MINUTES

SEWRPC ADVISORY COMMITTEE ON REGIONAL WATER QUALITY MANAGEMENT PLAN UPDATE FOR THE GREATER MILWAUKEE WATERSHEDS

DATE: September 20, 2007

TIME: 1:30 p.m.

PLACE: City of Mequon City Hall
Upper Level Council Chambers
11333 N. Cedarburg Road
Mequon, Wisconsin

Committee Members Present

Daniel S. Schmidt, Chairman	SEWRPC Commissioner
Michael G. Hahn, Secretary	Chief Environmental Engineer, Southeastern Wisconsin Regional Planning Commission
Martin A. Aquino (for Jeffrey J. Mantes)	Environmental Manager, Environmental Engineering, City of Milwaukee
John R. Behrens	Commissioner-Secretary, Silver Lake Protection and Rehabilitation District
John M. Bennett	City Engineer, City of Franklin
Marsha B. Burzynski (for James L. McNelly)	Regional Water Resources Planner, Wisconsin Department of Natural Resources
Elizabeth Hellman (for Kristine M. Krause)	Environmental Department, We Energies
Andrew A. Holschbach	Director, Ozaukee County Planning, Resources, and Land Management Department
Judy Jooss (for Diane M. Georgetta)	Town and Country Resource Conservation and Development, Inc.
Steve Keith	Acting Director of Environmental Services, Milwaukee County
James F. Lubner	Sea Grant Advisory Services Specialist, University of Wisconsin Sea Grant Institute
Michael Martin (for Kevin L. Shafer)	Director of Technical Services, Milwaukee Metropolitan Sewerage District
Charles S. Melching	Associate Professor, Civil & Environmental Engineering, Marquette University
Matthew Moroney	Executive Director, Metropolitan Builders Association of Greater Milwaukee
Paul E. Mueller	Administrator, Washington County Planning and Parks Department
Stephen Poloncsik (for Peter G. Swenson)	Senior Staff Engineer, U.S. Environmental Protection Agency
Chad Sampson (for Julie A. Anderson)	County Conservationist, Racine County
Thomas A. Wiza	Director of Engineering and Public Works, City of Cedarburg

Staff Members and Guests

Joseph E. Boxhorn	Senior Planner, Southeastern Wisconsin Regional Planning Commission
Troy E. Deibert	Water Resources Engineer, HNTB Corporation
Jill Hapner	County Conservationist, Washington County Land Conservation Department

WELCOME AND INTRODUCTIONS

Mr. Schmidt thanked the Advisory Committee members for attending this meeting. He indicated that roll call would be accomplished with a sign-in sheet circulated by SEWRPC staff.

APPROVAL OF MINUTES OF THE MEETING OF AUGUST 7, 2007

Mr. Schmidt asked Mr. Hahn to review the highlights of the minutes of the August 7, 2007, meeting of the Committee.

Mr. Melching and Ms. Jooss noted some typographical errors and minor omissions in the minutes.

[Secretary's Note: Those errors or omissions were corrected.]

Ms. Jooss noted that the last Secretary's Note on page 5 refers to the recommended plan as the areawide water quality management plan for southeastern Wisconsin, while the plan is only for the greater Milwaukee watersheds. Mr. Hahn replied that the reference would be made more specific.

[Secretary's Note: The revised text in the last Secretary's Note on page 5 was revised to read as follows (In this Secretary's Note and in subsequent Notes, revised and added text is indicated in bold letters for clarification purposes only. The report text will not be bold):

"In accordance with both Section 208 of the Federal Water Pollution Control Act as amended and with Chapter NR 121 of the *Wisconsin Administrative Code,* a certified copy will be transmitted to the WDNR with a request that the Department approve the plan as the official areawide water quality management plan for the **greater Milwaukee watersheds** and recommend to the Governor that the plan be certified by him and transmitted to the USEPA for that agency's approval."]

Mr. Lubner asked whether the numbers 0 to 4,375 in the last sentence of footnote number one in the Secretary's Note on page 7 was correct. Mr. Hahn responded that this was a typographical error and would be corrected.

[Secretary's Note: The last sentence of footnote number one in the Secretary's Note on page 7 was revised to read as follows:

"For example, based on that approach, 35 animal units are equivalent to 25 milking cows; 35 steers; 87 55-pound pigs; and **1,050** to 4,375 chickens, depending on the type and whether the manure is liquid or nonliquid."]

Mr. Melching asked what the time frame is for the amount of money recommended to be budgeted for water quality planning listed on page 11 of the Minutes. Mr. Hahn replied that this is an annual amount. Mr. Martin suggested that the text be revised to indicate that.

[Secretary's Note: As noted below, the text of Chapter XI was revised to reflect that the $1.2 million amount is an annual cost.]

Mr. Hahn stated that, as discussed on page 16 of the Minutes, SEWRPC staff received comments from Mr. Thomas J. Bunker, Racine Water and Wastewater Utility after the August 7, 2007, Committee meeting. He continued that Mr. Bunker suggested deleting Appendix Q from the draft report. Mr. Hahn noted SEWRPC staff decided to retain Appendix Q, because it was felt that it presents valuable information about implementation costs to the communities, but does not place obligations on the communities. He indicated that the footnote on page 16 was added in response to Mr. Bunker's comments. He noted that the SEWRPC staff has not received a response from Mr. Bunker regarding the August 7, 2007, meeting minutes.

Mr. Hahn stated that, as discussed on page 18 of the Minutes, Committee meeting, SEWRPC staff received comments from Ms. Marsha Burzynski and Mr. William G. Wawrzyn, WDNR, after the August 7, 2007, meeting. Mr. Wawrzyn suggested that the plan recommend revisions to Chapter NR 104 of the *Wisconsin Administrative Code* for certain stream reaches in the study area for which the WDNR has recommended revisions to water use objectives. Mr. Hahn indicated that one item to be reviewed by the Committee at this meeting is a discussion of analyses relative to whether several stream reaches could support more stringent water use objectives.

Mr. Hahn noted that the Secretary's Note on pages 24 and 25 of the Minutes was added to address developments in facility planning needs for wastewater treatment plants that were obtained after the preliminary draft of Chapter X of PR-50 was issued.

Mr. Hahn stated that the third Secretary's Note on page 25 extends the use of enhanced urban illicit discharge control and/or innovative methods to identify and control possible pathogen sources in stormwater runoff from selected urban areas to all urban areas in the study area. He explained that this modifies the recommended plan.

There being no further additions or revisions, the minutes were approved, on a motion by Mr. Holschbach, seconded by Mr. Bennett, and carried unanimously.

CONSIDERATION OF REVISED EXCERPTS FROM THE PRELIMINARY DRAFT OF CHAPTER XI, "PLAN IMPLEMENTATION," OF SEWRPC PLANNING REPORT NO. 50 (PR NO. 50), *A REGIONAL WATER QUALITY MANAGEMENT PLAN UPDATE FOR THE GREATER MILWAUKEE WATERSHEDS*

Mr. Schmidt asked Mr. Hahn to review the revised excerpts from the preliminary draft of the chapter.

Mr. Hahn stated that the excerpts from Chapter XI that are to be reviewed reflect the agreements reached at the August 24, 2007, meeting of the Oversight Committee for the Regional Water Quality Management Plan Update and the MMSD 2020 Facilities Plan at which the implementation chapter was discussed. He noted that the "track changes" option was used to indicate revisions. He explained that the Oversight Committee decided that the plan should remain silent on a particular institutional framework for plan implementation. To reflect this, he continued, pages 19 through 21 were removed from the draft chapter. He noted that a structure for plan implementation has been in place for 30 years and that this existing structure will continue to function. He added that MMSD is examining a regional water quality partnership as a means of providing additional impetus to plan implementation.

Mr. Hahn pointed out that a section on Total Maximum Daily Loads (TMDLs) was added to page 19 of the draft chapter. He added that this section was added as an outgrowth of a TMDL program that MMSD is starting.

Mr. Martin asked that the word "intends" in the third paragraph of page 19 be changed to "is proposing". Mr. Hahn replied that this would be changed.

[Secretary's Note: The first sentence of the third full paragraph on page 19 was revised to read as follows:

"The MMSD **is proposing** to develop third-party TMDLs for the Kinnickinnic, Menomonee, Milwaukee River, and Milwaukee Harbor watersheds and to coordinate that process with the WDNR and USEPA."]

Mr. Poloncsik asked that the plan also recognize TMDL development for the Root River and Oak Creek watersheds. Mr. Hahn replied that the report would be revised to reflect the fact that the WDNR would eventually develop TMDLs for these watersheds.

[Secretary's Note: The following paragraph was added after the third full paragraph on page 19 of the Chapter XI excerpts that were distributed for review at this meeting:

"The WDNR is responsible for developing TMDLs for impaired waterbodies. Wisconsin's list of impaired waters includes a priority ranking of impaired waters indicating the relative time frame for when TMDLs will be developed. In the most recent impaired waters list TMDL development for the mainstem of Oak Creek and the impaired reaches of the mainstem of the Root River are given a low priority, indicating likely completion of TMDLs for these waters within five to 13 years.[1] The priority ranking for the Root River Canal in the Root River watershed is given as "medium," indicating likely completion of a TMDL for this stream within a two- to five-year period.

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[1]*Wisconsin Department of Natural Resources*, Approved Wisconsin 303(d) Impaired Waters List, *September 2006.*"]

Mr. Hahn stated that the paragraph inserted on page 54 discusses some additional grant and loan programs for funding implementation of the plan and recommends that the State Legislature increase the levels of cost-share funding for several WDNR and DATCP programs addressing nonpoint source pollution.

Referring to the insert for pages 68 and 69, Mr. Hahn stated that the $1.2 million listed for annual water quality planning reflects what the Regional Planning Commission requires to fully realize its role as the designated regional water quality planning agency. This amount has changed from a higher amount in the previous draft, because the current draft envisions a different role for the Regional Planning Commission in plan implementation.

[Secretary's Note: In order to clarify the time frame for this budgeted amount, the second to last sentence in the first paragraph on page 69 was revised to read as follows:

"Based on recent SEWRPC budgets for water quality planning, large portions of which have come from the seven-county property tax levy and service contracts, it is recommended that the total annual amount budgeted for water quality planning be increased to $1.2 million, that the cost of funding that planning work be split evenly with half being provided by the Regional Planning Commission and half coming from State/Federal funding, and that the amount be adjusted over time to reflect increasing costs and/or responsibilities."]

Mr. Bennett asked why SEWRPC was removed as the plan implementation organization. He explained that the communities are comfortable working with SEWRPC and are apprehensive about working with another layer of government or some other organization. He expressed concern that a regional partnership might create another layer of government to which local communities would have to report. Mr. Hahn replied that the changes came out of discussions at the Oversight Committee meeting on August 24. He noted that the framework that was established under the initial regional water quality management plan, and which has been adapted over time, will be used for plan implementation. He noted that certain mandates apply and will continue to apply. He stated that the intent of the regional partnership is not to create another layer of government, and he noted that the partnership is an attempt to include all stakeholders in order to enhance plan implementation. He said that is similar to the Milwaukee Basin Partnership and the Root-Pike Watershed Initiative Network. He indicated that the partnership was not anticipated to have any true authority or regulatory role. Instead, he continued, it will act as a clearing house for coordination and ideas.

Mr. Martin commented that MMSD does not intend to change the relationship between SEWRPC and the local communities or the role of SEWRPC in water quality planning. He indicated that MMSD was concerned that the initial draft of the chapter seemed to change the role of the partnership from MMSD's concept. He noted that what the partnership will do is being developed and its role is evolving. He added that local communities will not report to the partnership.

Mr. Bennett asked who will be involved in determining the regional partnership's role. Mr. Martin replied that the group MMSD is working with on the partnership grew out of the Public Policy Forum's examination of a water resource management strategy for the Region. Mr. Melching stated that he attended the first large partnership meeting. He commented that it should have included more representatives from both the Technical Advisory Committee and from those who will be involved with plan implementation. He expressed concern that most of the representatives attending the meeting seemed uninformed about the recommended plan. Mr. Hahn responded that the process of forming the regional partnership is being headed by Nancy Frank from the University of Wisconsin-Milwaukee. He continued that at this point Ms. Frank is trying to keep the size of the group manageable while including representatives from many interests, such as MMSD, SEWRPC, WDNR, Friends of Milwaukee's Rivers, and the Milwaukee Basin Partnership. He noted that Ms. Frank asked the members for suggestions on who should be invited to participate. He added that SEWRPC staff suggested inviting several members of the Technical Advisory Committee, including Mr. Melching and all County Planning Directors from the counties within the study area.

Mr. Holschbach noted that the study area includes local governments outside the SEWRPC area. He commented that he would like to see a partnership with more authority, perhaps like the Priority Watershed Program. He expressed hope that such a partnership would be able to increase funding for implementation activities.

Mr. Bennett asked whether a regional partnership would make recommendations to agencies such as MMSD, SEWRPC, and the WDNR. Mr. Martin replied that this could be a role of the partnership. He said that the partnership would shine light on what needs to be done to improve water quality. He noted that the partnership's role is still evolving. He also emphasized that the partnership will not have authority over the municipalities. He suggested that separate partnerships might be formed for each watershed to focus on specific problems.

Mr. Bennett suggested adding a description of the proposed partnership. Mr. Holschbach concurred, commenting that it would be helpful to add language on the institutional framework for plan implementation. Mr. Hahn replied that this was attempted in the original draft of Chapter XI of PR No. 50; however, a consensus could not be achieved in the Oversight Committee. He continued that the compromise that was reached was for the chapter to stay silent on the issue of an overall institutional framework. He added that given the well-established existing implementation framework, removing this language does not leave anything lacking in the chapter.

Mr. Aquino commented that, while the idea is for the regional partnership to help to implement this plan because of the different interests involved, they may not act to expedite plan implementation. Mr. Hahn responded that SEWRPC and the WDNR are involved in the partnership. He noted that SEWRPC's view is that the idea behind the partnership is plan implementation and that if the partnership departs from this, there is no rationale for its existence. He pointed out that under Federal law, TMDLs are mandated for the impaired streams, regardless of whether this partnership forms.

Mr. Melching commented that the partnership structure creates the potential for the creation of bad ideas for implementation. Mr. Hahn replied that SEWRPC staff would continue their efforts to broaden the membership of the partnership to include more representatives from the Technical Advisory Committee.

Mr. Melching also noted that a disconnect between the partnership group and the agencies responsible for plan implementation could lead to both groups competing for money from the same sources. He noted that this might be a problem as some members in the partnership may not regard implementation of the plan as their goal.

Mr. Mueller concurred with Mr. Melching's comments and expressed concern that the people whose job it is to implement the plan are being informed that there is another group making decisions about plan implementation. Mr. Hahn responded that the partnership initiative is not a part of this plan. He emphasized that this plan preserves the structure for plan implementation that has been applied for 30 years.

Mr. Bennett commented that in the past, agricultural nonpoint source pollution has been exempt from regulatory mandates. He asked whether there will be a mechanism with teeth for dealing with nonpoint source pollution. Mr. Hahn replied that existing legal structure relating to agricultural nonpoint source pollution has no teeth. He indicated that the function of the plan is to define what needs to be done and to define the costs and effort needed.

A motion to approve the excerpts from preliminary draft Chapter XI, "Plan Implementation," of SEWRPC Planning Report No. 50, *A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds*, as amended, was made by Mr. Lubner, seconded by Mr. Martin, and carried with all members voting aye except for Mr. Mueller, who voted no.

CONSIDERATION OF THE SUBSECTION, "EVALUATION OF WATER QUALITY MODELING ANALYSIS DATA RELATIVE TO THE 'AUXILIARY USES' WITH MORE-STRINGENT WATER QUALITY STANDARDS," OF CHAPTER X, "RECOMMENDED WATER QUALITY MANAGEMENT PLAN," OF SEWRPC PR NO. 50, *A REGIONAL WATER QUALITY MANAGEMENT PLAN UPDATE FOR THE GREATER MILWAUKEE WATERSHEDS*

Mr. Schmidt asked Mr. Hahn to review the preliminary draft of the subsection.

Mr. Hahn began review of the subsection. He explained that the subsection presents analyses examining whether some stream reaches could meet higher water use objectives under recommended plan conditions. He pointed out that handouts accompanying the insert include an updated version of Table X-6 and maps from Appendix M showing the locations of the monitoring sites. He noted that the updated table includes results for Indian, Lincoln, and Stony Creeks in the Milwaukee River watershed which were unavailable when the insert was written and noted that text will be added to summarize these analyses.

Mr. Poloncsik requested that explicit recommendations regarding revisions to NR 104 be added to the subsection. Mr. Hahn responded that these would be added.

[Secretary's Note: A revised version of the insert is attached herein as Exhibit A. It is suggested that the Committee members focus their review on those portions of the exhibit dealing with the Milwaukee River watershed streams, including Indian, Lincoln, and Stony Creeks, and also on the *Recommendations* subsection.]

Mr. Melching noted that compliance with the single sample standard for fecal coliform bacteria for assessment point LM-6 on page 8 of the updated version of Table X-6 shows 84 percent compliance, but the last column on the table indicates that the standard is met 85 percent of the time or more under recommended plan conditions. Mr. Hahn replied that the numbers were so close for this site, that SEWRPC staff took some latitude in assessing compliance.

A motion to approve preliminary draft of the subsection ***Evaluation of Water Quality Modeling Analysis Data Relative to "Auxiliary Uses" with More-Stringent Water Quality Standards*** of Chapter X, "Recommended Water Quality Management Plan" of SEWRPC PR No. 50, *A Regional Water Quality Management Plan Update* *for the Greater Milwaukee Watersheds*, as amended, was made by Mr. Moroney, seconded by Mr. Melching, and carried unanimously by the Committee.

OLD BUSINESS

Mr. Hahn reminded the Committee that it had approved the preliminary draft subsection, ***Cost-Effectiveness Analysis of Wastewater Treatment Options for the City of South Milwaukee,*** of Chapter X, "Recommended Water Quality Management Plan," of SEWRPC Planning Report No. 50, *A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds,* subject to the approval of that subsection by the City of South Milwaukee. He noted that SEWRPC staff has received a letter from the City indicating that they concur with the recommendation in the draft subsection. Mr. Hahn distributed copies of the letter from the City of South Milwaukee Engineer to the Committee.

[Secretary's Note: A copy of the letter from the City of South Milwaukee is attached herein as Exhibit B.]

NEW BUSINESS

Mr. Hahn stated that three public information meetings and hearings have been scheduled to provide the public with opportunities to learn more about and comment on the findings and recommendations of Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds. He indicated that the sessions will be held from 4:30 p.m. to 7:00 p.m. on October 15, 2007 at Gateway Technical College in the City of Racine, October 16 at the Downtown Transit Center in the City of Milwaukee, and October 23 at Riveredge Nature Center near the Village of Newburg. He continued that the meetings will each follow a similar format. He noted that 1) each session will begin with a meeting in "open house" format from 4:30 p.m. to 5:30 p.m. to provide the public to meet with Commission staff one-on-one or in small groups in order to receive information, ask questions, and provide comments; 2) at about 5:30 p.m. a presentation will be made by the Commission staff, and 3) at about 6:00 p.m. a public hearing will be conducted, providing a forum for public comment. He noted that a court reporter will be present for the entire duration of each meeting to record comments from the public.

[Secretary's Note: A copy of the meeting notice is attached herein as Exhibit C.]

VERIFICATION OF NEXT MEETING DATE AND LOCATION

Mr. Schmidt reminded the Committee that the next meeting of the Advisory Committee was scheduled for Wednesday, October 31, 2007, from 1:30 to 3:30 p.m. at the Mequon City Hall in the upper Council Chambers.

ADJOURNMENT

The September 20, 2007, meeting of the Advisory Committee on the regional water quality management plan update was adjourned at 2:48 p.m. on a motion by Mr. Bennett, seconded by Mr. Holschbach and carried unanimously by the Committee.

The following sections of the minutes address comments on the plan that were received before or after the September 20, 2007, meeting and additions made by the SEWRPC staff to address past Advisory Committee comments.

ADDITIONAL COMMENTS ON PRELIMINARY DRAFT CHAPTER XI, "PLAN IMPLEMENTATION," OF SEWRPC PR NO. 50 AS PROVIDED BY MS. JUDY JOOSS, TOWN AND COUNTRY RESOURCE CONSERVATION, AND DEVELOPMENT, INC.

Ms. Jooss noted that the Adopt-A-Lake Program was no longer active and suggested that references to it be deleted from Chapter XI.

[Secretary's Note: The second sentence of the revised text in the last Secretary's Note on page 8 of the minutes of the August 7, 2007, meeting was removed.]

ADDITIONAL COMMENTS ON PRELIMINARY DRAFT CHAPTER X, "RECOMMENDED WATER QUALITY MANAGEMENT PLAN," OF SEWRPC PR NO. 50 AS PROVIDED BY MR. CHARLES S. MELCHING

Reasons for increases in observed, instream phosphorus concentrations over time were discussed during the September 26, 2007, Modeling Subcommittee meeting. At that meeting, Mr. Melching said that a reasonable approach to addressing the issue would be for industries that currently use municipal water to which orthophosphates or polyphosphates have been added as anti-corrosive agents to seek alternative sources of noncontact cooling water that would be lower in phosphorus. The recommended regional water quality management plan update calls for water utilities in the study area to give further consideration to changing to an alternative technology that does not result in increased phosphorus loading.

[Secretary's Note: After further consideration, the SEWRPC staff decided not to add a recommendation that industries consider obtaining alternative sources of industrial cooling water. The following points offer reasons for that decision.

- Adequate capacity may not be obtained from wells located in the shallow aquifer, and wells developed in the deep aquifer would further contribute to drawdown of the water table.
- As the deep aquifer has been drawn down over time, the quality of the water from the aquifer has declined. The quality of untreated water from the deep aquifer may not be adequate for industrial cooling water applications.
- As the deep aquifer is drawn down, pumping costs increase significantly.
- The loss of industrial customers could have a significant negative effect on water utility revenues and water charges for the remaining users. Because a large portion of water supply costs are fixed, the cost savings from providing less water only amount to about 20 percent of the lost revenue, and the difference would generally be passed on to the remaining customers.

The last sentence of the second full paragraph on page 28 was revised as follows:

"It is, however, recommended that water utilities in the study area give further consideration to changing to an alternative technology that does not result in increased phosphorus loading **if such a technology is both effective in controlling corrosion in pipes and cost-effective for the utility to implement**."]

ADDITIONAL COMMENTS ON PRELIMINARY DRAFT CHAPTER X, "RECOMMENDED WATER QUALITY MANAGEMENT PLAN," OF SEWRPC PR NO. 50 AS PROVIDED BY MS. MARSHA BURZYNSKI (WDNR)

In response to a comment from Ms. Burzynski, the recommendation regarding expansion of the Milwaukee Estuary Area of Concern, the second last sentence of the fourth paragraph on page 44 was revised as follows:

[Secretary's Note: "In support of this, it is recommended that consideration be given to extending the Milwaukee Estuary Area of Concern to include:

- **The Little Menomonee River from W. Brown Deer Road (STH 100) to its confluence with the Menomonee River (Moss-American Superfund site),**
- **The Menomonee River from its confluence with the Little Menomonee River to N. 35th Street,**
- **Cedar Creek from Bridge Street to its confluence with the Milwaukee River,**
- **The Milwaukee River from its confluence with Cedar Creek to the site of the former North Avenue dam (includes the Estabrook Park dam and the associated impoundment), and**
- **Lincoln Creek**."

A map will be added to the report showing the extent of the existing and proposed Area of Concern.]

SEWRPC STAFF REVISIONS TO DRAFT CHAPTER X, "RECOMMENDED WATER QUALITY MANAGEMENT PLAN," OF SEWRPC PR NO. 50

At the January 31, 2007, meeting of Technical Advisory Committee, Mr. Melching said it was important for the plan to document the decision process that led to the adoption of buffer effectiveness assumptions for the modeling.

[Secretary's Note: The attached Exhibit C-1, which is to be inserted in the report as Appendix M-1, sets forth additional justification for the general recommendation regarding 75-foot-wide riparian buffers.

The following was added after the first sentence of the first paragraph on page 32 of Chapter X:

"In support of the generally recommended 75-foot buffer width, Appendix M-1 sets forth the results of a literature review and analysis by SEWRPC staff regarding buffer width and effectiveness in controlling nonpoint source pollution and providing biological protection."]

The previous drafts of Chapter X that were reviewed by the Advisory Committee did not include a section on dredging and dredged materials disposal. That section has now been drafted, and it is attached as Exhibit C-2.

[Secretary's Note: The title of the subsection beginning on the top of page 44 of PR No. 50, Chapter X was changed as follows:

"*Restoration, Remediation, **and Dredging** Programs*"]

[Secretary's Note: The following subsection was inserted after the third paragraph on page 44 of PR No. 50, Chapter X:

"*Milwaukee Estuary Remedial Action Plan*
The process of developing the Remedial Action Plan (RAP) for the Milwaukee Estuary Area of Concern has been ongoing since 1988. The WDNR is the lead agency for development of the plan, and they have been advised by a Technical Advisory Committee, a Citizen's Advisory Committee, and a Citizen's Education and Participation

Subcommittee. The RAP process has focused on issues related to remediation of contaminated sediments, eutrophication, nonpoint source pollution, beach water quality, fish and wildlife populations, and habitat.

The Milwaukee Estuary Area of Concern (AOC) includes the Milwaukee River downstream from the site of the former North Avenue Dam, the Menomonee River downstream from S. 35th Street, the Kinnickinnic River downstream from S. Chase Avenue, the inner and outer harbors, and the nearshore waters of Lake Michigan bounded by a line extending north from Sheridan Park to the intake from the City of Milwaukee's Linnwood water treatment plant. Eleven beneficial use impairments have been identified in the Milwaukee Estuary AOC including restrictions on fish and wildlife consumption, degradation of fish and wildlife populations, fish tumors or other deformities, bird or animal deformities or reproductive problems, degradation of benthos, restrictions on dredging activities, eutrophication or undesirable algae, beach closings, degradation of aesthetics, degradation of phytoplankton and zooplankton populations, and loss of fish and wildlife habitat.[1] While these impairments are the result of many causes, many are related, at least in part, to the presence of toxic substances in water, sediment, and the tissue of organisms.

A joint WDNR/USEPA. effort is currently underway to examine and assess the identified beneficial use impairments for the Milwaukee Estuary AOC, to eliminate those that no longer apply, and to develop restoration criteria to address the remaining beneficial use impairments, with the ultimate goal of **delisting** the AOC."]

[Secretary's Note: The following subsection heading was added before the fourth paragraph on page 44:

"*Management of Contaminated Sediment Sites*"]

[Secretary's Note: The last sentence of the fourth paragraph on page 44 was deleted.]

[Secretary's Note: The following subsection heading was added before the fifth paragraph on page 44:

"*Monitoring of Toxic Substances*"]

[Secretary's Note: The attached Exhibit C-2 was inserted after the fifth paragraph on page 44.]

SEWRPC STAFF REVISIONS TO CHAPTER V, "SURFACE WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE KINNICKINNIC RIVER WATERSHED," OF SEWRPC TR NO. 39

This section of the minutes addresses unresolved issues raised at the October 12, 2005, Technical Advisory Committee meeting. At that meeting is was noted that the *Wet-Weather and Dry Weather Loads* subsection of the chapter would be prepared later and provided to the Committee.

[Secretary's Note: SEWRPC staff performed the analyses and prepared the subsection. It is included herein as Exhibit D to be inserted into the chapter at the indicated place after the subsection entitled *Nonpoint Source Loads*.]

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[1]*Wisconsin Department of Natural Resources,* Milwaukee Estuary Remedial Action Plan Progress through January 1994, *1995.*

SEWRPC STAFF REVISIONS TO CHAPTER VI, "SURFACE WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE MENOMONEE RIVER WATERSHED," OF SEWRPC TR NO. 39

This section of the minutes addresses unresolved issues raised at previous committee meetings and resulting from the provision of additional data to SEWRPC staff.

At the August 3, 2005 Technical Advisory Committee meeting it was noted that the *Wet-Weather and Dry Weather Loads* subsection of the chapter would be prepared later and provided to the Committee.

[Secretary's Note: SEWRPC staff performed the analyses and prepared the subsection. It is included herein as Exhibit E to be inserted into the chapter *Loads* at the indicated place after the subsection *Nonpoint Source*.]

In October 2006, the results of MMSD's Honey Creek Bacteria Survey became available to SEWRPC staff.

[Secretary's Note: A summary of the findings of the study was drafted for inclusion in the bacteria section of the chapter and is attached as Exhibit F.]

SEWRPC STAFF REVISIONS TO CHAPTER VIII, "SURFACE WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE OAK CREEK WATERSHED," OF SEWRPC TR NO. 39

This section of the minutes addresses unresolved issues in the analysis of toxic contaminants in the Oak Creek watershed. Following review of this chapter, WDNR staff provided additional data related to sampling for contaminants in sediment conducted in Oak Creek Park Pond.

[Secretary's Note: SEWRPC staff analyzed the data provided by the WDNR and drafted additional text included herein as Exhibit G to be inserted to the chapter at the end of the subsection **Toxic Contaminants in Sediment**.]

SEWRPC STAFF REVISIONS TO CHAPTER X, "SURFACE WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE MILWAUKEE HARBOR ESTUARY AND ADJACENT NEARSHORE LAKE MICHIGAN AREAS," OF SEWRPC TR NO. 39

This section of the minutes addresses unresolved issues raised at previous meetings of the Technical Advisory Committee.

At the August 29, 2006, meeting, Mr. Melching suggested that a comparison of trends in water temperatures in the estuary and Lake Michigan to trends in air temperatures would possibly explain some of the changes in water temperatures.

[Secretary's Note: SEWRPC staff performed analyses to examine the effects of trends in air temperature or other influences on trends in water temperature in the estuary and outer harbor and drafted additional text, included herein as Exhibit H, which is to be inserted in the chapter at the end of the *Temperature* subsection in the subsection entitled **Water Quality of the Milwaukee Harbor Estuary**.]

At the October 31, 2006 meeting, it was requested that Figures X-76, X-77, X-78, and X-79 be redesigned to improve clarity.

[Secretary's Note: Figures X-76, X-77, X-78, and X-79 were redesigned and are attached herein as Exhibit I. Maps X-11A and X-11B were developed to show the locations at which the sediment samples depicted in the figures were collected and are attached herein as Exhibit J. The following sentence was added to the first paragraph of the subsection **Toxic Contaminants in Sediment**:

"Sample sites from the University of Wisconsin-Milwaukee studies and Kinnickinnic remediation studies are shown on Maps X-11A and X-11B, respectively."]

SEWRPC STAFF REVISIONS TO APPENDIX B, "CITIZEN MONITORING DATA FROM THE GREATER MILWAUKEE WATERSHEDS WITHIN SOUTHEASTERN WISCONSIN," OF SEWRPC TR NO. 39

SEWRPC staff developed Appendix B-3 which summarizes citizen monitoring data from the Milwaukee River watershed.

[Secretary's Note: Appendix B-3 is attached herein as Exhibit K.]

Respectfully Submitted,

Michael G. Hahn
Secretary

#131158 V1 - RWQMP UPDATE MINUTES 09/20/07
300-4001
MGH/JEB/pk
10/15/07, Revised 11/01/07

Exhibit A

INSERT TO PAGE 74 OF CHAPTER X, "RECOMMENDED WATER QUALITY MANAGEMENT PLAN," OF SEWRPC PR NO. 50, *A REGIONAL WATER QUALITY MANAGEMENT PLAN UPDATE FOR THE GREATER MILWAUKEE WATERSHEDS*. INSERT FOLLOWING THE SUBSECTION ENTITLED *Comparison of Water Quality vs. 2020 Baseline with Five-Year Level of Protection Against SSOs from MMSD System*

Evaluation of Water Quality Modeling Analysis Results Relative to the "Auxiliary Uses" with More-Stringent Water Quality Standards

As noted previously in this chapter, the water use objectives for streams in the study area are set forth in detail in Table VII-1 of this report. Those objectives include both the codified objectives and auxiliary uses to be considered for planning purposes. Those auxiliary uses were generally established by the WDNR in "State of the Basin" reports, as noted in Table VII-1. For those waters assigned an auxiliary use objective the potential for achieving a higher objective or classification than currently codified was evaluated under the regional water quality management plan update. The evaluations of alternative classifications were done both in response to changes in conditions since the last relevant *Administrative Code* sections were promulgated and in consideration of modeled improvements in water quality under recommended plan conditions. This evaluation was made to assist in future planning and management strategies and is not intended to be directed as a change to the current regulatory framework.

Those surface waters where auxiliary upgraded water use objectives or classifications have been evaluated in the planning process are set forth in Table X-7, which includes comparisons of pollutant concentrations for existing year 2000 conditions, revised 2020 baseline conditions, revised 2020 baseline conditions with a five-year level of protection against sanitary sewer overflows, recommend plan conditions, and the extreme measures condition. The locations of the assessment points are shown graphically on Maps M-1 through M-6 in Appendix M of this report. The locations where auxiliary use objectives were evaluated were chosen based on the satisfaction of the following two criteria:

- An auxiliary use objective is given in Table VII-1 and

- The water quality models developed for the plan update include an output assessment point in the stream reach where the auxiliary use objective is assigned.

Based on application of these criteria, stream reaches to be evaluated were identified in the Kinnickinnic, Menomonee, Milwaukee, and Root River watersheds, including within the Kinnickinnic, Menomonee, and Milwaukee River portions of the Milwaukee Harbor estuary. At all evaluated locations in the Kinnickinnic and Menomonee River watersheds and the Milwaukee Harbor estuary, and at two of the three evaluated locations in the Milwaukee River watershed, "special variance" is the regulatory, codified water use objective and "fish and aquatic life" and "full recreational use" are the potential "auxiliary use" objectives. As shown in Table VI-1 in Chapter VI of this report, the only numerical water quality standards that differ between those water use objectives are for dissolved oxygen and fecal coliform bacteria. Thus, in those cases Table X-7 presents comparative information on fecal coliform bacteria and dissolved oxygen concentrations. For Stony Creek, which is the one other evaluation location in the Milwaukee River watershed, the codified use is "fish and aquatic life" and the auxiliary use is "coldwater." In that case, the dissolved oxygen concentration is the differentiating standard. For three of the four tributaries in the Root River watershed the codified use is "limited forage fish" and the auxiliary use is "fish and aquatic life." For the fourth tributary in the Root River watershed the codified use is "limited aquatic life" and the auxiliary use is "limited forage fish." For those uses, the dissolved oxygen concentration is also the differentiating standard.

As noted previously in this chapter, a stream or stream reach was assumed to substantially comply with numerical water quality standards or criteria if those standards or criteria were estimated to be met 85 percent of the time or more. That criterion was used to assess the possibility of a stream or stream reach meeting the auxiliary use objective under modeled recommended plan conditions. In addition, water quality data from the baseline period were compared to the standards or criteria supporting the auxiliary use objectives to determine whether a stream or stream reach is currently meeting the auxiliary use objective.[1] Fecal coliform bacteria counts were considered on an annual basis and for the 153-day swimming season from May 1 through September 30. If the bacteria criteria were met for the swimming season, it would be reasonable to conclude that the stream in question would meet the water use objective.

An evaluation of compliance with the water quality standards associated with the auxiliary use objectives under recommended plan conditions is presented in the following subsections. That evaluation included consideration of whether, for a given stream or stream reach, a recommendation could be made to 1) upgrade the existing regulatory water use objective or 2) propose a planned water use objective that might be achieved under recommended plan conditions. The evaluation of upgrading the existing regulatory water use objective was based on consideration of observed water quality data for the baseline period and the evaluation of possible planned water use objectives considered both observed and estimated future modeled water quality conditions.

In general, even though anticipated water quality conditions at some locations assessed below fall short of the compliance criterion, implementation of the recommended plan and possible future extension of those recommendations as represented by the extreme measures condition would still result in significant improvement in fecal coliform concentrations.

Kinnickinnic River Watershed Upstream of the Estuary
As shown in Table X-7, the dissolved oxygen standard is met more than 85 percent of the time at assessment point KK-10, which is located just upstream of the Milwaukee Harbor estuary. In addition, Table X-7a shows that during the baseline period, concentrations of dissolved oxygen at sampling stations upstream from the assessment point were greater than or equal to the standard in more than 85 percent of the samples collected. However, compliance with the fecal coliform bacteria standards would not be achieved 85 percent or more of the time under either recommended plan or the extreme measures condition (Table X-7). In addition, during the baseline period, concentrations of fecal coliform bacteria in this reach generally exceeded the single sample standard (Table X-7a). While the current level of compliance with the standard for dissolved oxygen concentration, and the anticipated level of compliance with that standard under recommended plan conditions, are sufficient to support a fish and aquatic life water use objective, habitat limitations related to the presence of concrete-lined and enclosed channel in a substantial portion of the Kinnickinnic River upstream from the assessment point make it unlikely that the Kinnickinnic River upstream from the estuary could support a fish and aquatic life use objective under current channel conditions. The MMSD has initiated a study to evaluate alternatives for stream rehabilitation and possible removal of the concrete lining in the stream. Depending on the results of that study, attainment of a fish and aquatic life standard may become more viable. The anticipated improvement in fecal coliform concentrations would not be sufficient for this reach of the River to meet the standards for a full recreational use water use objective.

Menomonee River Watershed Upstream of the Estuary—Recommended Plan Conditions
The four assessment points in the Menomonee River watershed upstream of the estuary include:

- MN-14 at the mouth of Underwood Creek,

[1] *The baseline period used for the Kinnickinnic River, Menomonee River, and Oak Creek watersheds was 1998-2001. As this study progressed, data became available and were incorporated into the analyses. Because of this, the baseline period used for the Milwaukee River and Root River watersheds was 1998-2004.*

- MN-16 at the mouth of Honey Creek,

- MN-17 on the main stem of the Menomonee River just downstream of the confluence with Honey Creek, and

- MN-18 on the main stem of the Menomonee River just upstream of the Milwaukee Harbor estuary.

DISSOLVED OXYGEN

The dissolved oxygen standard is met more than 85 percent of the time at each of the assessment points (Table X-7). In addition, during the baseline period, concentrations of dissolved oxygen at sampling stations along Honey and Underwood Creeks and the mainstem of the Menomonee River just downstream of the confluence with Honey Creek were greater than or equal to the standard in more than 85 percent of the samples (Table X-7a). While the levels of compliance with the standard for dissolved oxygen concentration in the Menomonee River, Honey Creek, and Underwood Creek are sufficient to support fish and aquatic life water use objectives, habitat limitations related to the presence of enclosed channel and/or concrete-lined channel in a portion of the Menomonee River upstream of IH 94, in Honey Creek, and in downstream reaches of Underwood Creek make it unlikely that these stream reaches could support a fish and aquatic life use objective. However, the reaches of the Menomonee River upstream and downstream of the concrete-lined portion could attain a fish and aquatic life standard. The MMSD is considering approaches to address the remaining concrete-lined reach in the Menomonee River. Modification of that reach to improve fish passage, while not essential to the attainment of a fish and aquatic life objective in the River upstream of the concrete lining, would result in a much greater diversity of fish and other aquatic organisms in the upstream reach. Also, a planned MMSD project to remove all or portions of the concrete lining and rehabilitate the stream channel in the reach of Underwood Creek downstream of STH 100 (N. Mayfair Road) could enable attainment of the fish and aquatic life objective in that reach.

FECAL COLIFORM BACTERIA

For the assessment points in both Underwood Creek (MN-14) and Honey Creek (MN-16), while the annual compliance with the fecal coliform standards does not meet the 85 percent criterion, full implementation of the recommended plan would be expected to achieve over 80 percent compliance with the single sample standard for the May through September swimming season (Table X-7). However, converting the days of compliance with the geometric mean standard for the 153-day period from May through September only yields about 50 percent compliance for each subwatershed. In addition, the levels of compliance with the single sample full recreational use standard at sampling stations along Honey and Underwood Creeks during the baseline period did not meet the 85 percent criterion (Table X-7a). Thus, the anticipated improvement in fecal coliform concentrations would not be sufficient for Honey and Underwood Creeks to meet the standards for full recreational use.

For the two Menomonee River main stem sites (MN-17 and 18), despite anticipated improvements in fecal coliform bacteria concentrations under the recommended plan, compliance with the standards would not be achieved 85 percent or more of the time (Table X-7). In addition, the level of compliance with the single sample full recreational use standard at the sampling stations along this reach during the baseline period did not meet the 85 percent criterion (Table X-7a). Thus, the anticipated improvement in fecal coliform concentrations would not be sufficient for the lower reach of the River upstream of the estuary to meet the standards for full recreational use.

Milwaukee River Watershed Upstream of the Estuary

The three assessment points in the Milwaukee River watershed include:

- ML-22 at the mouth of Stony Creek,

- ML-31 at the mouth of Indian Creek, and

- ML-32 at the mouth of Lincoln Creek.

DISSOLVED OXYGEN

As shown in Table X-7, the dissolved oxygen standard is met more than 85 percent of the time at assessment points ML-22 and ML-31 under recommended plan conditions (Table X-7). The levels of compliance with the standard for dissolved oxygen in Stony Creek are sufficient to support a coldwater water use objective. Dissolved oxygen concentrations from limited sampling conducted in Stony Creek during the baseline period support this conclusion (Table X-7a). In all of the samples collected, concentrations of dissolved oxygen were above 7 mg/l. While the anticipated levels of compliance with the standard for dissolved oxygen in Indian Creek (Table X-7) and the levels of compliance in samples collected during the baseline period (Table X-7a) are sufficient to support a fish and aquatic life use objective, the presence of concrete-lined channel in reaches upstream of N. Manor Lane in the Village of Fox Point make it unlikely that these reaches could support that use objective. The reaches of Indian Creek downstream of N. Manor Lane could attain a fish and aquatic life use objective.[2]

For the assessment point in Lincoln Creek (ML-32), despite the anticipated improvements in dissolved oxygen concentrations under the recommended plan, compliance with the standard for dissolved oxygen would not be achieved 85 percent or more of the time under recommended plan conditions (Table X-7). By contrast, dissolved oxygen concentrations from sampling conducted in the Creek show that compliance with the dissolved oxygen standard was achieved in 85 percent or more of the samples collected during the baseline period (Table X-7a); however, there are several reasons why these data may not be representative of current conditions in the Creek. First, most of the baseline period data were collected while construction activities related to the Lincoln Creek Environmental Restoration and Flood Control Project were being conducted. This project resulted in considerable changes in the stream, including widening and deepening of some sections of stream channel and removal of over two miles of concrete lining from the channel. Because construction activities began in 1998 and continued until 2002, most of the baseline period data reflect conditions during construction and not current, post-construction conditions. Second, most of the samples examined for dissolved oxygen were collected during the daytime, when dissolved oxygen concentrations would be expected to be high. Few samples were collected after sundown, when dissolved oxygen concentrations would be expected to be lower. Given this, the available data may overestimate the mean concentrations of dissolved oxygen and underestimate the frequency of events during which dissolved oxygen concentrations in the Creek dropped below the standard for fish and aquatic life. By contrast, because the model results reflect concentrations throughout the day and night, they probably give a more representative picture of the variability in dissolved oxygen concentrations in the stream. Finally, high densities of attached algae, such as *Cladophora,* were reported to be growing in some sections of the Creek during the baseline period.[3] During the day, photosynthesis by these algae will increase concentrations of dissolved oxygen in the Creek. By contrast, the respiratory requirements of these algae during dark periods can result in substantial reductions in dissolved oxygen concentrations. For these reasons, the model results most likely give a more representative picture of current and anticipated dissolved oxygen concentrations in Lincoln Creek. These results indicate that the anticipated improvements in dissolved oxygen concentrations would not be sufficient to support a fish and aquatic life use objective in Lincoln Creek.

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[2]*MMSD recently removed about 0.75 mile of concrete cunette from Indian Creek between Port Washington Road and N. Manor Lane.*

[3]*Timothy J. Ehlinger, Craig D. Sandgren, and Lori Schacht DeThorne, "Monitoring of Stream Habitat and Aquatic Biotic Integrity: Lincoln Creek, Milwaukee County Wisconsin," Report to the Great Lakes Protection Fund and Milwaukee Metropolitan Sewerage District, April 2003.*

FECAL COLIFORM BACTERIA
For the assessment points in both Indian Creek (ML-31) and Lincoln Creek (ML-32), despite anticipated improvements in fecal coliform bacteria under the recommended plan, compliance with the standards would not be achieved 85 percent or more of the time (Table X-7). In addition, concentrations of fecal coliform bacteria in these streams did not achieve compliance with the single sample standard in 85 percent or more of the samples collected during the baseline period (Table X-7a). Thus, the anticipated improvement in fecal coliform concentrations would not be sufficient for these streams to meet the standards for full recreational use.

Limited data collected during the baseline period suggest that two other streams in the Milwaukee River watershed, Mole Creek and Wallace Creek, might be able to achieve an auxiliary use objective of "coldwater" (Table X-7a). While few samples were available from these streams, dissolved oxygen concentrations in all of the samples analyzed were greater than or equal to 7 mg/l. Because no assessment points were located on these streams, no model results are available for these streams to indicate anticipated levels of compliance with the dissolved oxygen standard supporting a "coldwater" water use objective under recommended plan conditions.

Root River Watershed
The four assessment points in the Root River watershed include:

- RT-5 near the mouth of Whitnall Park Creek,
- RT-6 near the mouth of Tess Corners Creek,
- RT-19 at the mouth of Ives Grove Ditch, and
- RT-20 at the mouth of Hoods Creek.

The model results indicate that the dissolved oxygen standard is met more than 85 percent of the time at each of the assessment points under recommended plan conditions (Table X-7). No sampling data were available for these streams.

For the assessment points in Whitnall Park Creek (RT-5), Tess Corners Creek (RT-6), and Hoods Creek (RT-20), the compliance with the standard for dissolved oxygen concentration under the recommended plan could be sufficient for those streams to meet the standards for a fish and aquatic life water use objective.

For the assessment point in Ives Grove Ditch (RT-19), the compliance with the standard for dissolved oxygen concentration under the recommended plan could be sufficient for this stream to meet the standards for a limited forage fish water use objective.

Milwaukee Harbor Estuary
The six assessment points in the Milwaukee Harbor estuary include:

- LM-1 in the Milwaukee River portion of the estuary,
- LM-2 in the Menomonee River portion of the estuary,
- LM-3 in the Menomonee River portion of the estuary just upstream of the confluence with the Milwaukee River,
- LM-4 in the Milwaukee River portion of the estuary just downstream of the confluence with the Menomonee River,

- LM-5 in the Kinnickinnic River portion of the estuary, and

- LM-6 at the mouth of the Milwaukee River at the Hoan Bridge and the entrance to the outer harbor.

DISSOLVED OXYGEN

Under anticipated plan conditions, the dissolved oxygen standard is met more than 85 percent of the time at each of the assessment points along the Milwaukee River (Table X-7). Thus, the anticipated dissolved oxygen concentrations could be sufficient for the Milwaukee River portion of the estuary to meet the standards for a fish and aquatic life water use objective. Data collected during the baseline period show that dissolved oxygen concentrations in the Milwaukee River portion of the estuary were in compliance with the fish and aquatic life standard in 85 percent or more of the samples collected (Table X-7a). This is consistent with the results from the model which show that under existing conditions in the Milwaukee River portion of the estuary, dissolved oxygen concentrations should be greater than or equal to the fish and aquatic life standard more than 85 percent of the time.

In the Kinnickinnic River portion of the estuary, dissolved oxygen concentrations at the two downstream sampling stations, those located at Greenfield Avenue (extended) and the Jones Island Ferry, achieved compliance with the standard for fish and aquatic life in 85 percent or more of the samples collected during the baseline period. Since one of these stations, the Greenfield Avenue (extended) station, is at the same location as assessment point LM-5, it is reasonable to conclude that the model results are representative of the existing level of compliance with the fish and aquatic life standard in the lower Kinnickinnic River portion of the estuary. Farther upstream, at the S. 1st Street sampling station, dissolved oxygen concentrations did not achieve compliance with the standard for fish and aquatic life in 85 percent or more of the samples collected during the baseline period. The low level of compliance at this station accounts for the overall low level of compliance in the Kinnickinnic River portion of the estuary. It also suggests that the anticipated levels of compliance forecast by the model for assessment point LM-5 may not be representative of dissolved oxygen conditions in the Kinnickinnic River portion of the estuary upstream of LM-5. This may be the result of high levels of high oxygen demand related to decomposition of organic material in sediment in the upstream portions of this reach. As of 2007, a remediation project was ongoing for contaminated sediment in the Kinnickinnic River between S. Kinnickinnic Avenue and W. Becher Street. This reach includes the S. 1st Street sampling station. Removal of contaminated sediment from this reach is likely to remove considerable organic material and may improve dissolved oxygen conditions in the upper section of the Kinnickinnic River portion of the estuary.

The situation in the Menomonee River portion of the estuary is more complicated. For the Menomonee River, there are some differences between the levels of compliance with standards indicated by observed data and those indicated by the results of the model. [4] The model results indicate that existing dissolved oxygen concentrations in

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[4]*The calibration and validation of the Milwaukee Harbor estuary/Lake Michigan hydrodynamic/water quality model indicated good agreement with observed dissolved oxygen concentrations at assessment points LM-2 and LM-3. The model runs were made for the observed climatological conditions from 1988 through 1997 occurring with existing (year 2000) land use and stream conditions. That climatological data period was chosen because it is representative of long-term average conditions. The baseline dissolved oxygen data were collected for a different time period, from 1998 through 2001. While comparison of the baseline observed data with the simulated values is useful in drawing conclusions regarding existing and projected future compliance with water quality standards supporting water use objectives, the observed data and simulated values may not always be directly comparable because of the different time periods represented and because the continuously simulated results reflect a greater base of information, than do the observed data that were collected at discrete, less numerous, points in time. Thus, some differences in the observed data and simulated values would be expected.*

these portions of the estuary should be greater than or equal to the fish and aquatic life standard more than 85 percent of the time. As shown in Table X-7a, on average, dissolved oxygen concentrations in that portion of the estuary did not achieve compliance with the standard for fish and aquatic life in 85 percent or more of the samples collected during the baseline period. It is important to note that the overall lower level of compliance with the fish and aquatic life standard based on aggregating results from several sampling stations masks differences among stations in the levels of compliance achieved.

In the Menomonee River portion of the estuary during the baseline period dissolved oxygen concentrations in samples collected at the sampling station farthest upstream, N. 25th Street, achieved compliance with the standard for fish and aquatic life in 85 percent or more of the samples collected. The levels of compliance with this standard observed at each of the three other sampling stations in the downstream portions of the estuary were below 85 percent of the samples collected. The locations of two of the sampling stations in the lower Menomonee River estuary, Muskego Avenue and S. 2nd Street, correspond to the locations of assessment points LM-2 and LM-3, respectively. The results of the water quality simulation model indicate that existing dissolved oxygen concentrations at these assessment points should achieve compliance with the standard for fish and aquatic life 85 percent or more of the time (Table X-7). Thus, the results of the model in the Menomonee River portion of the estuary differ from the observed sampling data in this respect. The model results also indicate that there should be little change in the Menomonee River portion of the estuary between existing conditions and recommended plan conditions in the levels of compliance achieved with the fish and aquatic life standard. If this last point is an accurate reflection of the differences that can be expected between existing and recommended plan dissolved oxygen conditions in the Menomonee River portion of the estuary, it suggests that levels of compliance in this reach may not differ substantially from those observed during the baseline period. In any case, the differences between the observed dissolved oxygen concentrations and the results of the water quality simulation model make it unclear whether this reach will achieve compliance with the fish and aquatic life standard 85 percent or more of the time under recommended plan conditions.

Fecal Coliform Bacteria

For assessment points LM-1, 4, and 6, which are located in the Milwaukee River portion of the estuary, while the annual compliance with the fecal coliform standards under recommended plan conditions does not meet the 85 percent criterion, full implementation of the recommended plan would be expected to achieve 85 percent or greater compliance with both the geometric mean and single sample standards for the May through September swimming season (Table X-7). Thus, the anticipated improvement in fecal coliform concentrations could be considered sufficient for assessment points LM-1, 4, and 6 to meet the standards for a full recreational use water use objective during the period from May through September. During the baseline period, concentrations of fecal coliform bacteria did not achieve compliance with the single sample standard in 85 percent or more of the samples collected when examined on either and annual basis or a May-to-September basis (Table X-7a). While the level of compliance with this standard increased from upstream to downstream in the Milwaukee River portion of the estuary, compliance levels at all sampling stations in this reach were below 85 percent. This was the case for both annual compliance and compliance during the May through September swimming season.

For assessment point LM-5 in the Kinnickinnic River portion of the estuary, compliance with the fecal coliform bacteria standards under recommended plan conditions would be expected 85 percent or more of the time on both an annual and May through September basis (Table X-7). Thus, the anticipated improvement in fecal coliform concentrations would be sufficient for the Kinnickinnic River portion of the estuary to meet the standards for a full recreational use water use objective. During the baseline period, concentrations of fecal coliform bacteria did not achieve compliance with the single sample standard in 85 percent or more of the samples collected when examined on either an annual basis or a May-to-September basis (Table X-7a). While the level of compliance with this standard was higher at the two downstream sampling stations, compliance levels at all sampling stations in the Kinnickinnic River portion of the estuary were below 85 percent. This was the case for both annual compliance and compliance during the May through September swimming season.

For assessment point LM-2 in the upper Menomonee River portion of the estuary, despite anticipated improvements in fecal coliform bacteria concentrations under the recommended plan, compliance with the standards would not be achieved 85 percent or more of the time (Table X-7). Thus, the anticipated improvement in fecal coliform concentrations would not be sufficient for the upper Menomonee River portion of the estuary to meet the standards for a full recreational use water use objective. For assessment point LM-3 in the lower Menomonee River portion of the estuary, while the annual compliance with the fecal coliform standards does not meet the 85 percent criterion, full implementation of the recommended plan would be expected to achieve 85 percent or greater compliance with both the geometric mean and single sample standards for the May through September swimming season (Table X-7). Thus, the anticipated improvement in fecal coliform concentrations could be considered sufficient for assessment point LM-3 to meet the standards for a full recreational use water use objective during the period from May through September. During the baseline period, concentrations of fecal coliform bacteria in the Menomonee River portion of the estuary did not achieve compliance with the single sample standard in 85 percent or more of the samples collected when examined on either an annual basis or a May-to-September basis (Table X-7a). While there was no longitudinal trend in the levels of compliance in this reach, compliance levels at all sampling stations in the Menomonee River portion of the estuary were below 85 percent. This was the case for both annual compliance and compliance during the May through September swimming season.

It is important to note that the results of the model show improvements under recommended plan conditions in the levels of compliance with fecal coliform bacteria standards in all portions of the estuary (Table X-7).

Summary of Ability to Meet Auxiliary Water Use Objectives Under Recommended Plan Conditions
Based on the foregoing, it is concluded that under recommended plan conditions:

- The standards for a fish and aquatic life water use objective could be met at all of the assessment points within the Milwaukee River (LM-1, LM-4, and LM-6) portion of the estuary.

- While the standards for a fish and aquatic life water use objective could be met at the assessment point within the Kinnickinnic River (LM-5) portion of the estuary, it is unclear whether the upper portion of this reach could achieve compliance with the standard. It is likely the standards supporting a fish and aquatic life water use objective could be met in the lower portion of this reach.

- It is uncertain whether the standards for a fish and aquatic life water use objective could be met at the assessment points in the Menomonee River portion of the estuary (LM-2 and LM-3).

- The standards for a full recreational use water use objective could be met throughout the year at assessment point LM-5 in the Kinnickinnic River portion of the estuary.

- The standards for a full recreational use water use objective could be met for the May through September period at assessment points LM-1 in the Milwaukee River portion of the estuary, LM-3 in the Menomonee River portion of the estuary just upstream of the confluence with the Milwaukee River, LM-4 in the Milwaukee River portion of the estuary just downstream of the confluence with the Menomonee River, and LM-6 at the mouth of the Milwaukee River at the Hoan Bridge.

- The standards for a fish and aquatic life water use objective could be met at assessment points MN-17 on the main stem of the Menomonee River just downstream of the confluence with Honey Creek and MN-18 on the main stem of the Menomonee River just upstream of the Milwaukee Harbor estuary. Thus, with the exception of a concrete-lined channel reach upstream of IH 94, the lower reaches of the Menomonee River associated with those assessment points could attain a fish and aquatic life water use objective.[5] The standards for a full recreational use water use objective could not be met at these assessment points.

- While the dissolved oxygen standards supporting a fish and aquatic life water use objective could be met at assessment points KK-10 in the Kinnickinnic River, MN-14 at the mouth of Underwood Creek, and MN-16 at the mouth of Honey Creek, the high proportions of concrete-lined and enclosed channel in these streams make it unlikely that they could support a fish and aquatic life use objective under current channel conditions. However, a planned MMSD project to remove all or a portion of the concrete lining and rehabilitate the stream channel in the reach of Underwood Creek downstream of STH 100 (N. Mayfair Road) would enable attainment of the fish and aquatic life objective in that reach. Also, depending on the results of an ongoing study of the downstream reach of the Kinnickinnic River, it may be possible to remove the concrete lining in that reach and to attain a fish and aquatic life objective at some time in the future. The anticipated improvement in fecal coliform concentrations at these assessment points would not be sufficient for Honey and Underwood Creeks to meet the standards for a full recreational use water use objective.

- The dissolved oxygen standards supporting a fish and aquatic life water use objective could be met at assessment point ML-31 at the mouth of Indian Creek. For much of the Creek, this suggests that a fish and aquatic life water use objective could be attained. The high proportions of concrete-lined channel upstream of N. Manor Drive make it unlikely that the upper reaches of this stream could support a fish and aquatic life use objective. The anticipated improvement in fecal coliform concentrations at this assessment point would not be sufficient for Indian Creek to meet the standards for a full recreational use water use objective.

- The anticipated improvement in dissolved oxygen concentrations at assessment point ML-32 would not be sufficient for Lincoln Creek to meet the standards for a fish and aquatic life water use objective. While observed dissolved oxygen concentrations in the Creek during the baseline period suggest that a fish and aquatic life water use objective might be achievable, it is unlikely that these data are representative of current conditions in the Creek due to restoration efforts that were ongoing during the baseline period. The anticipated improvement in fecal coliform concentrations at this assessment point would not be sufficient for Lincoln Creek to meet the standards for a full recreational use water use objective.

- The standards for a coldwater water use objective could be met at assessment point ML-22 at the mouth of Stony Creek.

- The standards for a fish and aquatic life water use objective could be met at assessment points RT-5 near the mouth of Whitnall Park Creek, RT-6 near the mouth of Tess Corners Creek, and RT-20 near the mouth of Hoods Creek.

- The standards for a limited forage fish water use objective could be met at assessment point RT-19 at the mouth of Ives Grove Ditch.

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[5]*As noted previously, the MMSD is considering approaches to address the remaining concrete-lined reach in the Menomonee River. Modification of that reach to improve fish passage, while not essential to the attainment of a fish and aquatic life objective in the River upstream of the concrete lining, would result in a much greater diversity of fish and other aquatic organisms in the upstream reach.*

For the stream reaches described above, Table X-7b lists the proposed water use objectives that are projected to be achieved under recommended plan conditions.

Recommendations

Based upon the results described above, it is recommended that the WDNR consider pursuing changes to the existing regulatory water use objectives as set forth in Table X-7b. Table X-7b also indicates recommended planned water use objectives that are considered to be achievable under recommended plan conditions.

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Table X-7

WATER QUALITY SUMMARY STATISTICS FOR THE RECOMMENDED PLAN: COMPARISON TO STANDARDS FOR "AUXILIARY USES"[a]

Assessment Point	Regulatory Water Use Objective Evaluated in Tables M-1 through M-6	Auxiliary Use Objective(s) Evaluated in This Table	Water Quality Indicator	Statistic	Condition: Existing	Condition: Revised 2020 Baseline	Condition: Revised 2020 Baseline with Five-Year LOP[b]	Condition: Recommended Plan	Condition: "Extreme Measures" Condition	Is Standard Met 85 Percent of Time or More Under Recommended Plan Conditions?
Kinnickinnic River Watershed										
KK-10 Kinnickinnic River	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	5,859	4,942	4,633	3,091	1,613	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	56	58	59	65	71	No
				Geometric mean (cells per 100 ml)	842	702	686	449	230	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	18	27	27	61	185	No
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	3,401	2,999	2,470	1,634	904	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	69	71	72	78	83	No
				Geometric mean (cells per 100 ml)	498	416	398	253	130	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	12	16	16	37	109	No
			Dissolved Oxygen	Mean (mg/l)	11.4	11.4	11.4	11.4	11.3	- -
				Median (mg/l)	11.5	11.5	11.5	11.5	11.4	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	100	100	100	100	100	Yes
Menomonee River Watershed										
MN-14 Underwood Creek	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	8,133	6,588	6,588	4,250	2,166	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	63	64	64	65	68	No
				Geometric mean (cells per 100 ml)	691	552	552	369	195	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	58	84	84	142	218	No
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	2,964	2,460	2,460	1,332	692	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	79	79	79	81	84	No
				Geometric mean (cells per 100 ml)	351	279	279	180	96	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	24	40	40	79	134	No
			Dissolved Oxygen	Mean (mg/l)	11.0	11.1	11.1	11.1	11.1	- -
				Median (mg/l)	11.1	11.2	11.2	11.2	11.2	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	97	98	98	98	98	Yes

Table X-7 (continued)

Assessment Point	Regulatory Water Use Objective Evaluated in Tables M-1 through M-6	Auxiliary Use Objective(s) Evaluated in This Table	Water Quality Indicator	Statistic	Condition: Existing	Condition: Revised 2020 Baseline	Condition: Revised 2020 Baseline with Five-Year LOP[b]	Condition: Recommended Plan	Condition: "Extreme Measures" Condition	Is Standard Met 85 Percent of Time or More Under Recommended Plan Conditions?
Menomonee River Watershed (continued)										
MN-16 Honey Creek	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	9,286	7,761	7,761	4,864	2,156	
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	66	66	66	68	72	No
				Geometric mean (cells per 100 ml)	612	512	512	338	162	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	67	82	82	144	235	No
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	4,073	3,413	3,413	1,882	801	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	81	81	81	82	85	No
				Geometric mean (cells per 100 ml)	325	273	273	178	86	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	29	36	36	78	138	No
			Dissolved Oxygen	Mean (mg/l)	11.0	11.0	11.0	11.0	11.0	- -
				Median (mg/l)	10.7	10.6	10.6	10.6	10.6	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	90	91	91	91	91	Yes
MN-17 Menomonee River	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	6,926	5,903	5,863	4,198	2,657	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	47	47	47	49	52	No
				Geometric mean (cells per 100 ml)	1,124	981	978	704	471	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	12	22	22	50	107	No
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	3,622	3,064	2,985	1,833	1,100	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	67	67	67	70	73	No
				Geometric mean (cells per 100 ml)	496	415	412	271	173	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	5	12	12	32	78	No
			Dissolved Oxygen	Mean (mg/l)	11.1	10.9	10.9	10.9	10.9	- -
				Median (mg/l)	11.1	11.0	11.0	11.0	10.9	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	100	100	100	100	100	Yes

Table X-7 (continued)

Assessment Point	Regulatory Water Use Objective Evaluated in Tables M-1 through M-6	Auxiliary Use Objective(s) Evaluated in This Table	Water Quality Indicator	Statistic	Condition: Existing	Condition: Revised 2020 Baseline	Condition: Revised 2020 Baseline with Five-Year LOP[b]	Condition: Recommended Plan	Condition: "Extreme Measures" Condition	Is Standard Met 85 Percent of Time or More Under Recommended Plan Conditions?
Menomonee River Watershed (continued)										
MN-18 Menomonee River	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	6,889	5,945	5,907	4,214	2,552	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	48	48	48	50	52	No
				Geometric mean (cells per 100 ml)	1,081	955	952	685	449	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	15	26	26	54	114	No
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	3,557	3,073	2,998	1,861	1,052	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	68	68	68	71	74	No
				Geometric mean (cells per 100 ml)	468	399	396	261	163	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	7	14	14	35	84	No
			Dissolved Oxygen	Mean (mg/l)	11.0	10.9	10.9	10.9	10.9	- -
				Median (mg/l)	11.0	10.9	11.0	10.9	10.9	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	100	100	100	100	100	Yes
Milwaukee River Watershed										
ML-22 Stony Creek	Fish and Aquatic Life	Coldwater	Dissolved Oxygen	Mean (mg/l)	11.4	11.4	11.4	11.4	11.4	- -
				Median (mg/l)	11.5	11.5	11.5	11.5	11.5	- -
				Percent compliance with dissolved oxygen standard (>6 mg/l, >7 mg/l October-December)[c]	100	100	100	100	100	Yes

Table X-7 (continued)

Assessment Point	Regulatory Water Use Objective Evaluated in Tables M-1 through M-6	Auxiliary Use Objective(s) Evaluated in This Table	Water Quality Indicator	Statistic	Condition: Existing	Condition: Revised 2020 Baseline	Condition: Revised 2020 Baseline with Five-Year LOP[b]	Condition: Recommended Plan	Condition: "Extreme Measures" Condition	Is Standard Met 85 Percent of Time or More Under Recommended Plan Conditions?
Milwaukee River Watershed (continued)										
ML-31 Indian Creek	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	7,135	6,898	6,898	3,071	1,841	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	43	44	43	48	53	No
				Geometric mean (cells per 100 ml)	614	649	649	306	182	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	138	138	128	168	198	No
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	2,587	3,275	3,275	1,608	2,137	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	65	67	64	65	67	No
				Geometric mean (cells per 100 ml)	130	159	159	82	72	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	102	102	96	110	122	No
			Dissolved Oxygen	Mean (mg/l)	8.0	8.1	8.1	8.0	7.7	- -
				Median (mg/l)	7.8	8.0	8.0	7.8	7.6	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	87	87	87	87	86	Yes
ML-32 Lincoln Creek	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	3,770	4,405	4,400	1,764	1,179	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	38	37	35	40	46	No
				Geometric mean (cells per 100 ml)	561	742	741	334	208	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	138	134	120	132	161	No
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	1,223	1,866	1,860	851	1,239	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	65	65	61	63	65	No
				Geometric mean (cells per 100 ml)	106	162	162	82	71	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	102	101	92	96	108	No
			Dissolved Oxygen	Mean (mg/l)	6.4	7.1	7.1	6.6	6.5	- -
				Median (mg/l)	6.3	7.0	7.0	6.6	6.5	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	72	80	80	79	78	No

Table X-7 (continued)

Assessment Point	Regulatory Water Use Objective Evaluated in Tables M-1 through M-6	Auxiliary Use Objective(s) Evaluated in This Table	Water Quality Indicator	Statistic	Condition: Existing	Condition: Revised 2020 Baseline	Condition: Revised 2020 Baseline with Five-Year LOP[b]	Condition: Recommended Plan	Condition: "Extreme Measures" Condition	Is Standard Met 85 Percent of Time or More Under Recommended Plan Conditions?
Root River Watershed										
RT-5 Whitnall Park Creek	Limited Forage Fish	Fish and Aquatic Life	Dissolved Oxygen	Mean (mg/l)	8.5	8.5	8.5	8.5	8.5	- -
				Median (mg/l)	8.4	8.4	8.4	8.4	8.4	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	92	92	92	92	92	Yes
RT-6 Tess Corners Creek	Limited Forage Fish	Fish and Aquatic Life	Dissolved Oxygen	Mean (mg/l)	10.3	10.3	10.3	10.3	10.3	- -
				Median (mg/l)	10.4	10.4	10.4	10.4	10.4	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	96	97	97	97	97	Yes
RT-19 Ives Grove Ditch	Limited Aquatic Life	Limited Forage Fish	Dissolved Oxygen	Mean (mg/l)	10.1	9.9	9.9	9.9	9.9	- -
				Median (mg/l)	8.8	8.8	8.8	8.7	8.7	- -
				Percent compliance with dissolved oxygen standard (>3 mg/l)[c]	95	96	96	96	96	Yes
RT-20 Hoods Creek	Limited Forage Fish	Fish and Aquatic Life	Dissolved Oxygen	Mean (mg/l)	11.0	11.0	11.0	11.0	11.0	- -
				Median (mg/l)	11.7	11.8	11.8	11.8	11.8	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	94	94	94	94	94	Yes
Milwaukee Harbor Estuary										
LM-1 Milwaukee River Estuary	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	1,101	863	850	387	332	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	48	51	52	67	70	No
				Geometric mean (cells per 100 ml)	175	145	144	61	51	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	164	173	173	215	230	No
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	457	353	328	195	241	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	77	81	81	86	92	Yes
				Geometric mean (cells per 100 ml)	26	22	21	9	9	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	115	121	122	140	140	Yes
			Dissolved Oxygen	Mean (mg/l)	10.0	9.9	9.9	9.9	9.9	- -
				Median (mg/l)	10.8	10.8	10.8	10.9	10.7	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	93	93	93	94	93	Yes

Table X-7 (continued)

Assessment Point	Regulatory Water Use Objective Evaluated in Tables M-1 through M-6	Auxiliary Use Objective(s) Evaluated in This Table	Water Quality Indicator	Statistic	Condition: Existing	Condition: Revised 2020 Baseline	Condition: Revised 2020 Baseline with Five-Year LOP[b]	Condition: Recommended Plan	Condition: "Extreme Measures" Condition	Is Standard Met 85 Percent of Time or More Under Recommended Plan Conditions?
Milwaukee Harbor Estuary (continued)										
LM-2 Menomonee River Estuary	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	3,466	3,208	3,169	2,242	1,280	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	37	38	38	43	48	No
				Geometric mean (cells per 100 ml)	595	546	542	370	233	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	118	121	122	146	172	No
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	1,250	1,111	1,040	704	418	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	61	62	63	70	78	No
				Geometric mean (cells per 100 ml)	135	119	117	77	49	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	87	90	90	107	126	No
			Dissolved Oxygen	Mean (mg/l)	9.3	9.5	9.5	9.5	9.5	- -
				Median (mg/l)	9.7	10.0	10.0	10.0	9.9	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	94	94	94	94	95	Yes
LM-3 Menomonee River Estuary	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	931	828	808	526	321	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	58	59	59	68	78	No
				Geometric mean (cells per 100 ml)	141	127	126	76	53	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	192	199	200	237	264	No
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	494	442	406	274	180	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	78	79	79	85	91	Yes
				Geometric mean (cells per 100 ml)	40	35	34	22	16	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	122	127	128	138	143	Yes
			Dissolved Oxygen	Mean (mg/l)	9.1	9.3	9.3	9.4	9.3	- -
				Median (mg/l)	9.7	10.0	10.0	10.0	9.9	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	94	94	94	94	94	Yes

Table X-7 (continued)

Assessment Point	Regulatory Water Use Objective Evaluated in Tables M-1 through M-6	Auxiliary Use Objective(s) Evaluated in This Table	Water Quality Indicator	Statistic	Condition: Existing	Condition: Revised 2020 Baseline	Condition: Revised 2020 Baseline with Five-Year LOP[b]	Condition: Recommended Plan	Condition: "Extreme Measures" Condition	Is Standard Met 85 Percent of Time or More Under Recommended Plan Conditions?
Milwaukee Harbor Estuary (continued)										
LM-4 Milwaukee River Estuary	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	850	731	716	401	279	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	56	58	58	69	76	No
				Geometric mean (cells per 100 ml)	147	132	131	71	55	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	188	194	195	234	259	No
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	399	345	319	208	167	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	80	81	81	89	92	Yes
				Geometric mean (cells per 100 ml)	37	31	31	18	16	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	123	127	128	140	144	Yes
			Dissolved Oxygen	Mean (mg/l)	9.5	9.6	9.6	9.7	9.7	- -
				Median (mg/l)	10.1	10.3	10.3	10.4	10.3	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	95	94	94	95	96	Yes
LM-5 Kinnickinnic River Estuary	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	352	358	265	182	129	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	79	82	82	91	96	Yes
				Geometric mean (cells per 100 ml)	52	48	47	30	21	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	269	278	278	323	358	Yes
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	255	298	166	135	118	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	93	94	94	96	97	Yes
				Geometric mean (cells per 100 ml)	17	15	15	10	9	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	141	143	143	149	151	Yes
			Dissolved Oxygen	Mean (mg/l)	8.2	8.2	8.3	8.4	8.4	- -
				Median (mg/l)	8.7	8.7	8.8	8.9	9.0	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	92	92	92	93	93	Yes

Table X-7 (continued)

Assessment Point	Regulatory Water Use Objective Evaluated in Tables M-1 through M-6	Auxiliary Use Objective(s) Evaluated in This Table	Water Quality Indicator	Statistic	Condition: Existing	Condition: Revised 2020 Baseline	Condition: Revised 2020 Baseline with Five-Year LOP[b]	Condition: Recommended Plan	Condition: "Extreme Measures" Condition	Is Standard Met 85 Percent of Time or More Under Recommended Plan Conditions?
Milwaukee Harbor Estuary (continued)										
LM-6 Mouth of Milwaukee River at Hoan Bridge at entrance to the Outer Harbor	Special Variance	Fish and Aquatic Life and Full Recreational Use	Fecal Coliform Bacteria (annual)	Mean (cells per 100 ml)	445	396	383	222	160	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	71	73	73	84	90	Yes
				Geometric mean (cells per 100 ml)	78	74	73	44	35	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	244	246	246	288	312	No
			Fecal Coliform Bacteria (May-September: 153 days total)	Mean (cells per 100 ml)	229	203	180	124	107	- -
				Percent compliance with single sample standard (<400 cells per 100 ml)[c]	88	90	90	94	96	Yes
				Geometric mean (cells per 100 ml)	26	23	23	15	14	- -
				Days of compliance with geometric mean standard (<200 cells per 100 ml)[c]	135	137	138	147	150	Yes
			Dissolved Oxygen	Mean (mg/l)	9.5	9.6	9.6	9.6	9.6	- -
				Median (mg/l)	10.0	10.1	10.1	10.2	10.1	- -
				Percent compliance with dissolved oxygen standard (>5 mg/l)[c]	99	98	98	99	99	Yes

[a]*See Table VII-1 for auxiliary uses to be considered for planning purposes.*

[b]*Five-Year LOP refers to a five-year recurrence interval level of protection against sanitary sewer overflows.*

[c]*Standard for "auxiliary use" objective.*

Source: Tetra Tech, Inc.; HydroQual, Inc.; and SEWRPC.

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Table X-7a

COMPARISON OF WATER QUALITY PARAMETER CONCENTRATIONS TO STANDARDS SUPPORTING AUXILIARY USES

Stream	Sampling Stations	Samples with Concentrations of Dissolved Oxygen Greater than or Equal to Auxiliary Standard (percent)[a]	Samples with Concentrations of Fecal Coliform Bacteria Greater than or Equal to Auxiliary Standard (percent)[a,b]	
		Annual	Annual	May to September
Kinnickinnic River Watershed				
Kinnickinnic River Upstream of the Estuary	2	99.2 (130)	22.5 (129)	16.3 (80)
Menomonee River Watershed				
Menomonee River Mainstem	1	100.0 (117)	8.5 (117)	1.1 (87)
Honey Creek	5	85.9 (92)	21.7 (92)	20.5 (73)
Underwood Creek	5	87.5 (80)	46.3 (80)	46.7 (60)
Milwaukee River Watershed				
Indian Creek..	4	90.6 (32)	43.8 (32)	41.7 (24)
Lincoln Creek	5	93.6 (404)	30.9 (388)	42.3 (149)
Mole Creek..	1	100 (5)	- -	- -
Stony Creek	1	100 (6)	- -	- -
Wallace Creek...	1	100 (5)	- -	- -
Milwaukee River Estuary				
Kinnickinnic River..	3	72.3 (184)	56.9 (181)	47.9 (117)
Menomonee River...	4	69.0 (306)	46.3 (300)	41.5 (188)
Milwaukee River..	6	92.2 (408)	45.2 (403)	35.9 (256)

[a]*Number in parentheses indicates sample size.*

[b]*Fecal coliform bacteria compared to the single sample standard of 400 cells per 100 ml.*

NOTE: The information in this table is for the “baseline period” for analysis of data, as defined in Chapter III of this report. The baseline period used for the Kinnickinnic River, Menomonee River, and Oak Creek watersheds is 1998-2001. As this study progressed, data became available and were incorporated into the analyses. Because of this, the baseline period used for the Milwaukee River and Root River watersheds is 1998-2004.

Source: SEWRPC.

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Table X-7b

RECOMMENDATIONS REGARDING WATER USE OBJECTIVES

Assessment Point	Regulatory Water Use Objective Evaluated in Tables M-1 through M-6	Auxiliary Use Objective(s) Proposed by WDNR and Evaluated in Table X-7	Recommended Existing Water Use Objective[a]	Recommended Planned Water Use Objective[a,b]
KK-10 Kinnickinnic River	Special Variance	Fish and Aquatic Life and Full Recreational Use	Special Variance	Special Variance[c]
MN-14 Underwood Creek	Special Variance	Fish and Aquatic Life and Full Recreational Use	Special Variance	Special Variance[d]
MN-16 Honey Creek	Special Variance	Fish and Aquatic Life and Full Recreational Use	Special Variance	Special Variance
MN-17 and MN-18 Menomonee River from N. 70th Street to the Upstream End of the Milwaukee Harbor Estuary	Special Variance	Fish and Aquatic Life and Full Recreational Use	Special Variance	**Special Variance (Fish and Aquatic Life with Limited Recreational Use Standards)**
ML-22 Stony Creek	Fish and Aquatic Life	Coldwater	**Coldwater**[e]	**Coldwater**[e]
ML-31 Indian Creek Downstream of N. Manor Lane	Special Variance	Fish and Aquatic Life and Full Recreational Use	**Special Variance (Fish and Aquatic Life with Limited Recreational Use Standards)**	**Special Variance (Fish and Aquatic Life with Limited Recreational Use Standards)**
Indian Creek Upstream of N. Manor Lane	Special Variance	Fish and Aquatic Life and Full Recreational Use	Special Variance	Special Variance
ML-32 Lincoln Creek	Special Variance	Fish and Aquatic Life and Full Recreational Use	Special Variance	Special Variance[f]
RT-5 Whitnall Park Creek	Limited Forage Fish	Fish and Aquatic Life	Limited Forage Fish	Limited Forage Fish
RT-6 Tess Corners Creek	Limited Forage Fish	Fish and Aquatic Life	Limited Forage Fish	Limited Forage Fish
RT-19 Ives Grove Ditch	Limited Aquatic Life	Limited Forage Fish	Limited Aquatic Life	Limited Aquatic Life
RT-20 Hoods Creek	Limited Forage Fish	Fish and Aquatic Life	Limited Forage Fish	Limited Forage Fish
LM-1. LM-4, and LM-6 Entire Milwaukee River Estuary	Special Variance	Fish and Aquatic Life and Full Recreational Use	**Fish and Aquatic Life and Full Recreational Use**	**Fish and Aquatic Life and Full Recreational Use**
LM-2 and LM-3 Entire Menomonee River Estuary	Special Variance	Fish and Aquatic Life and Full Recreational Use	Special Variance	Special Variance
LM-5 Kinnickinnic River Estuary from Union Pacific Railroad Swing Bridge to Confluence with the Milwaukee River	Special Variance	Fish and Aquatic Life and Full Recreational Use	**Fish and Aquatic Life and Limited Recreational Use**	**Fish and Aquatic Life and Full Recreational Use**
Kinnickinnic River Estuary upstream from Union Pacific Railroad Swing Bridge	Special Variance	Fish and Aquatic Life and Full Recreational Use	Special Variance	Special Variance[g]

[a]*Bold text indicates a change from the current regulatory water use objective.*

[b]*Anticipated to be achieved under recommended plan conditions.*

[c]*Subject to re-evaluation if concrete lining were removed from the stream channel.*

[d]*Subject to re-evaluation following removal of the concrete channel lining in the reach from N. Mayfair Road (STH 100) to the confluence with the Menomonee River.*

[e]*Subject to more extensive collection of temperature data.*

[f]*Re-evaluate when more dissolved oxygen data are available.*

[g]*Re-evaluate when contaminated sediment in the upper reach of the Kinnickinnic River portion of the estuary is remediated under the WDNR Kinnickinnic River Environmental Restoration Project.*

Source: Tetra Tech, Inc.; HydroQual, Inc.; and SEWRPC.

Exhibit B

city of . . .
South Milwaukee

*Proud Past ...
Promising Future*

OFFICE OF THE CITY ENGINEER
(414) 768-8053
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September 20, 2007

Mr. Michael G. Hahn
SEWRPC Chief Environmental Engineer
W239 N1812 Rockwood Drive
P.O. Box 1607
Waukesha, WI 53187-1607

RE: SEWRPC Planning Report No. 50
A Regional Water Quality Management Plan Update
For the Greater Milwaukee Watersheds

Dear Mr. Hahn:

The City of South Milwaukee generally concurs with the subsection and supporting tables included in the above referenced report entitled "Cost Effectiveness, Analysis of Wastewater Treatment Options for the City of South Milwaukee".

The City does not have comments on the subsection.

Sincerely,
CITY OF SOUTH MILWAUKEE

Kyle E. Vandercar, P.E.
City Engineer

jm

Exhibit C

SEWRPC HOLDS PUBLIC HEARINGS ON REGIONAL WATER QUALITY MANAGEMENT PLAN

Citizens are invited to public information meetings and hearings related to the protection and improvement of water quality in a major portion of southeastern Wisconsin. These sessions will provide opportunities to learn more about, and to comment on, the findings and recommendations documented in Southeastern Wisconsin Regional Planning Commission (SEWRPC) Planning Report No. 50, *A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds*. The plan includes recommendations related to land use, surface water quality, and groundwater quality in the Kinnickinnic, Menomonee, Milwaukee, and Root River watersheds; the Oak Creek watershed; and the direct drainage area to Lake Michigan. These watersheds are roughly comprised of areas draining toward Lake Michigan from extreme northeastern Dodge County, southeastern Fond du Lac County, southwestern Sheboygan County, eastern Washington County, all of Ozaukee County except the northeastern portion, extreme eastern Waukesha County, all of Milwaukee County, eastern Racine County, and a small portion of the Town of Paris in Kenosha County. The study area also includes the nearshore Lake Michigan area from the Village of Fox Point to the Village of Wind Point. Copies of the report chapters, including the recommended plan chapter, are now available for review on the SEWRPC web site at *http://www.sewrpc.org/waterqualityplan/chapters.asp*.

The plan was prepared by SEWRPC, in partnership with the Milwaukee Metropolitan Sewerage District (MMSD) under the "Water Quality Initiative," and in cooperation the Wisconsin Department of Natural Resources (WDNR) and the U.S. Geological Survey (USGS). The plan was developed in close coordination with the MMSD 2020 Facilities Plan. Preparation of the plan was guided by a Technical Advisory Committee composed of representatives of county and municipal government, special-purpose units of government, MMSD, WDNR, USGS, the U.S. Environmental Protection Agency, academic institutions, and environmental and conservation organizations. In addition, the regional water quality management plan and MMSD Facilities Plan were presented and discussed at periodic meetings of a joint Citizens Advisory Council formed specifically to provide input on the two plans and at meetings of watershed officials, consisting of the elected and appointed representatives from the counties, cities, villages, and towns in the study area.

The following 4:30-7:00 p.m. sessions will be held during October 2007:

October 15 at Gateway Technical College, Racine Campus, Racine Building, 901 Pershing Drive, Parking Lot D, Great Lakes Room (#110)

October 16 at the Downtown Transit Center, Harbor Lights Room (upper floor), 909 E. Michigan Street, Milwaukee

October 23 at Riveredge Nature Center, 4458 W. Hawthorne Drive, Newburg, WI, 53060, located a mile north of STH 33 on CTH Y, northeast of Newburg

Each session will begin with a meeting in "open house" format from 4:30-5:30 p.m., which will provide an opportunity to meet one-on-one or in small groups with the Commission staff to receive information, ask questions, and provide comment. A presentation will be made by the Commission staff at 5:30 p.m., followed by a public hearing providing a forum for public comment in "town hall" format from approximately 6:00 p.m. to 7:00 p.m.

In addition to providing comments at the public meetings and hearings, written comments may also be submitted. Written comments should be received no later than Wednesday, October 24, 2007.

For more information, please contact:

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Exhibit C-1

SEWRPC Planning Report No. 50

A REGIONAL WATER QUALITY MANAGEMENT PLAN UPDATE FOR THE GREATER MILWAUKEE WATERSHEDS

Appendix M-1

RIPARIAN BUFFER EFFECTIVENESS ANALYSIS

INTRODUCTION

The scientific literature on the effectiveness of riparian buffers in improving water quality through processing and removing anthropogenic contaminants from surface and ground waters is extensive. Added to this literature is legal practice that has established the principle of shoreline setbacks, especially with respect to both the shoreland management of lakes and flowages and to flood control. Recently, riparian buffers have been employed as an environmental management tool. Despite significant research efforts, there remains no consensus for what constitutes optimal riparian buffer design or proper buffer width to achieve maximum pollutant removal effectiveness, water quality protection, and biological protection. The Wisconsin Buffer Initiative (WBI) further developed two key concepts that are relevant to this plan: 1) riparian buffers are very effective in protecting water resources, and 2) riparian buffers need to be a part of a larger conservation system to be most effective.[1] However, it is important to note that the WBI limited its assessment and recommendations solely to the protection of water quality, and did not consider the additional values and benefits of riparian buffers such as flood control, prevention of channel erosion, provision of fish and wildlife habitat, enhancement of environmental corridors, and water temperature moderation, among others.

This analysis seeks to identify documented scientific information extracted from published literature, which allowed the derivation of the recommended 75-foot-wide riparian buffer width for lakes and streams in the regional water quality management plan update study area, and by extension, the Southeastern Wisconsin Region. This will aid managers and planners in making decisions about establishing, maintaining, or restoring riparian buffers adjacent to all waterbodies. Although, buffer width stands out as one factor influencing the capacity for buffers to remove potential contaminants, numerous other factors described herein play significant roles in the establishment of 75-foot-wide riparian buffers as part of this comprehensive water quality management plan update.

More than 65 peer-reviewed scientific publications dating from 1975 through 2005 were examined for data on the effectiveness of riparian buffers for total suspended solids (TSS), nitrogen, and phosphorus removal around streams and lakes. These data form the basis for defining the relationship between buffer width and percent removal efficiencies for those contaminants. When introduced into the natural environment in quantities or

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[1]*University of Wisconsin-Madison, College of Agricultural and Life Sciences,* The Wisconsin Buffer Initiative*, December 2005.*

concentrations exceeding the absorption capacity of shoreland buffers, these potential pollutants have the ability to negatively impact waterways and waterbodies, diminishing their utility as recreational and aesthetic resources and reducing their value as essential elements of aquatic ecosystems.

As part of this analysis, three key elements were incorporated into the general 75-foot buffer width recommendation set forth in the regional water quality management plan update. These elements are:

- The value of riparian buffers as vegetated zones adjacent to streams, lakes, and wetlands and their use as a best management practice (BMP) for **controlling contaminants** such as nutrients and TSS entering waterbodies.

- The value of riparian buffers as habitat areas adjacent to streams, lakes, and wetlands and their use as a BMP for **protecting and maintaining species** habitat and diversity, especially amongst species of economic concern.

- The role of riparian buffers as a **component of comprehensive watershed management plans**, which must also include point source and nonpoint source control of nutrients and TSS loadings.

CONTROL OF CONTAMINANTS

Riparian buffers are one of the most effective best management practices to protect water resources in terms of water quality, riverbank stability, wildlife habitat, and aesthetics. These strips of grass, shrubs, and/or trees along the banks of rivers, streams, and lake shorelines filter polluted runoff and provide a transition zone between the land and water and associated human uses. These buffers work in various ways and with varying degrees of effectiveness. Effectiveness depends upon a number of factors including the nature of the specific contaminant, its environmental reactivity, the mass of contaminant being conveyed across the land surface, and the distance and slope across which the contaminant is being carried. The role of buffers in controlling and managing the transfer of several major contaminants through the land-water ecotone, or interface, is briefly reviewed below.

Sediment Filter
Riparian buffers help catch and filter out sediment and debris from surface runoff. Depending upon the width and complexity of the buffer, generally 50 percent to 100 percent of the sediment particles—as well as the nutrients and other contaminants attached to them—can settle out and be retained within the buffer strip as plants slow sediment-laden runoff waters. These buffers act as physical filters, retaining particulates within the mass of plant materials, roots, and stalks. For this purpose, wider forested buffers are even more effective than narrow grassed buffers.

Nutrient Filter, Transformer, and Sink
Riparian buffers “trap” pollutants that could otherwise wash into surface and ground water. Such buffers act both as a physical filter, retaining contaminants that adhere to sediment particles through the settling processes described above, and as biological filters. The plants that comprise the buffer strips can utilize a portion of the nutrient load being processed through the buffer strip for nutrition and growth. Phosphorus and nitrogen from sources such as fertilizer application and animal waste can become pollutants if more is applied to the land than upland plants can use. These “excess” nutrients can be transported by runoff of rainfall or snowmelt to aquatic systems, such as streams and lakes where the nutrients are then available to support and sustain the growth and reproduction of shoreland and aquatic plants. In large quantities, these plants commonly limit recreational use of the waters and shorelands, and interfere with the aesthetic enjoyment of these areas.

Phosphorus stimulates growth (i.e. it is a growth limiting element) of both terrestrial and aquatic plants in the Southeastern Wisconsin Region, and is largely responsible for the eutrophication of our waterbodies. The affinity of this element to soil particles results in approximately 80 percent or more of the available phosphorus being captured when sediment is filtered out of surface runoff by passing through the buffer.

In the case of nitrogen, another important element for plant growth, the chemical and biological activity in the soil, particularly in the soils of streamside forests, can capture and transform nitrogen and other pollutants into less biologically-available forms. Nitrogen-fixing bacteria are especially useful in capturing "excessive" nitrogen and transforming the elemental nitrogen into biologically available and/or gaseous forms.

It should be noted that, with respect to aquatic systems, the vegetation within the buffers acts as a temporary sink as the nutrients and excess water are taken up by root systems and stored in the biomass of trees during the growing season. A large portion of these nutrients are then re-released into the environment during the autumn as the plants senesce or die; however, nutrients entering the aquatic environment during the fall are less likely to create or contribute to conditions that interfere with human recreational use and aesthetic enjoyment of the downstream water resources.

Stream Flow Regulator
Riparian buffers slow the passage of water across the land surface and allow water to infiltrate into the soil. This recharge contributes to the maintenance of the groundwater supply. Groundwater reaches streams and rivers at a much slower rate, and over longer periods of time, than surface runoff. Thus, increasing recharge helps maintain stream flow during the driest times of the year.

Bed and Bank Stabilizer
Riparian buffer vegetation helps to stabilize streambanks and shorelines and reduce erosion. The roots of the plants hold bank soils together, and the stems protect banks by deflecting the erosive action of waves, ice, boat wakes, and storm runoff. In like manner, riparian buffers also can reduce the amount of streambed scour by absorbing surface water runoff and slowing water velocities. When plant cover is removed, more surface water reaches a stream, causing the water to crest higher during storms or snowmelt, and subjecting the shorelands to higher flow velocities that can scour shorelines and streambeds.

Effectiveness of Shoreland Buffers
The following range of buffer widths can be gleaned from the literature:

- To Stabilize Eroding Banks: On smaller streams, good erosion control may only require covering the banks with shrubs and trees, and a 35-foot-wide managed grass buffer. If there is active bank erosion, or on larger streams, at least a 50-foot width is necessary. Severe bank erosion on larger streams may require engineering actions to stabilize and protect the bank; however, once completed, bank protection can be done with plants. For better stabilization, more of the buffer should be planted in shrubs and trees.

- To Filter Sediment and Attached Contaminants from Runoff: For slopes of less than 15 percent, most sediment settling occurs within a 35-foot-wide buffer of grass. Greater width is needed on steeper slopes, for shrubs and trees, or where sediment loads are particularly high.

- To Filter Dissolved Nutrients and Pesticides from Runoff: A width of up to 100 feet or more may be necessary on steeper slopes and on less permeable soils to allow runoff to soak in sufficiently, and for vegetation and microbes to work on nutrients and pesticides. Most pollutants are removed within 75 feet.

Based upon the literature review, for the purposes of contaminant management, a buffer width of 75 feet represents the most appropriate width for water quality protection. As shown in Figures M-1-1 through M-1-4, and consistent with the water quality modeling assumptions applied for the regional water quality management plan update, a 75-foot buffer width provides a high level of effectiveness in reducing TSS loads delivered to the buffer by about 75 percent, delivered total nitrogen loads by about 65 percent, delivered nitrate loads by about 75 percent, and delivered total phosphorus loads by about 70 percent. There are increased benefits of reduction beyond the 75-foot width for each of these parameters. For example, about 90 percent removal effectiveness would be expected for both nitrate and total phosphorus at approximately a 300-foot buffer width. Coincidently, this 300-foot buffer width is well within the range for added biological community benefits as described below. However, examination of Figures M-1-1 through M-1-4 indicates that for a relatively high cost, as indicated by the incremental buffer width beyond 75 feet, a relatively small improvement in water quality would be achieved, as indicated by the incremental increase in pollutant removal effectiveness beyond that for the 75-foot buffer.

It should also be noted that buffer effectiveness is determined by slope, soil permeability, and nature of vegetative cover. Steep slopes and soils of low permeability have less capacity to provide water quality benefits and therefore, require greater buffer widths than less steeply sloped and more permeable soils. Steeply sloped lands promote rapid runoff of water and associated contaminants, while less permeable soils limit infiltration and interflow. Studies show that subsurface flows provide more effective pollutant removal capacity than surface runoff flows.[2] However, the effectiveness and efficiency of all buffers can be limited by the extent of contaminant loading, with even the largest buffers having reduced effectiveness under conditions of extremely high loadings. Thus, a system of riparian buffers along with agricultural nutrient management plans and urban stormwater management plans is recommended under the regional water quality management plan update to provide effective control of nonpoint source pollution.

The nature of vegetated cover within the buffer also will determine in part the magnitude of nutrient removal based upon: the requirements of specific plants primarily for nitrogen and phosphorus necessary for growth; the season, with the majority of removal occurring during the growing season; and the degree of physical filtration, with more densely packed stems typically slowing runoff and retaining a greater percentage of soil bound pollutants. Seasonality in terms of both plant growth cycles and freeze thaw cycles can influence the net effectiveness of pollutant removal, with plants actively taking up or removing nutrients in the spring and summer and releasing those nutrients during the fall when plants senesce, while frozen ground limits the ability of water to infiltrate during the winter months reducing the percentage of uptake of nutrients.[3] Modifying the timing and rate of delivery of contaminants to aquatic systems can significantly modify undesirable biological responses in receiving waters such as lakes and streams.

BIOLOGICAL PROTECTION

Riparian buffers can be complex ecosystems that provide habitat and improve the stream and lake communities that they shelter. Habitat and riparian corridor conditions are strongly influenced by the width and nature of the buffers adjacent to a waterbody and are an important BMP with regard to protecting water from contamination by nonpoint source pollutants, as previously noted. There are many different kinds of buffers. While these buffers may be applied to a variety of situations and may be called by different names, their functions are much the

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[2]*Paul M. Mayer, Steven K. Reynolds, and Timothy J. Canfield,* Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness: A Review of Current Science and Regulations*, U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, EPA/600/R-05/118, October 2005.*

[3]*D.M. Robertson, S.J. Field, J.F. Elder, G.L. Goddard, and W.F. James,* Phosphorus Dynamics in Delavan Lake Inlet, Southeastern Wisconsin*, 1994, U.S. Geological Survey Water Resources Report 96-4160, 1996; W.F. James, C.S. Smith, J.W Barko, and S.J. Field, "Direct and Indirect Influences on Aquatic Macrophyte Communities on Phosphorus Mobilization from Littoral Sediments of an Inlet Region in Lake Delavan, Wisconsin," U.S. Army Corps of Engineers,* Technical Report W-95-2*, September 1995.*

same—the improvement and protection of surface water and groundwater quality; reduction of erosion on croplands, streambanks, and lakeshores; and, provision of protection and cover for insects, fish, birds, amphibians, reptiles, and mammals. The types of riparian buffers include, but are not limited to: streamside or lakeshore plantings of trees, shrubs, and grasses; filter strips or grassed waterways; and undisturbed shoreland vegetation.

Wildlife Habitat
The distinctive habitat offered by riparian buffers is home to a multitude of plant and animal species, including those rarely found outside of this band of land influenced by a river or lake. Continuous stretches of riparian buffer serve as wildlife travel corridors. Consequently, streambanks and lakeshores form integral elements of the environmental corridor concept developed and implemented within the Region in accordance with the regional land use and natural areas and critical species habitat protection and management plans.

Aquatic Habitat
Riparian buffers benefit aquatic habitat by improving the quality of nearby waters through shading, filtering, and moderating stream flow. Trees and shrubs provide shade during the summer months, maintaining cooler and more even water temperatures, especially along small streams. Cooler water holds more oxygen and reduces stress on fish and other aquatic creatures. A few degrees difference in temperature can have a major effect on their survival. High value species, such a trout, for example, require cooler water temperatures for survival and reproduction.

The woody debris generated from within the riparian buffer supports the aquatic food web by providing food and cover for fish and their food organisms. By slowing water velocities, providing substrate for insects, among other benefits the woody debris encourages a range of organisms within a system that would be less diversely populated if it did not contain woody debris.

Recreation and Aesthetics
Riparian buffers are especially valuable in providing a green screen along waterways, blocking views of nearby development, and allowing privacy for riverfront landowners. Buffers also provide such recreational opportunities as hiking trails. For many humans, it is these attributes of riparian buffers that are most obvious and most enjoyable.

To Protect Fisheries
Research has shown that a minimum 100-foot buffer width is required to protect the quality and health of the aquatic food web.[4] However, the highest quality fishery communities were associated with the widest riparian buffers that ranged from approximately 650-3,000 feet in width, which indicates that buffer widths greater than 100 feet continue to provide additional protection benefits to the fishery community. Regardless of the type of fishery, the 100-foot minimum is a relevant buffer width standard to protect and maintain a coldwater, coolwater, or warmwater fishery and associated aquatic community. The quality of these communities improves with increases beyond the minimum buffer width. In addition, research also has shown that impacts to the continuity and fragmentation of the riparian corridor buffer width are equally as important in protecting aquatic communities. Similarly, both width and continuity of undisturbed buffer strips were related positively to stream health as indicated by aquatic insect IBI, aquatic insect species richness, fisheries Index of Biotic Integrity (IBI),

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[4]*Jana S. Stewart, Lizhu Wang, John Lyons, Judy A. Horwatich, Roger Bannerman, "Influences of watershed, riparian-corridor, and reach-scale characteristics on aquatic biota in agricultural watersheds,"* Journal of the American Water Resources Association*, Vol. 37, No. 6, 1475-1487, 2001; Wisconsin Department of Natural Resources Bureau of Integrated Science Services,* Buffer Width and Continuity for Preserving Stream Health in Agricultural Landscapes*, Issue Fifty-six, December 2005.*

and trout presence.[5] These researchers found that stream health was generally well protected with riparian buffers that ranged from about 110-130 feet in width, contained less than 13 fragments per kilometer (e.g., number of road crossings or some equivalent per length of buffer), and at least 31 percent of the buffer was comprised of 100 feet or more in width. As shown in Figure M-1-5, stream health (i.e. aquatic insect IBI) and buffer characteristics were linearly related where stream health improves with buffer width from about 50 to 160 feet in width. Narrow buffers having some fragmentation had modest effects on reducing stresses to stream health, whereas wide buffers without fragmentation had substantial effects. Consistent with these findings related to stream health, the regional water quality management plan update includes a recommendation that opportunities to expand riparian buffers beyond the recommended 75-foot width be pursued along high-quality stream systems including those designated as outstanding or exceptional resource waters of the State, trout streams, or other waterways that support and sustain the life cycles of economically important species such as salmon, walleye, and northern pike.

Land use within the watershed also is an important variable influencing fish and macroinvertebrate abundance and diversity, which is why riparian buffers alone cannot address the stresses of excessive nutrient loading, stormwater runoff, or other nonpoint source pollution. For example, researchers found that combined upland (barnyard runoff controls, manure storage, and contour plowing and reduced tillage) and riparian (streambank fencing, streambank sloping, limited streambank rip rapping) Best Management Practices (BMPs) treatments significantly improved overall stream habitat quality, bank stability, instream cover for fishes, and fish abundance and diversity.[6] Specifically, improvements were most pronounced at sites with riparian BMPs; however, in sites with limited upland BMPs installed in the watershed there were no improvements in water temperature or the quality of fish community. The regional water quality management plan update recommends buffers as part of an overall system of agricultural controls such as those listed above.

To Protect Wildlife Habitat

Buffer widths for wildlife depend upon the desired species to be protected. As shown in Figure M-1-6, large streamside forest buffer widths of up to 350 feet are needed for wildlife habitat purposes in contrast to those required for protection of water quality. The larger the buffer zone, the more valuable it is as wildlife habitat. Larger animals—such as fox, deer, raccoon, and large birds of prey—and interior forest species—especially forest dwelling birds that require deep forest habitat—generally require more room. Additionally, the diversity of various sedges, grasses, forbs, shrubs, and trees may be dependent upon the area available for seed dispersal, germination, and growth. Nevertheless, a narrow width and reduced diversity of vegetation may be acceptable as a travel corridor if connected to larger diverse areas of habitat. Even small patches of trees are better for migrating birds than no buffer or monotypical stands such as lawns or crops. These wildlife buffer concepts underlie the primary environmental corridor specifications of a 200-foot minimum width and two mile length[7]

SYNTHESIS

Buffers can be used for a variety of purposes from enhancing aquatic species diversity through reducing water temperature entering streams to enhancing terrestrial species diversity through the provision of safe passages with adequate food and shelter. For these reasons, buffer size may vary widely, depending on the specific functions

[5]*Wisconsin Department of Natural Resources Bureau of Integrated Science Services,* Buffer Width and Continuity for Preserving Stream Health in Agricultural Landscapes*, Issue Fifty-six, December 2005.*

[6]*Lizhu Wang, John Lyons, and Paul Kanehl, "Effects of watershed best management practices on habitat and fish in Wisconsin streams,"* Journal of the American Water Resources Association*, Vol. 38, No. 3, 663-680, June 2002.*

[7]*Paul Beier and Reed F. Noss, "Do Habitat Corridors Provide Connectivity?,"* Conservation Biology, Review*, Vol. 12, No. 6, 1241-1252, December 1998.*

required for a particular buffer or for the protection of a particular species as shown in Figure M-1-6. Buffers that have widths in the 15- to 35-foot range generally provide limited water quality benefit and minimal protection of aquatic resources under most conditions. Under most circumstances, a minimum buffer width of about 50 to 100 feet is necessary to protect wetlands and streams. In general, minimum buffer widths in the 50- to 65-foot range would be expected to provide for the maintenance of the natural physical and chemical characteristics of aquatic resources. Buffer widths at the upper end of the 50- to 100-foot range seem to be necessary for the maintenance of the biological components of many wetland and stream systems, although it is important to note that site-specific conditions, such as slope, vegetation, and soil characteristics, can greatly influence the need for either wider or narrower buffers. Based upon the literature review, for the purposes of habitat management, a buffer width of 75 feet represents the minimum width necessary for provision of protection of aquatic organisms and habitat. However, a buffer of only 75 feet is not adequate to protect all aquatic and terrestrial plant and animal species.

It is clear that "one size does not fit all" with regard to riparian buffers. Buffer width depends on the purpose which the buffer is meant to serve. There is no single generic buffer which will keep the water clean, stabilize the bank, protect the fish and wildlife, and satisfy human demands. The minimum acceptable width is one that will provide acceptable levels of all of these beneficial uses at an acceptable cost. Consequently, a basic buffer should be about 75 feet from the top of the bank at the water's edge.

In practice, the size and vegetation of the buffer should match the land use and topography of the site.

- Topography: A buffer is more important for water quality in areas that collect runoff and deliver it to streams, and less critical on lands that drain away from the water. Steeper slopes call for a wider riparian buffer to allow more opportunity for the buffer to capture pollutants from faster moving runoff.

- Hydrology and Soils: The ability of the soil to remove pollutants and nutrients from surface and ground water depends upon the type of soil, its depth, and relation to the water table. On wetter soils, a wider buffer is needed to achieve the same benefit.

- Vegetation: The purposes of the buffer will influence the type of vegetation to plant or encourage. In urban and residential areas, trees and shrubs do a better job at capturing pollutants from parking lots and lawn runoff and providing visual screening and wildlife habitat. Between croplands and waterways, a buffer of shrubs and grasses can provide many of the benefits of a forested buffer without shading crops, although trees can be used on the north side of fields. Trees have several advantages over other plants in improving water quality and offering habitat. Trees are not easily smothered by sediment and have greater root mass to resist erosion. Above ground, they provide better cover for birds and other wildlife using waterways as migratory routes. Trees can especially benefit aquatic habitat on smaller streams. In general, native vegetation is preferable to non-native plants.

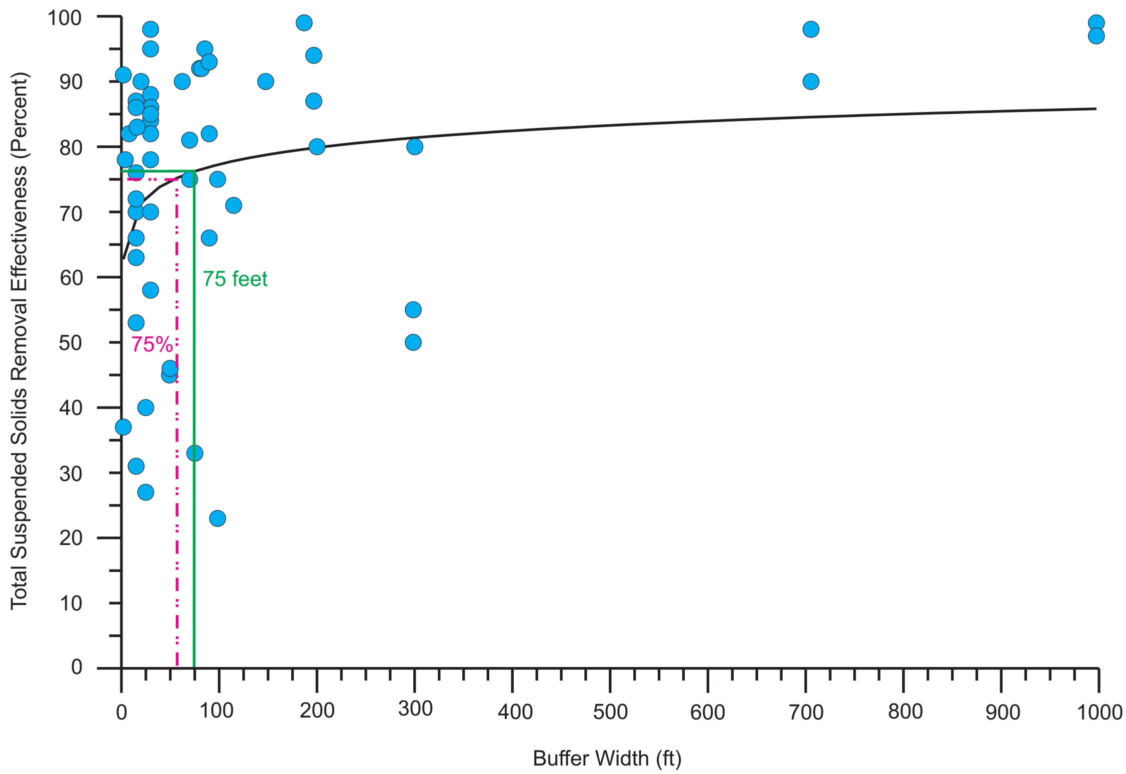
CONCLUDING REMARKS

While it is clear from the literature that wider buffers can provide a greater range of values for aquatic systems, the need to balance human access and use with the environmental benefits to be achieved suggests that a 75-foot-wide riparian buffer provides a minimum width necessary to contribute to good water quality and a healthy aquatic ecosystem. In general, most pollutants are removed within a 75-foot buffer width. While water quality benefits increase somewhat when buffers exceed the 75-foot width, such increases in width are increasingly less cost effective as a smaller portion of the total pollutant load is removed at a significantly higher cost. From an ecological point of view, buffers beyond a 75-foot width provide greater benefits.

These findings form the basis for the Washington County shoreland protection program, for example, and underlie many of the other shoreland ordinances adopted elsewhere in Wisconsin. A 75-foot buffer width is consistent with the required shoreland setbacks set forth in Chapter NR 115 of the *Wisconsin Administrative Code*, and with other recommended setbacks currently included within legal definitions of the shoreland area. Thus, a 75-foot wide buffer appears to be the best and most practical compromise between human use of the landscape and the needs of the environment that sustain such human uses. However, the quality and continuity of these corridors play important roles in their effectiveness, with greater levels of fragmentation by roadways and other structures limiting the effectiveness of those buffers that are put into place.

Figure M-1-1

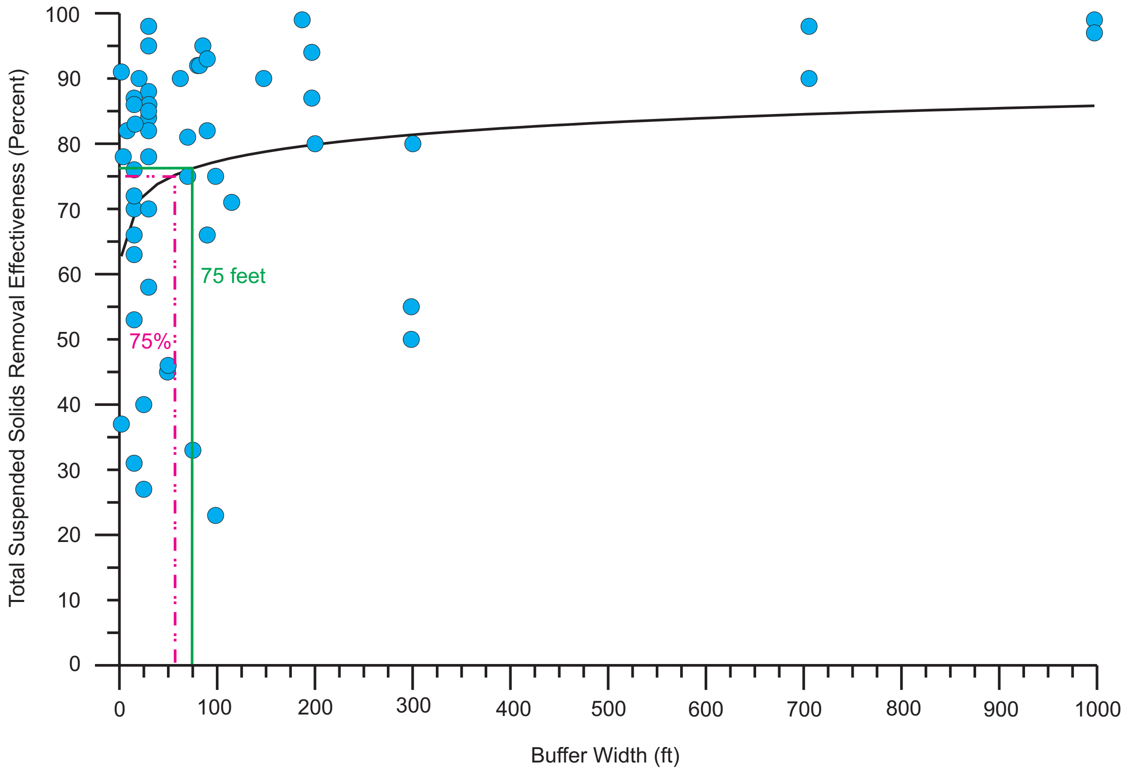
RELATIONSHIP OF TOTAL SUSPENDED SOLIDS REMOVAL EFFECTIVENESS TO RIPARIAN BUFFER WIDTH



Source: SEWRPC.

Figure M-1-2

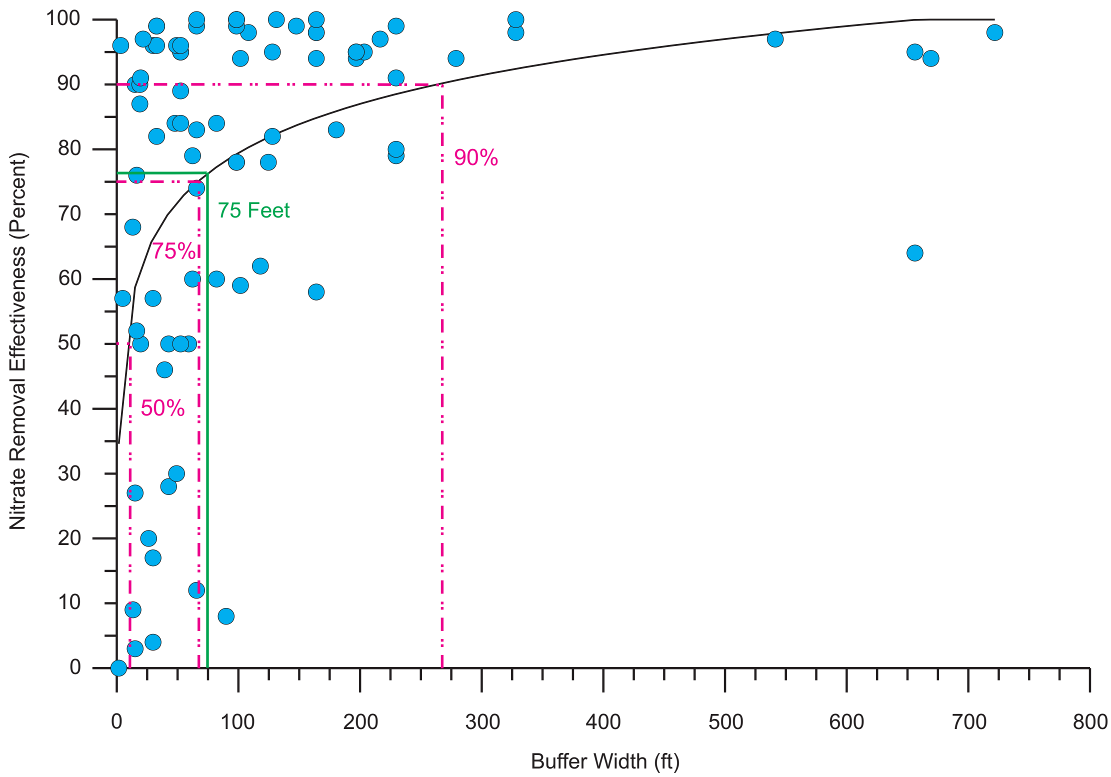
RELATIONSHIP OF TOTAL NITROGEN REMOVAL EFFECTIVENESS TO RIPARIAN BUFFER WIDTH



Source: SEWRPC.

Figure M-1-3

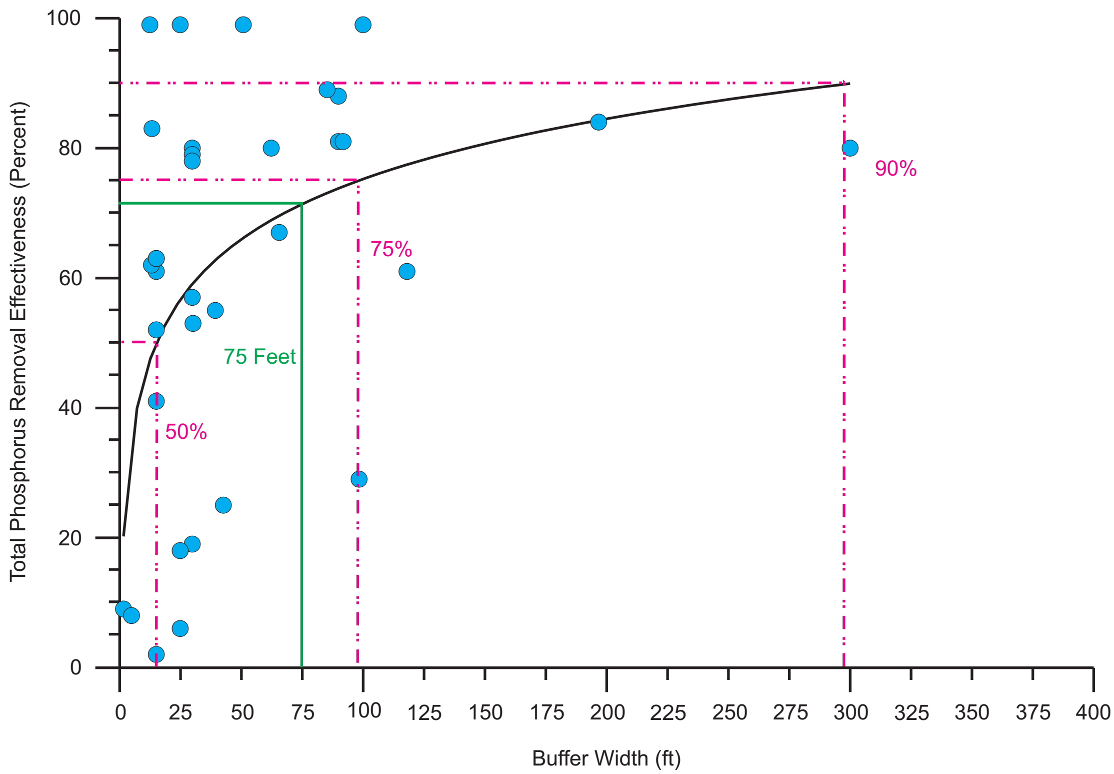
RELATIONSHIP OF NITRATE REMOVAL EFFECTIVENESS TO RIPARIAN BUFFER WIDTH



Source: SEWRPC.

Figure M-1-4

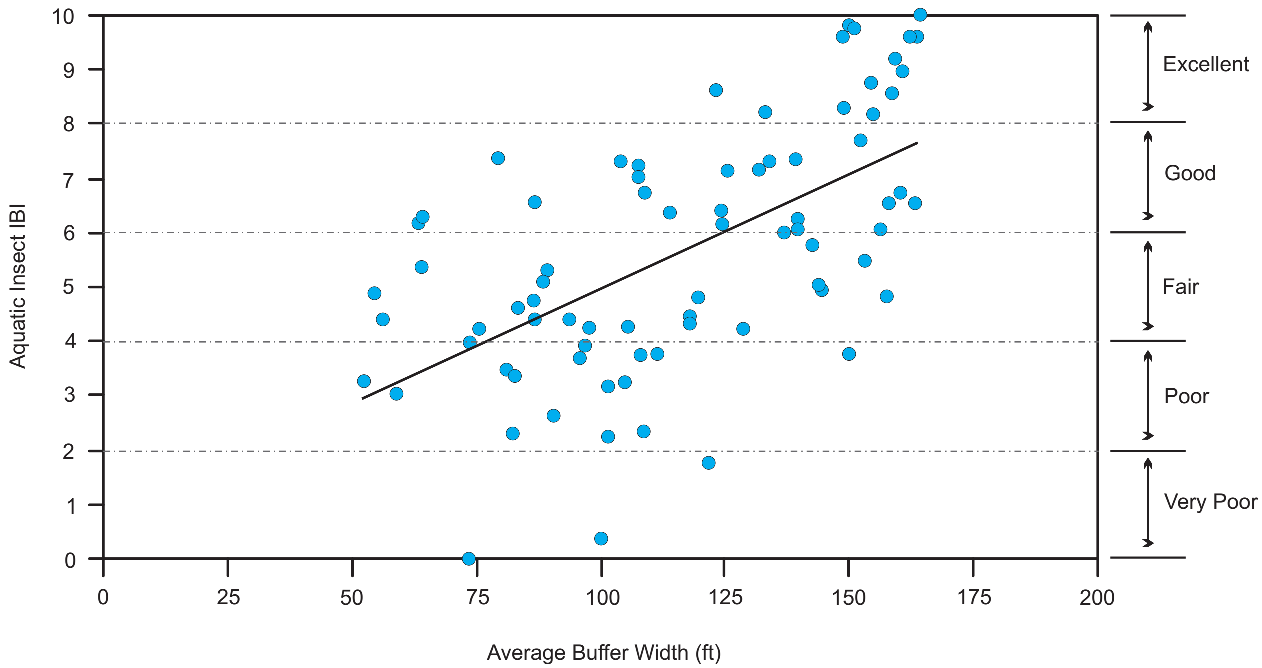
RELATIONSHIP OF TOTAL PHOSPHORUS REMOVAL EFFECTIVENESS TO RIPARIAN BUFFER WIDTH



Source: SEWRPC.

Figure M-1-5

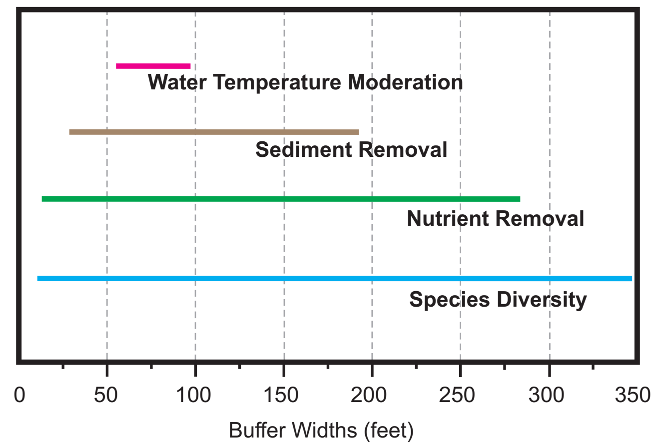
MACROINVERTEBRATE INDEX OF BIOTIC INTEGRITY SCORES AND AVERAGE BUFFER WIDTH



Source: Adapted from B.M. Weigel and others, "Buffer Width and Continuity for Preserving Stream Health in Agricultural Landscapes," Bureau of Integrated Science Services, Wisconsin Department of Natural Resources, Issue 56, 2005.

Figure M-1-6

RANGE OF BUFFER WIDTHS FOR PROVIDING SPECIFIC BUFFER FUNCTIONS



NOTE: Site-specific evaluations are required to determine the need for buffers and specific buffer characteristics.

Source: Adapted from A.J. Castelle and others, "Wetland and Stream Buffer Size Requirments–A Review," Journal of Environmental Quality*, Vol. 23.*

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Exhibit C-2

SEWRPC Planning Report No. 50

A REGIONAL WATER QUALITY MANAGEMENT PLAN UPDATE FOR THE GREATER MILWAUKEE WATERSHEDS

Chapter X

RECOMMENDED WATER QUALITY MANAGEMENT PLAN

[INSERT AFTER THE FIFTH PARAGRAPH ON PAGE 44]

Dredging and Dredged Materials Disposal

A dredging and dredged material disposal plan was developed under the SEWRPC Milwaukee Harbor estuary study.[1] The regional water quality management plan update revises the recommendations from that study, taking into account the current status of navigational dredging programs and the implementation status of remedial action plans in the Milwaukee Estuary Area of Concern, which is one of 43 sites in the Great Lakes area targeted for priority attention under the U.S.-Canada Great Lakes Water Quality Agreement (Annex 2 of the 1987 Protocol) due to impairment of beneficial use of the area's ability to support aquatic life.

The need for dredging in the Milwaukee Harbor estuary is determined primarily by the need to maintain commercial navigation. That need may, however, also be determined by the need for the construction of new or updated port facilities; port safety; the need to provide for water quality improvement by reducing the impacts of polluted sediment on the water column and on the flora and fauna of the area; and the need to improve aquatic habitat. Each of these potential needs was carefully considered in the SEWRPC Milwaukee Harbor estuary study, and was reevaluated under the regional water quality management plan update.

CURRENT NAVIGATIONAL DREDGING ACTIVITIES IN THE LAKE MICHIGAN INNER AND OUTER HARBOR AREAS

Dredging and the disposal of the dredged materials is presently carried out within the Milwaukee Harbor estuary for maintenance of adequate water depths for commercial navigation. Dredged materials are disposed of at the Jones Island Confined Disposal Facility (CDF) constructed by the U. S. Army Corps of Engineers (USCOE) in 1975 along the shoreline of the southern portion of the outer harbor (see Map X-11e). As shown on Map X-11e, the current USCOE dredging program is focused on the outer harbor where a 28-foot depth below the established low water datum is maintained, the main gap from the outer harbor into Lake Michigan where a 30-foot depth is maintained, a short reach of the Milwaukee River downstream of E. Buffalo Street where a 21-foot depth is maintained, the Menomonee River from N. 20th Street extended to its confluence with the Milwaukee River where an 18-foot depth is maintained, the South Menomonee Canal where an approximately 16-foot depth is maintained, and the Kinnickinnic River from S. Kinnickinnic Avenue to the Union Pacific Railroad swing bridge (21-foot depth) and from the swing bridge to the confluence with the Milwaukee River (27-foot depth). The reach

[1]*SEWRPC Planning Report No. 37,* A Water Resources Management Plan for the Milwaukee Harbor Estuary, *Volume Two, "Alternative and Recommended Plans," December 1987.*

of the Milwaukee River estuary upstream of E. Buffalo St. that was historically dredged has now been Federally deauthorized and is no longer dredged. The reach of the Menomonee River from N. 25th Street downstream to N. 20th Street and the Burnham Canal have not been Federally deauthorized for dredging, but these reaches are part of the USCOE "backlog" and they have not been regularly maintained in recent years.

The Port of Milwaukee dredges within the municipal mooring basin along the Kinnickinnic River (27-foot-depth) and in the ship slips in the outer harbor, while the slips in the inner harbor are maintained by private concerns.

DREDGING NEEDS

Dredging for Navigation

Materials deposited by sedimentation in the inner harbor and outer harbor, if not removed by dredging, become a hindrance to commercial navigation and related activities in the Port of Milwaukee. Commercial vessels cannot operate at full capacity—or in extreme cases, at all—if shallower waters that are the result of sediment accumulation in the channels, mooring basin, and outer harbor must be negotiated. In order to accommodate the draft of large lake- and sea-going commercial vessels, the channels of the St. Lawrence Seaway are intended to he uniformly constructed and maintained at 27 feet below established low water datum.[2] Since the viability of the Port of Milwaukee and industries along portions of the estuary depend, in part, upon the economical operation of such lake- and seagoing vessels, the Milwaukee Harbor estuary should be maintained at similar depths. The extent of the dredging recommended for navigation maintenance is shown on Map X-11e, which also shows the depths to be maintained by dredging.

No substantial additional dredging is presently envisioned in the Milwaukee Harbor estuary. Should projects develop requiring such work, additional dredged materials will be generated. However, such quantities would likely be limited and would have a minimal effect on the recommended dredging methods and dredged material disposal facilities.

Dredging for Water Quality Improvement

Dredging for water quality improvement was not specifically recommended under the Milwaukee Harbor estuary study; however, the toxic substances management plan element did recommend that a second level, detailed study of the problems associated with toxic substances in the bottom sediments of the Milwaukee Harbor estuary be conducted. Since the Harbor estuary study was published, the need for dredging in the Kinnickinnic River in the reach from W. Becher Street downstream to S. Kinnickinnic Avenue has been identified under the RAP process for the Milwaukee Estuary Area of Concern.[3] The Kinnickinnic River Environmental Restoration Project, which is scheduled for implementation during 2008 and 2009, calls for 1) dredging up to 170,000 cubic yards of sediments contaminated with polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs), which will remove about 90 percent of the PCB mass in the project area, and 2) creating an 80-foot-wide, 20 to

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[2]*Lake level fluctuations may intermittently complicate port access and management of vessels.*

[3]*Altech Environmental Services, Inc.,* Final Report – Sediment Sampling from the Kinnickinnic River, Milwaukee, Wisconsin, *prepared for U.S. Army Corps of Engineers Detroit District, March 2003.*

24-foot-deep navigational channel.[4] It is proposed to place the dredged material in the CDF, which would essentially exhaust the existing capacity of the CDF.[5]

It is recommended that the Kinnickinnic River Environmental Restoration Project be implemented and that implementation of the Milwaukee Estuary Remedial Action Plan be continued and supported.

Dredging to Improve Aquatic Habitat

Another consideration regarding dredging is the need to improve aquatic habitat within the estuary. Detailed inventories of the existing habitat were conducted as part of the 1987 SEWRPC Milwaukee Harbor estuary study, and the findings documented in Chapter VI of Volume One of that report. Review of the conditions documented in the Harbor estuary study supplemented by information collected under the regional water quality management plan update effort, indicates that no widespread dredging should be undertaken to improve aquatic habitat. This conclusion was reached because the inventories found that there are adequate localized areas within the inner harbor that provide suitable feeding, cover, and spawning habitats for warmwater fish and aquatic life, even though habitat conditions for a desirable fishery throughout most of the inner harbor are generally poor. For example, in the reach of the Milwaukee River from the North Avenue dam to N. Humboldt Avenue, there are numerous scoured areas with a substrate of rocks, sand, and hard clay. In addition, WDNR has implemented several restoration projects to enhance gamefish spawning habitat and nursery areas such as the North Avenue Dam walleye spawning shoal.[6] Inventory data indicate that many warmwater fish species, including walleye, smallmouth and largemouth bass, northern pike, bullhead, catfish, suckers, carp, and sunfish, currently spawn in this reach. Similarly, there are localized shallow areas in the upper ends of the Menomonee and Kinnickinnic River estuaries, as well as in the upper ends of the Burnham and South Menomonee Canals, that support rooted aquatic vegetation that is used for spawning by northern pike, yellow perch, carp, and sunfish. Many of the fish that spawn in the inner harbor migrate in from Lake Michigan during spring and summer. As a result of pollution abatement actions including the MMSD Water Pollution Abatement Program with its construction of the Inline Storage System, inputs of organic material and other pollutants into the estuary through combined sewer overflows and other sources of pollution have been reduced. These reductions coupled with decomposition and flushing of organic materials have resulted in river beds with cleaner sediments containing less organic matter. Thus, existing localized areas providing habitat have been improved for the maintenance of a limited, yet diverse, population of warmwater fish within the inner harbor.

Within the outer harbor, the existing bottom sediments, although in some locations classified as heavily polluted, are known to be conducive to the successful propagation of diverse populations of warmwater fish and aquatic life. The Milwaukee Harbor estuary study concluded that further site-specific analyses could indicate that it would

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[4]*Barr Engineering,* Concept Design Documentation Report Kinnickinnic River, Wisconsin Milwaukee Estuary Area of Concern Sediment Removal, *prepared for U.S. Army Corps of Engineers Detroit District and Wisconsin Department of Natural Resources, April 2004.*

[5]*The U.S. Army Corps of Engineers and the Great Lakes National Program Office of the USEPA have conducted research at the Jones Island CDF to determine the feasibility of bioremediating dredged material contaminated with PAHs and PCBs. If contaminated dredged material can be cost-effectively cleaned to satisfy the requirements for beneficial use, it could allow the service life of the CDF to be extended by treating, removing, and beneficially using dredged material. Currently, this technology does not appear to be sufficiently developed to affect CDF capacity over the period of this plan update.*

[6]*Wisconsin Department of Natural Resources,* Milwaukee River Estuary Habitat Restoration Project Fact Sheet*, 2006.*

be desirable to dredge or otherwise modify selected small areas within the estuary in order to improve habitat for aquatic life. However, it is recommended that such limited dredging be considered only if site-specific evaluation or findings support such a need.

Conclusion Regarding Dredging Needs

In view of the above, it is recommended that dredging be limited primarily to the areas and depths noted on Map X-11e.

DREDGED MATERIAL DISPOSAL

The USCOE recommends providing an additional 20 years capacity for dredged material by raising the CDF dikes about eight feet and mounding the spoil pile within the facility. The SEWRPC Milwaukee Harbor estuary study recommended construction of an expansion to the existing CDF that would be located immediately north of the existing facility.[7] It is recommended that consideration be given to such a means of expanding the CDF in addition to the proposed approach put forth by the USCOE.

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[7] *During 1986, prior publication of the Milwaukee Harbor estuary study, the CDF was upgraded by reconstructing portions of the outer walls to provide for better filtering of the effluent leaving the facility.*

Map X-11e

RECOMMENDED DREDGING ELEMENT OF THE REGIONAL WATER QUALITY MANAGEMENT PLAN UPDATE

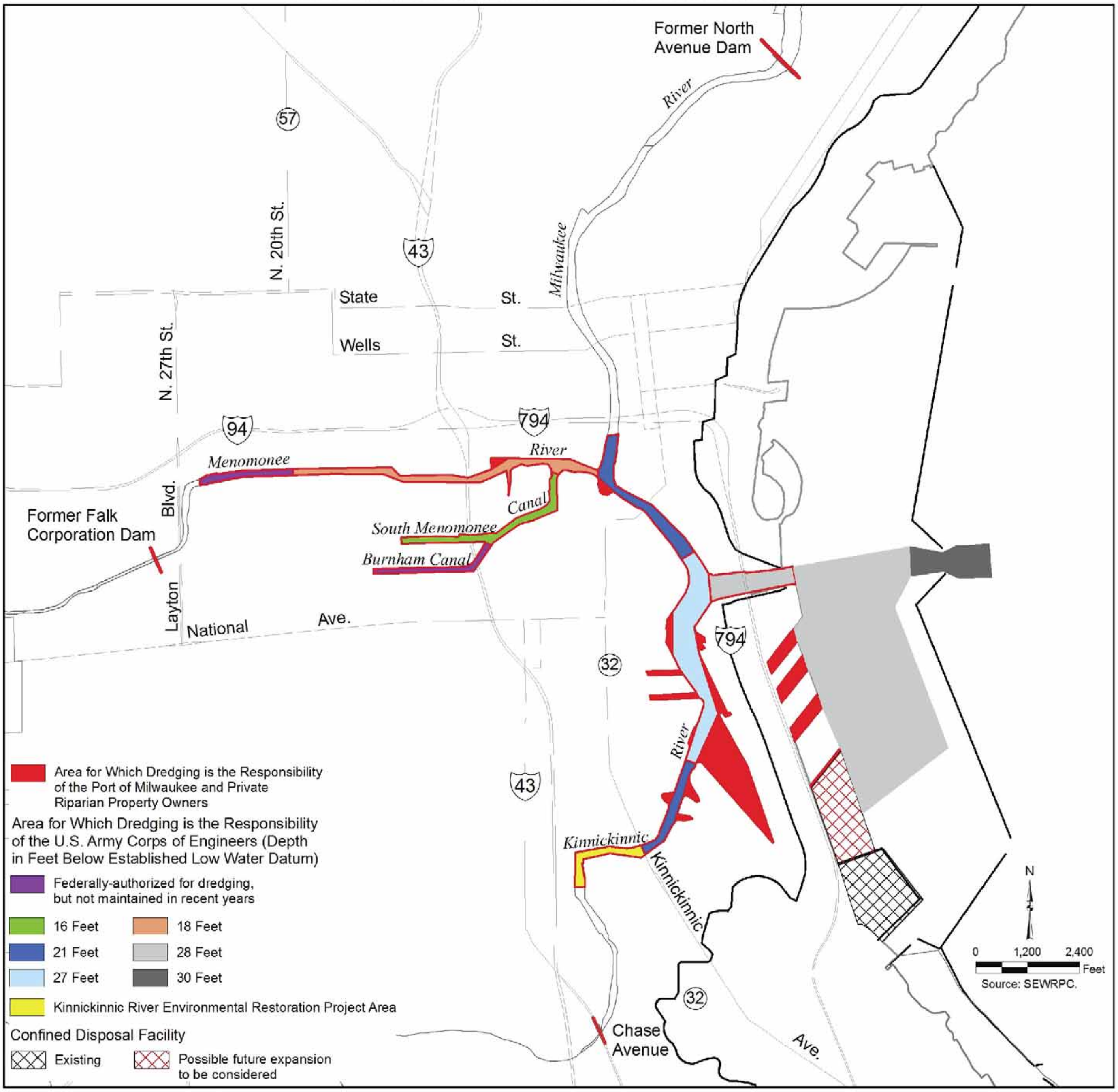

Exhibit D

Technical Report No. 39

WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE GREATER MILWAUKEE WATERSHEDS

Chapter V

SURFACE WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE KINNICKINNIC RIVER WATERSHED

[THIS SECTION IS TO BE INSERTED AT THE DESIGNATED AREA ON PAGE 81 OF CHAPTER V]

Wet-Weather and Dry-Weather Loads

It is important to distinguish between instream water quality during dry weather conditions and during wet weather conditions. Differences between wet-weather and dry-weather instream water quality reflect differences between the dominant sources and loadings of pollutants associated with each condition. Dry-weather instream water quality reflects the quality of groundwater discharge to the stream plus the continuous or intermittent discharge of various point sources, for example industrial cooling or process waters, and leakage or other unplanned dry-weather discharges from sanitary sewers or private process water systems. While instream water quality during wet weather conditions includes the above discharges, and in extreme instances discharges from separate and/or combined sanitary sewer overflows, the dominant influence, particularly during major rainfall or snowmelt runoff events, is likely to be the soluble or insoluble substances carried into streams by direct land surface runoff. That direct runoff moves from the land surface to the surface waters by overland routes, such as drainage swales, street and highway ditches, and gutters, or by underground storm sewer systems.

Daily average loads of six pollutants—total phosphorus, total suspended solids, fecal coliform bacteria, total nitrogen, biochemical oxygen demand, and copper, were estimated for both wet-weather and dry-weather conditions for one site along the Kinnickinnic River—S. 7th Street station (River Mile 2.80)—based upon flow and water quality data. A water quality sample was assumed to represent wet-weather conditions when daily mean flow was in the upper 20th percentile of the flow duration curve for the relevant flow gage. This includes flows that are high due to rainfall events, runoff from snowmelt, or a combination of rainfall and snowmelt.

The flow duration curve for the Kinnickinnic River at S. 11th Street in Milwaukee is shown in Figure V-36a. This stream flow gage began operation in October 1982. Prior to October 1982 flow data was collected from the Kinnickinnic River at a stream flow gage located at S. 7th Street. Figure V-36a includes data from both gages. To adjust for the fact that the stream flow gage at S. 11th Street is about 0.4 mile upstream from the stream flow gage at S. 7th Street, the data from the S. 11th Street gage were multiplied by the ratio of the drainage area above the S. 7th Street gage and the drainage area above the S. 11th Street gage. Water quality samples were considered to reflect wet-weather conditions when daily mean flow for the corresponding date equaled or exceeded 23.73 cubic feet per second (cfs). On dates when daily mean flow was less than this threshold, the corresponding water quality samples were considered to reflect dry-weather conditions. Daily average pollutant loads were estimated by appropriately combining daily average flow and pollutant ambient concentration.

Figure V-36b shows the daily average pollutant loads for total phosphorus, total suspended solids, fecal coliform bacteria, total nitrogen, and biochemical oxygen demand from the Kinnickinnic River at the S. 7th Street sampling station. In all cases, the estimated loads occurring during wet-weather periods were considerably higher than the estimated loads occurring during dry-weather periods. For the 1998 through 2001 baseline period, the mean estimated daily average wet-weather load of total phosphorus was about 159 pounds, which is almost 30 times the mean estimated daily average dry-weather load of about 5.4 pounds. For the baseline period, the mean estimated daily average wet-weather load of total suspended solids was about 301,400 pounds, over seven times the mean estimated daily average dry-weather load of about 40,730 pounds. For the baseline period, the mean estimated daily average wet-weather load of fecal coliform bacteria was about 60 trillion cells, over 50 times the mean estimated daily average dry-weather load of 1.14 trillion cells. For the baseline period, the mean estimated daily average wet-weather load of total nitrogen was 1,525 pounds, about 22 times the mean estimated daily average dry-weather load of 69 pounds. For the baseline period, the mean estimated daily average wet-weather load of BOD was about 4,280 pounds, about 26 times the mean estimated daily average dry-weather load of about 167 pounds. For the baseline period, the mean estimated daily average wet-weather load of copper was about 12 pounds, about 27 times the mean estimated daily average dry-weather load of about 0.45 pound.

Figure V-36b also shows the occurrence of individual wet-weather events during which the estimated daily average pollutant load was many times higher than typical wet-weather loads. The presence of these outliers indicates that individual wet-weather events can contribute a substantial fraction of the annual pollutant load to the stream. For example, Figure V-36b shows that the maximum estimated daily average wet-weather load of total suspended solids detected at the S. 7th Street station during the baseline period of 1998-2001 was about 2,039,000 pounds. Comparing this to Table V-18 shows that this single day's load represents about 38 percent of the estimated average annual load of total suspended solids in the entire watershed. Similarly, Figure V-36a shows that the maximum estimated daily average wet-weather load of total nitrogen detected during the baseline period of 1998- 2001 was about 15,550 pounds. Comparing this to Table V-20 shows that this single day's load represents about 21 percent of the estimated average annual load of total nitrogen in the entire watershed. While these two examples may represent extreme cases, they do indicate that a large fraction of the annual pollutant load to the watershed is contributed by a small number of wet-weather events.

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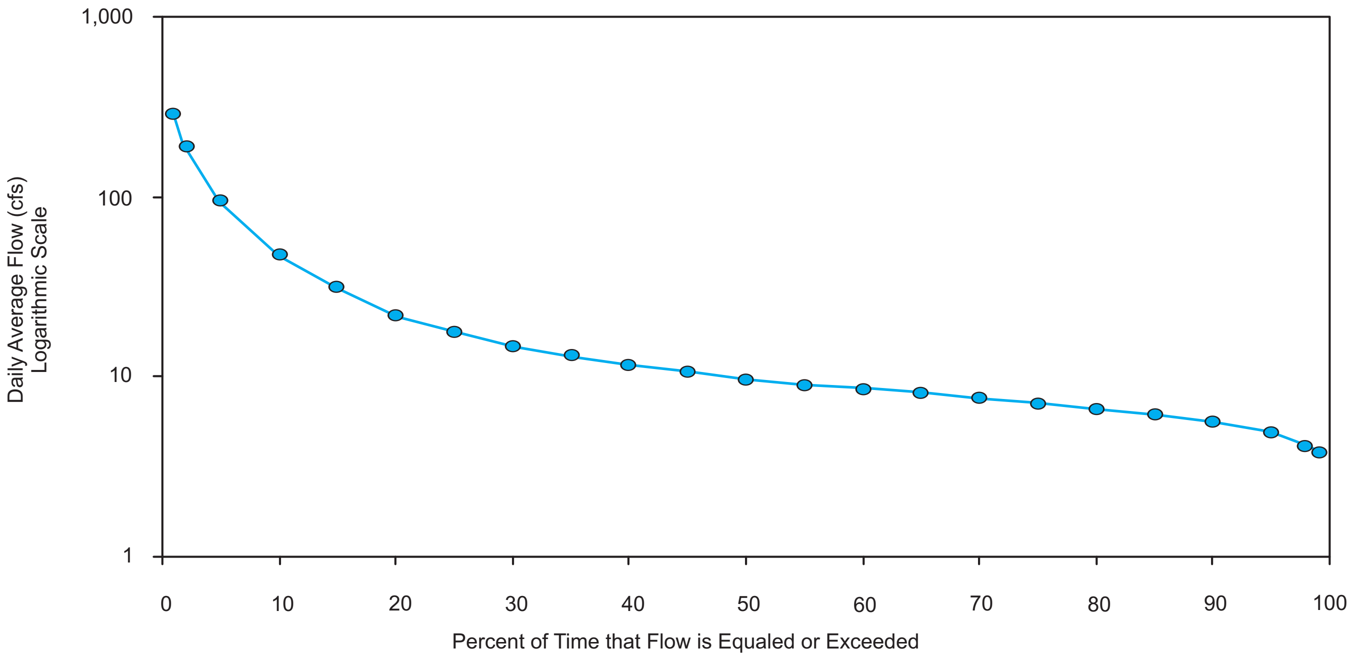
Figure V-36a

FLOW DURATION CURVE FOR USGS STREAM GAUGE ON THE KINNICKINNIC RIVER AT S. 11TH STREET (USGS GAUGE 04087159): 1976-2004

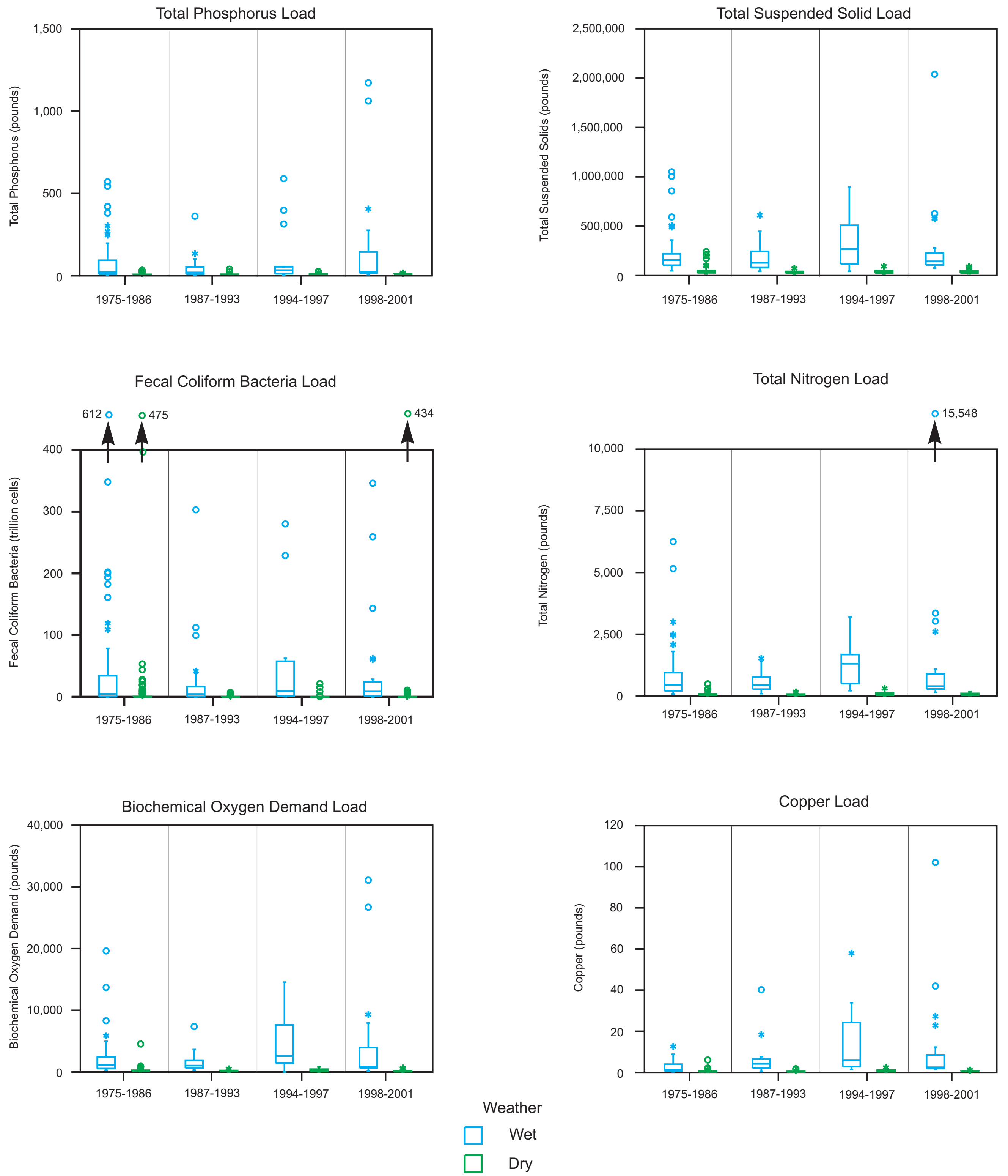


NOTE: The stream gauge at S. 11th Street came online in 1982. Data from 1976-1982 are from the stream gauge at S. 7th Street (USGS Gauge 04087160).

Source: U.S. Geological Survey and SEWRPC.

Figure V-36b

DAILY AVERAGE POLLUTION LOADS IN THE KINNICKINNIC RIVER AT S. 7TH STREET (RIVER MILE 3.2): 1975-2001



NOTE: See Figure V-4 for description of symbols.

Source U.S. Geological Survey, U.S. Environmental Protection Agency, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, and SEWRPC.

Exhibit E

Technical Report No. 39

WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE GREATER MILWAUKEE WATERSHEDS

Chapter VI

SURFACE WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE MENOMONEE RIVER WATERSHED

[THIS SECTION IS TO BE INSERTED AT THE DESIGNATED AREA ON PAGE 101 OF CHAPTER VI]

Wet-Weather and Dry-Weather Loads

It is important to distinguish between instream water quality during dry weather conditions and during wet weather conditions. Differences between wet-weather and dry-weather instream water quality reflect differences between the dominant sources and loadings of pollutants associated with each condition. Dry-weather instream water quality reflects the quality of groundwater discharge to the stream plus the continuous or intermittent discharge of various point sources, for example industrial cooling or process waters, and leakage or other unplanned dry-weather discharges from sanitary sewers or private process water systems. While instream water quality during wet weather conditions includes the above discharges, and in extreme instances discharges from separate and/or combined sanitary sewer overflows, the dominant influence, particularly during major rainfall or snowmelt runoff events, is likely to be the soluble or insoluble substances carried into streams by direct land surface runoff. That direct runoff moves from the land surface to the surface waters by overland routes, such as drainage swales, street and highway ditches, and gutters, or by underground storm sewer systems.

Daily average loads of six pollutants—total phosphorus, total suspended solids, fecal coliform bacteria, total nitrogen, biochemical oxygen demand, and copper, were estimated for both wet-weather and dry-weather conditions for one site along the Menomonee River—the 70th Street station (River Mile 8.0)—based upon flow and water quality data. A water quality sample was assumed to represent wet-weather conditions when daily mean flow was in the upper 20th percentile of the flow duration curve for the relevant flow gage. This includes flows that are high due to rainfall events, runoff from snowmelt, or a combination of rainfall and snowmelt. The flow duration curve for the Menomonee River at 70th Street in Wauwatosa is shown in Figure VI-36a. For this station, water quality samples were considered to reflect wet-weather conditions when daily mean flow for the corresponding date equaled or exceeded 125.38 cubic feet per second (cfs). On dates when daily mean flow was less than this threshold, the corresponding water quality samples were considered to reflect dry-weather conditions. Daily average pollutant loads were estimated by appropriately combining daily average flow and pollutant ambient concentration.

Figure VI-36b shows the daily average pollutant loads for total phosphorus, total suspended solids, fecal coliform bacteria, total nitrogen, biochemical oxygen demand, and copper from the Menomonee River at the 70th Street sampling station. In all cases, the estimated loads occurring during wet-weather periods were considerably higher than the estimated loads occurring during dry-weather periods. For the 1998 through 2001 baseline period, the mean estimated daily average wet-weather load of total phosphorus was about 964 pounds, which is about 44 times the mean estimated daily average dry-weather load of about 22 pounds. For the baseline period, the mean estimated daily average wet-weather load of total suspended solids was about 1,578,000 pounds, about nine times the mean estimated daily average dry-weather load of about 170,700 pounds. For the baseline period, the mean estimated daily average wet-weather load of fecal coliform bacteria was about 304 trillion cells, about 16 times the mean estimated daily average dry-weather load of 19 trillion cells. For the baseline period, the mean estimated daily average wet-weather load of total nitrogen was 9,003 pounds, about 26 times the mean estimated daily average dry-weather load of 342 pounds. For the baseline period, the mean estimated daily average wet-weather load of BOD was about 15,830 pounds, about 39 times the mean estimated daily average dry-weather load of about 408 pounds. For the baseline period, the mean estimated daily average wet-weather load of copper was about 66.6 pounds, almost 28 times the mean estimated daily average dry-weather load of about 2.4 pounds.

Figure VI-36b also shows the occurrence of individual wet-weather events during which the estimated daily average pollutant load was many times higher than typical wet-weather loads. The presence of these outliers indicates that individual wet-weather events can contribute a substantial fraction of the annual pollutant load to the stream. For example, Figure VI-36b shows that the maximum estimated daily average wet-weather load of total suspended solids detected at the 70th Street station during the baseline period of 1998-2001 was about 7,620,000 pounds. Comparing this to Table VI-27 shows that this single day's load represents about 42 percent of the estimated average annual load of total suspended solids in the entire watershed. Similarly, Figure VI-36b shows that the maximum estimated daily average wet-weather load of copper detected during the baseline period of 1998-2001 was about 539 pounds. Comparing this to Table VI-31 shows that this single day's load represents about 28 percent of estimated average annual load of copper in the entire watershed. While these two examples may represent extreme cases, they do indicate that a large fraction of the annual pollutant load to the watershed can be contributed by a small number of wet-weather events.

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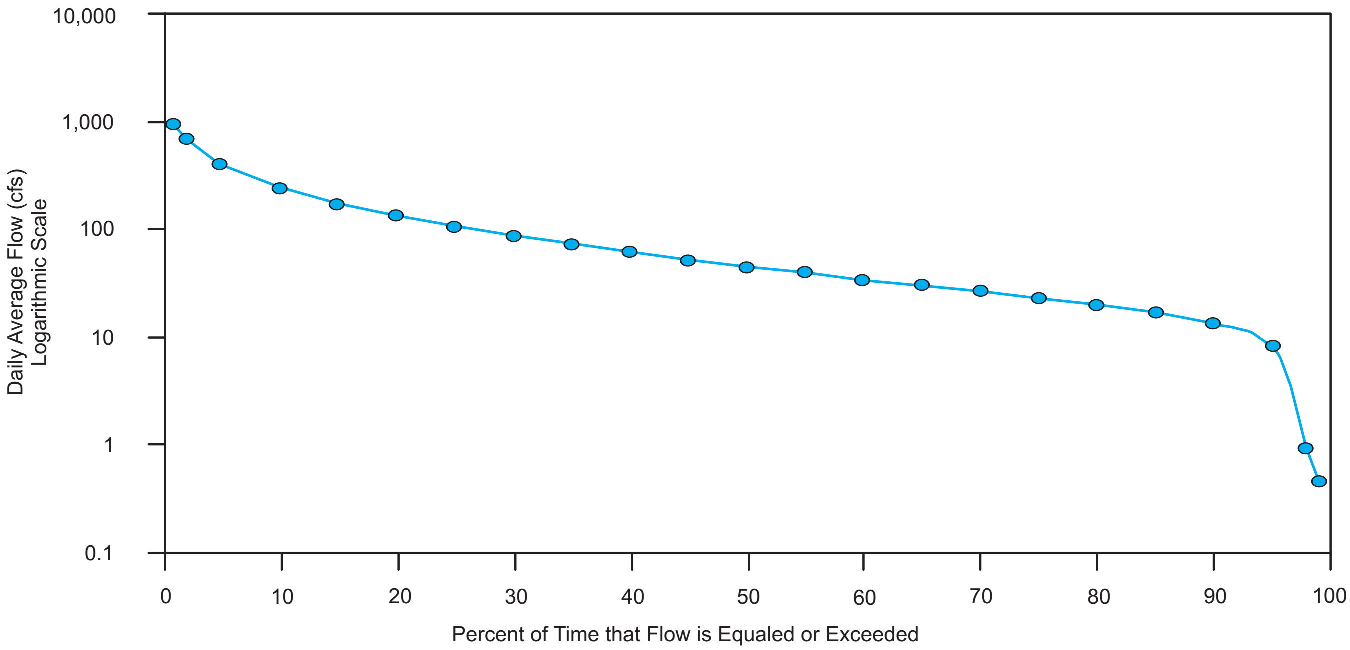
Figure VI-36a

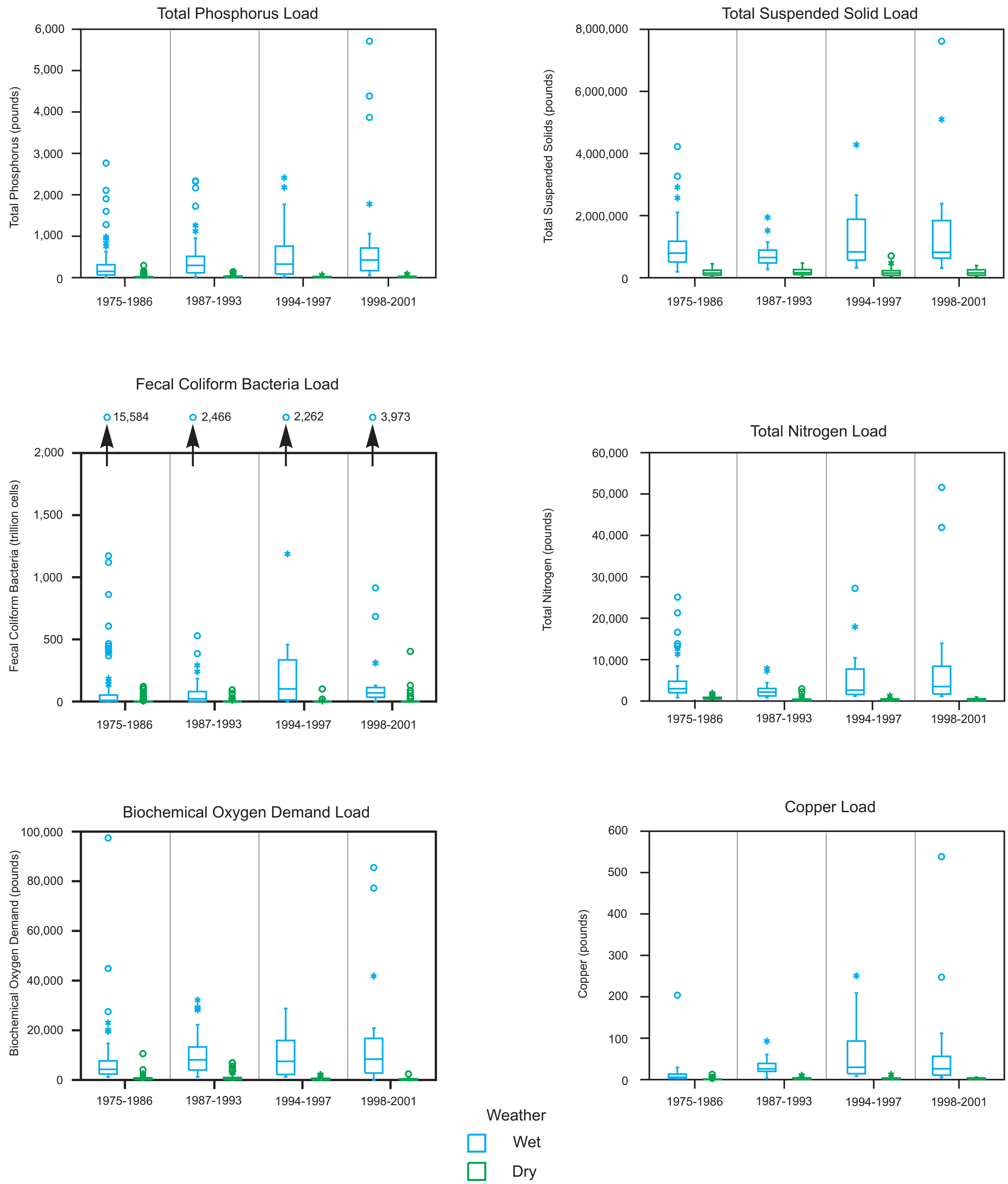
FLOW DURATION CURVE FOR USGS STREAM GAUGE ON THE MENOMONEE RIVER AT 70TH STREET (USGS GAUGE 04087120): 1961-2004



Source: U.S. Geological Survey and SEWRPC.

Figure VI-36b

DAILY AVERAGE POLLUTION LOADS IN THE MENOMONEE RIVER AT 70TH STREET (RIVER MILE 8.0): 1975-2001



NOTE: See Figure VI-3 for description of symbols.

Source U.S. Geological Survey, U.S. Environmental Protection Agency, Wisconsin Department of Natural Resources, Milwaukee Metropolitan Sewerage District, and SEWRPC.

Exhibit F

Technical Report No. 39

WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE GREATER MILWAUKEE WATERSHEDS

Chapter VI

SURFACE WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE MENOMONEE RIVER WATERSHED

[THIS PARAGRAPH SHOULD BE INSERTED AT THE END OF THE SUBSECTION ON BACTERIA, AFTER THE FIRST PARTIAL PARAGRAPH ON PAGE 14]

Honey Creek has a history of high concentrations of bacteria. The mean concentration of fecal coliform bacteria detected in samples from Honey Creek during the years 2001-2004 was 12,218 cells per 100 ml. Similarly, the mean concentration of *E. coli* detected in samples from Honey Creek during the years 2001-2004 was 17,427 cells per 100 ml. The mean concentration of fecal coliform bacteria exceeds both Wisconsin's water quality standard for full recreational use and the special variance standard that applies to Honey Creek. In order to identify potential sources of high bacteria concentrations, MMSD conducted an intensive monitoring survey of the Creek during July and August 2006.[1] Concentrations of fecal coliform bacteria and *E. coli* were monitored in the stream, in three storm sewer outfalls that discharge into the stream, and within selected storm sewers. In addition, samples from the stream and from three storm sewer outfalls were tested for the presence of strains of the bacterium *Bacteroides* specific to human fecal material. Several findings emerged from this study:

- Concentrations of fecal coliform bacteria in Honey Creek exceeded both Wisconsin's water quality standard for full recreational use and the special variance applicable to Honey Creek.

- Concentrations of fecal coliform bacteria and *E. coli* were also very high in the three monitored storm sewer outfalls discharging into Honey Creek. Throughout the investigation, the highest concentrations of fecal coliform bacteria and *E. coli* were detected in the storm sewer outfall at 79th Street and Mt. Vernon Avenue.

- Bacterial counts in the monitored storm sewer outfalls tended to be higher in samples collected during the morning and noon than in samples collected during the afternoon. This corresponds with times that higher flows are typically observed in sanitary sewer systems.

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[1]*Milwaukee Metropolitan Sewerage District,* Honey Creek Bacteria Investigation Survey, *July-August 2006.*

- Tests for human-specific *Bacteroides* showed positive results at all three instream sampling sites and all three monitored storm sewer outfalls, indicating sanitary sewage contamination.

- Concentrations of fecal coliform bacteria and *E. coli* increased at sampling stations in Honey Creek downstream from State Fair Park during and shortly after the run of the Wisconsin State Fair. In general, concentrations of fecal coliform bacteria and *E. coli* collected at the sampling stations downstream from the fair grounds were higher than concentrations collected at the sampling station upstream of the fair grounds.

- High in-pipe concentrations of fecal coliform bacteria and *E. coli* were detected in storm sewers in State Fair Park.

As a result of the Honey Creek survey, several actions have been taken. The City of Milwaukee has conducted dye and smoke testing of sanitary sewers and has identified, and is in the process of assessing and repairing, some cracked sewers. State Fair Park has increased its use of best management practices, including street sweeping and cleaning, and is conducting an infrastructure inventory to identify the locations of storm sewers within the park. In addition, the Fair Park was recently issued a WPDES stormwater discharge permit. MMSD continues to monitor Honey Creek for bacterial concentrations, including continuing examination of the stream and storm sewer outfalls for strains of *Bacteroides* specific to human fecal material.

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Exhibit G

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WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE GREATER MILWAUKEE WATERSHEDS

Chapter VIII

SURFACE WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE OAK CREEK WATERSHED

[THIS SECTION IS TO BE INSERTED AFTER THE THIRD PARAGRAPH ON PAGE 36 OF CHAPTER VIII AT THE END OF THE SUBSECTION TOXIC CONTAMINANTS IN SEDIMENT]

Sediment from Oak Creek Park Pond has also been sampled for the presence of toxic contaminants. Toxicants that have been sampled for include metals, PAHs, and PCBs. Sediment samples taken from Oak Creek Park Pond between 1997 and 2001 showed detectable concentrations of arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc (Table VIII-7a). Mean concentrations of copper, lead, nickel, and zinc in the samples were between the TECs and PECs, indicating that these toxicants are likely to be producing some level of toxic effects in benthic organisms.

Concentrations of PAHs in four sediment samples collected between 1997 and 2001 ranged between 18,150 μg PAH/kg sediment and 22,730 μg PAH/kg sediment with a mean value of 20,000 μg PAH/kg sediment. Total organic carbon data were available for three of these samples. Concentrations of total PCBs in three sediment samples collected in 2001 ranged between 42 micrograms PCB per kilogram sediment (μg PCB/kg sediment) and 230 μg PCB/kg sediment with a mean value of 118 μg PCB/kg sediment. Total organic carbon data were available for all of these samples.

The combined effects of several toxicants in the sediment of Oak Creek Park Pond were estimated using the methodology described in Chapter III of this report. For sediments in Oak Creek Park Pond, overall mean PEC-Q values range between 0.23 and 0.34. These values suggest that benthic organisms in Oak Creek Park Pond are experiencing incidences of toxicity ranging between about 21 and 27 percent.

Table VIII-7a

CONCENTRATIONS OF TOXIC METALS IN SEDIMENT SAMPLES FROM OAK CREEK PARK POND: 1997-2001[a]

Statistic	Metals							
	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc
Mean	4.0	0.34	36.8	44.0	68.2	0.074	25.8	180.0
Standard Deviation	4.9	0.40	8.6	6.3	24.9	0.010	4.6	26.0
Minimum	0.0	0.00	27.0	36.0	43.0	0.065	20.0	150.0
Maximum	10.0	0.80	48.0	50.0	96.0	0.083	30.0	210.0
Number of Samples	4	4	4	4	4	3	4	4
Date of Earliest Sample	1997	1997	1997	1997	1997	2001	1997	1997
Date of Latest Sample	2001	2001	2001	2001	2001	2001	2001	2001

[a]*All concentrations in mg/kg based on dry weight.*

Source: Wisconsin Department of Natural Resources.

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Exhibit H

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WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE GREATER MILWAUKEE WATERSHEDS

Chapter X

SURFACE WATER QUALITY CONDITIONS AND SOURCES OF POLLUTION IN THE MILWAUKEE HARBOR ESTUARY AND ADJACENT NEARSHORE LAKE MICHIGAN AREAS

[THIS MATERIAL SHOULD BE INSERTED AT THE END OF THE SUBSECTION TEMPERATURE IN THE SUBSECTION WATER QUALITY OF THE MILWAUKEE HARBOR ESTUARY]

Water temperatures in the estuary, outer harbor, and nearshore Lake Michigan areas were further examined to test for the presence of time-based trends related to sources other than the effect of air temperature on water temperatures. This was done through a two-step process. First, the relationships between monthly mean water temperatures at sampling sites and monthly mean air temperatures at General Mitchell International Airport were determined by performing linear regressions using air temperature as the independent variable and water temperature as the dependent variable. Second, in instances where statistically significant relationships between air temperature and water temperature were detected, the residuals from the air temperature-water temperature regressions were examined for the presence of time-based trends through linear regression of the residuals against time. In linear regression analysis, residuals consist of the deviations from the line fitted by the regression to the observed value (Figure X-8a). For any data point in a regression, the residual is the difference between the value of the dependent variable in the observed data and the value of the dependent variable predicted by the regression equation for the corresponding value of the independent variable. The residuals in a linear regression represent the variation in the data that is not accounted for by the relationship between the independent and dependent variables, including both variation due to other factors and random variation. The effect of this procedure is to remove the influence of air temperature from the data and allow for examination of the water temperature data for the presence of time-based trends that are not related to changes in air temperature. The detection of a statistically significant regression in the second step indicates the presence of a trend toward water temperatures changing over time that is due to some factor other than changes in air temperature. The use of this procedure allows for the detection of trends whose presence would otherwise be obscured by the variability related to changes in air temperature.

Table X-4a shows results of regression analysis for selected sampling stations in the estuary, outer harbor, and nearshore Lake Michigan areas. At all stations, there were strong relationships between monthly mean air temperature and monthly mean water temperature. At stations in the estuary and outer harbor, these relationships accounted for about 69 percent to 91 percent of the variation in the water temperature data. While the relationships between air and water temperature at stations in the nearshore Lake Michigan area are weaker, they still account for a substantial portion of the variation in the water temperature data. Statistically significant regressions were found between the residuals and time at several stations in the estuary and outer harbor. There was a distinct geographic pattern to where significant regressions were found. No significant time-based trends were found in the residuals at Kinnickinnic River station at S. 1st Street, the Menomonee River station at N. 25th Street, and the Milwaukee River station at Wells Street, all stations in upstream reaches of the estuary (Table X-4a). At one station in the upstream reaches of the estuary, the Milwaukee River station at Walnut Street, a statistically significant trend was detected toward the residuals decreasing over time. This indicates that, when the effects of air temperature are removed from the data, there is a trend toward water temperatures decreasing over time at this site. It is important to note that the magnitude of the decrease is small, less than 0.1 degree Celsius per year, and that this trend accounts for a small portion of the variation in the data. A different pattern was seen at stations in downstream reaches of the estuary. At these sites, statistically significant trends were detected toward the residuals increasing over time, indicating that when the effects of air temperature are removed from the data, there are trends toward water temperatures increasing over time. The strongest relationship, both in terms of the amount of variation accounted for and in terms of the magnitude of the increase, was detected at the Menomonee River station at Burnham Canal (Table X-4a). When the effects of air temperature are removed from the analysis, water temperatures at this site appear to be increasing at a rate of about 0.61 degrees Celsius per year. This station is within the influence of thermal discharges from several industrial dischargers, most notably the We Energies power plant. Increasing trends were detected at the other stations in the downstream reaches of the estuary. The rates of temperature increase, after accounting for the effects of air temperature, at these sites were less than the rate at the Burnham Canal stations, ranging from about 0.06 to 0.10 degrees Celsius per year. It is important to note that these stations are all downstream of the Burnham Canal station. Similar trends were detected at stations in the outer harbor. The rate of temperature increase, after accounting for the effects of air temperature, at these sites was about 0.04 degrees Celsius per year. These rates of increase are lower than the rates of increase observed at stations in the downstream portions of the estuary. No significant time-based trends were found in the residuals at stations in Lake Michigan outside of the outer harbor.

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Table X-4a

TRENDS IN WATER TEMPERATURE ADJUSTED FOR THE EFFECT OF AIR TEMPERATURE IN THE MILWAUKEE HARBOR ESTUARY, OUTER HARBOR, AND NEARSHORE LAKE MICHIGAN AREAS: 1975-2004

		Regression				
		Air Temperature versus Water Temperature		Residuals versus Time		
Sampling Station	Samples	Trend	R^2	Trend	R^2	Slope (ºC per year)
Estuary						
Kinnickinnic River at S. 1st Street	194	↑	0.89	0	- -	- -
Kinnickinnic River at Greenfield Avenue (extended)	170	↑	0.80	↑	0.27	0.065
Menomonee River at 25th Street	151	↑	0.86	0	- -	- -
Menomonee River at Burnham Canal	83	↑	0.69	↑	0.34	0.610
Menomonee River at S. 2nd Street	182	↑	0.85	↑	0.06	0.096
Milwaukee River at Walnut Street	216	↑	0.90	↓	0.04	-0.066
Milwaukee River at Wells Street	208	↑	0.91	0	- -	- -
Milwaukee River at Water Street	205	↑	0.81	↑	0.02	0.063
Milwaukee River at Union Pacific Railroad	179	↑	0.79	↑	0.05	0.087
Outer Harbor						
OH-01	210	↑	0.85	↑	0.02	0.044
OH-03	213	↑	0.84	↑	0.02	0.038
OH-07	212	↑	0.82	↑	0.02	0.043
Nearshore Lake Michigan Area						
NS-01	97	↑	0.38	0	- -	- -
NS-04	98	↑	0.60	0	- -	- -
NS-14	186	↑	0.68	0	- -	- -
SS-01	167	↑	0.59	0	- -	- -

Source: SEWRPC.

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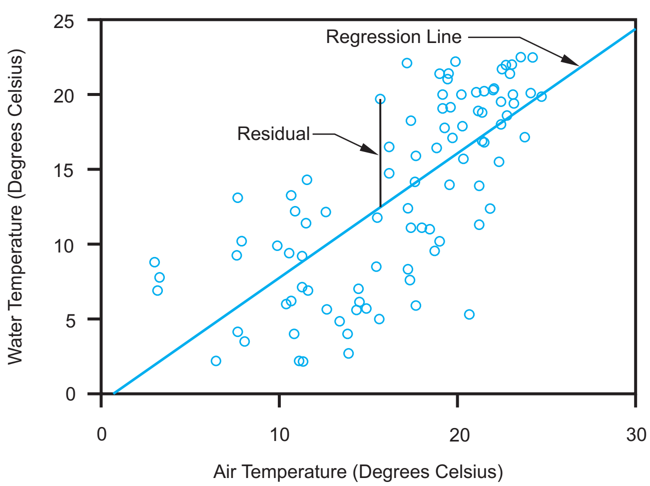
Figure X-8A

RESIDUALS IN LINEAR REGRESSION



Source: SEWRPC.

Exhibit I

Figure X-76

CONCENTRATIONS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN SEDIMENTS FROM THE MILWAUKEE HARBOR ESTUARY AND OUTER HARBOR: 1990-1991

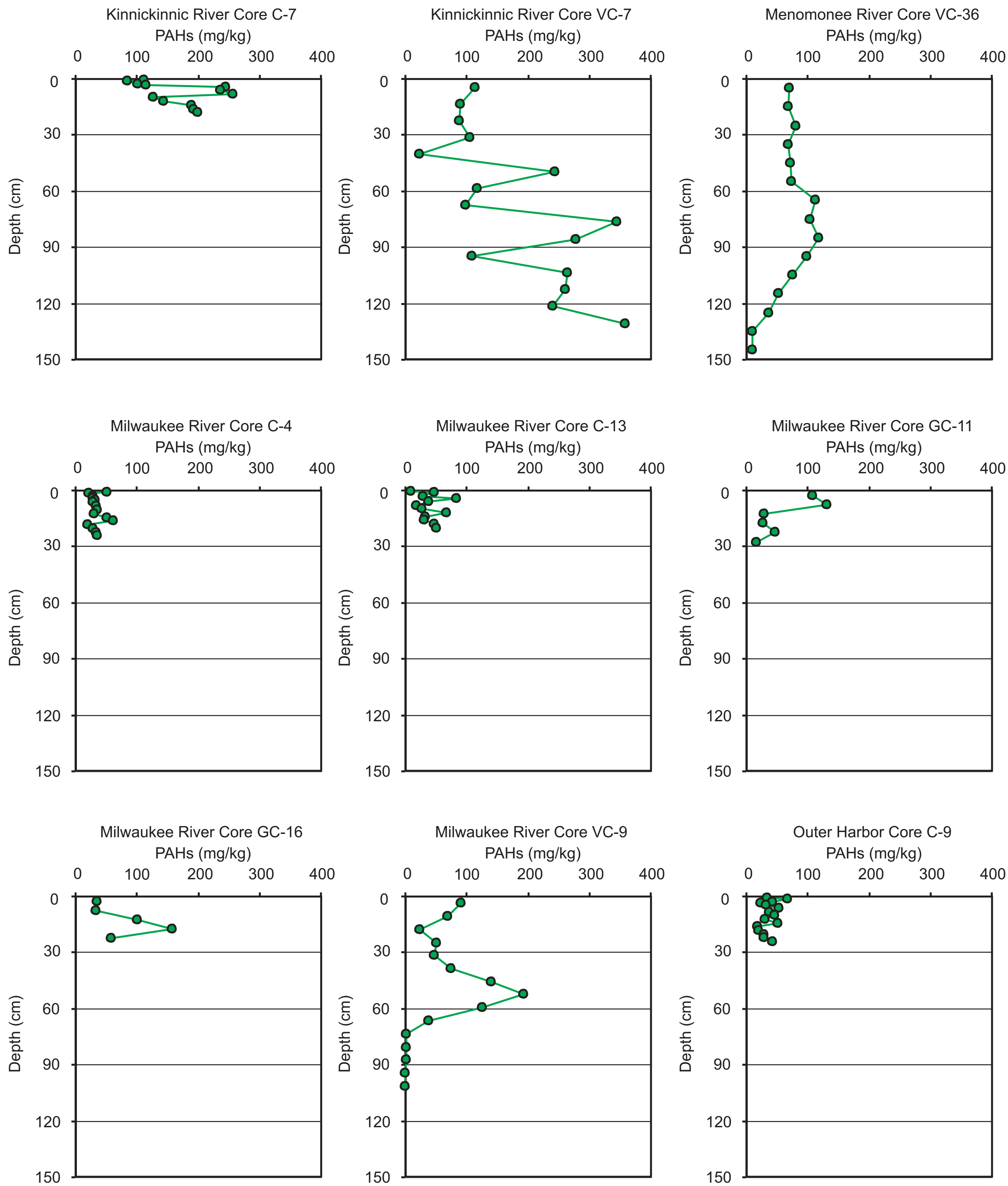
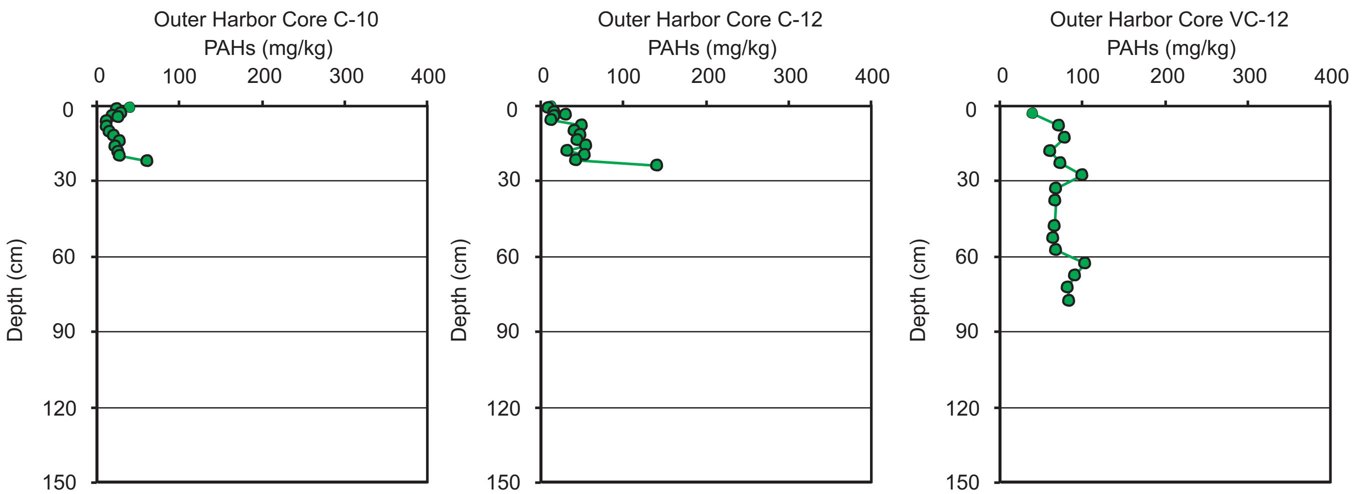


Figure X-76 (continued)



Source: University of Wisconsin-Milwaukee and SEWRPC.

Figure X-77

CONCENTRATIONS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN SEDIMENTS FROM THE KINNICKINNIC RIVER PORTION OF THE MILWAUKEE HARBOR ESTUARY: 2002

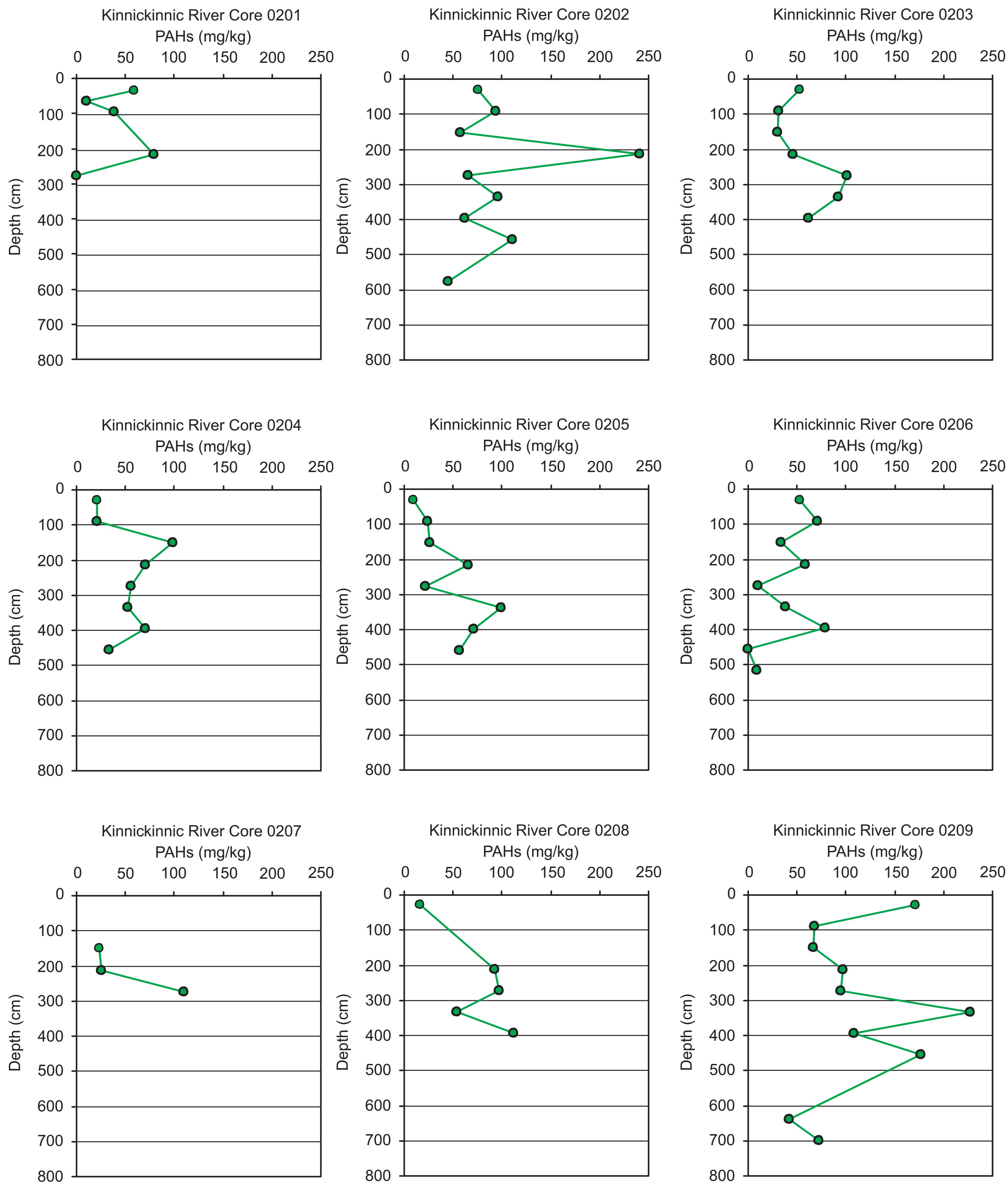
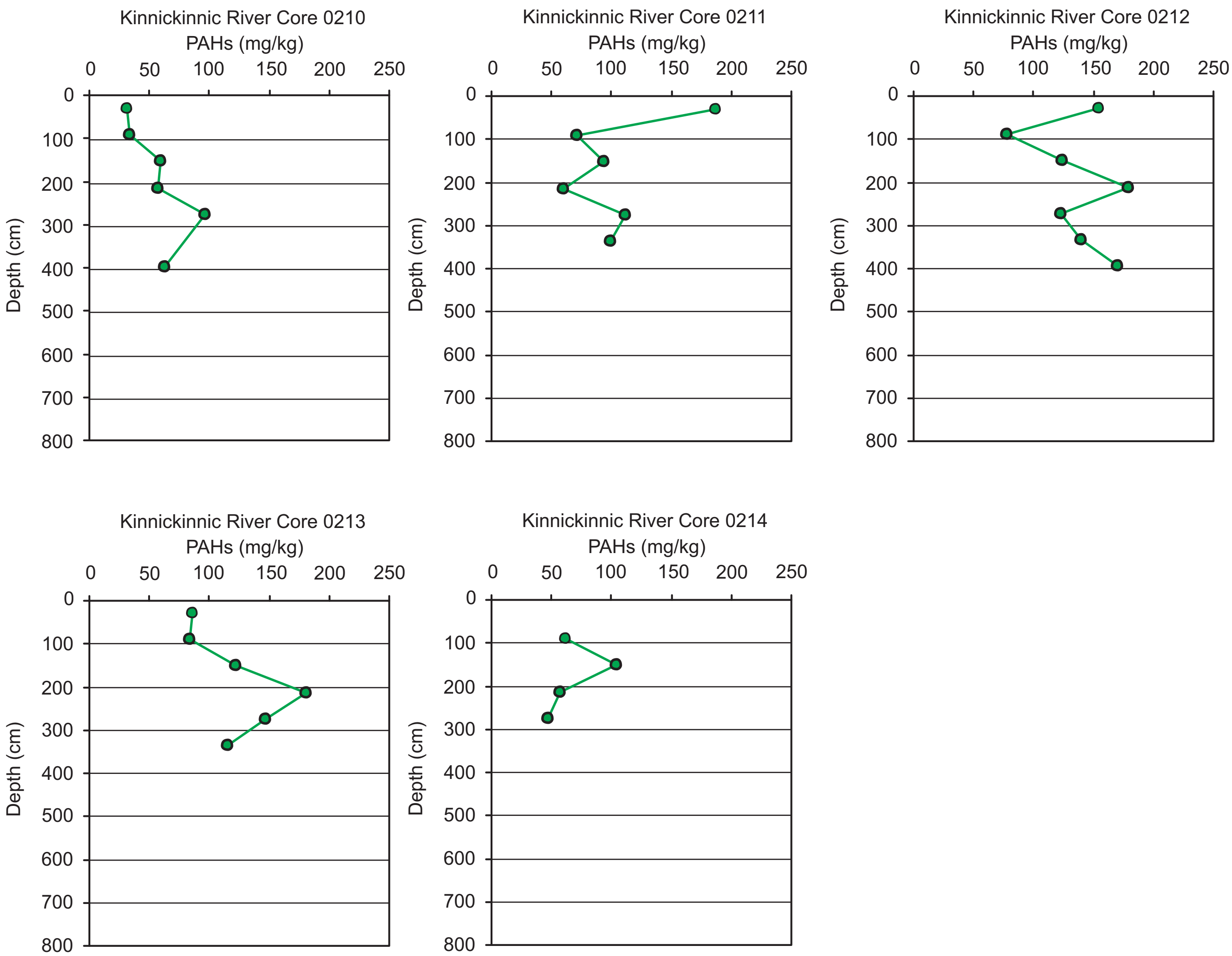


Figure X-77 (continued)



Source: Altech Environmental Services, Inc., Wisconsin Department of Natural Resources, and SEWRPC.

Figure X-78

CONCENTRATIONS OF POLYCHLORINATED BIPHENYLS (PCBS) IN SEDIMENTS FROM THE MILWAUKEE HARBOR ESTUARY AND OUTER HARBOR: 1990-1991

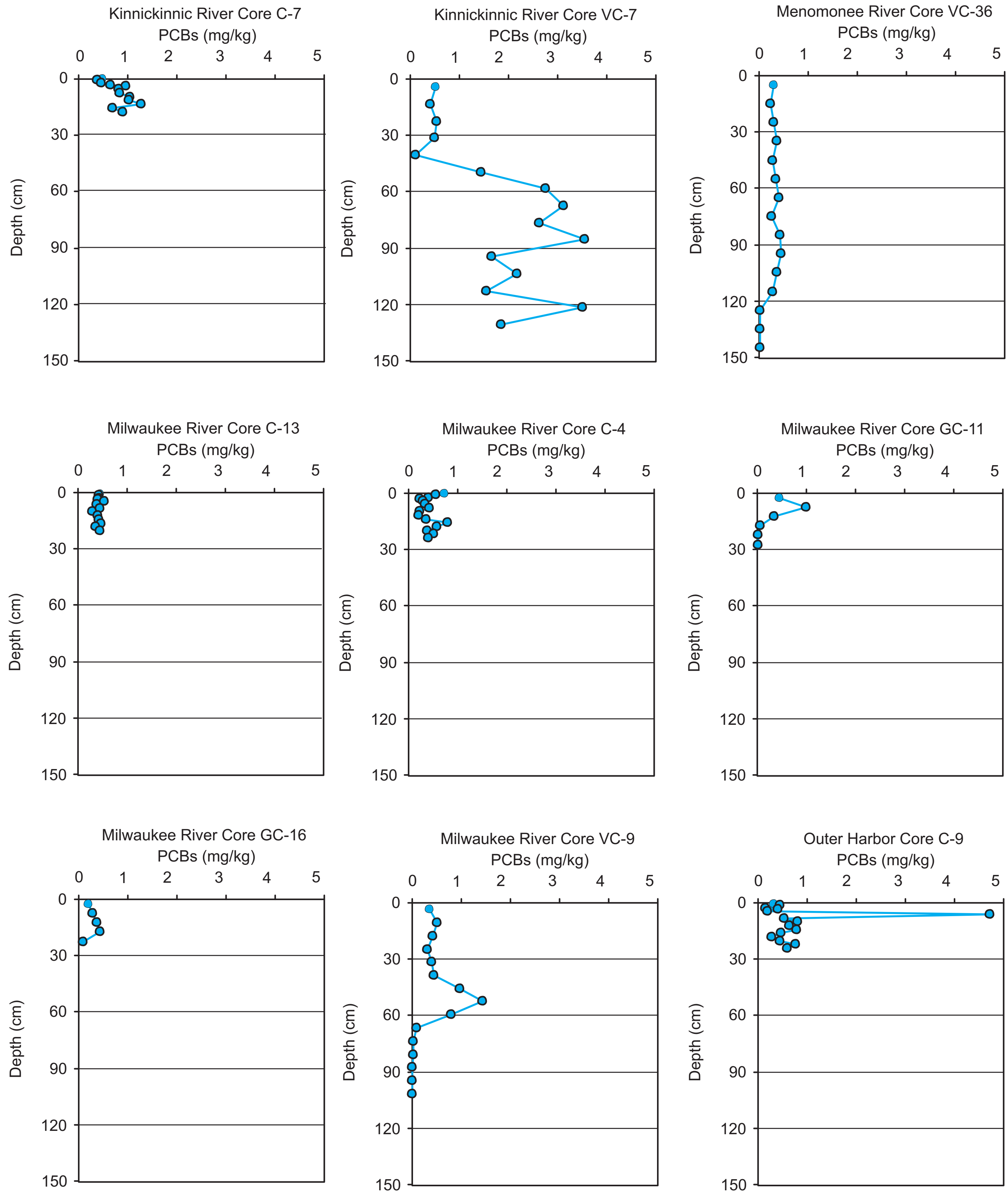
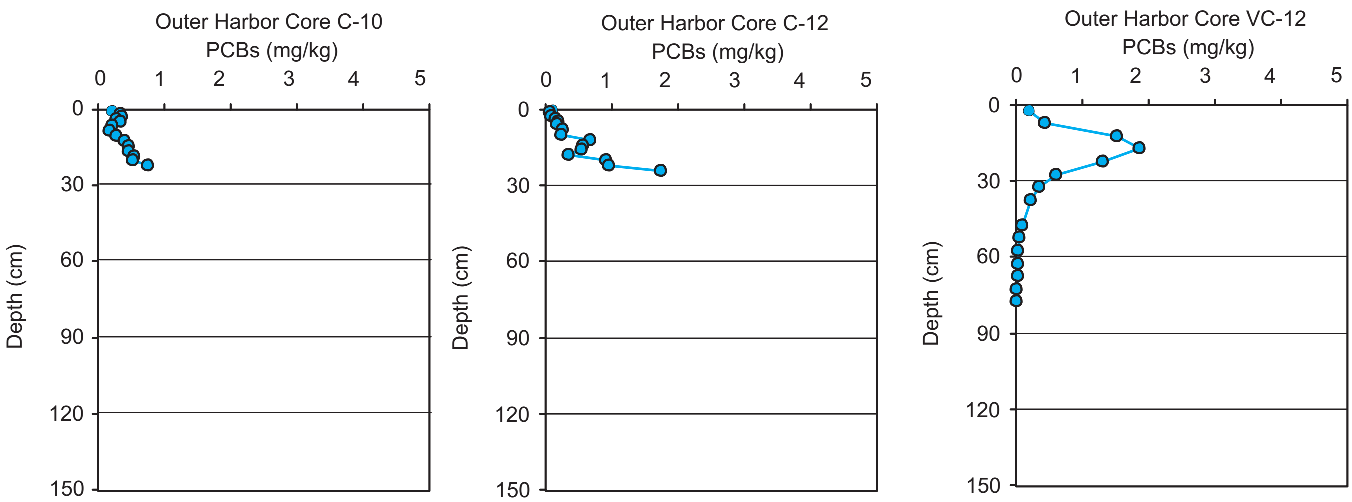


Figure X-78 (continued)



Source: University of Wisconsin-Milwaukee and SEWRPC.

Figure X-79

CONCENTRATIONS OF POLYCHLORINATED BIPHENYLS (PCBS) IN SEDIMENTS FROM THE KINNICKINNIC RIVER PORTION OF THE MILWAUKEE HARBOR ESTUARY: 2002

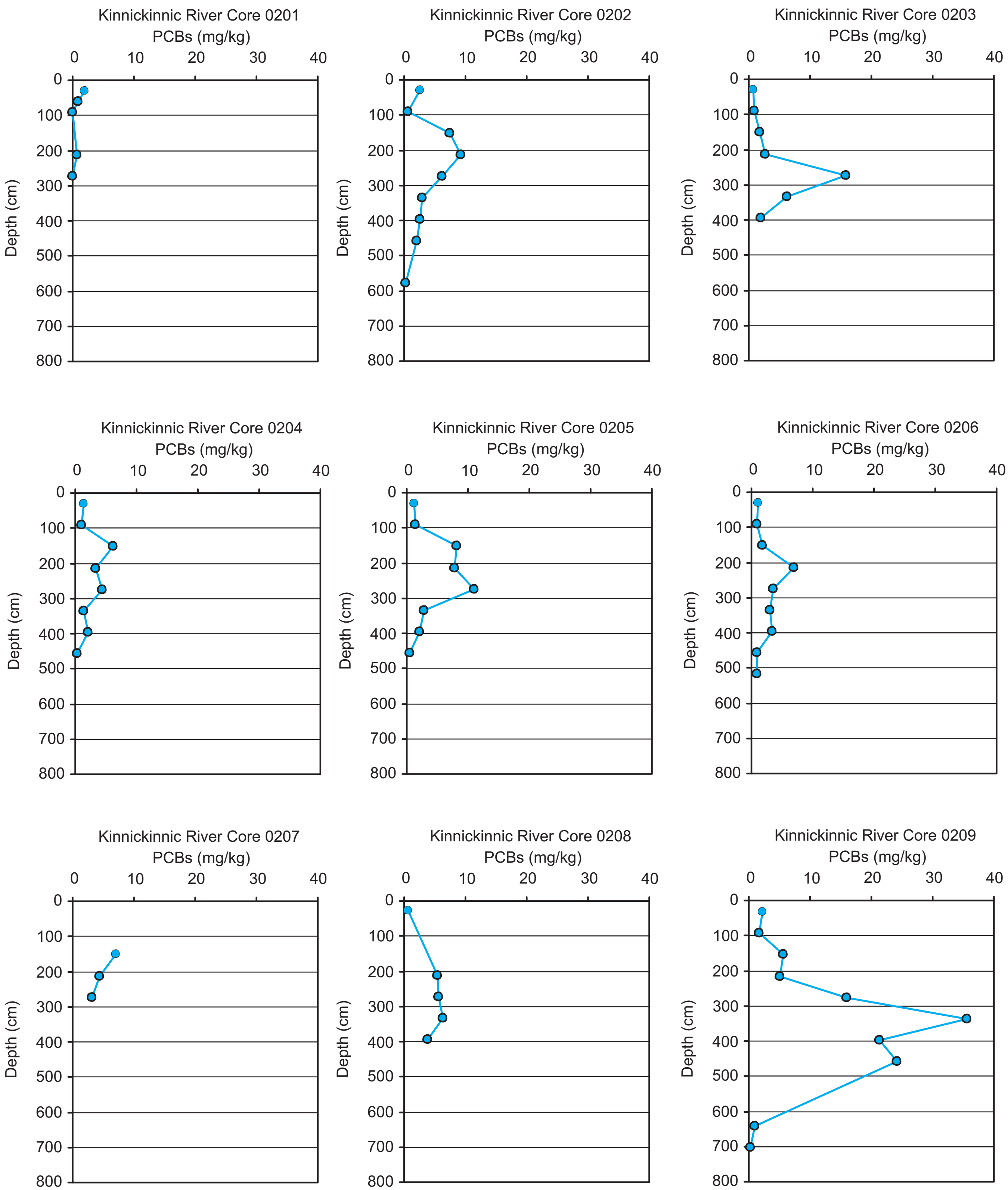
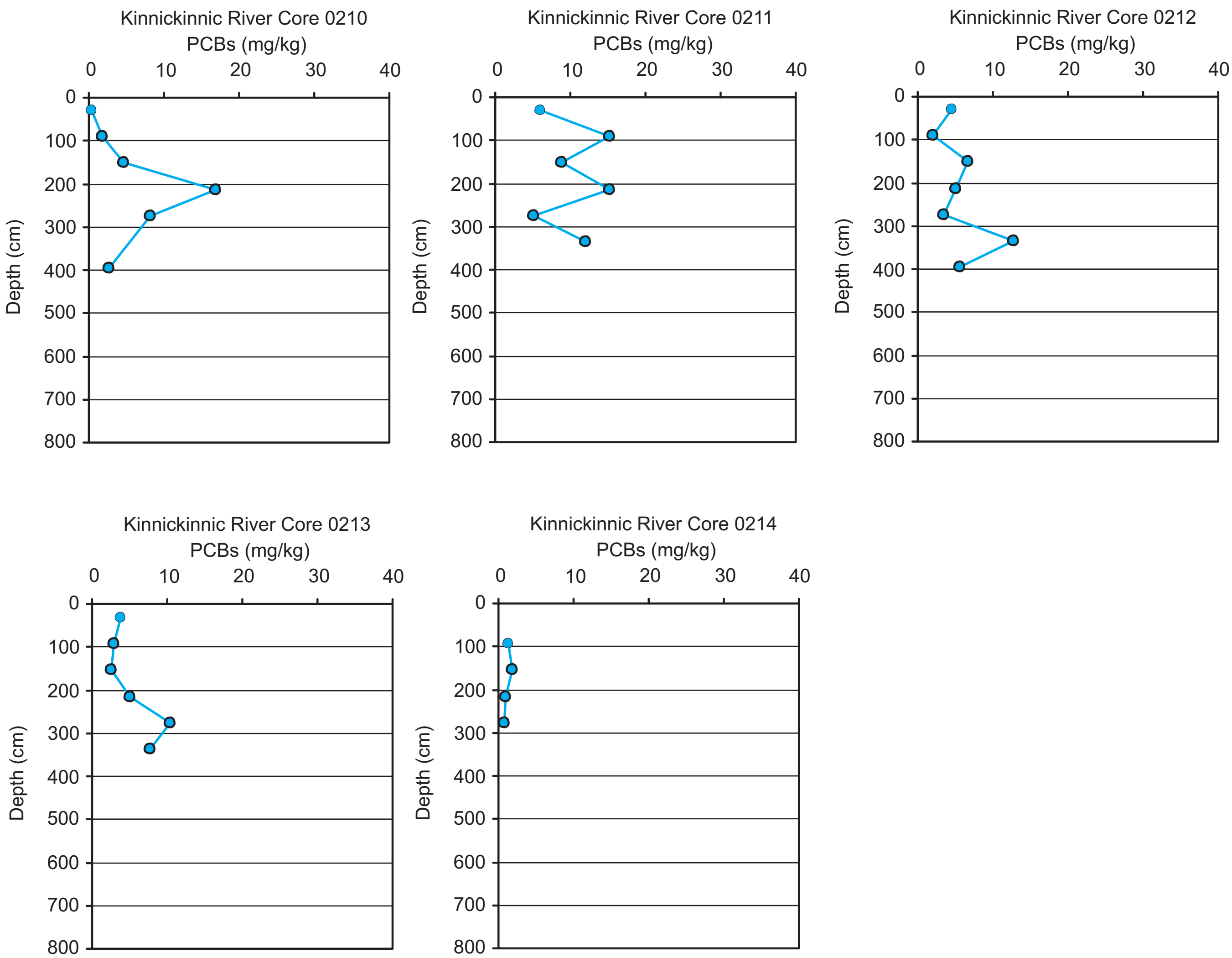


Figure X-79 (continued)

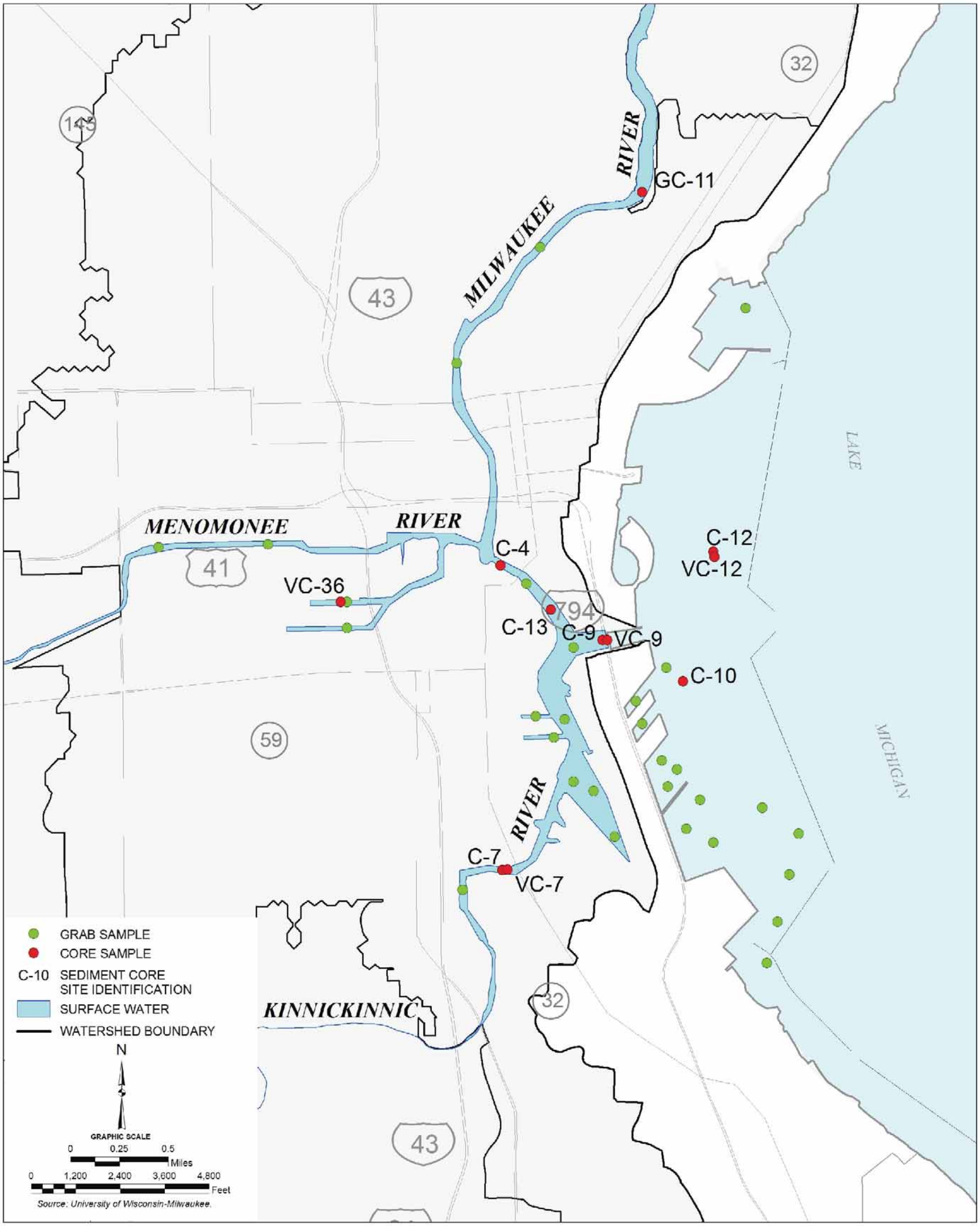


Source: Altech Environmental Services, Inc., Wisconsin Department of Natural Resources, and SEWRPC.

Exhibit J

Map X-11A

SEDIMENT SAMPLING LOCATIONS IN THE MILWAUKEE HARBOR ESTUARY AND OUTER HARBOR: 1990-1991



PRELIMINARY DRAFT

Map X-11B

SEDIMENT SAMPLING LOCATION IN THE KINNICKINNIC RIVER PORTION OF THE MILWAUKEE HARBOR ESTUARY: 2002

PRELIMINARY DRAFT

Exhibit K

Appendix B-3

CITIZEN MONITORING DATA FROM THE MILWAUKEE RIVER WATERSHED: 1998-2004

Subwatershed	Biochemical Oxygen Demand (mg/l)	Dissolved Oxygen (mg/l)	Fecal Coliform Bacteria (#/100 ml)	Nitrate (mg/l)	pH (stu)	Temperature (Celsius)	Total Phosphorus (mg/l)	Total Solids (mg/l)	Water Clarity (feet)
Middle Milwaukee River									
Samples	6	10	6	6	13	10	6	6	6
Mean	4.3	9.5	238	0.84	7.9	16.2	3.7	422	2.9
Minimum	1.0	5.0	20	0.05	6.7	4.0	0	300	2.0
Maximum	10.0	13.5	790	5.00	8.3	26.7	12.0	660	4.0
Standard Deviation	3.3	2.7	293	2.04	0.4	7.5	5.1	123	0.7
Range of number of samples per station per year	0-2	0-4	0-2	0-2	0-4	0-4	0-2	0.2	0-2
Upper Lower Milwaukee River									
Samples	7	- -	6	9	9	5	9	9	7
Mean	2.7	- -	929	0.20	8.0	11.3	1.25	248	2.9
Minimum	1.1	- -	33	0	7.5	7.0	0.01	45	2.0
Maximum	4.1	- -	2,700	1.79	8.5	13.0	4.00	490	5.0
Standard Deviation	1.1	- -	1012	0.60	0.3	2.5	1.45	170	1.0
Range of number of samples per station per year	0-2	- -	0-2	0-2	0-2	0-2	0-2	0-2	0-2
Lower Milwaukee River									
Samples	57	10	57	57	57	16	57	56	57
Mean	4.3	13.2	6,520	2.6	8.1	9.9	2.5	2.5	428
Minimum	0	4.4	0	0	6.3	5.0	0	1.2	0.05
Maximum	26	20.0	217,746	99.6	10.0	15.4	30.0	5.7	1,400
Standard Deviation	3.8	4.7	31,276	13.2	0.8	2.7	6.4	1.1	220
Range of number of samples per station per year	0-3	0-3	0-3	0-3	0-3	0-2	0-3	0-3	0-3
Cedar Creek									
Samples	24	11	25	25	26	10	25	24	22
Mean	4.0	10.4	103	2.0	7.9	8.9	0.9	269	4.6
Minimum	0.9	2.6	0	0	6.0	2.0	0	6	2.1
Maximum	9.9	17.0	520	9.8	10.1	12.0	7.0	514	6.5
Standard Deviation	2.4	4.3	129	2.5	0.8	2.8	1.9	167	1.3
Range of number of samples per station per year	0-3	0-2	0-5	0-3	0-3	0-2	0-3	0-3	0-3
Lower Cedar Creek									
Samples	3	1	3	3	3	- -	3	3	3
Mean	4.7	11.0	423	10.8	7.8	- -	0.2	263	4.1
Minimum	2.0	11.0	60	0.4	7.5	- -	0.2	38	3.3
Maximum	9.0	11.0	1,150	26.0	8.0	- -	0.2	440	5.0
Standard Deviation	3.8	- -	629	13.4	0.3	- -	0	205	0.9
Range of number of samples per station per year	0-1	0-1	0-1	0-1	0-1	- -	0-1	0-1	0-1

Appendix B-3 (continued)

Subwatershed	Biochemical Oxygen Demand (mg/l)	Dissolved Oxygen (mg/l)	Fecal Coliform Bacteria (#/100 ml)	Nitrate (mg/l)	pH (stu)	Temperature (Celsius)	Total Phosphorus (mg/l)	Total Solids (mg/l)	Water Clarity (feet)
North Branch Milwaukee River									
Samples	6	2	5	6	6	2	5	5	4
Mean	6.1	11.8	65	0.08	8.5	10.0	0.23	364	4.6
Minimum	2.5	10.0	8	0	8.5	9.0	0.10	50	3.0
Maximum	8.5	13.5	175	0.20	8.5	11.0	0.50	800	5.6
Standard Deviation	2.3	2.5	64	0.07	0	1.4	0.16	357	1.1
Range of number of samples per station per year	0-2	0-1	0-2	0-2	0-2	0-1	0-2	0-2	0-2
Quaas Creek									
Samples	2	12	3	3	15	16	3	3	2
Mean	4.5	10.9	73	0.07	7.7	12.6	3.4	450	3.2
Minimum	2.0	8.0	20	0	7.3	0	0	280	1.6
Maximum	7.0	14.0	160	0.20	8.2	21.1	10.0	620	4.8
Standard Deviation	3.5	1.8	76	0.12	0.3	6.5	5.8	170	2.3
Range of number of samples per station per year	0-2	0-6	0-2	0-2	0-5	0-6	0-2	0-2	0-2
Stony Creek									
Samples	- -	2	- -	- -	2	2	- -	- -	- -
Mean	- -	10.3	- -	- -	7.5	11.5	- -	- -	- -
Minimum	- -	9.0	- -	- -	7.5	9.9	- -	- -	- -
Maximum	- -	11.5	- -	- -	7.5	13.0	- -	- -	- -
Standard Deviation	- -	1.8	- -	- -	0	2.2	- -	- -	- -
Range of number of samples per station per year	- -	0-2	- -	- -	0-2	0-2	- -	- -	- -

Source: Riveredge Nature Center and the University of Wisconsin-Extension.

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