Permit Numbers by Municipality or Chicago Community Area (Year 2000 versus 2003)

Greater Chicago Housing and Development Website and U.S. Census Bureau

Figure B-8. Change in number of annual building permits (year 2000 versus 2003) for municipalities and communities of the Greater Chicago area.

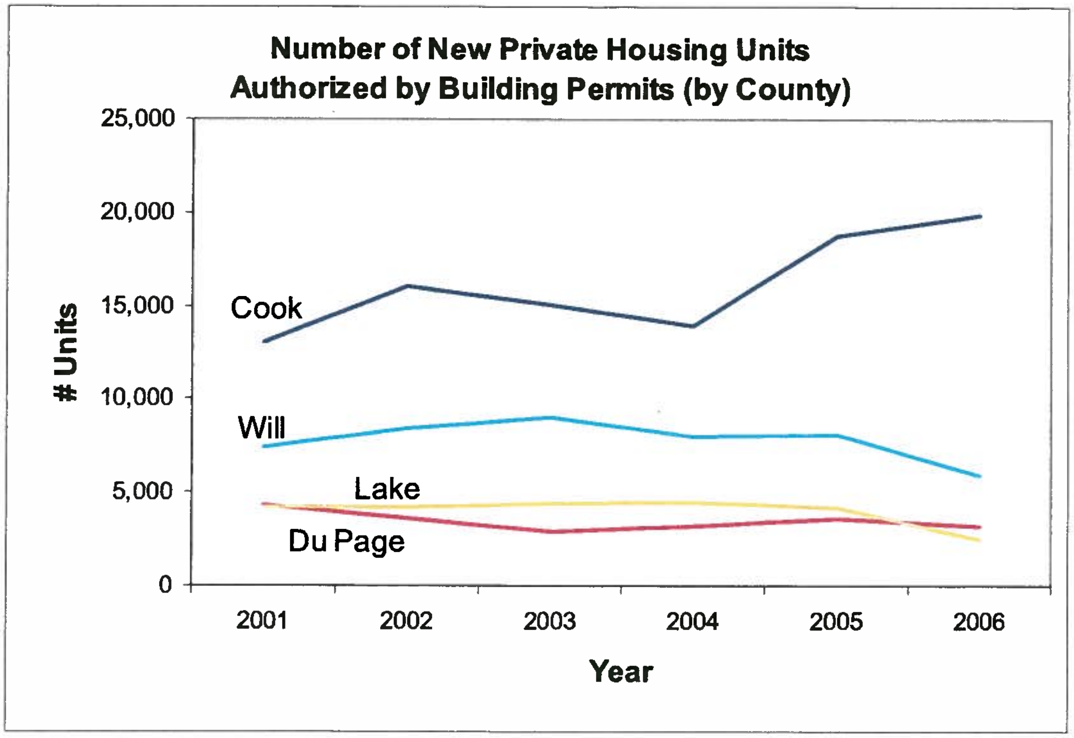


Figure B-9. Number of new private housing units authorized by building permits (2001-2006) for Cook, Du Page, Lake, and Will Counties (U.S. Census Bureau).

Combined Sewer Overflow Figures:
According to the Metropolitan Water Reclamation District of Greater Chicago, from January 1, 2006 to June 13, 2008 (latest MWRD data update), there were a combined total of 117 combined sewer overflows reported at the four major pumping stations of North Branch, Racine Ave., Westchester, and 125th St. There have been 17 system-wide CSO events (multiple stations per event) this summer (June 3 – August 6, 2008).

Individual maps of reaches with CSO events by date for 2008 to the present can be accessed at www.mwrdgc.dst.il.us/CSO/display_only.aspx These maps are updated the day following an overflow event. The seven most current daily maps are retained online with the oldest being deleted when a new map is added.

APPENDIX C

EA Engineering, Science, and Technology Report on Sediment Chemistry

SEDIMENT CHEMISTRY STUDY

UPPER ILLINOIS WATERWAY, DRESDEN AND LOWER BRANDON POOLS

Prepared for

Nijman Franzetti LLP
10 S. LaSalle St.
Suite 3600
Chicago, IL 60603

Prepared by

EA Engineering, Science, and Technology
444 Lake Cook Rd.
Suite 18
Deerfield, IL 60015
(847) 945-8010

September 2008

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SEDIMENT CHEMISTRY STUDY

UPPER ILLINOIS WATERWAY, DRESDEN AND LOWER BRANDON POOLS

EA Engineering, Science, and Technology conducted a sediment study in Dresden Pool and the lower portion of Brandon Pool, which includes the Des Plaines, Kankakee, and Illinois Rivers (i.e., the study area) (**Figure 1**). The purpose of this project was to determine if the sediment chemistry of the study area may preclude the attainment of a higher aquatic life use. Results of this sediment analysis were compared to sediment benchmarks and previous sediment sampling efforts in the same study area. Sampling locations were targeted in areas adjacent to the main channel of the river that would potentially provide suitable aquatic habitat. Therefore, sampling locations tended to be in shallow areas with lower water velocities and the potential for higher rates of fine-grained sediment deposition.

Thirty-five (35) sediment samples – 31 in the Dresden Pool and four in the Lower Brandon Pool – were collected for physical and chemical characterization (**Figure 1**). The physical composition of the sediment was described by total organic carbon, total solids (percent moisture), and grain size (sieve and hydrometer). The target analytes for the chemical determination of the sediment were: arsenic, silver, cadmium, chromium, copper, lead, mercury, nickel, zinc, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCB congeners).

1. FIELD SAMPLING

Sediment samples were collected using a petite, stainless steel Ponar grab sampler. At each location, five discrete grab samples were collected, combined in a stainless steel container, and gently homogenized using a stainless steel spoon/spatula. General observations of the sediment, including color and odor, were noted in the field log book (**Appendix A**), and digital photographs (**Appendix B**) and GPS coordinates (**Table 1**) were collected at each location.

Sediment samples were collected from 31 sites in the Dresden Pool and four in the Lower Brandon Pool between 6 May and 9 May 2008. Two field duplicate samples were collected – one from location DR08-11 and one from location DR08-28 – and submitted for chemical analysis. Multiple grabs (five) were collected at each location and homogenized to form one sample for each site. Each sample was homogenized in a stainless steel bowl using a stainless steel spoon until the sediment was thoroughly mixed and of uniform consistency. When compositing was completed, sub-samples of sediment were removed for bulk chemistry testing.

The homogenized material was transferred into appropriate labeled containers and each container was sealed with a custody seal. Once sealed, the sample containers were placed in a cooler on wet ice and documented on a chain of custody form. All equipment that came in contact with the sediment was decontaminated between each location (see **Section 2.4**). Sediment samples were kept in a cooled, insulated cooler onboard the workboat during each work day. At the end of each day, coolers were appropriately packed, iced, and shipped by overnight courier to the laboratory with chain of custody (COC) documentation.

Sediment samples were shipped via overnight delivery to the analytical laboratory, TestAmerica–Pittsburgh, on the day of collection. The sample containers, preservatives, and holding time requirements for sediment samples are provided in **Table 2-1**. Holding times for the sediment samples began when the sediment was collected, homogenized, and placed in the appropriate sample containers.

Sample Documentation

A log of field activities, sampling location coordinates, site observations, and sediment recoveries were recorded in a permanently bound, dedicated field logbook (**Appendix A**). Personnel names, local weather conditions, and other information that may impact the field sampling program were also recorded. Each page of the logbook was numbered and dated by the personnel entering information.

A sample numbering system was used to communicate between the field crew and the analytical laboratory. Sampling locations and samples were numbered as follows:

Example: DR08-01

The first two letters denote the site designation (DR=Dresden Reach; BR=Brandon Reach), the next two digits denote the sampling year (08=year 2008), and the last two digits indicate the sampling location number.

Table 1. Sediment Sampling Locations in the Dresden and Lower Brandon Pools

Sample ID	Date Sampled	Northing (m)	Easting (m)
		Illinois East NAD83	
DRESDEN POOL			
DR08-01	5/6/2008	525571.56	304526.11
DR08-02	5/6/2008	525297.55	305069.83
DR08-03	5/6/2008	524167.37	306199.93
DR08-04	5/6/2008	523905.67	307041.08
DR08-05	5/6/2008	524149.62	307200.08
DR08-06	5/6/2008	524200.28	308708.26
DR08-07	5/6/2008	524024.17	308799.00
DR08-08	5/6/2008	525951.89	309184.50
DR08-09	5/6/2008	525848.05	309429.79
DR08-10	5/6/2008	525895.80	309742.74
DR08-11	5/6/2008	527391.25	310137.04
DR08-12	5/6/2008	527559.48	310717.80
DR08-13	5/6/2008	527437.18	311063.46
DR08-14	5/7/2008	527750.97	311542.61
DR08-15	5/7/2008	528202.60	312423.72
DR08-16	5/7/2008	528301.38	312425.35
DR08-17	5/7/2008	529093.41	313371.70
DR08-18	5/7/2008	529752.25	314044.20
DR08-19	5/7/2008	530313.47	314050.10
DR08-20	5/7/2008	530791.69	313816.52
DR08-21	5/7/2008	530828.70	314066.66
DR08-22	5/7/2008	532283.21	313855.07
DR08-23	5/7/2008	533534.28	314667.19
DR08-24	5/7/2008	533613.87	315436.00
DR08-25	5/8/2008	534546.85	316278.60
DR08-26	5/8/2008	534824.74	316663.47
DR08-27	5/8/2008	535537.06	317628.58
DR08-28	5/8/2008	536176.57	318479.56
DR08-29	5/9/2008	536667.62	319046.21
DR08-30	5/9/2008	536568.31	319522.71
DR08-31	5/9/2008	536567.16	319485.10
LOWER BRANDON POOL			
BR08-01	5/8/2008	537485.12	320111.97
BR08-02	5/8/2008	537246.47	319934.34
BR08-03	5/8/2008	537195.15	319237.12
BR08-04	5/8/2008	537352.76	319435.33

Equipment Blanks

Equipment blanks were collected to determine the extent of contamination, if any, from the sampling equipment used as part of the project. Four equipment blanks were collected for the project, one during each day of the sampling. Equipment blanks are collected by pouring deionized water, which was provided by EA's Ecotoxicology Laboratory, over the petit Ponar grab sampler that was decontaminated using the procedure outlined in **Section 2.4**. The rinsate water was placed in laboratory-prepared containers, submitted to TestAmerica–Pittsburgh via overnight delivery, and tested for the same chemical parameters as the sediments.

Equipment Decontamination Procedures

Equipment that came into direct contact with sediment during sampling was decontaminated prior to deployment in the field to minimize cross-contamination. This included the petit Ponar sampler and stainless steel processing equipment (spoons, knives, and bowls). Any equipment that was reused in the field was decontaminated on-board the sampling boat between sample locations. While performing the decontamination procedure, phthalate-free nitrile gloves were used to prevent phthalate contamination of the sampling equipment or the samples.

The decontamination procedure utilized is described below:

- Rinse equipment using site water
- Rinse with 10 percent nitric acid (HNO_3)
- Rinse with distilled or de-ionized water
- Rinse with methanol followed by hexane
- Rinse with distilled or de-ionized water
- Air dry (in area not adjacent to the decontamination area)

Waste liquids produced during decontamination procedures were contained at the areas of decontamination. Decontamination waste liquid produced on-board the boat were collected in 5-gallon buckets with lids and returned to EA's warehouse facility for proper disposal.

Table 2. Required Containers, Preservation Techniques, and Holding Times for Sediment Samples [(a)]

Parameter	Volume Required [(b)]	Container[(c)]	Preservative	Holding Time
Inorganics				
Metals (including Mercury)	8 oz.	G	4°C	6 months (28 days for Hg)
Physical Parameters				
Grain Size and Total Solids	32 oz	P,G	4°C	6 months
Organics				
Total Organic Carbon	(d)	G	4°C	14 days
PCB Congeners	4 oz.	G	4°C	14 days until extraction, 40 days from extraction to analysis
PAHs	(d)	G	4°C	14 days until extraction, 40 days from extraction to analysis

Source: USEPA/USACE 1995

(a) From time of sample collection.
(b) Additional volume will be provided for samples designated as MS/MSDs.
(c) P = plastic; G = glass.
(d) Sufficient volume is provided from the 8 oz noted under Metals.

Table 3. Required Containers, Preservation Techniques, and Holding Times for Aqueous Samples (Equipment Blanks) [(a)]

Parameter	Volume Required [(b)]	Container[(c)]	Preservative	Holding Time
Inorganics				
Metals (including Mercury)	1 Liter	P	pH<2 with HNO3 Cool, 4°C	6 months (28 days for Hg)
Organics				
Total Organic Carbon	3- 40mLs	G, teflon lined, speta cap	H_2SO_4 or HCl to pH<2; Cool, 4°C	28 days
PAHs and PCB Congeners	4 Liters	G, Teflon lined cap	Cool, 4°C	7 days until extraction, 40 days from extraction to analysis

Source: USEPA/USACE 1995

(a) From time of sample collection.
(b) Additional volume will need to be provided for samples designated as MS/MSD/MDs
(c) P = plastic; G = glass.

2. ANALYTICAL TESTING PROGRAM

Samples collected during the field effort were tested for target analytes using analytical methods listed in **Table 4** as described in the laboratory's analytical standard operating procedures (SOP). Sediment samples were tested for the following analytes:

- Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc)
- PAHs,
- PCB congeners,
- total organic carbon (TOC),
- grain size, and
- total solids.

Table 4. Analytical Methods for Sediment Analysis

Analyte	Analytical Method
Sediment	
Metals	SW846 6020
Mercury	SW846 7471A
Polynuclear Aromatic Hydrocarbons (PAHs)	SW846 8270C SIM
Polychlorinated Biphenyls (PCB) Congeners	SW846 8082
Total Organic Carbon	Lloyd Khan
Grain Size	ASTM D422
Total Solids	SM 2540B

To meet program-specific regulatory requirements for chemicals of concern, all methods/SOPs were followed as stated with some specific requirements noted below:

PCB Congeners

PCBs for this project were analyzed and quantified as individual congeners by SW846 Method 8082. Twenty-six (26) PCB congeners were determined in the various matrices. These 26 congeners include all of the "summation" and "highest priority" congeners, plus several of the "secondary priority" congeners.

Total Organic Carbon (TOC)

TOC in sediments was determined using the 1988 EPA Region II combustion oxidation procedure (referred to as the Lloyd Kahn procedure).

Polynuclear Aromatic Hydrocarbons – PAHs

To achieve the target detection limits (TDLs) referenced in QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations - Chemical Evaluations (EPA 823-B-95-001, April 1995), the PAHs were determined utilizing SW846 Method 8270C using Selective Ion Monitoring (SIM).

Metals

Metals were determined utilizing Inductively Coupled Plasma (ICP) or Inductively Coupled Plasma/Mass Spectrometry (ICP/MS) according to the SW846 Method 6020, with the exception of mercury. For mercury, samples will be analyzed by Cold Vapor Atomic Absorption (CVAA) method [SW846 7470A (aqueous) or 7471A (sediment)].

2.1 Laboratory Quality Control Samples

Project specific [matrix spike (MS) / matrix spike duplicates (MSD)] and internal laboratory QA/QC samples (including method blanks, laboratory control samples, and surrogates) were analyzed. Quality control samples were analyzed at the frequency stated in **Table 5**. Standard Reference Materials (SRMs) were obtained from the National Institute of Standards and Technology (NIST) or a comparable source, if available.

Table 5. Laboratory QC Samples

QC Sample	Frequency
Standard Reference Material	1 per analytical batch of 1-20 samples, where available
Method Blanks	1 per analytical batch of 1-20 samples
Laboratory Control Sample	1 per analytical batch of 1-20 samples
Surrogates	Spiked into all field and QC samples (Organic Analyses)
Sample Duplicates	1 per analytical batch of 1-20 samples (Inorganic Analyses)
Matrix Spike/Matrix Spike Duplicate	1 per analytical batch of 1-20 samples

The following internal laboratory QA/QC samples were analyzed for this project:

- **Standard reference materials** (SRMs) represent performance-based QA/QC. A standard reference material is a soil/solution with a certified concentration that is analyzed as a sample and is used to monitor analytical accuracy. SRMs were analyzed for the PCB congeners and PAHs in sediment. Control criteria apply only to those analytes having SRM true values greater than 10 times the MDL established for the method.

- The **method (reagent) blank** was used to monitor laboratory contamination. The method blank is usually a sample of laboratory reagent water processed through the same analytical procedure as the sample (i.e., digested, extracted, distilled). One method blank was analyzed at a frequency of one per every analytical preparation batch of 20 or fewer samples.

- The **Laboratory Control Sample** (LCS) is a fortified method blank consisting of reagent water or solid fortified with the analytes of interest for single-analyte methods or selected analytes for multi-analyte methods according to the appropriate analytical method. LCS's were prepared and analyzed with each analytical batch, and analyte recoveries were used to monitor analytical accuracy and precision.

- A **sample duplicate** is a second aliquot of a field sample that is analyzed to monitor analytical precision associated with that particular sample. Sample duplicates were performed for every batch of 20 or fewer samples.

- **Surrogates** are organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromatography, but are not normally found in environmental samples. These compounds were spiked into all blanks, standards, samples, and spiked samples prior to analysis for organic parameters. Generally, surrogates are not used for inorganic analyses. Percent recoveries were calculated for each surrogate. Surrogates were spiked into samples according to the requirements of the reference analytical method. Surrogate spike recoveries were evaluated against the standard laboratory acceptance criteria limits, and were used to assess method performance and sample measurement bias. If sample dilution caused the surrogate concentration to fall below the quantitation limit, surrogate recoveries were not calculated.

2.2 Detection Limits

The detection limit is a statistical concept that corresponds to the minimum concentration of an analyte above which the net analyte signal can be distinguished with a specified probability from the signal because of the noise inherent in the analytical system. The method detection limit (MDL) was developed by USEPA and is defined as "the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero" (40 CFR 136, Appendix B). The reporting limit (RL) is the lowest concentration at which an analyte can be detected in a sample and its concentration can be reported with a reasonable degree of accuracy and precision. The RL is typically three to five times higher than the MDL and is determined based on corrections necessary for sample dilutions, percent moisture in the sample (for sediments), and sample weight.

Samples collected during the field effort were tested for target analytes using analytical methods and target detection limits (TDLs) for sediment and water (equipment blanks) listed in in the *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations - Chemical Evaluations* (EPA 823-B-95-001, April 1995). All analytical parameters, except total organic carbon (TOC), were quantified to the MDL. All detected values greater than or equal to the MDL, but less than the laboratory RL, were qualified as estimated. TOC samples were quantified to the laboratory RL. For sediment analyses, sample weights were adjusted for percent moisture (up to 50% moisture), where appropriate, prior to analysis to achieve the lowest possible reporting limits.

3. DATA ANALYSIS

3.1 Calculation of Total PCBs and Total PAHs

For each sample, total PCB concentrations were determined by summing the concentrations of the 18 summation congeners and multiplying the total by a factor of two. Multiplying by a factor of two estimated the total PCB concentration and accounted for additional congeners that were not tested as part of this program. These determinations were based upon testing of specific congeners recommended in the Inland Testing Manual (ITM) (USEPA/USACE 1998) and upon the National Oceanic and Atmospheric Administration (NOAA 1993) approach for total PCB determinations.

Total PAH concentrations were determined for each sample by summing the concentrations of the individual PAHs. For both the total PCB and total PAH concentrations, two values were reported, each representing the following methods for treating concentrations below the analytical detection limit:

- Non-detects = 0 (ND=0)
- Non-detects = 1/2 of the method detection limit (ND=½MDL)

Substituting one-half the method detection limit for non-detects (ND=½MDL) provides a conservative estimate of the concentration. This method, however, tends to produce results that are biased high, especially in data sets where the majority of samples are non-detects. This overestimation is important to consider when comparing the calculated total values to criteria values.

3.2 Comparison to Sediment Benchmarks

Sediment quality guidelines are numerical chemical concentrations intended to either be protective of biological resources or predictive of adverse effects to those resources, or both (Wenning and Ingersoll 2002). The SQGs were developed as informal (non-regulatory) guidelines for use in interpreting chemical data from analyses of sediments. One of the biological-effects approaches that have been used to assess sediment quality relative to the potential for adverse effects on benthic organisms in freshwater ecosystems is the Threshold Effects Concentration (TEC) / Probable Effects Concentration (PEC) approach (MacDonald et al. 1996). These sediment quality guidelines were used to identify potential adverse biological effects associated with contaminated sediments. TECs typically represent concentrations below which adverse biological effects are not expected to occur, while PECs typically represent concentrations in the middle of the effects range and above which effects are expected to occur more often than not (Macdonald et al. 2000). Concentrations that are between the TEC and PEC represent the concentrations at which adverse biological effects occasionally occur.

4. VISUAL OBSERVATIONS OF SEDIMENT

At each sampling location, the sediment was photograph and described, and any noticeable petroleum odors or sheens in the sediment were recorded in the logbook (**Appendix A**). The results of the field observations indicated that the sediments were comprised of a mixture of fine grained sands, silts, and clays. Sediment from the majority of the sampling locations had both sheen and an odor, as summarized in **Table 6**.

Table 6. Summary of field observations of the sediment in the Dresden and Lower Brandon Pools.

LOCATION	WATER DEPTH (ft)	SEDIMENT FIELD DESCRIPTION	SHEEN	ODOR
DR08-01	4.9	Dark brown to gray silt	X	X
DR08-02	4.1	Dark to light gray silt with sand and clay	X	--
DR08-03	2.8	Light gray sand with silt	--	--
DR08-04	3.9	Light gray silt with sand	X	X
DR08-05	2.6	Light gray with fine-grained sands	X	X
DR08-06	4.8	Light gray clayey silt	--	X
DR08-07	4.8	Dark gray to black fine grained silt with clay	--	--
DR08-08	3.3	Light gray fine-grained silt	--	--
DR08-09	6.2	Gray silt with fine-grained sand	--	--
DR08-10	2.3	Dark brown sandy silt	X	X
DR08-11	3.8	Dark brown sandy silt	X	X
DR08-12	1.7	Dark gray silty sand	--	X
DR08-13	4.2	Dark gray clayey silt	X	X
DR08-14	3.1	Dark gray sandy silt	X	X
DR08-15	5.7	Gray clayey silt	X	X
DR08-16	3.8	Dark gray to black clayey silt	X	X
DR08-17	3.4	Dark gray silt with fine grained sands	X	X
DR08-18	4.1	Black silt	X	X
DR08-19	3.1	Dark brown silt with medium grained sands	--	--
DR08-20	1.1	Dark gray sandy silt	X	X
DR08-21	2.1	Dark brown to gray sandy silt	X	X
DR08-22	2.3	Dark brown sandy silt	X	X
DR08-23	5.2	Dark brown sandy silt	X	X
DR08-24	2.8	Dark brown sandy silt	X	X
DR08-25	1.8	Dark brown sandy silt	X	X
DR08-26	2.0	Dark brown sandy silt	X	X
DR08-27	2.3	Dark brown sandy silt	X	X
DR08-28	1.9	Dark gray sandy silt	X	X
DR08-29	0.8	Dark gray sandy silt	X	X
DR08-30	2.2	Dark gray sandy silt	X	X
DR08-31	0.9	Dark gray sandy silt	--	X
BR08-01	3.6	Dark gray silt with fine-grained sands	X	X
BR08-02	4.7	Dark gray silt	X	X
BR08-03	1.6	Dark gray silt	X	X
BR08-04	2.1	Dark gray silt with fine-grained sands	X	X

5. SEDIMENT CHEMISTRY RESULTS

The results of the physical and chemical analysis of samples from Dresden pool are summarized in **Table 7**, and the results for samples from the Lower Brandon pool are summarized in **Table 8**. The target analytes for the physical and chemical description of the sediment were total organic carbon, total solids (percent moisture), grain size, metals (arsenic, silver, cadmium, chromium, copper, lead, mercury, nickel, and zinc), PAHs, and PCB congeners. Sample weights were adjusted for percent moisture (up to 50 percent moisture) prior to analysis to achieve the lowest possible detection limits. Analytical results are reported on a dry weight basis.

Analytical results and definitions of organic and inorganic data qualifiers are provided in **Tables 7 and 8**. Values for detected chemical constituents are shaded and bolded in the data tables, and RLs/MDLs are presented for non-detected chemical constituents. Analytical narratives that included an evaluation of laboratory quality assurance/quality control results and copies of final raw data sheets (Form I's) were provided by the laboratory. TestAmerica–Pittsburgh will retain and archive the results of these analyses for seven years from the date of issuance of the final results.

Concentrations of tested metals, PAHs, and PCB congeners were elevated in the sediments collected in both the Dresden and the Lower Brandon pools, and comparisons to TECs and PECs indicated that detected concentrations of metals, PAHs, and total PCBs had concentrations between the TEC and the PEC at almost every sampling location (**Tables 9 and 10**). In the Dresden pool, detected concentrations for the metals exceeded PEC values at several locations (**Table 9**): cadmium – 12 locations (39 percent); chromium – 6 locations (19 percent); copper – 4 locations (13 percent); lead – 9 locations (29 percent); mercury - 4 locations (13 percent); nickel – 9 locations (29 percent); and zinc – 9 locations (29 percent). For the tested organic constituents in the Dresden pool, total PAH concentrations (ND=1/2MDL) exceeded PEC concentrations at a total of 19 locations (61 percent) and total PCB concentrations (ND=1/2MDL) exceeded PEC concentrations at a total of 8 locations (26 percent) (**Table 9**).

In the Lower Brandon pool, detected concentrations of each of the metals, with the exception of arsenic, copper, and mercury, and the total PAH and total PCB concentrations (ND=1/2MDL) exceeded PEC values in each of the four samples (**Table 10**).

The sediment chemical analysis indicated that both the Dresden and the Lower Brandon pools had high concentrations of metals (Figure 2) and tested organic constituents (Figure 3), indicating that large portions of the Dresden and Lower Brandon Pools are of poor sediment quality. Detected concentrations were frequently higher than the PEC value, which is the concentration above which adverse biological effects are expected to occur more often than not (MacDonald et al. 2000). These data indicate that the sediment quality in this portion of the Dresden Pool and the lower portion of Brandon Pool would overall be characterized as poor.

For metals (**Figure 2**), only two sampling locations did not exceed the TEC for the suit of eight metals evaluated (DR08-02 and DR08-03). All other sample locations exceeded at least the TEC for a minimum of five metals and many exceeded the PEC for a majority of the eight metals evaluated (**Tables 9 and 10**). There is a clustering of sediments with elevated metal concentrations (concentrations that exceed the PEC) at three groups of locations - locations BR08-01 through BR08-04; locations DR08-13, DR08-15, and DR08-16; and locations DR08-24 through DR08-26 (**Figure 2**).

Lower quality sediments as determined by exceeding the TECs and PECs for total PAHs and total PCBs were observed at all sample locations for PAHs and all but one sample location (DR08-03) for PCBs (**Figure 3**). Similar to the metals data, a clustering of the sample locations with the poorest sediment quality (concentrations that exceed the PEC for both PAHs and PCBs) were observed at three groups of locations – locations BR08-01 through BR08-04; locations DR08-04, DR08-15, and DR08-16; and locations DR08-18, DR08-20 and DR08-21 (**Figure 3**).

6. COMPARISON TO HISTORICAL DATA

Data from this study was compared to the results of sediment sampling conducted in the same study area in 1994-1995 (Burton 1995) and metals data from three locations as compiled by MWRDGC (2007). Sampling locations in this study were targeted in areas adjacent to the main channel of the river that would potentially provide suitable aquatic habitat. Therefore, sampling locations tended to be in shallow areas with lower water velocities and higher rates of fine-grained sediment deposition. Most chemicals in the environment, including metals, PAHs, and PCBs, tend to be particle reactive, binding to sediment particles in the water column and are subsequently deposited along with the sediment particles, predominately in areas where water velocities decrease, allowing for increased rates of deposition and organic matter accumulation.

Similar to previous studies (Burton et al. 1995, MWRDGC 2007), this study also indicates that the sediments in the Dresden and the Lower Brandon pools have poor sediment quality. To determine whether the sediment quality at specific locations has improved since the 1994-1995, 18 of those locations were re-sampled in this study, and the detected concentrations of metals and PAHs were compared (**Table 11**). Sediment samples in most riverine systems have a high degree of spatial heterogeneity, making it often difficult to make absolute determinations of sediment quality improvement over time when comparing samples from different sampling events. The results of the sampling effort during the 2008 study in comparison to the 1994-1995 study are provided as a weight of evidence type approach and should be considered as the total system rather than simply focusing on specific sampling locations.

For the detected metals, the majority of the detected concentrations from the 2008 study are either higher or within a factor of two or less, indicating that overall, the sediment quality has essentially remained the same or has degraded in several areas (**Table 11**). When environmental samples are compared using the weight of evidence approach, a factor of two is a general rule of thumb to determine if sample concentrations are similar when compared. For sediment samples with metal concentrations that exceeded either the TEC or the PEC, the concentrations in the 2008 study were often less than a factor of two compared to the results of the 1994-1995 study.

A direct comparison of the PAH and PCB data between the 2008 study and the 1994-1995 study is complicated by the vast improvements in instrumentation commercially available and techniques for detecting specific PAHs and PCBs. Many of the individual organic parameters had considerably higher detection limits in the 1994-1995 study than in the 2008 study. Based on the results in **Table 11**, it is our opinion that the differences are not improvement of the sediment quality, but rather improvements in detection limits and are most likely similar between the two sampling periods. Regardless of this discrepancy, concentrations of total PAHs and total PCBs were elevated in both studies, with concentrations that commonly exceeded TEC and PEC values, further evidence that the overall sediment quality in the Dresden and the Lower Brandon pools is poor.

This comparison indicates that, overall, the metals concentrations were generally comparable between the two sampling efforts, and concentrations of total PAHs and total PCBs were elevated in both years. While given the fact that the sampling efforts for both the 1994-1995 and 2008 studies were not set up with an experimental design to allow trend analysis or statistical analysis, there was no clear trend to indicate that the sediment quality of the Dresden and Lower Brandon pools was either greatly improving or degrading between the 1994-1995 study and the 2008 study. However, the results do indicate that the sediment quality remains poor, as evidenced by the high number of sampling locations that exceeded the PECs for many of the metals (**Figure 2**), and total PAHs and total PCBs (**Figure 3**); and that almost all sampling locations had concentrations that were between the TEC and the PEC. It is our opinion that the system has not substantially improved with regards to sediment quality over the last 13 years.

7. REFERENCES

Burton, G.A. 1995. The Upper Illinois Waterway Study, 1994-1995 Sediment Contamination Assessment. Prepared for the Commonwealth Edison Company, Chicago, Illinois. Final.

MacDonald, D.D., R.S. Carr, F.D. Calder, E.R. Long, and C.G. Ingersoll. 1996. Development and Evaluation of Sediment Quality Guidelines for Florida Coastal Waters. *Ecotoxicology* 5:253-278.

MacDonald D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

Metropolitan Water Reclaimation District of Great Chicago (MWRDGC). 2007. Water and sediment quality along the Illinois Waterway from the Lockport Lock to the Peoria Lock during 2006. Report No. 07-39. January 2008.

National Oceanic and Atmospheric Administration (NOAA). 1993. *Sampling and Analytical Methods of the National Status and Trends Program: National Benthic Surveillance and Mussel Watch Projects 1984-1992. Vol 1: Overview and Summary of Methods.* NOAA Tech. Memo. NOS ORCA 71. Silver Spring, MD.

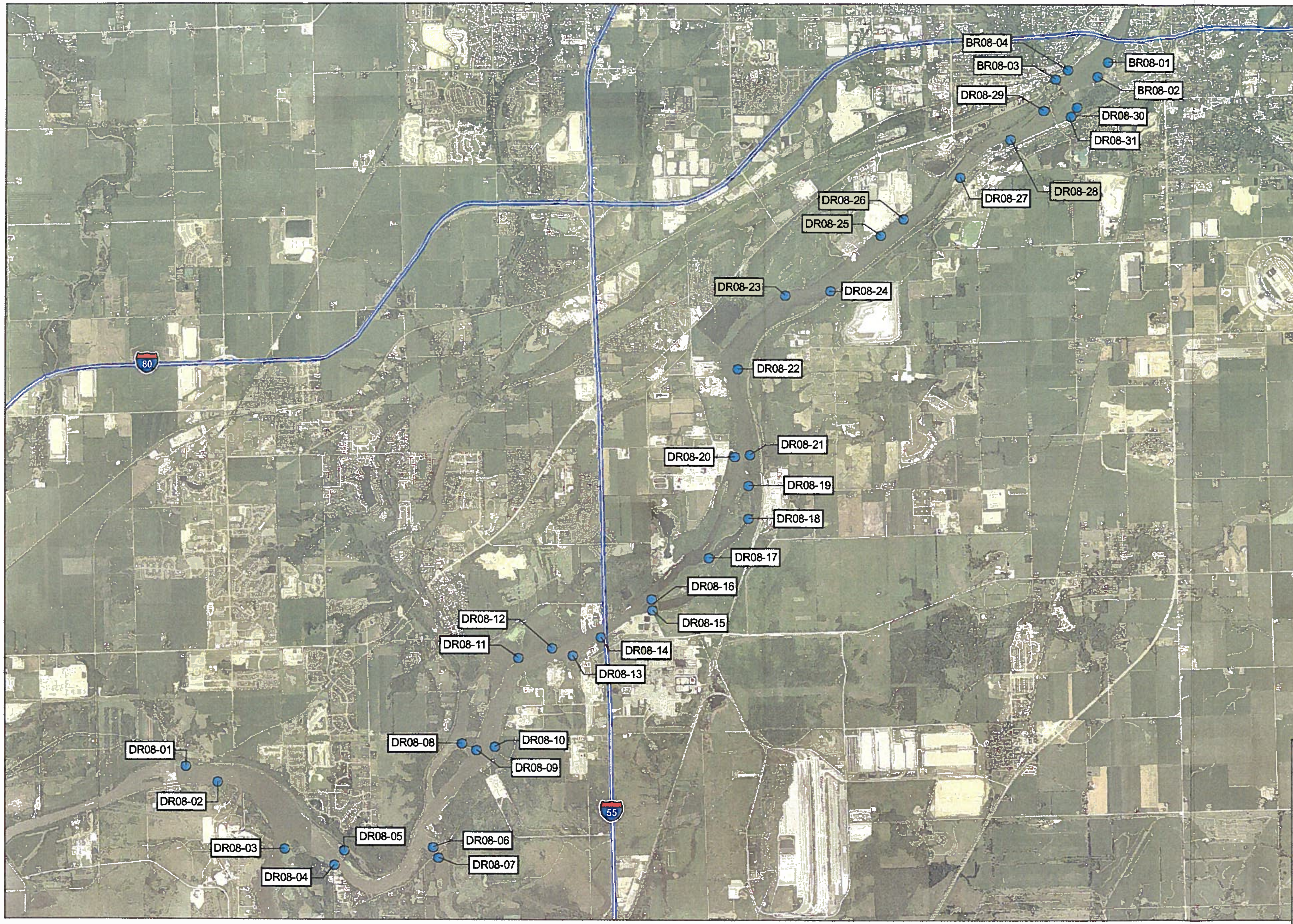
U.S. Environmental Protection Agency (USEPA). 2001 *Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual.* Office of Water. EPA-823-B-01-002. October.

U.S. Environmental Protection Agency (USEPA). 1997. *Test Methods for Evaluating Solid Waste. Physical/Chemical Methods.* 3rd Edition, including final update III. EPA SW-846, Washington D.C.

U.S. Environmental Protection Agency (USEPA) / U.S. Army Corps of Engineers (USACE). 1998. *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S.- Testing Manual (Inland Testing Manual).* EPA-823-B-98-004.

U.S. Environmental Protection Agency (USEPA) / U.S. Army Corps Engineers (USACE). 1995. *QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations.* EPA-823-B-95-001.

Wenning, R.J. and C.G. Ingersoll. 2002. *Summary of the SETAC Pellston Workshop on Use of Sediment Quality Guidelines and Related Tools for the Assessment of Contaminated Sediments*; 17-22 August 2002. Fairmount, Montana, USA. Society of Toxicology and Chemistry (SETAC). Pensacola, FL, USA.



Legend

● Field Sampling Location, May 2008

"Sample Identification"

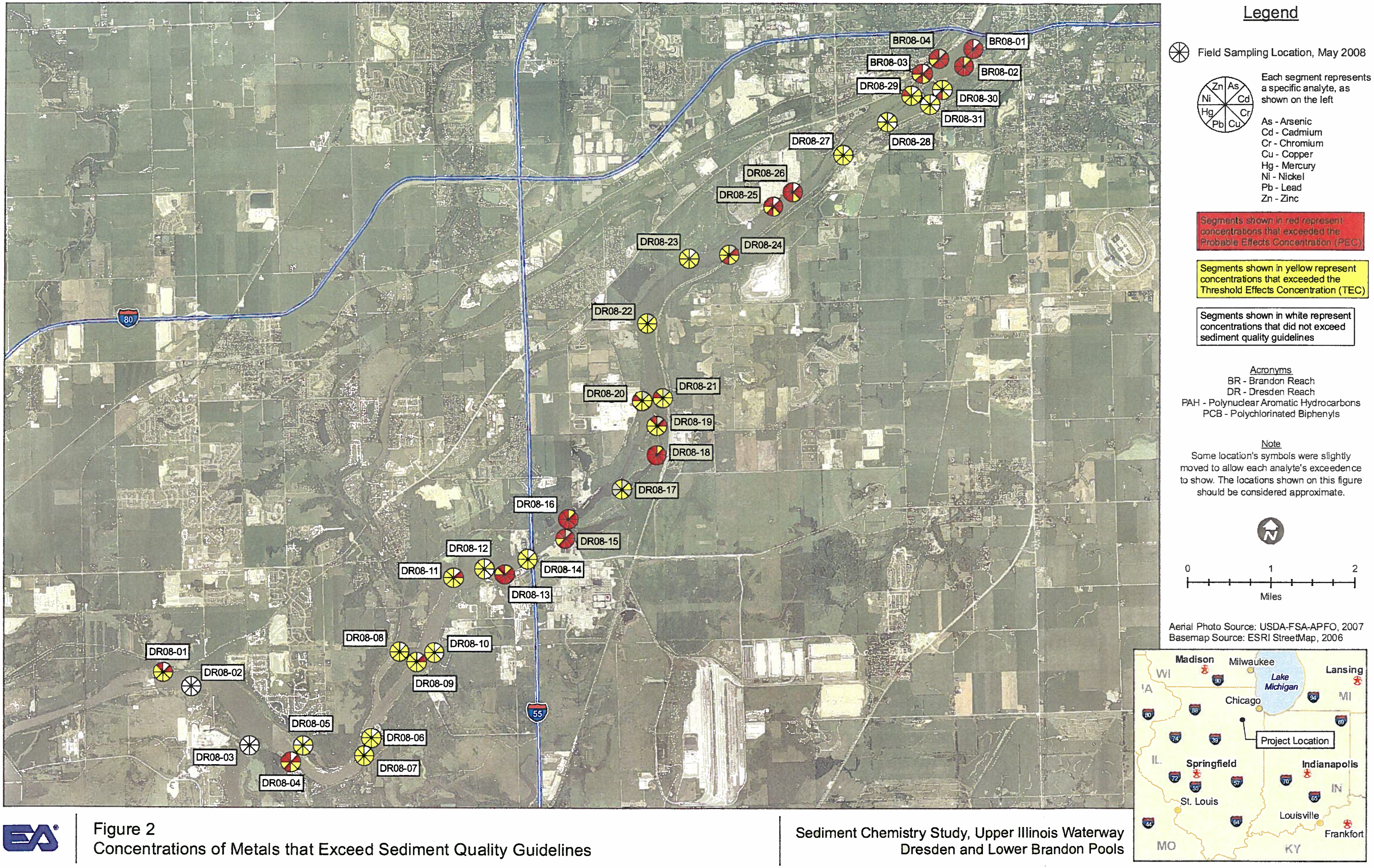
Acronyms
BR - Brandon Reach
DR - Dresden Reach

0 1 2
Miles

Aerial Photo Source: USDA-FSA-APFO, 2007
Basemap Source: ESRI StreetMap, 2006

Figure 1
Sediment Sampling Locations in the Dresden and Lower Brandon Pools

Sediment Chemistry Study, Upper Illinois Waterway
Dresden and Lower Brandon Pools



Legend

Field Sampling Location, May 2008

Each segment represents a specific analyte, as shown on the left

As - Arsenic
Cd - Cadmium
Cr - Chromium
Cu - Copper
Hg - Mercury
Ni - Nickel
Pb - Lead
Zn - Zinc

🟥 Segments shown in red represent concentrations that exceeded the Probable Effects Concentration (PEC)

🟨 Segments shown in yellow represent concentrations that exceeded the Threshold Effects Concentration (TEC)

⬜ Segments shown in white represent concentrations that did not exceed sediment quality guidelines

Acronyms
BR - Brandon Reach
DR - Dresden Reach
PAH - Polynuclear Aromatic Hydrocarbons
PCB - Polychlorinated Biphenyls

Note
Some location's symbols were slightly moved to allow each analyte's exceedence to show. The locations shown on this figure should be considered approximate.

Aerial Photo Source: USDA-FSA-APFO, 2007
Basemap Source: ESRI StreetMap, 2006

Figure 2
Concentrations of Metals that Exceed Sediment Quality Guidelines

Sediment Chemistry Study, Upper Illinois Waterway
Dresden and Lower Brandon Pools

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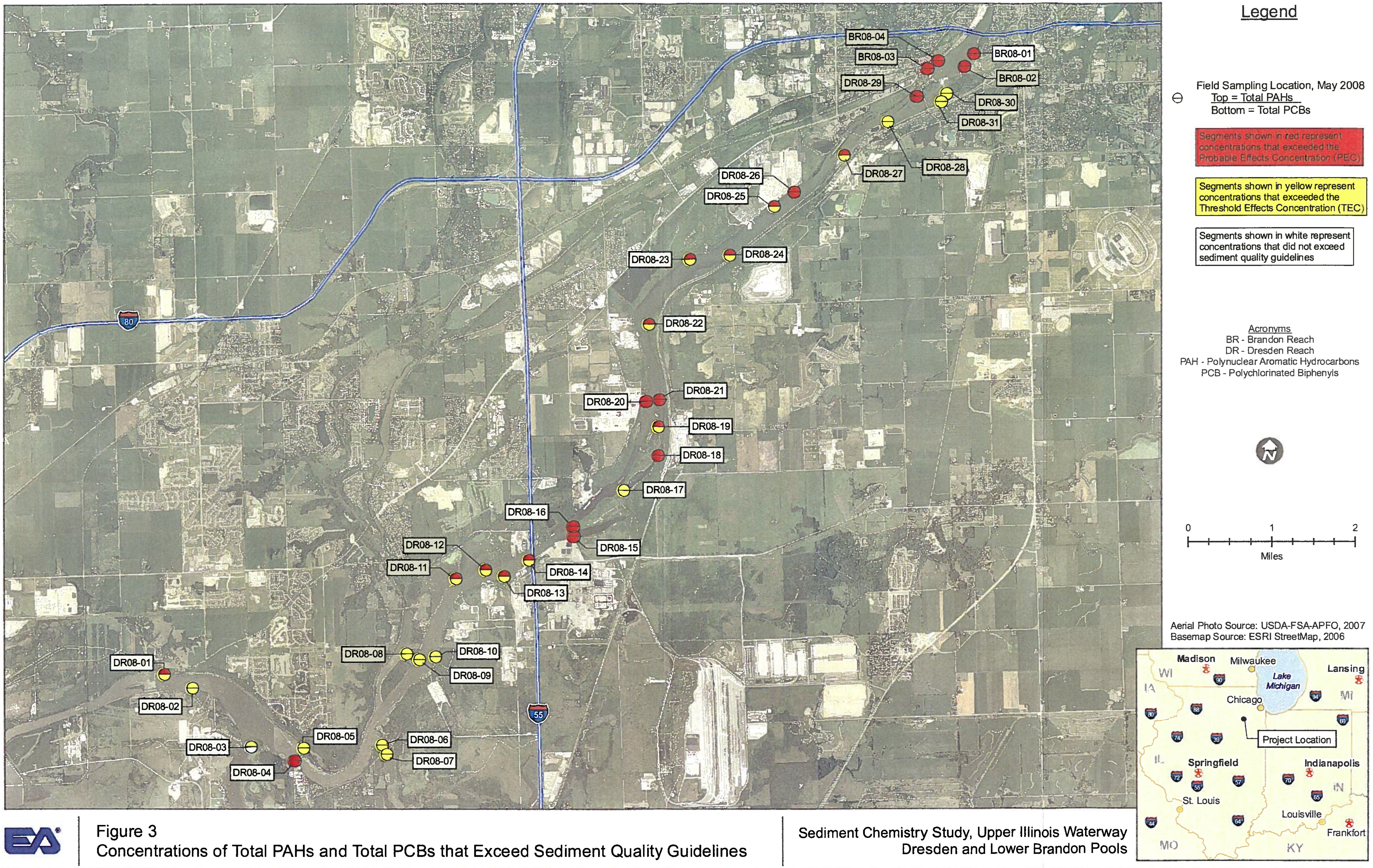

Aerial Photo Source: USDA-FSA-APFO, 2007
Basemap Source: ESRI StreetMap, 2006

Figure 3
Concentrations of Total PAHs and Total PCBs that Exceed Sediment Quality Guidelines

Sediment Chemistry Study, Upper Illinois Waterway
Dresden and Lower Brandon Pools

C:\WORK\1458102\MXD\Figure3

TABLE 7A. CONCENTRATIONS OF TARGET ANALYTES IN SEDIMENT

DRESDEN POOL, MAY 2008

ANALYTE	UNITS	RL	TEC*	PEC*	DR08-01	DR08-02	DR08-03	DR08-04	DR08-05	DR08-06	DR08-07	DR08-08	DR08-09	DR08-10	DR08-11	DR08-11FD	DR08-12	DR08-13	DR08-14	DR08-15	DR08-16
TOTAL ORGANIC CARBON	MG/KG	0.90	--	--	**41,400**	**24,400**	**6,700**	**28,700**	**21,800**	**26,500**	**33,200**	**15,700**	**23,700**	**14,500**	**23,600**	**16,600**	**13,200**	**29,400**	**13,300**	**26,300**	**28,300**
PERCENT SOLIDS	%	--	--	--	32.8	45.9	66.9	39	54.6	31.1	32.7	41.3	46.2	57.5	53.5	53.1	66.9	43.3	54.8	35.9	36.4
GRAVEL	%	--	--	--	0.0	0.0	0.0	0.7	0.7	0.0	0.0	0.0	0.4	0.1	0.1	0.7	0.0	2.9	1.5	0.0	0.8
SAND	%	--	--	--	16.3	50.3	73.1	25.1	51.1	2.2	4.3	6.2	49.5	67.4	62.3	60.1	88.2	39.9	61.7	9.9	21.0
COARSE SAND	%	--	--	--	0.2	0.3	0.1	1.0	2.2	0.0	0.0	0.1	0.3	0.3	3.1	2.8	1.0	0.4	1.4	0.0	1.8
MEDIUM SAND	%	--	--	--	0.6	2.7	3.5	4.0	4.4	0.1	0.2	0.5	3.8	3.3	11.7	11.3	14.4	6.5	9.1	1.7	6.0
FINE SAND	%	--	--	--	15.5	47.3	69.5	20.1	44.5	2.1	4.1	5.6	45.4	63.8	47.5	46.0	72.8	33.0	51.2	8.2	13.2
SILT	%	--	--	--	64.4	27.4	21.0	58.4	38.6	69.8	73.3	75.1	36.0	22.8	28.7	28.7	6.6	30.2	26.4	61.8	47.2
CLAY	%	--	--	--	19.2	22.3	6.0	15.8	9.6	28.1	22.4	18.7	14.0	9.7	8.9	10.6	5.2	27.1	10.4	28.3	31.0
SILT+CLAY	%	--	--	--	83.6	49.7	27.0	74.2	48.2	97.9	95.7	93.8	50.0	32.5	37.6	39.3	11.8	57.3	36.8	90.1	78.2
ARSENIC	MG/KG	0.11	9.79	33	**8**	**4**	**2**	**6**	**3**	**3**	**4**	**4**	**5**	**3**	**5**	**5**	**3**	**26**	**4**	**6**	**13**
CADMIUM	MG/KG	0.11	0.99	4.98	**7.5**	**0.91**	**0.49**	**7.4**	**2.9**	**4.5**	**2.8**	**3.6**	**5.2**	**3**	**9.1**	**4.1**	**1.3**	**17.3**	**3.1**	**12.7**	**29.3**
CHROMIUM	MG/KG	0.22	43.4	111	**93.4 J**	**16.6 J**	**7.5 J**	**106 J**	**34.6 J**	**59.2 J**	**45.9 J**	**46.4 J**	**59.5 J**	**34 J**	**56.2 J**	**54.5 J**	**27.2 J**	**196 J**	**51.9 J**	**158 J**	**301 J**
COPPER	MG/KG	0.22	31.6	149	**112**	**19.1**	**7.5**	**123**	**43.8**	**67.8**	**52**	**62.3**	**72.9**	**42.5**	**56.9**	**60**	**28.7**	**185**	**64**	**161**	**214**
LEAD	MG/KG	0.11	35.8	128	**125**	**22.2**	**10.1**	**143**	**54.4**	**85.7**	**72.3**	**65.8**	**97.8**	**67.3**	**90.5**	**90.8**	**46.8**	**311**	**110**	**176**	**312**
MERCURY	MG/KG	0.05	0.18	1.06	**0.72**	**0.12**	**0.031**	**0.63**	**0.24**	**0.56**	**0.27**	**0.29**	**0.45**	**0.44**	**0.56**	**0.45**	**0.72**	**3.1**	**0.3**	**0.79**	**1.5**
NICKEL	MG/KG	0.11	22.7	48.6	**37.2**	**12.2**	**7.5**	**50.5**	**22.7**	**24.3**	**29.3**	**29**	**37.5**	**23.8**	**41.1**	**45**	**27.2**	**36.3**	**25**	**64.7**	**106**
SILVER	MG/KG	0.11	--	--	**2.3**	**0.35**	**0.062**	**2.7**	**0.97**	**2.1**	**1.2**	**1.3**	**1.3**	**0.82**	**0.94**	**0.83**	**0.36**	**4.5**	**1.1**	**4.3**	**7**
ZINC	MG/KG	0.54	121	459	**519 J**	**84.7 J**	**44 J**	**611 J**	**213 J**	**264 J**	**225 J**	**296 J**	**455 J**	**267 J**	**354 J**	**356 J**	**204 J**	**836 J**	**314 J**	**655 J**	**1280 J**
ACENAPHTHENE	UG/KG	204	--	--	**300**	**130 J**	130 U	**320**	**220**	**210 J**	**160 J**	**160**	**250**	**210**	**490**	**400**	**250**	**3,000**	**390**	**220**	**800**
ACENAPHTHYLENE	UG/KG	204	--	--	**700**	**360**	**140**	**770**	**340**	**380**	**240**	**290**	**710**	**710**	**1,700**	**1,400**	**840**	**7,900**	**2,400**	**830**	**1,200**
ANTHRACENE	UG/KG	204	57	845	**820**	**390**	**140**	**870**	**410**	**440**	**270**	**320**	**650**	**650**	**1,500**	**1,300**	**740**	**14,000**	**2,300**	**910**	**1,700**
BENZO(A)ANTHRACENE	UG/KG	204	108	1,050	**2,000**	**1,900**	**57 J**	**2,300**	**1,000**	**770**	**210**	**740**	**1,900**	**1,800**	**5,300**	**5,300**	**3,200**	**84,000**	**9,500**	**2,600**	**6,300**
BENZO(A)PYRENE	UG/KG	204	150	1,450	**2,700**	**1,900**	**130**	**2,900**	**1,200**	**1,000**	**360**	**1,100**	**2,500**	**2,400**	**7,000**	**6,300**	**3,900**	**73,000**	**11,000**	**3,400**	**4,900**
BENZO(B)FLUORANTHENE	UG/KG	204	--	--	**3,100**	**2,200**	**210**	**3,500**	**1,400**	**1,400**	**560**	**1,400**	**2,700**	**2,700**	**6,500**	**6,500**	**4,000**	**74,000**	**16,000**	**5,200**	**7,800**
BENZO(GHI)PERYLENE	UG/KG	204	--	--	**2,100**	**1,200**	**61 J**	**2,200**	**840**	**840**	**220**	**880**	**1,900**	**1,800**	**4,700**	**4,300**	**2,600**	**36,000**	**8,900**	**3,000**	**4,300**
BENZO(K)FLUORANTHENE	UG/KG	204	--	--	**1,300**	**770**	**41 J**	**1,200**	**550**	**430**	**140 J**	**510**	**1,100**	**820**	**3,400**	**2,700**	**1,300**	**35,000**	130 U	47 U	92 U
CHRYSENE	UG/KG	204	166	1,290	**2,700**	**2,200**	**70 J**	**2,800**	**1,300**	**920**	**280**	**1,100**	**2,300**	**2,300**	**6,100**	**5,600**	**3,900**	**83,000**	**11,000**	**3,600**	**7,200**
DIBENZO(A,H)ANTHRACENE	UG/KG	204	33	--	**620**	**410**	130 U	**650**	**250**	**230**	**77 J**	**210**	**550**	**500**	**1,300**	**1,200**	**680**	**9,000**	**2,400**	**590**	**950**
FLUORANTHENE	UG/KG	204	423	2,230	**3,100**	**1,500**	**340**	**3,300**	**1,800**	**1,400**	**720**	**1,400**	**2,500**	**2,300**	**5,200**	**4,900**	**2,600**	**110,000**	**9,800**	**5,100**	**15,000**
FLUORENE	UG/KG	204	77	536	**680**	**390**	130 U	**590**	**400**	**560**	200 U	**430**	**490**	**460**	**750**	**620**	**430**	**5,800**	**620**	**340**	**1,100**
INDENO(1,2,3-CD)PYRENE	UG/KG	204	--	--	**1,900**	**1,200**	**70 J**	**1,900**	**790**	**740**	**250**	**820**	**1,600**	**1,600**	**4,200**	**3,900**	**2,400**	**35,000**	**7,600**	**2,500**	**3,200**
NAPHTHALENE	UG/KG	204	176	561	**240**	**38 J**	130 U	**200**	**89 J**	**87 J**	200 U	**69 J**	**130 J**	**140**	**370**	**370**	**110 J**	**990 J**	**470**	**380**	**390**
PHENANTHRENE	UG/KG	204	204	1,170	**1,200**	**410**	**100 J**	**1,300**	**470**	**520**	**200**	**490**	**880**	**810**	**2,000**	**1,700**	**690**	**12,000**	**3,000**	**1,600**	**1,400**
PYRENE	UG/KG	204	195	1,520	**2,900**	**1,200**	**98 J**	**3,100**	**1,700**	**1,200**	**330**	**1,400**	**2,200**	**2,000**	**4,400**	**3,900**	**2,100**	**90,000**	**7,200**	**3,800**	**11,000**
TOTAL PAHs (ND=0)	UG/KG	---	1,610	22,800	**26,360**	**16,198**	**1,457**	**27,900**	**12,759**	**11,127**	**4,017**	**11,319**	**22,360**	**21,200**	**54,910**	**50,390**	**29,740**	**672,690**	**92,580**	**34,070**	**67,240**
TOTAL PAHs (ND=1/2RL)	UG/KG	---	1,610	22,800	**26,360**	**16,198**	**1,717**	**27,900**	**12,759**	**11,127**	**4,217**	**11,319**	**22,360**	**21,200**	**54,910**	**50,390**	**29,740**	**672,690**	**92,645**	**34,094**	**67,286**
TOTAL PAHs (ND=RL)	UG/KG	---	1,610	22,800	**26,360**	**16,198**	**1,977**	**27,900**	**12,759**	**11,127**	**4,417**	**11,319**	**22,360**	**21,200**	**54,910**	**50,390**	**29,740**	**672,690**	**92,710**	**34,117**	**67,332**

*_Source_ : MacDonald et al. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

NOTE: Shaded and bold values indicate parameters for detected constituents. Values not shaded or bold represent non-detected concentrations reported at the RL/MDL.
Physical parameters (ie., grain size and TOC) are reported as percent total sample.

RL = average reporting limit
TEC = Threshold Effect Concentration
PEC = Probable Effect Concentration
FD = field duplicate
B (organic) = detected in the laboratory method blank
J (organic) = compound was detected, but below the reporting limit (value is estimated)
J (inorganic) = detected in the laboratory method blank
U = compound was analyzed, but not detected
COL = more than 40% difference between initial and confirmation results; the lower result is reported
EST = estimated value

TABLE 7A. CONCENTRATIONS OF TARGET ANALYTES IN SEDIMENT

DRESDEN POOL, MAY 2008

ANALYTE	UNITS	RL	TEC*	PEC*	DR08-17	DR08-18	DR08-19	DR08-20	DR08-21	DR08-22	DR08-23	DR08-24	DR08-25	DR08-26	DR08-27	DR08-28	DR08-28FD	DR08-29	DR08-30	DR08-31
TOTAL ORGANIC CARBON	MG/KG	0.90	--	--	**15,100**	**43,900**	**25,600**	**70,800**	**15,100**	**47,400**	**37,000**	**37,500**	**33,500**	**73,000**	**24,800**	**21,400**	**26,300**	**83,500**	**45,000**	**21,500**
PERCENT SOLIDS	%	--	--	--	47.7	39.8	40.1	61.3	58.6	58.3	57.7	49.4	57	50.6	57.3	67.3	66.2	54	57.8	59.7
GRAVEL	%	--	--	--	5.3	0.0	1.7	0.6	0.0	1.0	0.4	0.0	0.0	0.0	2.8	1.1	1.3	0.6	0.0	0.2
SAND	%	--	--	--	28.4	32.5	53.2	85.2	80.9	74.4	71.9	55.6	62.7	44.9	67.2	80.8	79.4	63.3	41.5	41.9
COARSE SAND	%	--	--	--	0.6	0.6	1.9	1.8	1.1	2.3	3.3	0.5	0.8	0.2	2.3	3.7	5.6	3.6	1.1	4.1
MEDIUM SAND	%	--	--	--	3.0	2.4	8.4	14.8	9.0	16.9	15.8	2.8	4.6	2.4	11.0	21.2	20.0	18.1	7.9	11.3
FINE SAND	%	--	--	--	24.8	29.5	42.9	68.6	70.8	55.2	52.8	52.3	57.3	42.3	53.9	55.9	53.8	41.6	32.5	26.5
SILT	%	--	--	--	50.6	44.3	34.3	10.0	13.4	16.8	21.8	34.5	32.5	48.1	24.9	14.8	15.5	22.8	43.0	40.1
CLAY	%	--	--	--	15.6	23.2	10.9	4.2	5.7	7.7	5.9	10.0	4.7	7.1	5.1	3.3	3.9	13.3	15.4	17.8
SILT+CLAY	%	--	--	--	66.2	67.5	45.2	14.2	19.1	24.5	27.7	44.5	37.2	55.2	30.0	18.1	19.4	36.1	58.4	57.9
ARSENIC	MG/KG	0.11	9.79	33	**4**	**17**	**6**	**5**	**4**	**4**	**3**	**8**	**4**	**6**	**4**	**3**	**3**	**6**	**10**	**9**
CADMIUM	MG/KG	0.11	0.99	4.98	**1.5**	**41.3**	**5**	**4.9**	**3.9**	**3.4**	**3.7**	**7.3**	**5.5**	**7.9**	**4.4**	**1.7**	**1.7**	**3.7**	**2.2**	**2**
CHROMIUM	MG/KG	0.22	43.4	111	**28 J**	**355 J**	**77.3 J**	**79.1 J**	**55.3 J**	**47.4 J**	**57.3 J**	**71.3 J**	**125 J**	**147 J**	**56.5 J**	**34.1 J**	**33.1 J**	**57.2 J**	**19.8 J**	**33.2 J**
COPPER	MG/KG	0.22	31.6	149	**37.4**	**284**	**87**	**57.7**	**58.5**	**48.5**	**73.1**	**81.7**	**97.5**	**140**	**68.4**	**38.2**	**32.7**	**49.6**	**103**	**47.2**
LEAD	MG/KG	0.11	35.8	128	**39.8**	**366**	**127**	**100**	**92.3**	**83.9**	**86.9**	**138**	**222**	**215**	**89.9**	**51.1**	**56.7**	**98.7**	**241**	**105**
MERCURY	MG/KG	0.05	0.18	1.06	**0.13**	**3.3**	**0.58**	**0.48**	**0.66**	**0.51**	**0.32**	**0.87**	**0.97**	**2.6**	**0.3**	**0.24**	**0.13**	**0.29**	**0.15**	**0.24**
NICKEL	MG/KG	0.11	22.7	48.6	**18.2**	**90.6**	**38**	**77.2**	**49.4**	**45.7**	**35.3**	**29.1**	**57.2**	**56.4**	**34.1**	**21.5**	**21.7**	**55.1**	**32.1**	**22.7**
SILVER	MG/KG	0.11	--	--	**0.6**	**8.4**	**1.5**	**0.97**	**0.81**	**0.79**	**1.1**	**2.2**	**1.3**	**2.1**	**0.96**	**0.46**	**0.41**	**0.64**	**0.38**	**0.61**
ZINC	MG/KG	0.54	121	459	**145 J**	**1450 J**	**491 J**	**342 J**	**374 J**	**312 J**	**335 J**	**305 J**	**547 J**	**757 J**	**330 J**	**158 J**	**172 J**	**429 J**	**333 J**	**383 J**
ACENAPHTHENE	UG/KG	204	--	--	**51**	**2,600**	**340**	**1,700**	**910**	**1,600**	**580**	**670**	**1,600**	**910**	**410**	**130**	**130**	**620**	**47**	**36**
ACENAPHTHYLENE	UG/KG	204	--	--	**130**	**3,000**	**1,500**	**10,000**	**4,000**	**12,000**	**3,500**	**1,400**	**1,900**	**2,700**	**1,300**	**250**	**340**	**3,200**	**37**	**160**
ANTHRACENE	UG/KG	204	57	845	**140**	**6,600**	**1,300**	**5,800**	**4,200**	**11,000**	**6,900**	**1,400**	**4,000**	**3,000**	**1,200**	**590**	**420**	**3,000**	**140**	**130**
BENZO(A)ANTHRACENE	UG/KG	204	108	1,050	**500**	**18,000**	**4,600**	**43,000**	**13,000**	**93,000**	**25,000**	**5,200**	**16,000**	**12,000**	**5,800**	**1,900**	**1,200**	**12,000**	**590**	**570**
BENZO(A)PYRENE	UG/KG	204	150	1,450	**580**	**15,000**	**5,400**	**45,000**	**15,000**	**86,000**	**22,000**	**4,800**	**18,000**	**15,000**	**7,200**	**1,400**	**1,300**	**12,000**	**590**	**600**
BENZO(B)FLUORANTHENE	UG/KG	204	--	--	**720**	**17,000**	**8,000**	**45,000**	**19,000**	**92,000**	**22,000**	**6,100**	**25,000**	**13,000**	**9,600**	**2,100**	**1,900**	**16,000**	**880**	**820**
BENZO(GHI)PERYLENE	UG/KG	204	--	--	**520**	**11,000**	**3,000**	**31,000**	**12,000**	**55,000**	**14,000**	**3,700**	**13,000**	**11,000**	**4,500**	**730**	**510**	**9,300**	**360**	**380**
BENZO(K)FLUORANTHENE	UG/KG	204	--	--	**320**	**5,300**	42 U	**17,000**	130 U	**34,000**	**13,000**	68 U	320 U	**10,000**	64 U	32 U	33 U	310 U	32 U	34 U
CHRYSENE	UG/KG	204	166	1,290	**610**	**21,000**	**5,700**	**41,000**	**14,000**	**94,000**	**25,000**	**6,600**	**18,000**	**14,000**	**7,100**	**1,700**	**1,500**	**12,000**	**570**	**590**
DIBENZO(A,H)ANTHRACENE	UG/KG	204	33	--	**90**	**2,900**	**1,300**	**2,700**	**4,300**	**5,500**	**3,500**	**1,000**	**2,500**	**3,100**	**1,500**	**190**	**170**	**2,700**	**89**	**120**
FLUORANTHENE	UG/KG	204	423	2,230	**960**	**45,000**	**6,700**	**43,000**	**21,000**	**130,000**	**43,000**	**10,000**	**44,000**	**23,000**	**9,100**	**4,400**	**2,600**	**16,000**	**1,500**	**1,000**
FLUORENE	UG/KG	204	77	536	**64**	**4,800**	**430**	**1,500**	**1,100**	**2,000**	**940**	**920**	**1,800**	**1,200**	**460**	**210**	**160**	**570**	**51**	**57**
INDENO(1,2,3-CD)PYRENE	UG/KG	204	--	--	**450**	**8,400**	**3,000**	**27,000**	**11,000**	**50,000**	**13,000**	**3,000**	**12,000**	**10,000**	**4,600**	**730**	**550**	**8,200**	**360**	**340**
NAPHTHALENE	UG/KG	204	176	561	**50**	**1,100**	**390**	**1,100**	**870**	**1,400**	**570**	**270**	**970**	**1,300**	**460**	**94**	**120**	**720**	**29 J**	**38**
PHENANTHRENE	UG/KG	204	204	1,170	**300**	**10,000**	**2,000**	**3,900**	**5,600**	**7,700**	**11,000**	**1,500**	**19,000**	**8,100**	**2,200**	**1,600**	**760**	**2,900**	**510**	**400**
PYRENE	UG/KG	204	195	1,520	**700**	**32,000**	**4,200**	**32,000**	**12,000**	**85,000**	**28,000**	**6,300**	**24,000**	**13,000**	**5,000**	**2,200**	**1,400**	**8,900**	**710**	**640**
TOTAL PAHs (ND=0)	UG/KG	---	1,610	22,800	**6,185**	**203,700**	**47,860**	**350,700**	**137,980**	**760,200**	**231,990**	**52,860**	**201,770**	**141,310**	**60,430**	**18,224**	**13,060**	**108,110**	**6,463**	**5,881**
TOTAL PAHs (ND=1/2RL)	UG/KG	---	1,610	22,800	**6,185**	**203,700**	**47,881**	**350,700**	**138,045**	**760,200**	**231,990**	**52,894**	**201,930**	**141,310**	**60,462**	**18,240**	**13,077**	**108,265**	**6,479**	**5,898**
TOTAL PAHs (ND=RL)	UG/KG	---	1,610	22,800	**6,185**	**203,700**	**47,902**	**350,700**	**138,110**	**760,200**	**231,990**	**52,928**	**202,090**	**141,310**	**60,494**	**18,256**	**13,093**	**108,420**	**6,495**	**5,915**

**Source*: MacDonald et al. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

NOTE: Shaded and bold values represent detected concentrations.

Physical parameters (ie., grain size and TOC) are reported as percent total sample.

RL = average reporting limit	**B** (organic) = detected in the laboratory method blank
TEC = Threshold Effect Concentration	**J** (organic) = compound was detected, but below the reporting limit (value is estimated)
PEC = Probable Effect Concentration	**J** (inorganic) = detected in the laboratory method blank
FD = field duplicate	**U** = compound was analyzed, but not detected

COL = more than 40% difference between initial and confirmation results; the lower result is reported

EST = estimated value

TABLE 7B. CONCENTRATIONS OF TARGET ANALYTES IN SEDIMENT

DRESDEN POOL, MAY 2008

ANALYTE	UNITS	RL	TEC*	PEC*	DR08-01	DR08-02	DR08-03	DR08-04	DR08-05	DR08-06	DR08-07	DR08-08	DR08-09	DR08-10	DR08-11	DR08-11FD	DR08-12	DR08-13	DR08-14	DR08-15	DR08-16
PCB 8 *	UG/KG	1.42	--	--	**3.9**	1.1 U	0.97 U	**5.5 COL**	**1.9**	**2.2 EST**	1.5 U	**1.6 COL**	**2.5 COL**	**2.9**	**4.4 EST**	**4.9**	**2.3**	**1.8**	**3.7 EST**	**5.5 COL**	**2.8 COL**
PCB 18 *	UG/KG	1.42	--	--	**13**	**1.6**	0.97 U	**23**	**8.1**	**7**	**2.6**	**6.6**	**10**	**11**	**18**	**18**	**8.5**	**6.8**	**11**	**26**	**25 COL**
PCB 28 *	UG/KG	14.18	--	--	**28**	**3.2 J**	**0.7 J**	**38**	**16**	**19**	**6.8 J**	**14**	**19**	**21**	**29**	**29**	**16**	**9.6 J**	**23**	**51**	**38**
PCB 44 *	UG/KG	1.42	--	--	**27**	**2.8**	**0.81 J**	**37**	**15**	**17**	**6.3**	**15**	**19**	**19**	**26**	**25**	**14**	**9.8**	**19**	**49**	**53**
PCB 49	UG/KG	1.42	--	--	**25**	**2.8 COL**	**0.87 J**	**33**	**12**	**17**	**6.1**	**13**	**16**	**16**	**21**	**20**	**11**	**11**	**17**	**46**	**46**
PCB 52 *	UG/KG	1.42	--	--	**33**	**3.4**	**0.86 J**	**43**	**17**	**21**	**7.7**	**17**	**23**	**21**	**29**	**27**	**15**	**13**	**23**	**58**	**73**
PCB 66 *	UG/KG	1.42	--	--	**26**	**2.7**	**0.71 J**	**30**	**13**	**17**	**6.7**	**13**	**16**	**16**	**22**	**21**	**12**	**7.5**	**17**	**41**	**48**
PCB 77 *	UG/KG	1.42	--	--	**4.6**	**0.36 J COL**	0.97 U	**5.3**	**2.1 COL**	**2.9 COL**	**1.1 J COL**	**2.4 COL**	**2.9 COL**	**2.6**	0.93 U	**3.2**	**1.6**	**1.5 COL**	**2.8 COL**	**6.6 COL**	**7.4 COL**
PCB 87	UG/KG	1.42	--	--	**11 COL**	**1.3 COL**	**0.36 J COL**	**12 COL**	**5.5 COL**	**7.9 COL**	**3.1 COL**	**6.1 COL**	**7.9 COL**	**6.2 COL**	**7.9 COL**	**7.4 COL**	**4.3 COL**	**5.4 COL**	**6.7 COL**	**19 COL**	**33 COL**
PCB 90	UG/KG	1.42	--	--	1.5 U	1.1 U	0.97 U	1.3 U	1 U	1.6 U	1.5 U	1.2 U	1.1 U	0.96 U	0.93 U	0.94 U	0.97 U	1.2 U	1 U	1.4 U	2.8 U
PCB 101 *	UG/KG	1.42	--	--	**33 EST**	**3.4 EST**	**0.86 J EST**	**37 EST**	**15 EST**	**23 EST**	**8.4 EST**	**18 EST**	**23 EST**	**18 EST**	**22 COL**	**21 COL**	**11 EST**	**14 EST**	**19 COL**	**56 COL**	**86 EST**
PCB 105 *	UG/KG	1.42	--	--	**9.2**	**1.1**	0.97 U	**9.4**	**4.5**	**6.6**	**2.6**	**4.5**	**6.5**	**5.4**	**6.6**	**6.5**	**3.8**	**4.3**	**5.5**	**14**	**23**
PCB 118 *	UG/KG	1.42	--	--	**22**	**2.3**	**0.64 J**	**25**	**10**	**16**	**6**	**11**	**16**	**12**	**15**	**15**	**8.2**	**10**	**13**	**36**	**65**
PCB 126 *	UG/KG	1.42	--	--	1.5 U	1.1 U	0.97 U	1.3 U	1 U	1.6 U	1.5 U	1.2 U	1.1 U	0.96 U	0.93 U	0.94 U	0.97 U	1.2 U	1 U	1.4 U	2.8 U
PCB 128 *	UG/KG	1.42	--	--	**4.6**	**0.61 J**	**0.2 J**	**4.9**	**1.9**	**3.6**	**1.5**	**2.4**	**3.3**	**2.4**	**2.4**	**2.4**	**1.2**	**2.3**	**2.3**	**8.4**	**15**
PCB 138 *	UG/KG	1.42	--	--	**23**	**2.6 EST**	**0.65 J EST**	**23**	**9.3**	**17**	**6.7 EST**	**11**	**16**	**11**	**12**	**12**	**6.3**	**10**	**13**	**36**	**66**
PCB 153 *	UG/KG	1.42	--	--	**24**	**2.7**	**0.65 J COL**	**24**	**9.4**	**19**	**6.7**	**12**	**16**	**12**	**11**	**12**	**6.1**	**9.2**	**14**	**40**	**68**
PCB 156	UG/KG	1.42	--	--	**2.4**	**0.27 J**	0.97 U	**2.5**	**0.98 J**	**1.9**	**0.73 J**	**1.2**	**1.7**	**1.2**	**1.3**	**1.3**	**0.74 J**	**1.2**	**1.2**	**3.7**	**7.4**
PCB 169 *	UG/KG	1.42	--	--	1.5 U	1.1 U	0.97 U	1.3 U	1 U	1.6 U	1.5 U	1.2 U	1.1 U	0.96 U	0.93 U	0.94 U	0.97 U	1.2 U	1 U	1.4 U	2.8 U
PCB 170 *	UG/KG	1.42	--	--	**9.2 EST**	**1.1 EST**	**0.3 J EST**	**8.6 EST**	**3.2 EST**	**7.1 EST**	**2.6 EST**	**4.4 EST**	**6 EST**	**4.2 EST**	**3.8 EST**	**3.9 EST**	**1.9 EST**	**3.2 EST**	**5 EST**	**14 EST**	**22 EST**
PCB 180 *	UG/KG	1.42	--	--	**17**	**1.7**	0.97 U	**16**	**5.5**	**13**	**4.7**	**7.6**	**10**	**7.2**	**6.2**	**6.4**	**3.1**	**5.5**	**8.4**	**25**	**42**
PCB 183	UG/KG	1.42	--	--	**4.5**	**0.47 J**	0.97 U	**4.3**	**1.5**	**3.5**	**1.2 J**	**2.1**	**2.8**	**2.1**	**1.8**	**1.9**	**0.9 J**	**1.5**	**2.4**	**7**	**11**
PCB 184	UG/KG	1.42	--	--	**0.75 J COL**	1.1 U	0.97 U	1.3 U	1 U	**0.54 J COL**	1.5 U	1.2 U	1.1 U	**0.39 J COL**	0.93 U	0.94 U	0.97 U	1.2 U	**COL**	**1.1 J COL**	2.8 U
PCB 187 *	UG/KG	1.42	--	--	**9.6**	**1.2**	**0.26 J**	**9.3**	**3.4**	**7.8**	**2.8**	**4.8**	**6.3**	**4.6**	**4.1**	**4.3**	**2**	**3.8**	**5.4**	**15**	**23**
PCB 195	UG/KG	1.42	--	--	**2.2 EST**	**0.31 T COL**	0.97 U	**1.9**	**0.75 J EST**	**1.7 EST**	**0.62 J EST**	**0.97 J**	**1.2**	**0.95 J EST**	**0.88 COL**	**0.9 COL**	**0.41 J EST**	**1.2 COL**	**1.2**	**2.9 T COL**	**4.9**
PCB 206	UG/KG	1.42	--	--	**3.3**	**0.54 J**	**0.15 J**	**3.1**	**0.86 J**	**2.7**	**0.88 J**	**1.3**	**2.1**	**1.6**	**3**	**2.6**	**0.38 J**	**15**	**1.2**	**3.8**	**8.2**
PCB 209	UG/KG	1.42	--	--	**3.8**	**0.6 J**	0.97 U	**2.9**	**0.79 J**	**2.5**	**0.85 J**	**1.3**	**1.8**	**1.5**	**2.8**	**2.5**	0.97 U	**16**	**1**	**4**	**10**
TOTAL PCBs (ND=0)	UG/KG	---	59.8	676	**574.2**	**61.54**	**13.28**	**678**	**270.6**	**398.4**	**146.4**	**290.6**	**391**	**340.6**	**423**	**423.2**	**226**	**224.6**	**370.2**	**963**	**1314.4**
TOTAL PCBs (ND=1/2RL)	UG/KG	---	59.8	676	**577.2**	**64.84**	**20.07**	**680.6**	**272.6**	**401.6**	**150.9**	**293**	**393.2**	**342.52**	**425.79**	**425.08**	**227.94**	**227**	**372.2**	**965.8**	**1320**
TOTAL PCBs (ND=RL)	UG/KG	---	59.8	676	**580.2**	**68.14**	**26.86**	**683.2**	**274.6**	**404.8**	**155.4**	**295.4**	**395.4**	**344.44**	**428.58**	**426.96**	**229.88**	**229.4**	**374.2**	**968.6**	**1325.6**

******Source*: MacDonald et al. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

NOTE: Shaded and bold values indicate detected concentrations. Values not shaed or bold indicated non-detected concentrations represented by the average RL.

RL = average reporting limit
TEC = Threshold Effect Concentration
PEC = Probable Effect Concentration
FD = field duplicate
COL = more than 40% difference between initial and confirmation results; the lower result is reported
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B (organic) = detected in the laboratory method blank
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TABLE 7B. CONCENTRATIONS OF TARGET ANALYTES IN SEDIMENT

DRESDEN POOL, MAY 2008

ANALYTE	UNITS	RL	TEC*	PEC*	DR08-17	DR08-18	DR08-19	DR08-20	DR08-21	DR08-22	DR08-23	DR08-24	DR08-25	DR08-26	DR08-27	DR08-28	DR08-28FD	DR08-29	DR08-30	DR08-31
PCB 8 *	UG/KG	1.42	--	--	1 U	3.1 J COL	4.9 EST	19	6.6 EST	7 EST	6	3	7	14 EST	7	5.9	4.7	8.7 EST	0.95 U	1 U
PCB 18 *	UG/KG	1.42	--	--	2.8	19	16	97	31	26	18	8.9	20	35	19	25	20	39	0.95 U	1.5
PCB 28 *	UG/KG	14.18	--	--	6.4 J	26 J	32	120	56	39	31	15	35	70	31	28	23	51	15	2.7 J COL
PCB 44 *	UG/KG	1.42	--	--	6.6	65	27	110	45	30	24	12	25	49	24	29	24	51	15	3
PCB 49	UG/KG	1.42	--	--	6 COL	52	25	85	36	24	21	9.6 COL	22	41	20 COL	23	19	41	13	3 COL
PCB 52 *	UG/KG	1.42	--	--	8	110	32	120	49	34	27	13	29	52	27	33	26	53	19	4.1
PCB 66 *	UG/KG	1.42	--	--	5.7	51	23	87	38	23	21	10	22	48	20	17	14	39	5.5	3.1
PCB 77 *	UG/KG	1.42	--	--	1.1 COL	3.8 U	4.2	9.6	5.3	3.7	3.2 COL	1.3 COL	4	7.2	3.2 COL	3.1	2.4	1.9 U	0.95 U	1 U
PCB 87	UG/KG	1.42	--	--	3.1 COL	68 COL	9.6 COL	26 COL	13 COL	8.1 COL	7.8 COL	4.2 COL	9.7 COL	15 COL	7.6 COL	8.4 COL	7.1 COL	12 COL	8.5 COL	2.9 COL
PCB 90	UG/KG	1.42	--	--	1 U	3.8 U	1.2 U	2.9 U	2.8 U	0.94 U	0.95 U	1 U	0.96 U	3 U	0.96 U	0.97 U	0.98 U	1.9 U	0.95 U	1 U
PCB 101 *	UG/KG	1.42	--	--	8.1 EST	140 COL	28 COL	74 EST	32 EST	21 COL	22 COL	11 COL	26 COL	39 COL	21 COL	25 EST	21 EST	33 EST	18 EST	6 EST
PCB 105 *	UG/KG	1.42	--	--	2.5 COL	45	8	21	10	6.3	6.4	3.4	8.8	13	6.2	6.1	4.8	10	6	2.1
PCB 118 *	UG/KG	1.42	--	--	5	130	18	49	22	14	15	7.5	20	27	14	15	12	22	15	4.7
PCB 126 *	UG/KG	1.42	--	--	1 U	3.8 U	1.2 U	2.9 U	2.8 U	0.94 U	0.95 U	1 U	0.96 U	3 U	0.96 U	0.97 U	0.98 U	1.9 U	0.95 U	1 U
PCB 128 *	UG/KG	1.42	--	--	1.2	30	3.5	6.8	3.2	1.7 COL	2.7	1.5	4.9 B	4.8 B	2.5 B	2.9 B	2.3 B	3.2 B	5.1 B	3 B
PCB 138 *	UG/KG	1.42	--	--	6.2	110	18	30	17	11	14	6.7	21	24	13	13	11	17	19	11
PCB 153 *	UG/KG	1.42	--	--	6.4	110	19	29	17	11	14	6.6	21	23	13	14	11	18	18	10
PCB 156	UG/KG	1.42	--	--	0.61 J	15	1.8	3.3	1.7 J	1.2	1.5	0.75 J	2.5	2.6 J	1.3	1.4	1.1	1.8 J	2	0.77 J
PCB 169 *	UG/KG	1.42	--	--	1 U	3.8 U	1.2 U	2.9 U	2.8 U	0.94 U	0.95 U	1 U	0.96 U	3 U	0.96 U	0.97 U	0.98 U	1.9 U	0.95 U	1 U
PCB 170 *	UG/KG	1.42	--	--	2.6 EST	30 EST	6.7 EST	8.9 EST	5.7 EST	3.4 EST	5.1 EST	2.5 EST	8.6 EST	9.1 EST	4.5 EST	4.8 EST	3.3 EST	5.9 EST	6.1 EST	4.5 EST
PCB 180 *	UG/KG	1.42	--	--	4.5	51	12	15	9.1	5.2	8.5	3.7	14	14	7.6	9.2	6	9.4	13	7.9
PCB 183	UG/KG	1.42	--	--	1.1	14	3.3	4.1	2.6 J	1.7	2.5	1.1	3.7	4	2.2	2.4	1.7	2.7	3.6	2.2
PCB 184	UG/KG	1.42	--	--	1 U	3.8 U	1.2 U	2.9 U	2.8 U	0.94 U	0.95 U	1 U	0.96 U	3 U	1.2	0.97 U	0.98 U	1.9 U	0.95 U	1 U
PCB 187 *	UG/KG	1.42	--	--	2.8	27	7.1	9.6	5.9	3.7	5.5	2.4	7.9	9.1	4.8	5.6	3.7	6.4	8.5	4.7
PCB 195	UG/KG	1.42	--	--	0.57 COL	6.3	1.5 EST	1.8 J EST	1.2 J	0.95 EST	1.1 EST	0.68 J EST	1.7	3 U	0.97 EST	0.97 U	0.76 T COL	1.1 T COL	1.9	0.94 J EST
PCB 206	UG/KG	1.42	--	--	0.59 J	13	1.7	2.1 J	1 J	0.59 J	1.1	1.7	1.5	1.8 J	0.94 J	1.9	1.1	1.3 J	5.3	1.7 COL
PCB 209	UG/KG	1.42	--	--	0.54 J	18	1.5	1.9 J PE	1.2 J PE	0.94 U	0.7 J COL	1.9	2.1	1.6 J	1.2 PE	0.47 J	0.7 J	1.1 J	2.3	1.7
TOTAL PCBs (ND=0)	UG/KG	---	59.8	676	139.8	1894.2	518.8	1611.8	705.6	480	446.8	217	548.4	876.4	435.6	473.2	378.4	733.2	326.4	136.6
TOTAL PCBs (ND=1/2RL)	UG/KG	---	59.8	676	142.8	1905.6	521.2	1617.6	711.2	481.88	448.7	219	550.32	882.4	437.52	475.14	380.36	738.9	331.15	140.6
TOTAL PCBs (ND=RL)	UG/KG	---	59.8	676	145.8	1917	523.6	1623.4	716.8	483.76	450.6	221	552.24	888.4	439.44	477.08	382.32	744.6	335.9	144.6

**Source*: MacDonald et al. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

NOTE: Shaded and bold values indicate detected concentrations. Values not shaded or bold indicated non-detected concentrations represented by the average RL.

RL = average reporting limit	**B** (organic) = detected in the laboratory method blank
TEC = Threshold Effect Concentration	**J** (organic) = compound was detected, but below the reporting limit (value is estimated)
PEC = Probable Effect Concentration	**J** (inorganic) = detected in the laboratory method blank
FD = field duplicate	**U** = compound was analyzed, but not detected

COL = more than 40% difference between initial and confirmation results; the lower result is reported

EST = estimated value

TABLE 8. CONCENTRATIONS OF TARGET ANALYTES IN SEDIMENT

LOWER BRANDON POOL, MAY 2008

ANALYTE	UNITS	RL	TEC**	PEC**	BR08-01	BR08-02	BR08-03	BR08-04
TOTAL ORGANIC CARBON	%	--	--	--	4.23	6.61	5.28	4.80
PERCENT SOLIDS	%	--	--	--	53.9	39.5	45.2	50.3
GRAVEL	%	--	--	--	3.5	0.0	0.0	0.5
SAND	%	--	--	--	54.7	19.2	19.4	58.0
COARSE SAND	%	--	--	--	2.2	0.1	0.0	4.4
MEDIUM SAND	%	--	--	--	4.6	0.7	0.8	12.6
FINE SAND	%	--	--	--	47.9	18.4	18.6	41.0
SILT	%	--	--	--	29.2	64.4	68.6	24.0
CLAY	%	--	--	--	12.5	16.4	11.9	17.5
SILT+CLAY	%	--	--	--	41.7	80.8	80.5	41.5
SILVER	MG/KG	0.11	9.79	33	**9**	**11**	**6**	**8**
CADMIUM	MG/KG	0.11	0.99	4.98	**21**	**23.3**	**8.4**	**18.4**
CHROMIUM	MG/KG	0.22	43.4	111	**274 J**	**282 J**	**125 J**	**244 J**
COPPER	MG/KG	0.22	31.6	149	**235**	**264**	**146**	**177**
LEAD	MG/KG	0.11	35.8	128	**456**	**322**	**196**	**315**
MERCURY	MG/KG	0.04	0.18	1.06	**1.4**	**2**	**0.84**	**0.83**
NICKEL	MG/KG	0.11	22.7	48.6	**163**	**109**	**50.3**	**129**
SILVER	MG/KG	0.11	--	--	**6.8**	**6.8**	**3**	**5.2**
ZINC	MG/KG	0.54	121	459	**933 J**	**1,170 J**	**642 J**	**800 J**
ACENAPHTHENE	UG/KG	361	--	--	**3,000**	**2,000**	**520**	**2,400**
ACENAPHTHYLENE	UG/KG	361	--	--	**10,000**	**5,300**	**1,500**	**8,200**
ANTHRACENE	UG/KG	361	57.2	845	**7,100**	**6,300**	**1,800**	**10,000**
BENZO(A)ANTHRACENE	UG/KG	361	108	1,050	**35,000**	**16,000**	**6,100**	**40,000**
BENZO(A)PYRENE	UG/KG	361	150	1,450	**35,000**	**21,000**	**6,900**	**38,000**
BENZO(B)FLUORANTHENE	UG/KG	361	--	--	**47,000**	**27,000**	**9,500**	**53,000**
BENZO(GHI)PERYLENE	UG/KG	361	--	--	**29,000**	**15,000**	**3,900**	**18,000**
BENZO(K)FLUORANTHENE	UG/KG	361	--	--	620 U	420 U	74 U	330 U
CHRYSENE	UG/KG	361	166	1,290	**38,000**	**26,000**	**6,400**	**47,000**
DIBENZO(A,H)ANTHRACENE	UG/KG	361	33.0	--	**9,500**	**4,600**	**990**	**6,700**
FLUORANTHENE	UG/KG	361	423	2,230	**45,000**	**36,000**	**11,000**	**65,000**
FLUORENE	UG/KG	361	77.4	536	**2,900**	**2,800**	**720**	**2,800**
INDENO(1,2,3-CD)PYRENE	UG/KG	361	--	--	**26,000**	**14,000**	**3,900**	**21,000**
NAPHTHALENE	UG/KG	361	176	561	**1,900**	**6,600**	**840**	**3,700**
PHENANTHRENE	UG/KG	361	204	1,170	**6,600**	**11,000**	**3,300**	**12,000**
PYRENE	UG/KG	361	195	1,520	**26,000**	**23,000**	**6,700**	**32,000**
TOTAL PAHs (ND=0)	UG/KG	---	1,610	22,800	**322,000**	**216,600**	**64,070**	**359,800**
TOTAL PAHs (ND=1/2RL)	UG/KG	---	1,610	22,800	**322,310**	**216,810**	**64,107**	**359,965**
TOTAL PAHs (ND=RL)	UG/KG	---	1,610	22,800	**322,620**	**217,020**	**64,144**	**360,130**
PCB 8 *	UG/KG	6.93	--	--	**60**	**24 COL**	**11 EST**	**47 COL**
PCB 18 *	UG/KG	6.93	--	--	**240**	**120**	**38**	**200**
PCB 28 *	UG/KG	69.3	--	--	**290**	**160**	**76**	**270**
PCB 44 *	UG/KG	6.93	--	--	**280**	**190**	**59**	**240**
PCB 49	UG/KG	6.93	--	--	**210**	**140**	**52**	**190**
PCB 52 *	UG/KG	6.93	--	--	**300**	**210**	**66**	**270**
PCB 66 *	UG/KG	6.93	--	--	**200**	**140**	**52**	**190**
PCB 77 *	UG/KG	6.93	--	--	**23 COL**	**18 COL**	**8.9**	**21 COL**
PCB 87	UG/KG	6.93	--	--	**80 COL**	**72 COL**	**20 COL**	**65 COL**
PCB 90	UG/KG	6.93	--	--	9.3 U	6.3 U	2.2 U	9.9 U
PCB 101 *	UG/KG	6.93	--	--	**COL**	**190 EST**	**57 EST**	**190 EST**
PCB 105 *	UG/KG	6.93	--	--	**56**	**53**	**16**	**48**
PCB 118 *	UG/KG	6.93	--	--	**140**	**120**	**39**	**130**
PCB 126 *	UG/KG	6.93	--	--	9.3 U	6.3 U	2.2 U	9.9 U
PCB 128 *	UG/KG	6.93	--	--	**23 B**	**23 B**	**7.2 B**	**20 B**
PCB 138 *	UG/KG	6.93	--	--	**110**	**110**	**36**	**93**
PCB 153 *	UG/KG	6.93	--	--	**100**	**110**	**38**	**90**
PCB 156	UG/KG	6.93	--	--	**12**	**12**	**3.8**	**10**
PCB 169 *	UG/KG	6.93	--	--	9.3 U	6.3 U	2.2 U	9.9 U
PCB 170 *	UG/KG	6.93	--	--	**31 EST**	**39 EST**	**14 EST**	**29 EST**
PCB 180 *	UG/KG	6.93	--	--	**55**	**72**	**26**	**49**
PCB 183	UG/KG	6.93	--	--	**16**	**19**	**6.8**	**14**
PCB 184	UG/KG	6.93	--	--	9.3 U	6.3 U	**1 J COL**	9.9 U
PCB 187 *	UG/KG	6.93	--	--	**34**	**40**	**15**	**29**
PCB 195	UG/KG	6.93	--	--	**5.4 J EST**	**8.3 EST**	**2.7 EST**	9.9 U
PCB 206	UG/KG	6.93	--	--	**6.6 J**	**8**	**2.9**	**5.9 J**
PCB 209	UG/KG	6.93	--	--	**8.7 J**	**11**	**2.1 J**	**9.3 J**
TOTAL PCBs (ND=0)	UG/KG	---	59.8	676	**4,324**	**3,238**	**1,118**	**3,832**
TOTAL PCBs (ND=1/2RL)	UG/KG	---	59.8	676	**4,343**	**3,251**	**1,123**	**3,852**
TOTAL PCBs (ND=RL)	UG/KG	---	59.8	676	**4,361**	**3,263**	**1,127**	**3,872**

* PCB congeners used for Total PCB summation, as per Table 9-3 of the ITM (USEPA/USACE 1998)

***Source* : MacDonald et al. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

NOTE: Shaded and bold values indicate detected concentrations. Values not shaed or bold indicated non-detected concentrations represented by the average RL.

RL = average reporting limit

TEC = Threshold Effect Concentration

PEC = Probable Effect Concentration

B (organic) = detected in the laboratory method blank

J (organic) = compound was detected, but below the reporting limit (value is estimated)

J (inorganic) = detected in the laboratory method blank

COL = more than 40% difference between initial and confirmation results; the lower result is reported

EST = estimated value

U = compound was analyzed, but not detected

TABLE 9. CONCENTRATIONS OF TARGET ANALYTES THAT EXCEEDED SEDIMENT QUALITY GUIDELINES

DRESDEN POOL, MAY 2008

ANALYTE	UNITS	RL	TEC*	PEC*	DR08-01	DR08-02	DR08-03	DR08-04	DR08-05	DR08-06	DR08-07	DR08-08	DR08-09	DR08-10	DR08-11	DR08-11FD	DR08-12	DR08-13	DR08-14	DR08-15	DR08-16
ARSENIC	MG/KG	0.109	9.79	33	--	--	--	--	--	--	--	--	--	--	--	--	--	26	--	--	13
CADMIUM	MG/KG	0.109	0.99	4.98	7.5	--	--	7.4	2.9	4.5	2.8	3.6	5.2	3.0	9.1	4.1	1.3	17.3	3.1	12.7	29.3
CHROMIUM	MG/KG	0.218	43.4	111	93.4 J	--	--	106 J	--	59.2 J	45.9 J	46.4 J	59.5 J	--	56.2 J	54.5 J	--	196 J	51.9 J	158 J	301 J
COPPER	MG/KG	0.218	31.6	149	112	--	--	123	44	68	52	62	73	43	57	60	--	185	64	161	214
LEAD	MG/KG	0.109	35.8	128	125	--	--	143	54	86	72	66	98	67	91	91	47	311	110	176	312
MERCURY	MG/KG	0.050	0.18	1.06	0.72	--	--	0.63	0.24	0.56	0.27	0.29	0.45	0.44	0.56	0.45	0.72	3.10	0.30	0.79	1.50
NICKEL	MG/KG	0.109	22.7	48.6	37	--	--	51	--	24	29	29	38	24	41	45	27	36	25	65	106
ZINC	MG/KG	0.544	121	459	519 J	--	--	611 J	213 J	264 J	225 J	296 J	455 J	267 J	354 J	356 J	204 J	836 J	314 J	655 J	1280 J
ANTHRACENE	UG/KG	204	57.2	845	820	390	140	870	410	440	270	320	650	650	1,500	1,300	740	14,000	2,300	910	1,700
BENZO(A)ANTHRACENE	UG/KG	204	108	1,050	2,000	1,900	--	2,300	1,000	770	210	740	1,900	1,800	5,300	5,300	3,200	84,000	9,500	2,600	6,300
BENZO(A)PYRENE	UG/KG	204	150	1,450	2,700	1,900	--	2,900	1,200	1,000	360	1,100	2,500	2,400	7,000	6,300	3,900	73,000	11,000	3,400	4,900
CHRYSENE	UG/KG	204	166	1,290	2,700	2,200	--	2,800	1,300	920	280	1,100	2,300	2,300	6,100	5,600	3,900	83,000	11,000	3,600	7,200
DIBENZO(A,H)ANTHRACENE	UG/KG	204	33	--	620	410	--	650	250	230	77 J	210	550	500	1,300	1,200	680	9,000	2,400	590	950
FLUORANTHENE	UG/KG	204	423	2,230	3,100	1,500	--	3,300	1,800	1,400	720	1,400	2,500	2,300	5,200	4,900	2,600	110,000	9,800	5,100	15,000
FLUORENE	UG/KG	204	77.4	536	680	390	--	590	400	560	--	430	490	460	750	620	430	5,800	620	340	1,100
NAPHTHALENE	UG/KG	204	176	561	240	--	--	200	--	--	--	--	--	--	370	370	--	990 J	470	380	390
PHENANTHRENE	UG/KG	204	204	1,170	1,200	410	--	1,300	470	520	--	490	880	810	2,000	1,700	690	12,000	3,000	1,600	1,400
PYRENE	UG/KG	204	195	1,520	2,900	1,200	--	3,100	1,700	1,200	330	1,400	2,200	2,000	4,400	3,900	2,100	90,000	7,200	3,800	11,000
TOTAL PAHs (ND=0)	UG/KG	--	1,610	22,800	26,360	16,198	--	27,900	12,759	11,127	4,017	11,319	22,360	21,200	54,910	50,390	29,740	672,690	92,580	34,070	67,240
TOTAL PAHs (ND=1/2RL)	UG/KG	--	1,610	22,800	26,360	16,198	1,717	27,900	12,759	11,127	4,217	11,319	22,360	21,200	54,910	50,390	29,740	672,690	92,645	34,094	67,286
TOTAL PAHs (ND=RL)	UG/KG	--	1,610	22,800	26,360	16,198	1,977	27,900	12,759	11,127	4,417	11,319	22,360	21,200	54,910	50,390	29,740	672,690	92,710	34,117	67,332
TOTAL PCBs (ND=0)	UG/KG	--	59.8	676	574	62	--	678	271	398	146	291	391	341	423	423	226	225	370	963	1,314
TOTAL PCBs (ND=1/2RL)	UG/KG	--	59.8	676	577	65	--	681	273	402	151	293	393	343	426	425	228	227	372	966	1,320
TOTAL PCBs (ND=RL)	UG/KG	--	59.8	676	580	68	--	683	275	405	155	295	395	344	429	427	230	229	374	969	1,326

**Source*: MacDonald et al. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

RL = average reporting limit

TEC = Threshold Effect Concentration

PEC = Probable Effect Concentration

FD = field duplicate

J (inorganic) = detected in the laboratory method blank

🟨 concentration exceeds TEC

🟥 concentration exceeds PEC

TABLE 9. CONCENTRATIONS OF TARGET ANALYTES THAT EXCEED SEDIMENT QUALITY GUIDELINES

DRESDEN POOL, MAY 2008

ANALYTE	UNITS	RL	TEC*	PEC*	DR08-17	DR08-18	DR08-19	DR08-20	DR08-21	DR08-22	DR08-23	DR08-24	DR08-25	DR08-26	DR08-27	DR08-28	DR08-28FD	DR08-29	DR08-30	DR08-31
ARSENIC	MG/KG	0.109	9.79	33	--	17	--	--	--	--	--	--	--	--	--	--	--	--	10	--
CADMIUM	MG/KG	0.109	0.99	4.98	1.5	41.3	6.0	4.9	3.9	3.4	3.7	7.3	5.5	7.9	4.4	1.7	1.7	3.7	2.2	2.0
CHROMIUM	MG/KG	0.218	43.4	111	--	355 J	77.3 J	79.1 J	55.3 J	47.4 J	57.3 J	71.3 J	125 J	147 J	56.5 J	--	--	57.2 J	--	--
COPPER	MG/KG	0.218	31.6	149	37	284	87	58	59	49	73	82	98	140	68	38	33	50	103	47
LEAD	MG/KG	0.109	35.8	128	40	366	127	100	92	84	87	138	222	215	90	51	57	99	241	105
MERCURY	MG/KG	0.050	0.18	1.06	--	3.30	0.58	0.48	0.66	0.51	0.32	0.87	0.97	2.60	0.30	0.24	--	0.29	--	0.24
NICKEL	MG/KG	0.109	22.7	48.6	--	91	38	77	49	46	35	29	57	56	34	--	--	55	32	--
ZINC	MG/KG	0.544	121	459	145 J	1450 J	491 J	342 J	374 J	312 J	335 J	305 J	547 J	757 J	330 J	158 J	172 J	429 J	333 J	383 J
ANTHRACENE	UG/KG	204	57.2	845	140	6,600	1,300	5,800	4,200	11,000	6,900	1,400	4,000	3,000	1,200	590	420	3,000	140	130
BENZO(A)ANTHRACENE	UG/KG	204	108	1,050	500	18,000	4,600	43,000	13,000	93,000	25,000	5,200	16,000	12,000	5,800	1,900	1,200	12,000	590	570
BENZO(A)PYRENE	UG/KG	204	150	1,450	580	15,000	5,400	45,000	15,000	86,000	22,000	4,800	18,000	15,000	7,200	1,400	1,300	12,000	590	600
CHRYSENE	UG/KG	204	166	1,290	610	21,000	5,700	41,000	14,000	94,000	25,000	6,600	18,000	14,000	7,100	1,700	1,500	12,000	570	590
DIBENZO(A,H)ANTHRACENE	UG/KG	204	33	--	90	2,900	1,300	2,700	4,300	5,500	3,500	1,000	2,500	3,100	1,500	190	170	2,700	89	120
FLUORANTHENE	UG/KG	204	423	2,230	960	45,000	6,700	43,000	21,000	130,000	43,000	10,000	44,000	23,000	9,100	4,400	2,600	16,000	1,500	1,000
FLUORENE	UG/KG	204	77.4	536	--	4,800	430	1,500	1,100	2,000	940	920	1,800	1,200	460	210	160	570	--	--
NAPHTHALENE	UG/KG	204	176	561	--	1,100	390	1,100	870	1,400	570	270	970	1,300	460	--	--	720	--	--
PHENANTHRENE	UG/KG	204	204	1,170	300	10,000	2,000	3,900	5,600	7,700	11,000	1,500	19,000	8,100	2,200	1,600	760	2,900	510	400
PYRENE	UG/KG	204	195	1,520	700	32,000	4,200	32,000	12,000	85,000	28,000	6,300	24,000	13,000	5,000	2,200	1,400	8,900	710	640
TOTAL PAHs (ND=0)	UG/KG	--	1,610	22,800	6,185	203,700	47,860	350,700	137,980	760,200	231,990	52,860	201,770	141,310	60,430	18,224	13,060	108,110	6,463	5,881
TOTAL PAHs (ND=1/2RL)	UG/KG	--	1,610	22,800	6,185	203,700	47,881	350,700	138,045	760,200	231,990	52,894	201,930	141,310	60,462	18,240	13,077	108,265	6,479	5,898
TOTAL PAHs (ND=RL)	UG/KG	--	1,610	22,800	6,185	203,700	47,902	350,700	138,110	760,200	231,990	52,928	202,090	141,310	60,494	18,256	13,093	108,420	6,495	5,915
TOTAL PCBs (ND=0)	UG/KG	--	59.8	676	140	1,894	519	1,612	706	480	447	217	548	876	436	473	378	733	326	137
TOTAL PCBs (ND=1/2RL)	UG/KG	--	59.8	676	143	1,906	521	1,618	711	482	449	219	550	882	438	475	380	739	331	141
TOTAL PCBs (ND=RL)	UG/KG	--	59.8	676	146	1,917	524	1,623	717	484	451	221	552	888	439	477	382	745	336	145

**Source*: MacDonald et al. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

RL = average reporting limit

TEC = Threshold Effect Concentration

PEC = Probable Effect Concentration

FD = field duplicate

J (inorganic) = detected in the laboratory method blank

🟨 **concentration exceeds TEC**

🟥 concentration exceeds PEC

TABLE 10. CONCENTRATIONS OF TARGET ANALYTES THAT EXCEED SEDIMENT QUALITY GUIDELINES

LOWER BRANDON POOL, MAY 2008

ANALYTE	UNITS	RL	TEC*	PEC*	BR08-01	BR08-02	BR08-03	BR08-04
ARSENIC	MG/KG	0.108	9.79	33	--	**10.5**	-	--
CADMIUM	MG/KG	0.108	0.99	4.98	21	23	8.4	18
CHROMIUM	MG/KG	0.215	43.4	111	274 J	282 J	125 J	244 J
COPPER	MG/KG	0.215	31.6	149	235	264	**146**	177
LEAD	MG/KG	0.108	35.8	128	456	322	196	315
MERCURY	MG/KG	0.0355	0.18	1.06	1.4	2.0	**0.84**	**0.83**
NICKEL	MG/KG	0.108	22.7	48.6	163	109	50	129
ZINC	MG/KG	0.535	121	459	933 J	1,170 J	642 J	800 J
ANTHRACENE	UG/KG	361	57.2	845	7,100	6,300	1,800	10,000
BENZO(A)ANTHRACENE	UG/KG	361	108	1050	35,000	16,000	6,100	40,000
BENZO(A)PYRENE	UG/KG	361	150	1450	35,000	21,000	6,900	38,000
CHRYSENE	UG/KG	361	166	1290	38,000	26,000	6,400	47,000
DIBENZO(A,H)ANTHRACENE	UG/KG	361	33	--	**9,500**	**4,600**	**990**	**6,700**
FLUORANTHENE	UG/KG	361	423	2,230	45,000	36,000	11,000	65,000
FLUORENE	UG/KG	361	77.4	536	2,900	2,800	720	2,800
NAPHTHALENE	UG/KG	361	176	561	1,900	6,600	840	3,700
PHENANTHRENE	UG/KG	361	204	1,170	6,600	11,000	3,300	12,000
PYRENE	UG/KG	361	195	1,520	26,000	23,000	6,700	32,000
TOTAL PAHs (ND=0)	UG/KG	--	1,610	22,800	322,000	216,600	64,070	359,800
TOTAL PAHs (ND=1/2RL)	UG/KG	--	1,610	22,800	322,310	216,810	64,107	359,965
TOTAL PAHs (ND=RL)	UG/KG	--	1,610	22,800	322,620	217,020	64,144	360,130
TOTAL PCBs (ND=0)	UG/KG	--	59.8	676	4,324	3,238	1,118	3,832
TOTAL PCBs (ND=1/2RL)	UG/KG	--	59.8	676	4,343	3,251	1,123	3,852
TOTAL PCBs (ND=RL)	UG/KG	--	59.8	676	4,361	3,263	1,127	3,872

*Source: MacDonald et al. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Arch. Environ. Contam. Toxicol. 39: 20-31.

RL = average reporting limit

TEC = Threshold Effect Concentration

PEC = Probable Effect Concentration

J (organic) = compound was detected, but below the reporting limit (value is estimated)

concentration exceeds TEC

concentration exceeds PEC

TABLE 11. COMPARISON OF SEDIMENT CONCENTRATIONS TO HISTORICAL DATA*

DRESDEN AND LOWER BRANDON POOLS, MAY 2008

	DR08-01		DR08-03		DR08-05		DR08-06			DR08-07	
Year	1994/1995	2008	1994/1995	2008	1994/1995	2008	1994/1995	1994/1995	2008	1994/1995	2008
River Mile	271.6	271.6	273.0	273.0	273.6	273.6	274.8	274.8	274.8	274.8	274.8
ARSENIC	6.44	7.90	8.25	2.20	5.94	3.40	6.92	6.36	3.20	5.52	4.40
CADMIUM	8.84	7.50	0.831	0.490	8.43	2.90	2.88	3.1	4.5	3.07	2.80
CHROMIUM	110	93.4 J	12.2	7.5 J	96.3	34.6 J	54.6	55	59.2 J	48.9	45.9 J
COPPER	112	112	17	8	102	44	53.1	54.5	67.8	47	52
LEAD	153	125	21.2	10.1	123	54	75.1	73	85.7	73	72
MERCURY	0.958	0.720	0.076	0.031	0.596	0.240	<0.040	0.24	0.56	0.238	0.270
NICKEL	54.5	37.2	14.4	7.5	48.7	22.7	38.4	42.9	24.3	33.9	29.3
ZINC	587	519 J	82.2	44 J	543	213 J	297	321	264 J	217	225 J
ACENAPHTHENE	<7,500	300	<5,900	130 U	<6,500	220	<6,700	<6,900	210 J	<7,700	160 J
ACENAPHTHYLENE	<7,500	700	<5,900	140	<6,500	340	<6,700	<6,900	380	<7,700	240
ANTHRACENE	<740	820	96	140	660	410	83	92	440	<76	270
BENZO(A)ANTHRACENE	3,200	2,000	340	57 J	3,300	1,000	390	460	770	260	210
BENZO(A)PYRENE	4,300	2,700	580	130	3,300	1,200	680	770	1,000	440	360
BENZO(B)FLUORANTHENE	8,800	3,100	980	210	3,500	1,400	1,100	1,100	1,400	1,100	560
BENZO(GHI)PERYLENE	7,100	2,100	1,100	61 J	4,900	840	1,200	1,100	840	740	220
BENZO(K)FLUORANTHENE	2,200	1,300	190	41 J	1,600	550	320	330	430	200	140 J
CHRYSENE	6,600	2,700	440	70 J	61,000	1,300	700	770	920	480	280
DIBENZO(A,H)ANTHRACENE	5,300	620	1,400	130 U	3,400	250	1,200	1,600	230	1,000	77 J
FLUORENE	<1,600	680	<1,200	130 U	<1,400	400	<1,400	<1,500	560	<1,600	200 U
INDENO(1,2,3-CD)PYRENE	3,200	1,900	430	70 J	2,500	790	560	600	740	370	250
NAPHTHALENE	<7,500	240	<5,900	130 U	<6,500	89 J	<6,700	<6,900	87 J	<7,700	200 U
PHENANTHRENE	2,600	1,200	720	100 J	1,800	470	1,410	550	520	270	200
PYRENE	6,200	2,900	1,400	98 J	5,700	1,700	1,400	1,500	1,200	910	330

	DR08-08		DR08-09		DR08-11		DR08-15		DR08-17	
Year	1994/1995	2008	1994/1995	2008	1994/1995	2008	1994/1995	2008	1994/1995	2008
River Mile	276.0	276.0	276.0	276.0	276.9	276.9	278.3	278.3	279.2	279.2
ARSENIC	5.43	3.90	5.88	5.20	11.7	4.7	7.59	6.30	4.44	4.40
CADMIUM	3.85	3.60	4.49	5.20	24.7	9.1	23.3	12.7	1.2	1.5
CHROMIUM	55.6	46.4 J	67.6	59.5 J	205	56.2 J	217	158 J	19.7	28 J
COPPER	69.5	62.3	68.8	72.9	176	57	188	161	22.2	37.4
LEAD	78	66	97.7	97.8	222	91	232	176	30.1	39.8
MERCURY	0.256	0.290	0.268	0.450	0.856	0.560	0.951	0.790	<0.034	0.13
NICKEL	37.8	29.0	50.5	37.5	61.2	41.1	84.9	64.7	13.8	18.2
ZINC	345	296 J	477	455 J	1,020	354 J	1,070	655 J	115	145 J
ACENAPHTHENE	<7,800	160	<7,700	250	<7,000	490	<8,700	220	<5,700	51
ACENAPHTHYLENE	<7,800	290	<7,700	710	<7,000	1,700	<8,700	830	<5,700	130
ANTHRACENE	130	320	270	650	1,100	1,500	840	910	57	140
BENZO(A)ANTHRACENE	650	740	2,000	1,900	6,300	5,300	4,300	2,600	360	500
BENZO(A)PYRENE	1,300	1,100	3,100	2,500	4,800	7,000	4,800	3,400	610	580
BENZO(B)FLUORANTHENE	2,000	1,400	4,300	2.700	8,500	6,500	8,600	5,200	670	720
BENZO(GHI)PERYLENE	2,500	880	4,100	1,900	6,600	4,700	6,400	3,000	1,200	520
BENZO(K)FLUORANTHENE	640	510	1,500	1,100	2,200	3,400	2,600	47 U	260	320
CHRYSENE	1,100	1,100	2,700	2,300	11,000	6,100	11,000	3,600	580	610
DIBENZO(A,H)ANTHRACENE	1,500	210	<77	550	4,900	1,300	6,100	590	920	90
FLUORENE	<1,600	430	<1,600	490	<1,500	750	<1,800	340	<1,200	64
INDENO(1,2,3-CD)PYRENE	1,400	820	1,400	1,600	3,300	4,200	2,700	2,500	650	450
NAPHTHALENE	<7,800	69 J	<7,700	130 J	<7,000	370	<8,700	380	<5,700	50
PHENANTHRENE	730	490	1,100	880	3,800	2,000	2,800	1,600	290	300
PYRENE	2.400	1.400	3,500	2,200	11,000	4,400	9,200	3,800	880	700

	DR08-20		DR08-25		DR08-27		DR08-29		DR08-30	
Year	1994/1995	2008	1994/1995	2008	1994/1995	2008	1994/1995	2008	1994/1995	2008
River Mile	280.4	280.4	283.6	283.6	284.5	284.5	285.6	285.7	285.8	285.8
ARSENIC	8.12	4.60	6.02	4.30	2.03	4.20	8.92	6.00	6.31	9.80
CADMIUM	6.77	4.90	8.99	5.50	0.76	4.40	3.9	3.7	<0.034	2.2
CHROMIUM	106	79.1 J	148	125 J	21.1	56.5 J	90.1	57.2 J	26.7	19.8 J
COPPER	112	58	120	98	13.5	68.4	61.9	49.6	26.2	103.0
LEAD	169	100	212	222	115	90	119	99	47.7	241.0
MERCURY	0.475	0.480	1.11	0.97	0.111	0.300	0.215	0.290	0.235	0.150
NICKEL	59.6	77.2	59.2	57.2	20.6	34.1	42.3	55.1	17.3	32.1
ZINC	578	342 J	868	547 J	119	330 J	346	429 J	122	333 J
ACENAPHTHENE	<8,500	1,700	<7,000	1,600	<4,900	410	<5,900	620	<5,500	47
ACENAPHTHYLENE	<8,500	10,000	<7,000	1,900	<4,900	1,300	<5,900	3,200	<5,500	37
ANTHRACENE	1,300	5,800	2,000	4,000	940	1,200	450	3,000	550	140
BENZO(A)ANTHRACENE	7,100	43,000	19,000	16,000	5,400	5,800	1,600	12,000	2,000	590
BENZO(A)PYRENE	9,800	45,000	20,000	18,000	6,400	7,200	2,300	12,000	2,900	590
BENZO(B)FLUORANTHENE	14,000	45,000	28,000	25,000	9,200	9,600	3,100	16,000	4,100	880
BENZO(GHI)PERYLENE	14,000	31,000	28,000	13,000	8,100	4,500	3,700	9,300	4,000	360
BENZO(K)FLUORANTHENE	4,300	17,000	9,800	320 U	2,800	64 U	1,000	310 U	1,300	32 U
CHRYSENE	9,200	41,000	24,000	18,000	7,300	7.100	250	12,000	2,500	570
DIBENZO(A,H)ANTHRACENE	14,000	2,700	27,000	2,500	6,800	1,500	1,500	2,700	2,400	89
FLUORENE	<1,800	1,500	1,600	1,800	<1,000	460	<1,300	570	<1,200	51
INDENO(1,2,3-CD)PYRENE	7,500	27,000	17,000	12,000	4,200	4,600	2,300	8,200	2,500	360
NAPHTHALENE	<8,500	1,100	<7,000	970	<4900	460	<5,900	720	<5,500	29 J
PHENANTHRENE	3,100	3,900	4,000	19,000	2,500	2,200	1,100	2,900	920	510
PYRENE	12,000	32,000	20,000	24,000	7,800	5,000	3,500	8.900	4,000	710

	BR08-01		BR08-02		BR08-03	
Year	1994/1995	2008	1994/1995	2008	1994/1995	2008
River Mile	286.4	286.4	286.2	286.2	286.0	286.0
ARSENIC	12.6	8.7	11.6	10.5	9.97	5.90
CADMIUM	27.3	21.0	10.5	23.3	12.8	8.4
CHROMIUM	323	274 J	149	282 J	192	125 J
COPPER	314	235	154	264	201	146
LEAD	423	456	272	322	284	196
MERCURY	1.1	1.4	0.985	2.00	0.093	0.840
NICKEL	199	163	82.5	109.0	75.4	50.3
ZINC	1420	933 J	841	1.170 J	1010	642 J
ACENAPHTHENE	71,000	3,000	84,000	2,000	<45,000	520
ACENAPHTHYLENE	<3,7000	10,000	<43,000	5,300	<45,000	1,500
ANTHRACENE	7,800	7,100	13,000	6,300	1,400	1,800
BENZO(A)ANTHRACENE	30,000	35,000	25.000	16,000	5,000	6,100
BENZO(A)PYRENE	30,000	35,000	23,000	21,000	4,600	6,900
BENZO(B)FLUORANTHENE	43,000	47,000	38,000	27,000	7,200	9,500
BENZO(GHI)PERYLENE	40,000	29,000	30,000	15,000	6,600	3.900
BENZO(K)FLUORANTHENE	17,000	620 U	12,000	420 U	2,300	74 U
CHRYSENE	36,000	38,000	35,000	26,000	6,800	6,400
DIBENZO(A,H)ANTHRACENE	22,000	9,500	19,000	4,600	9,200	990
FLUORENE	<7,800	2,900	<9,200	2,800	<9,600	720
INDENO(1,2,3-CD)PYRENE	23,000	26,000	15,000	14,000	2,700	3.900
NAPHTHALENE	<37,000	1,900	<43,000	6,600	<45,000	840
PHENANTHRENE	14,000	6,600	22,000	11,000	3,800	3,300
PYRENE	15,000	26,000	38,000	23,000	12,000	6.700

*Source: Burton, GA. 1995. The Upper Illinois Waterway Study, 1994-1995 Sediment Contamination Assessment. Prepared for Commonwealth Edison Company, Chicago, Illinois.

J (organic) = compound was detected, but below the reporting limit (value is estimated)

J (inorganic) = detected in the laboratory method blank

U = compound was analyzed, but not detected

🟩 2008 concentrations that exceed 1994-1995 concentrations

🟨 2008 concentrations that are within a factor of two lower than 1994-1995 concentrations

APPENDIX A

FIELD LOGBOOK

Location Date 5/6/08

Project / Client Nijman - Franzetti Sediment

14581.02

STATE PLANE
ILLINOIS EAST
NAD83

0634 arrive Dresden Lock + Dam
on board: Joe Vondruska + Karin Olson
load boat
clear, sunny, warm

0730 DR08-01

525632.78 N 304501.6 E	no sample recovered

- 1st attempt failed; moved location further out into river b/c dense macrophyte ~~[illegible]~~ roots impeded sample recovery

* new location 78 m from right descending bank (RDB)
188 m upstream of lock + dam
water depth 4.9 ft

525570.11 N 304526.87 E	new location

⇒

Location ______ Date 5/6/08

Project / Client Nijman - Franzetti Sediment
14581.02

DR08-01 (cont)

* material was dark brown to grey silty; lots of water + visible sheen; area sampled had dense macrophyte ~~mats~~ roots + root mass

slight petroleum odor

08:24 DR08-02 - on location

- ~~50~~ 52 m downstream 2nd mooring cell KAP
- 13 m from shore left descending bank (LDB)

525297.67 N
305066.82 E
Water depth = 4.1 ft
0834 - sample collected

* material is dark to light grey, primarily silt w/ some sand + clay clumps; some leaf debris visible; sheen visible at surface of sediment in pot

Location ______ Date 5/6/08

Project / Client Nijman - Franzetti Sediment
14581.02

0911 DR08-03

- 189 m upstream from mouth - Kankakee River
- 62 m from RDB from point that forms downstream end of backwater

524168.22 N
306200.37 E

water depth 2.8 ft

- Material is light grey, primarily sand with some silts grainy with visible sand grains

0948 DR08-04

Bay Hill Marina
- 45 m out from boat ramp
- 19 m from back of No Wake sign (b/w shore + sign)

Location

Date 5/6/08

Project / Client Nijman - Franzetti Sediment

14581.02

DR08-04 (cont)

523907.42 N

307041.19 E

water depth = 3.9 ft

light gray silt w/ some sand;
visible sand grains; visible sheen
noticable odor of ~~product~~ petroleum (KHO)

1021 DR08-05

524150.12 N

307200.20 E

water depth = 2.6 ft

- 30 m from mouth of I+M Canal
- 30 m from RDB

- light gray silt w/ some fine grained sands (touch, only ~~none~~ visible grains) organic matter (leaves, sticks) + some large gravel

---

Location

Date 5/6/08

Project / Client Nijman - Franzetti Sediment

14581.02

DR08-05 (cont)

- noticable odor of ~~product~~ petroleum (KHO) and slight oil sheen
- Corbicula present in sediment at location

1117 DR08-06

34 m from LDB
60 m from marina pier

524200.45 N

308708.11 E

water depth = 4.8 ft

- noticable odor of ~~product~~ petroleum (KHO)
light gray clayey silt, very fine grained (no sand grains)
low water content

Location

Date 5/6/08

Project / Client Nijman - Franzetti Sediment
14581.02

1140 DR08 - 08

- 57 m upstream of road
  (Grant Creek cutoff)
- 53 m from LDB

- water depth = 4.8 ft

3 [illegible]
52402~~4~~.91 N
308797.68 E

- dk. gray / black fine grained silt w/
  some clay, low H_2O content
  no petroleum odor, no visible sheen

1221 DR08 - 08 and DR08-08MS

- 22 m from SW tip of Bear / Moose
  Island
- 44 m downstream from orange
  painted post : start of electrofish
  location 414

525952.64 N
309184.43 E

Location

Date 5/6/08

Project / Client Nijman - Franzetti Sediment
14581.02

DR08-08 (cont)

- water depth = 3.3 ft

- location for MS/MSD

- light gray to brown fine -
  grained silt, low water content
  no visible sheen, no odor

1305 DR08-09
~~[illegible]~~

~~- 66 m SE of duck blind~~ [illegible]
~~- 57 m from SE tip of Bear/Moose~~
~~Island, towards main channel~~

~~- water depth = 4.3 ft~~

~~525840.57N~~
~~309393.20E~~

* location unsuccessful
b/c of no recovery
rocks + large gravel →
moved further offshore

Location

Date 5/6/08

Project / Client Nijman-~~Franzetti~~ Sediment
14581.02

1310 DR08-09
- 94 m from SE tip of Bear/Moose Island, 70 m due E of duck blind

Water depth = 6.2 ft

525548.18 N
309429.70 E

- grey silt w/ some fine-grained sand (no visible grains), some organic matter (sticks + leaves) no odor, no visible sheen

1403 DR08-10
* location added by Joe VonDruska
- water depth = 2.3 ft

525895.87 N
309742.79 E

- dark brown sandy silt; visible sand grains; petroleum odor and visible sheen

---

Location

Date 5/6/08

Project / Client Nijman-~~Franzetti~~ Sediment
14581.02

RM = river mile

DR08-10 (cont)
- 94 m downstream of the RM 276.1 day mark
- 55 m from LDB
228 m upstream of Dow Chemicals barge loading dock / terminal

1451 DR08-11 + DR08-11 FD
- 480 m SE of Dow Chemical's gravel boat ramp
247 m NW of barge terminal
171 m NE of duck blind
near mouth (~500 m) from Du Page River

527391.13 N
310137.07 E

- water depth = 3.8 ft

- 1453 field duplicate collected

Location ______ Date 5/6/08

Project / Client Nijman - Franzetti Sediment 14581.02

DR08 - 11 (cont)

- dark brown sandy silt with visible medium grained sands, organic matter petroleum odor; visible sheen ~~sand~~ some ~~coarse~~ medium grained gravel

1538 DR08-12

KAO - ~~195~~ 245 m Northwest of Dow Chemical barge terminal
195 ~~245~~ m north East of duck blind
590 m downstream from point located downstream of I-55 bridge (downstream of Du Page River delta point)

527560.20 N
310717.47 E

- industrial facilities on left bank
no development on right bank

Location ______ Date 5/6/08

Project/Client Nijman - Franzetti Sediment 14581.02

DR08-12 (cont)

- dark grey silty sand; visible medium grained sands slight odor of ~~product~~ petroleum; no visible sheen KAO

- water depth = 1.7 ft

1615 DR08-13

- water depth = 4.2 ft

- 247 m upstream of Dow Chemical barge terminal
- 340 m downstream of BASF barge terminal
- 45 m from LDB

527436.31 N
311064.39 E

Location

Date 5/6/08

Project / Client Nijman-~~Franzetti~~ Sediment
14581.02

DR08-13 (cont)

- dark gray clayey silt; organic matter (leaf debris) substantial petroleum odor and visible sheen

1721 EQBDAY 1

- equipment blank for petit ponar
- 7 jars total

* 2 coolers sent to TestAmerica - Pitt
tracking # J213 161 8998
J213 161 9004

Location

Date 5/7/08

Project / Client Nijman-~~Franzetti~~ Sediment
14581.02

0722 arrive marina

- on board: Joe Vondruska and Karin Olsen
- overcast and raining

0826 DR08-14

- 125 m downstream of Exxon Mobile furthest downstream docking cell
- 62 m downstream of I-55
- 154 m upstream of BASF barge terminal
- 35 m from LDB

527749.38 N
311541.77 E

* station added by Joe

water depth = 3.1 ft

dark gray sandy silt; visible fine grained sands, visible oil sheen, noticeable petroleum odor

Location
Date 5/7/08
Project / Client Nijman-Franzetti Sediment
14581.02

0906 DR08-15

528202.28 N
312424.05 E

water depth = 5.7 ft

-84 m downstream of Jackson Creek dam
-24 m from LDB
-36 m upstream of Exxon-Mobile intake

gray clayey silt, low H_2O content, visible oil sheen, noticeable petroleum odor

0925 DR08-16

528301.02 N
312425.64 E

Location
Date 5/7/08
Project / Client Nijman-Franzetti Sediment
14581.02

DR08-16 (cont)

water depth = 3.8 ft

-24 m from RDB
-73 m downstream from Jackson Creek dam
-dark gray to black clayey silt, visible sheen, strong petroleum odor

1012 DR08-17

-70 m downstream of mouth of Jackson Creek diversion channel
-75 m from LDB
-96 m from downstream tip of treats Island

592093.11 N
313372.95 E

water depth = 3.4 ft

-dark gray silt w/ fine grained sands (not visible, only touch),

⟹

Location ______ Date 5/7/08

Project / Client Nijman-Franzetti Sediment
14581.02

DR08-17 (cont)

- visible sheen, strong petroleum odor
- recovery difficult b/c sticks and leaves on bottom

1058 DR08-18

- 11 m up~~down~~stream (KAO) of powerline pole and ~~[illegible]~~ abutment
- 16 m from RDB

- water depth = 4.1 ft

529757.65 N
314045.21 E

- black silt, high H_2O content, visible sheen, strong petroleum odor

Location ______ Date 5/7/08

Project / Client Nijman-Franzetti Sediment
14581.02

1142 DR08-19

- 21 m from LDB
- 71 m upstream from mouth of Cedar Creek
- 206 m downstream from Stepan Chem barge terminal

530312.49 N
314049.81 E

water depth = 3.1 ft

- dark brown silt w/ some medium grained sand (visible), high H_2O content

1205 - 1225
MBI site RM 279.5

- potential sediment sampling site; investigated both banks; conditions predominated coarse grained gravels w/o sed. deposition

⟹

Location

Date 5/7/08

Project / Client Nijmeas-Franzetti Sediment
14581.02

MB1 site RM 279.5 (cont)

no Ponar attempts made b/c no suitable substrates were identified

1248 DR08-20

-12 m from RDB

-34 m from furthest downstream Amoco chemical docking cell

-water depth = 1.1 ft

530791.69 N
313816.77 E

-very strong petroleum odor and visible sheen (persistent & pronounced), some corbicula in sample

-sandy silt, dark gray medium grained sands (visible); high H_2O content

---

Location

Date 5/7/08

Project / Client Nijman-Franzetti Sediment
14581.02

1326 DR08-21

-water depth = 2.1 ft

-132 m downstream of RM 280.4 Cedar Creek daymark

-50 m from LDB

530829.91 N
314067.50 E

-dark brown to gray sandy silt, visible medium grained sands, slight petroleum odor, minor sheen, high H_2O content

1422 DR08-22

-50 m from LDB

EAO - ~~272~~ 312 m across river from ~~Sulfur~~ Canal Barge Co. terminal EAO

- water depth = 2.3 ft

⟹

Location
Date 5/7/08
Project / Client Nijman-Franzetti Sediment
14581.02

DR08-22
533283.54 N
313854.45 E

- dark brown sandy silt w/ visible medium grained sands; slight petroleum odor, mimimal sheen, sticks and Corbicula in sample

1453 DR08-23

- water depth = 5.2 ft

- 28 m upstream of Rock Run daymark
- 47 m from RDB

533533.85 N
314666.77 E

- dark brown sandy silt, visible medium grain sands, slight sheen, slight petroleum odor

---

Location
Date 5/7/08
Project / Client Nijman-Franzetti Sediment
14581.02

1522 DR08-24

- 28 m from LDB
- 122 m downstream of ~~red~~ Santa Fe Light and Daymark 282.8 RM

- water depth = 2.8 ft

533613.56 N
315436.18 E

- dark brown sandy silt; sand grains not visible (touch only); slight petroleum odor, slight sheen

1614 EQBDAY2

1725 2 coolers to TestAmerica
tracking # J213 161 9193
J213 161 9184

Location
Date 5/8/07
Project / Client Nijman-Franzetti Sediment
14581.02

0705 arrive marina + load boat
- on board: Joe Vondruska + Karin Olsen
- overcast, cool (low 50s), breezy

0742 DR08-16
take site photos; not collected yesterday b/c driving rains during sample collection

0754 DR08-18
take site photos; not collected yesterday b/c driving rains during sample collection

0843 DR08-25
- 493 m upstream from Empress casino
40 m from RDB; directly off from ~84 in stormH₂O outfall

- water depth = 1.8 ft

Location
Date 5/8/07
Project / Client Nijman-Franzetti Sediment
14581.02

DR08-25 (cont)
534548.22 N
316278.61 E

- dark brown sandy silt w/ some medium grained sands, visible sheen, slight petroleum odor

0910 DR08-26 and DR08-26MS

- 10 m upstream Caterpillar 42 in outfall
- 30 m from RDB
- outfall ~150 m upstream of onshore settling basin

- water depth = 2.0 ft

- 534825.44 N
316661.89 E

- dark brown sandy silt w/ medium grained sands visible, slight odor of petroleum, slight sheen

Location
Date 5/8/07
Project / Client Nijman-Franzetti Sediment
14581.02

0941 DR08-27

- 32 m from LDB
- 27 m from head of cove

- Water depth = 2.3 ft

535536.41 N
317629.03 E

- dark brown sandy silt w/ visible medium grained sands; slight petroleum odor, minor sheen, some Coribucula and organic matter (sticks, leaves) visible in sample

1012 ~~DR08-28~~

~~- 31 m from LDB~~
~~- 90 m from head of cove.~~
~~- 40 m upstream of main channel LDB~~
~~- 267 m SW of pennisula dividing channel from tailwaters~~

KAO

Location
Date 5/8/07
Project / Client Nijman-Franzetti Sediment
14581.02

~~DR08-28 (cont)~~

KAO

~~Water depth = 4.3 ft~~

~~536177.89 N~~
~~318483.37 E~~
no sample recovered

1022 DR08-28 → new location and DR08-28FD
Water depth = 1.9 ft

- wind moved boat off location, moved, reanchor, and set new location

- 1025 DR08-28 FD (field duplicate) collected

536176.84 N
318479.48 E

- dark gray sandy silt with medium to coarse grained sands
- Corbicula and organic matter & (mostly sticks)

Location

Date 5/8/08

Project / Client Nijman-Franzetti Sediment

14581.02

BR08-28 (cont)

- noticeable petroleum odor; moderate sheen

-31 m from LDB
81 m from head of cove
35 from LDB of main channel
275 SW of peninsula dividing channel from tailwaters

1105 pull boat from Big Basin Marina and move to boat ramp located above Brandon Lock

1203 put boat in above Brandon Lock (b/w I-80 + Lock); check in with USACE

1226 BR08-01

-10 m from LDB
385 m downstream of I-80 bridge
432 m upstream of Brandon Lock and Dam

Location

Date 5/8/08

Project / Client Nijman-Franzetti Sediment

14581.02

537484.68 N
KAB ~~320112.72 E~~
320112.72

water depth = 3.6 ft

- dark gray silt w/ fine grained sands (not visible, touch only) noticeable, pervasive petroleum odor; persistent moderate sheen; organic matter (mostly sticks)

1258 BR08-02

- end of 309 electrofishing area
- 175 m upstream of Brandon Lock + Dam
- 16 m from LDB

537246.52 N
319934.23 E

water depth = 4.7 ft

Location

Date 5/8/08

Project / Client Nijman-Franzetti Sediment
14581.02

BR08-02 (cont)

- dark gray silt with noticeable petroleum odor and moderate sheen
  organic matter (mostly sticks)

1324 BR08-03

- 17 m from I + M outlet
  43 m from RDB

- water depth = 1.6 ft

537194.82 N
319237.50 E

- dark gray silt w/ noticeable odor and slight sheen; few Corbicula and some organic matter

---

Location

Date 5/8/08

Project / Client Nijman-Franzetti Sediment
14581.02

1402 BR08-04

537348.62 N
319438.30 E

- 190 m upstream ~~from B[illegible]~~ ~~Adam~~ to access bridges from → ~~eastern portion~~ floating marina
- 10 m ~~for~~ from RDB

- water depth = 2.1 ft

- dark gray silt w/ fine grained sands (not visible, touch only) some organic matter (mostly sticks); noticeable petroleum odor and moderate sheen

1452 EQBDAY3

1535 2 coolers to Test America
tracking # J213 161 9013
J213 161 9219

Location
Date 5/9/08
Project / Client Nijman-Franzetti Sediment
14581.02

0755 arrive Brandon Lock + Dam and
check in with USACE
on board: Joe Vondruska + Karin Olsen
sunny, cool (upper 50s), light breeze

[illegible] (KAO)

0924 DR08-30

water depth = 2.2 ft

536568.91N
319522.52 E

- dark gray sandy silt, medium grained sands visible, some organic matter (mostly roots and sticks); minor sheen, slight petroleum odor; some clay clumps

- 5 m from left descending bank of Sugar Run
- 58 m upstream of mouth

Location
Date
Project / Client Nijman-Franzetti Sediment
14581.02

1005 DR08-31

Water depth = 0.9 ft

536566.62 N
319485.27 E

- mouth of Sugar Run, ~2 m from RDB

- dark gray sandy silt with medium to coarse grained sands, some organic matter, (mostly sticks) some gravel pieces; slight odor, no sheen

1118 DR08-29

Water depth = 0.8 ft

536667.48 N
319046.56 E

Location

Date 5/9/08

Project / Client Nijman-Franzetti Sediment

14581.02

DE08-29 (cont)

- dark gray sandy silt; medium to coarse grained sands w/ some gravel; some organic matter (mostly sticks and roots); algae on bottom slight odor, minor sheen

- 17 m from RDB
  39 m from head of cove
  27 m upstream of duck blind

1210 EQBDAY 4

1 cooler to Test America
tracking # J213 161 902 2
→ for Saturday delivery

Location

Date

Project / Client

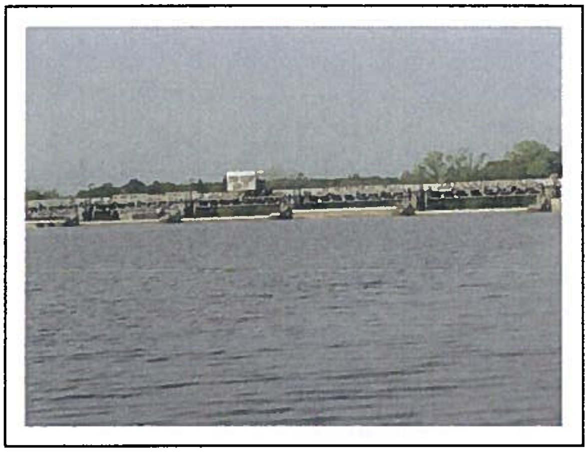
APPENDIX B

SAMPLING PHOTOGRAPHS

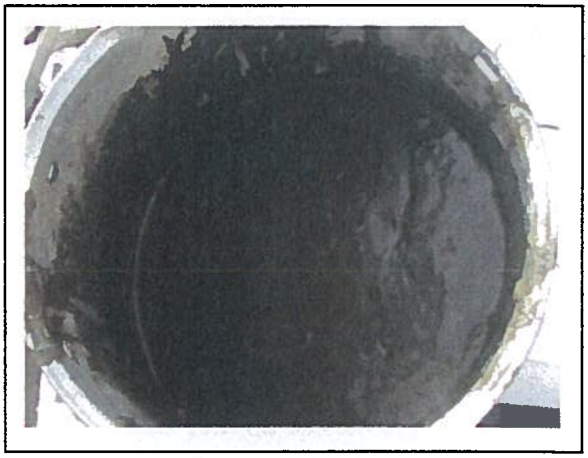
EA Engineering, Science, and Technology, Inc.

Photographic Record

Dresden Pool
May 6-9, 2008



Location DR08-01



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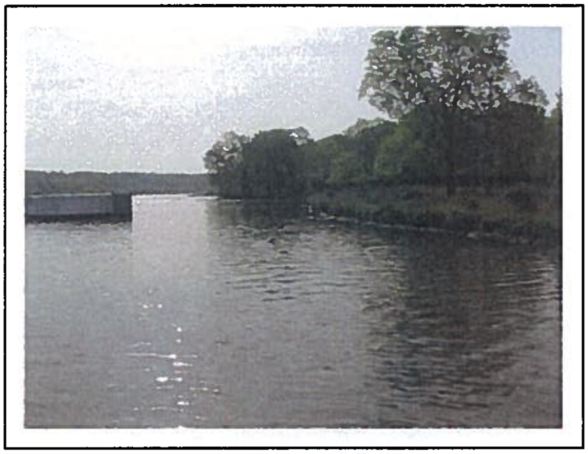
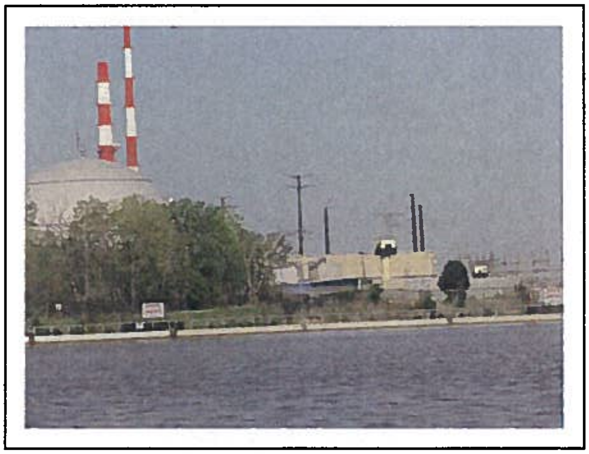


Location DR08-02

Location DR08-02

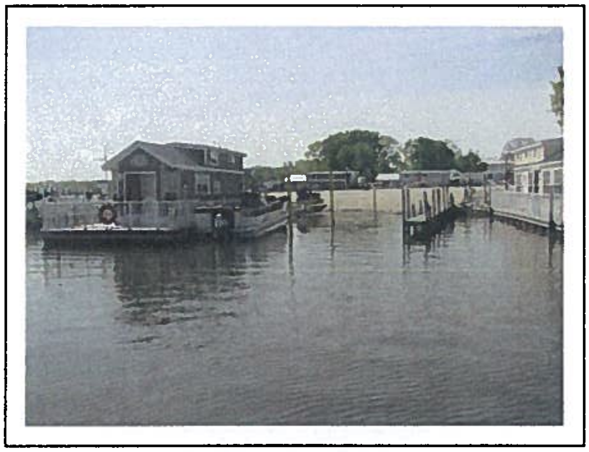


Location DR08-03

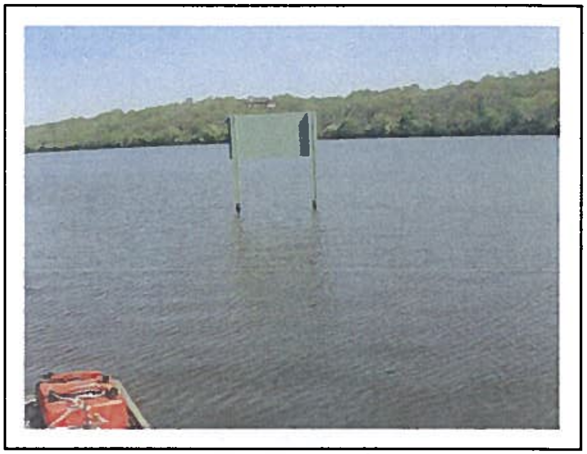
Location DR08-03

Photographic Record

Dresden Pool
May 6-9, 2008

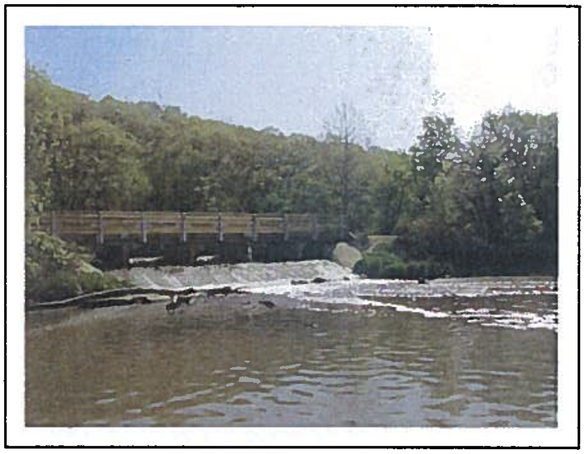


Location DR08-04



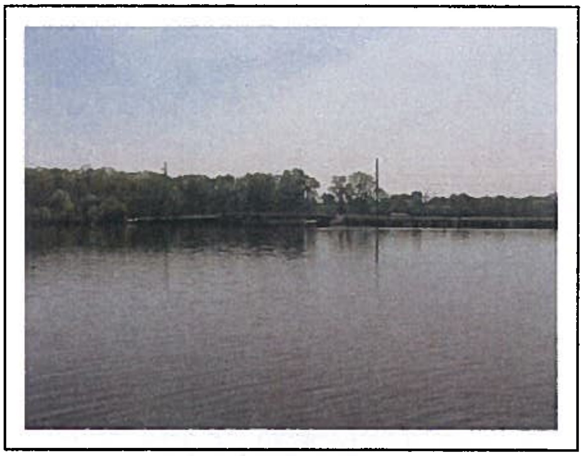
Location DR08-04

Location DR08-04



Location DR08-05

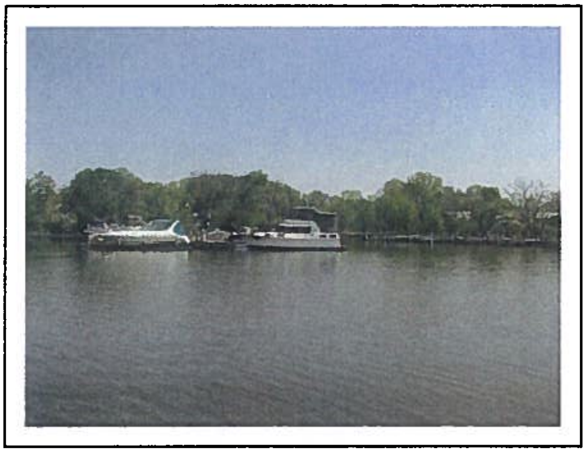
Location DR08-05



Location DR08-06

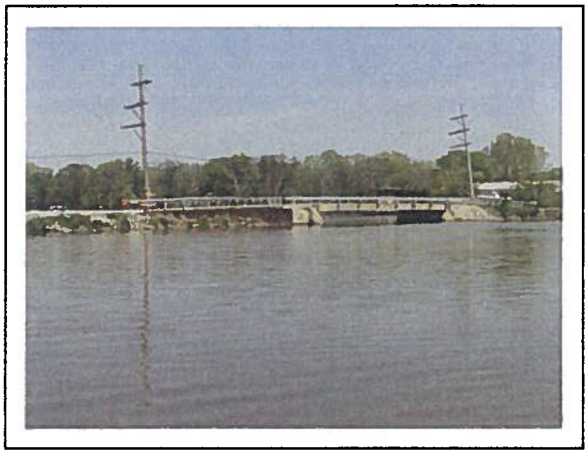
Photographic Record

Dresden Pool
May 6-9, 2008



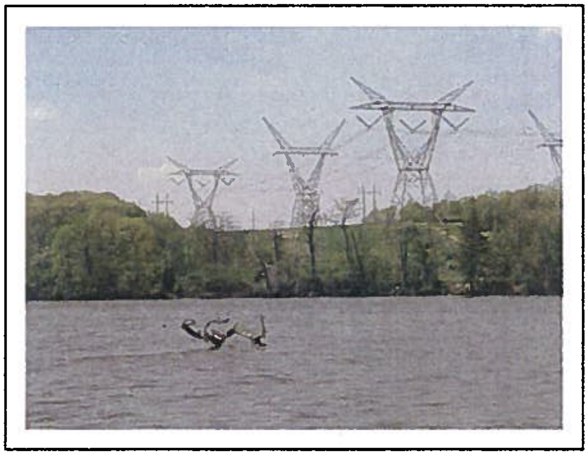
Location DR08-06

Location DR08-06



Location DR08-07

Location DR08-07



Location DR08-08

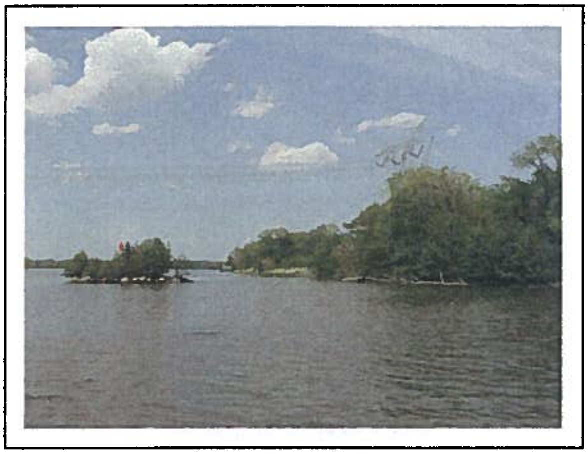
Location DR08-08

Photographic Record

Dresden Pool
May 6-9, 2008

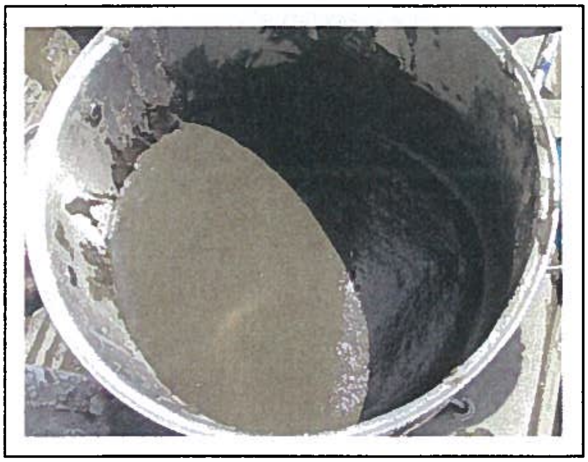
Location DR08-09

Location DR08-09

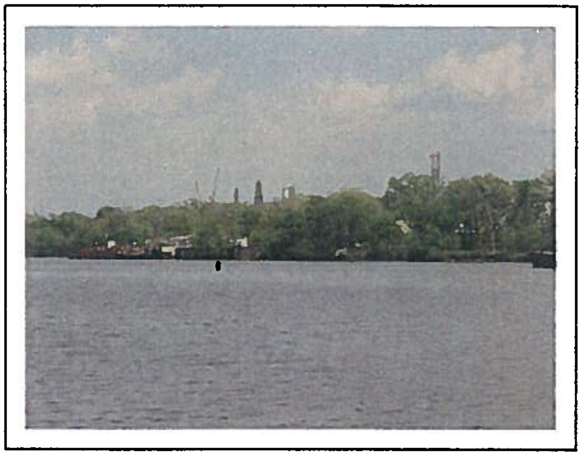


Location DR08-10

Location DR08-10



Location DR08-10



Location DR08-11

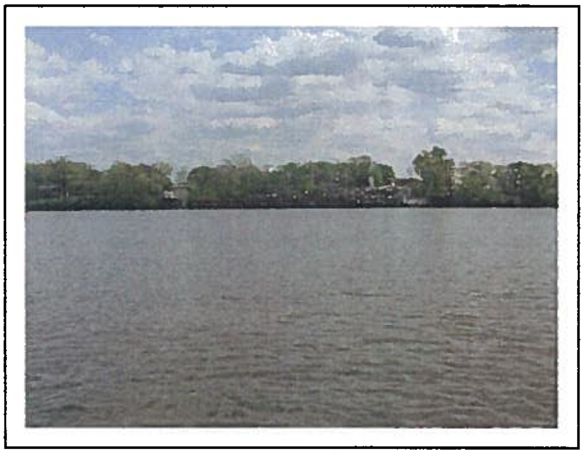
Photographic Record

Dresden Pool
May 6-9, 2008

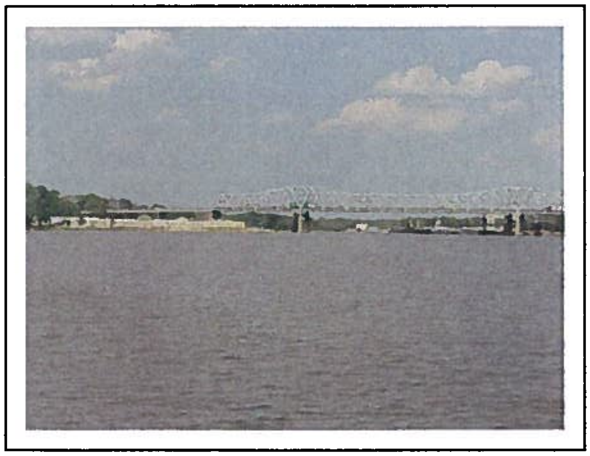
Location DR08-11

Location DR08-11

Location DR08-11



Location DR08-12

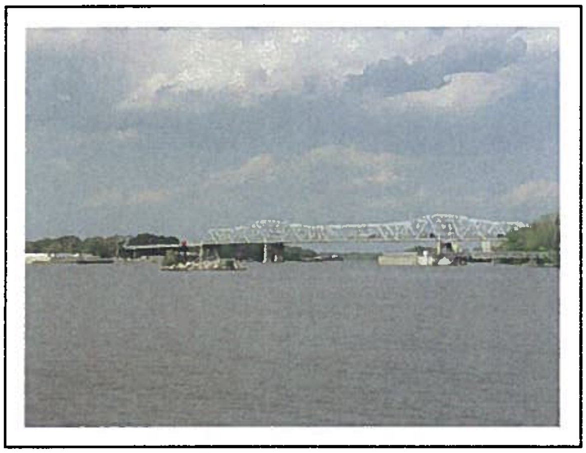


Location DR08-12

Location DR08-12

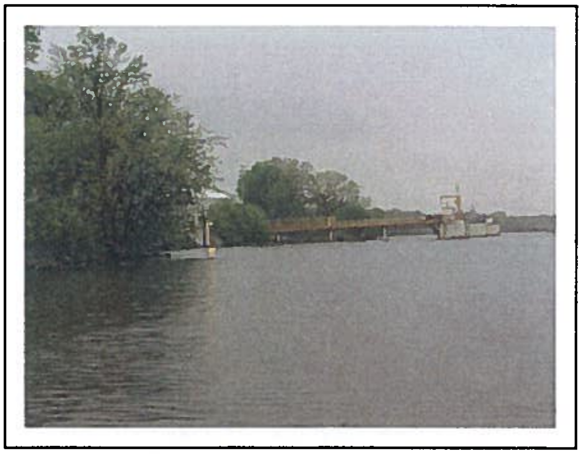
Photographic Record

Dresden Pool
May 6-9, 2008


Location DR08-13


Location DR08-13


Location DR08-14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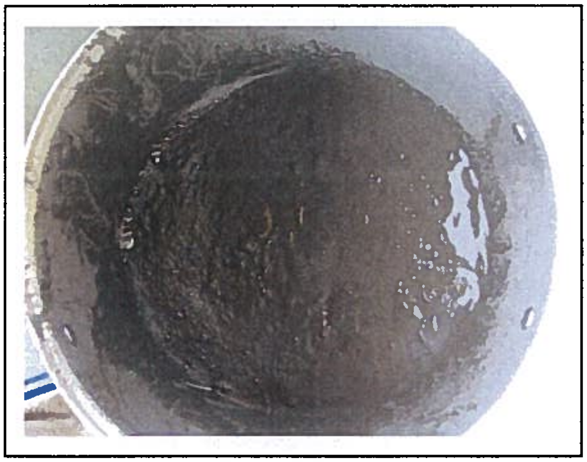
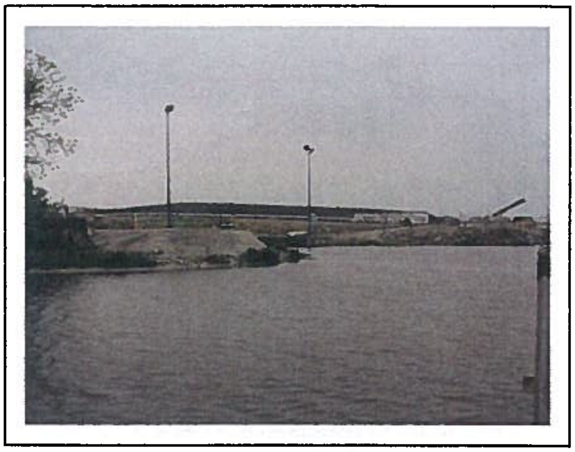
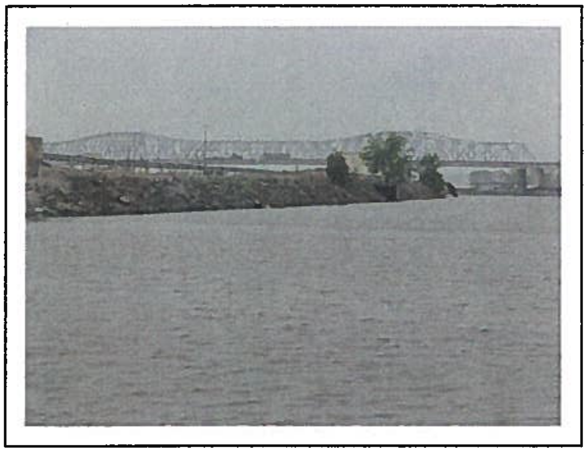

Location DR08-14


Location DR08-15

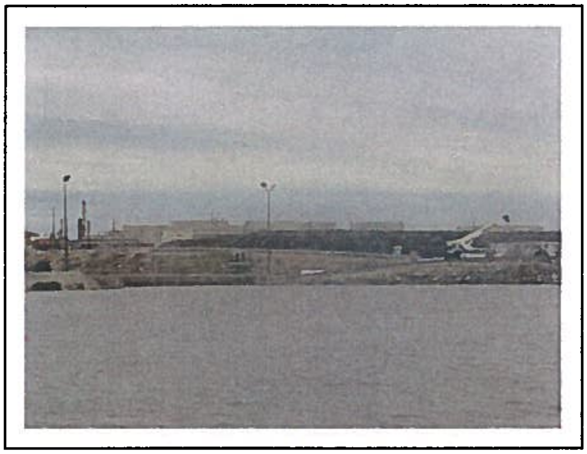
Photographic Record

Dresden Pool
May 6-9, 2008



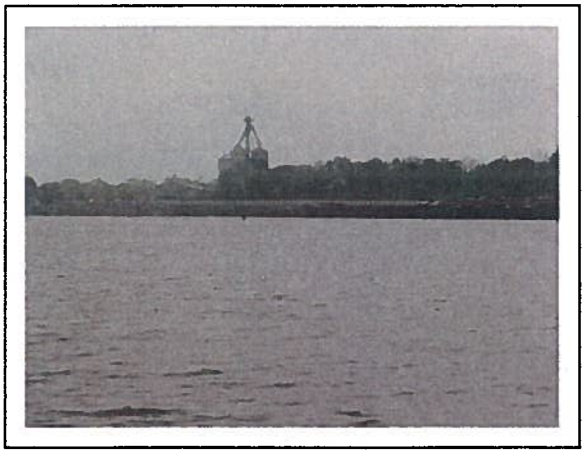
Location DR08-15

Location DR08-15



Location DR08-16

Location DR08-16

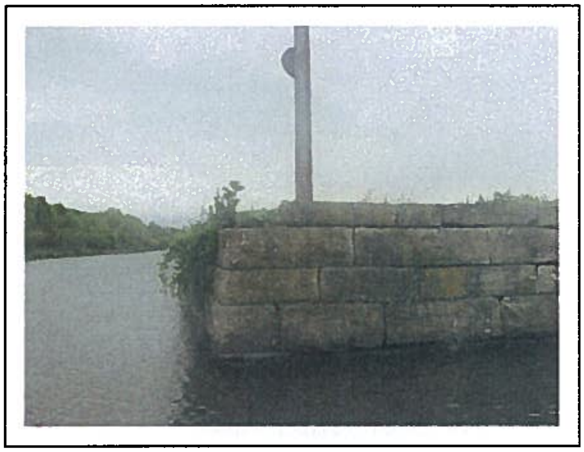


Location DR08-17

Location DR08-17

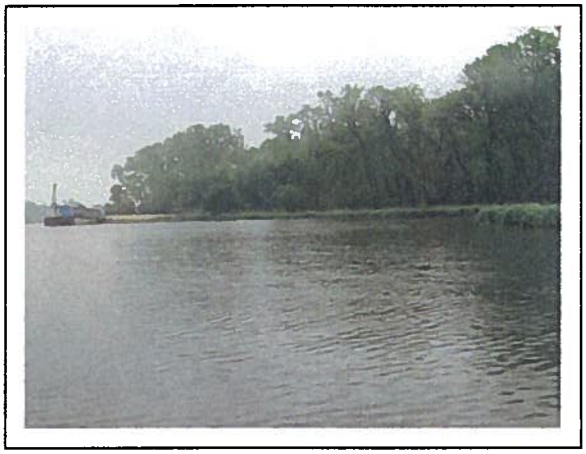
Photographic Record

Dresden Pool
May 6-9, 2008



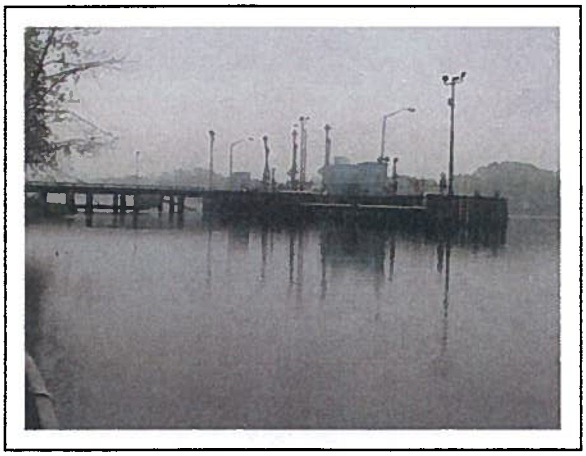
Location DR08-18

Location DR08-18



Location DR08-19

Location DR08-19

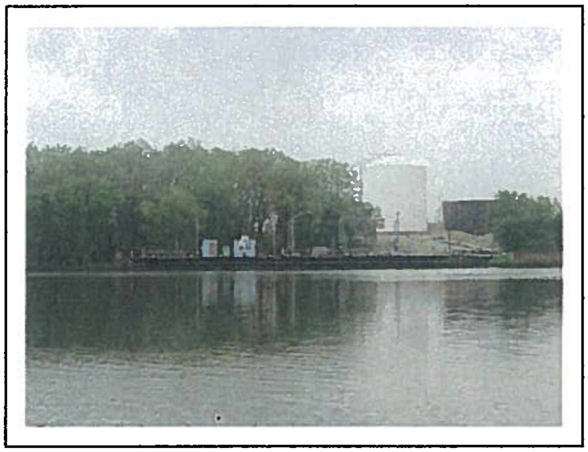


Location DR08-20

Location DR08-20

Photographic Record

Dresden Pool
May 6-9, 2008



Location DR08-21

Location DR08-21

Location DR08-22

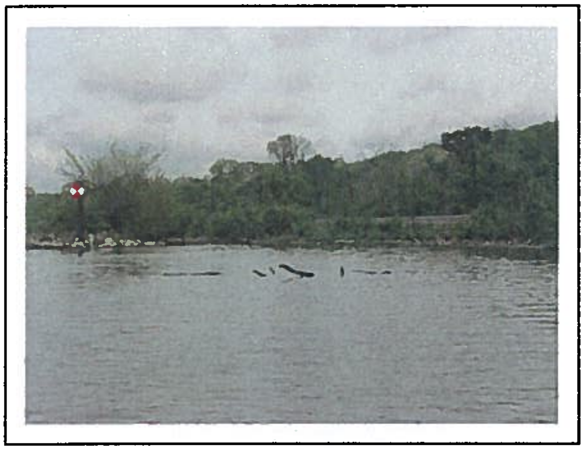
Location DR08-22

Location DR08-23

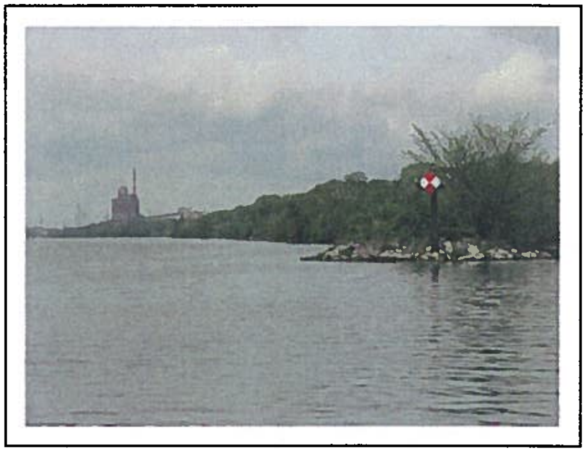
Location DR08-23

Photographic Record

Dresden Pool
May 6-9, 2008



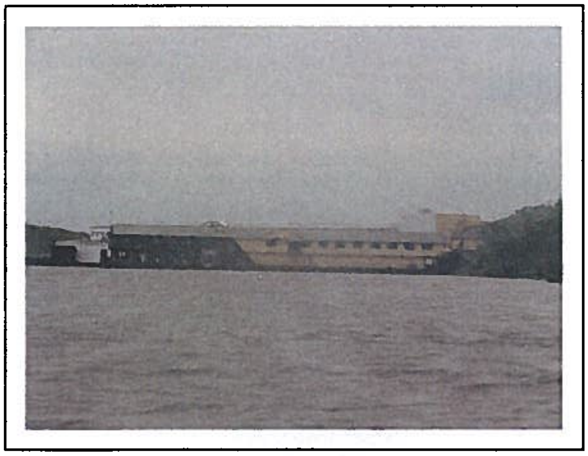
Location DR08-24



Location DR08-24

Location DR08-24

Location DR08-25



Location DR08-25

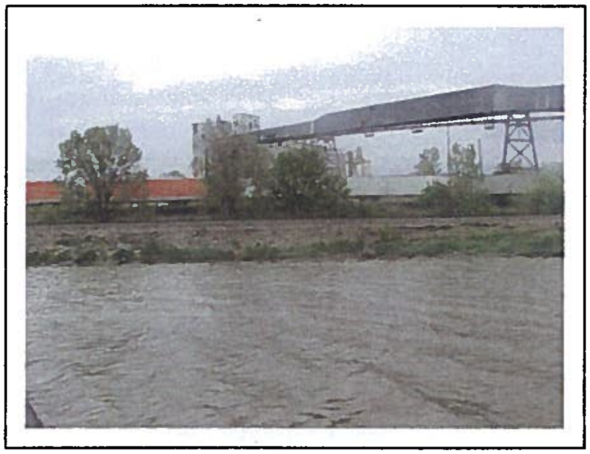
Location DR08-25

Photographic Record

Dresden Pool
May 6-9, 2008

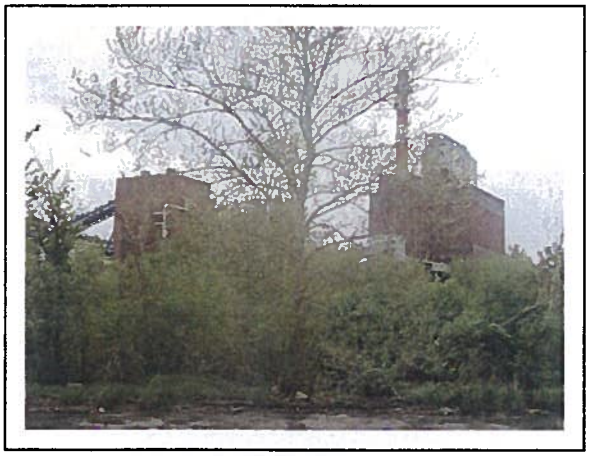
Location DR08-26

Location DR08-26

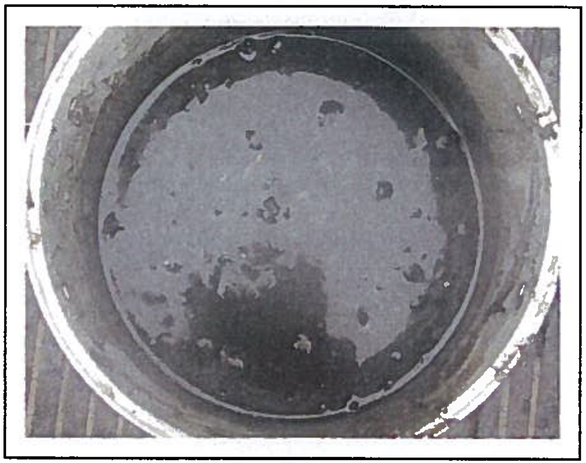


Location DR08-27

Location DR08-27



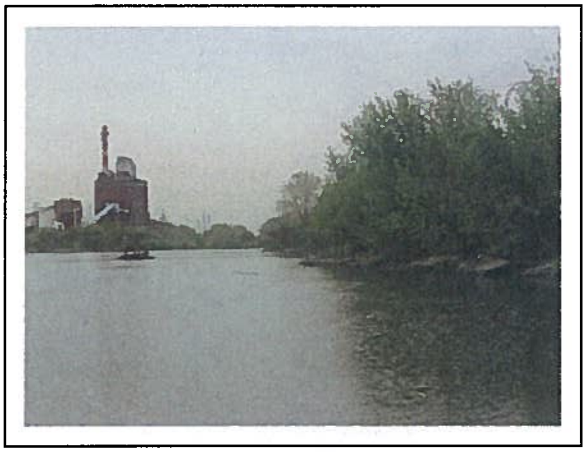
Location DR08-28



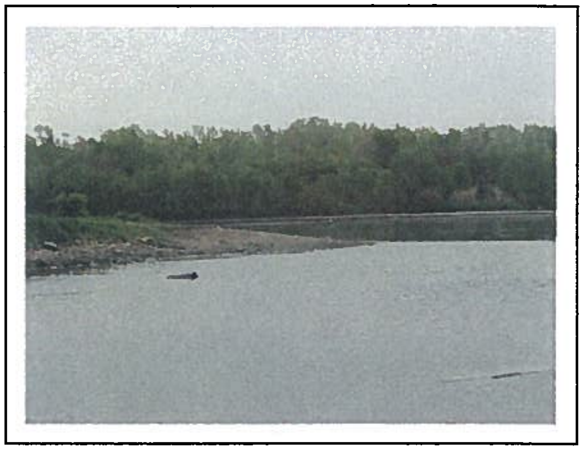
Location DR08-28

Photographic Record

Dresden Pool
May 6-9, 2008



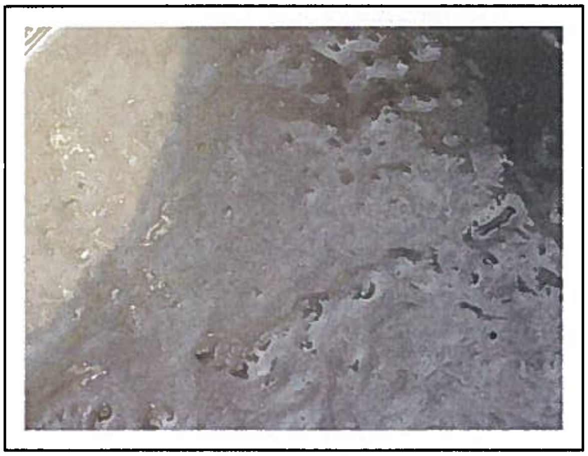
Location DR08-29



Location DR08-29

Location DR08-29

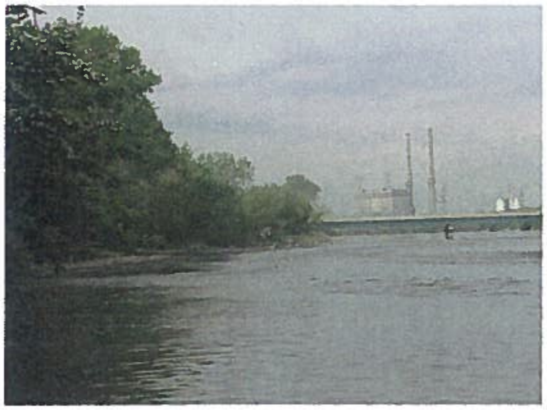
Location DR08-30



Location DR08-30

Photographic Record

Dresden Pool
May 6-9, 2008

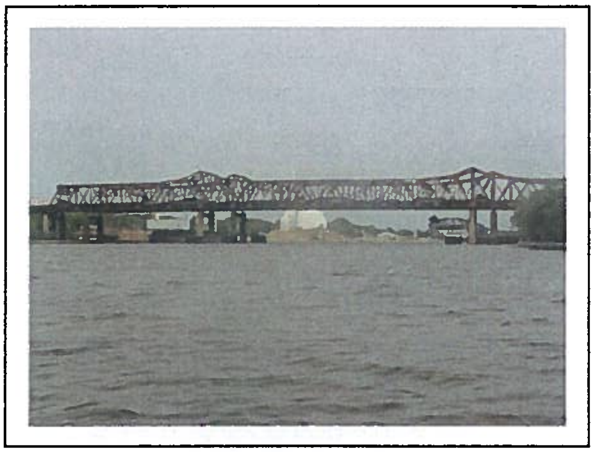


Location DR08-31

Location DR08-31

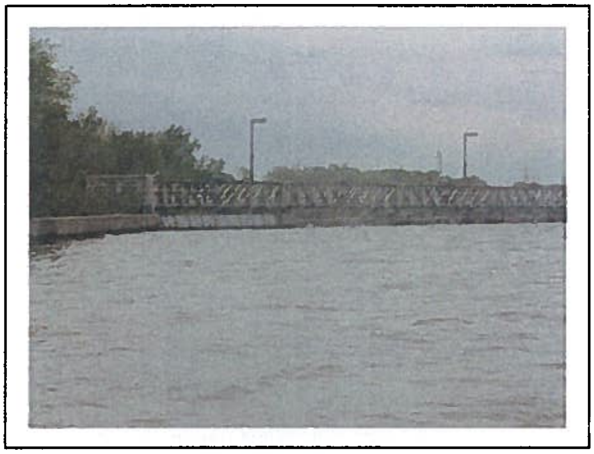
Photographic Record

Lower Brandon Pool
May 6-9, 2008

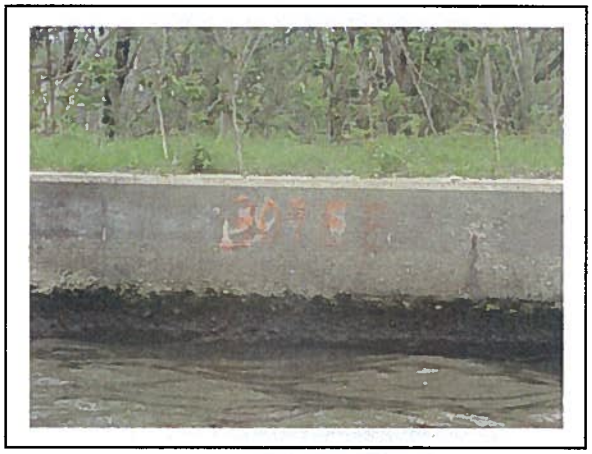


Location BR08-01

Location BR08-01

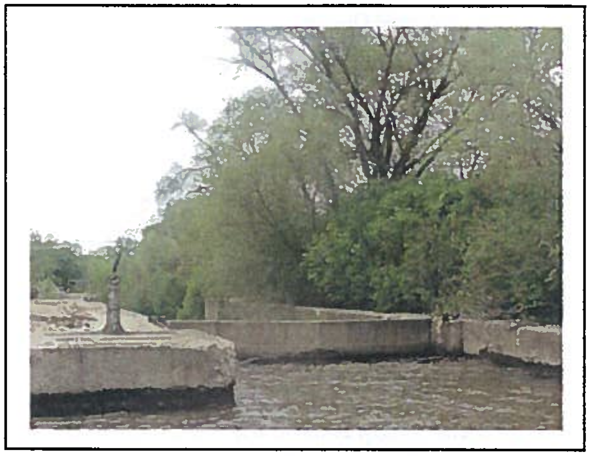


Location BR08-02



Location BR08-02

Location BR08-02

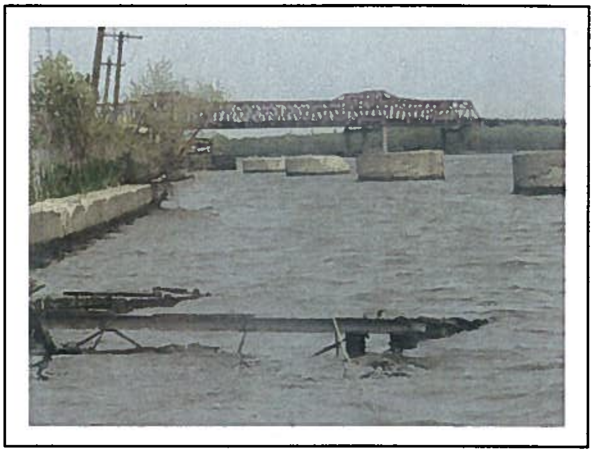


Location BR08-03

Photographic Record

Lower Brandon Pool
May 6-9, 2008

Location BR08-03



Location BR08-04