SUMMARY NOTES OF THE NOVEMBER 7, 2012, MEETING OF THE ROOT RIVER WATERSHED RESTORATION PLAN ADVISORY GROUP

INTRODUCTION

The November 7, 2012, meeting of the Root River Watershed Restoration Plan Advisory Group was convened at the Racine County Ives Grove Office Complex at 9:08 a.m. The meeting was called to order by Susan Greenfield, Executive Director of the Root-Pike Watershed Initiative Network (Root-Pike WIN). Attendance was taken by circulating a sign-in sheet.

In attendance at the meeting were the following individuals:

Susan Greenfield, Co-Chair	Executive Director, Root-Pike Watershed Initiative Network
Jeff Martinka, Co-Chair	Executive Director, Southeastern Wisconsin Watersheds Trust, Inc. (Sweet Water)
Michael G. Hahn, Secretary	Chief Environmental Engineer, Southeastern Wisconsin Regional Planning Commission
Joseph E. Boxhorn	Senior Planner, Southeastern Wisconsin Regional Planning Commission
Roger Chernik	Board of Directors President, River Bend Nature Center
Christopher Clayton	Urban River Restoration, River Alliance of Wisconsin
Craig D. Helker	Water Management Specialist, Wisconsin Department of Natural Resources
Alan V. Jasperson	Secretary-Treasurer, Racine County Board of Drainage Commissioners
Stevan M. Keith	Sustainability and Environmental Engineer, Milwaukee County Architecture, Engineering, and Environmental Services Division
Laura L. Kletti	Principal Engineer, Southeastern Wisconsin Regional Planning Commission
Christopher Magruder	Community Environmental Liaison, Milwaukee Metropolitan Sewerage District
Michael Marek	Land Management Advisor, Milwaukee Area Land Conservancy
Monte G. Osterman	Supervisor, Racine County Board of Supervisors
Aaron W. Owens	Planner, Southeastern Wisconsin Regional Planning Commission
Ronald Romeis	Assistant City Engineer, City of Franklin
Brian Russart	Natural Areas Coordinator, Milwaukee County Parks/University of Wisconsin-Extension
Chad Sampson	County Conservationist, Racine County
Melissa H. Warner	Commissioner, Village of Caledonia Storm Water Utility District
Sarah Wright	Research Assistant II, City of Racine Health Department
Andrew D. Yencha	Natural Resources Educator, University of Wisconsin-Extension

<u>Guests</u>

Matthew T. Magruder	Systems Data Technician, Milwaukee Metropolitan Sewerage District
Breanne L. McDonald	Project Manager, Milwaukee Metropolitan Sewerage District

Ms. Greenfield welcomed the attendees to the meeting and thanked them for their participation. She noted that the draft chapters to be reviewed were sent to the Group by electronic mail. She noted that there were attendees who were not at the previous meeting and asked the Advisory Group members to introduce themselves and state which organizations they represent.

REVIEW OF SUMMARY NOTES FROM SEPTEMBER 5, 2012, MEETING OF THE ROOT RIVER WATERSHED RESTORATION PLAN ADVISORY GROUP

At Ms. Greenfield's request Mr. Hahn addressed the summary notes from the September 5, 2012, meeting of the Advisory Group. He said that because there were no issues raised within the notes that would require further consideration by the Group, he would not do a detailed review, but would respond to any questions or comments from the Group. No questions or comments were offered on the summary notes, and they were approved by consensus of the Advisory Group.

REVIEW OF PARTIAL PRELIMINARY DRAFT CHAPTER IV, "CHARACTERIZATION OF THE WATERSHED," OF SEWRPC COMMUNITY ASSISTANCE PLANNING REPORT NO. 316 (CAPR NO. 316), "*A RESTORATION PLAN FOR THE ROOT RIVER WATERSHED*"

At Ms. Greenfield's request, Mr. Hahn began the review of the second partial preliminary draft of Chapter IV, "Characterization of the Watershed." He indicated that the portion of the chapter being reviewed includes material to be inserted into sections that were reviewed at the September 5, 2012, Advisory Group meeting, as well as material that follows the previously reviewed material. Subsection headings have been added to these summary notes to aid in their review.

Soils

Mr. Hahn noted that Map IV-14 which shows Federal and State soil classifications for agricultural uses was revised since the last Advisory Group meeting and will be distributed to the Group electronically with the summary notes. Ms. Greenfield asked what determines the prime agriculture designation. Mr. Boxhorn responded that the prime agriculture classification is related to soil types, slopes, and flooding. Ms. Greenfield asked whether the definition of prime agriculture land included contiguous areas as a factor and Mr. Boxhorn indicated that it did not.

Water Resources

Mr. Hahn stated that research has determined that water quality- and habitat-related changes occur in streams when the amount of connected impervious area in the contributing watershed rises above 8 percent. He noted that storm sewers and drain tiles often bypass the buffer along the stream, reducing the effectiveness of the buffer. Mr. Jasperson asked whether water filtering through soil before entering agricultural drainage tiles removes pollutants from the water. Mr. Hahn responded that some particulate contaminants may be removed by passage of water through the soil, but dissolved constituents would generally move through with no treatment benefit. Mr. Sampson commented that Racine County is investigating the use of buffers that are located downstream of the locations at which agricultural tiles discharge to a stream. He explained that this practice is being pursued by the Natural Resources Conservation Service (NRCS) in Iowa. Mr. Hahn stated that SEWRPC staff will investigate this further.

[Secretary's Note: Following the meeting, Mr. Sampson provided additional information on this practice. NRCS is building pilot projects that divert a portion of the drain tile flow laterally along the edge of the stream buffer into the shallow groundwater layer with the goal of removing nitrate. A diverter box is installed a short distance upstream of the existing tile outlet and new drain tile are installed, extending from the diverter box parallel to the stream A brochure from NRCS that explains the practice is attached herein as Exhibit A. Mr. Sampson indicated that Racine County has asked the NRCS to consider the County for future pilot projects. This subject will be addressed in Chapter V "Targets and Alternatives."]

Mr. Hahn stated that the research show that relatively low levels of connected impervious surface can cause changes in stream characteristics. He noted that degradation of fisheries and stream biotic communities occur at a threshold of approximately 10 percent connected impervious area. Mr. Marek asked if the effects on streams of increased imperviousness were reflected in changes to water temperature or other water quality parameters. Mr. Hahn replied that changes to water temperature and other water quality parameters could result from increased watershed imperviousness, and he noted that flashiness in flows could also be a result.

Mr. Chernik asked whether the relationship between temperature increase and connected impervious is linear. Mr. Hahn responded that location of the connected impervious surface relative to the stream is very important, and that the relationship between increases in imperviousness and temperature is most likely not linear.

Mr. Hahn noted the amount of urban land use in the Root River watershed increased from 24 percent in 1970 to 33 percent in 2000. Ms. Wright asked whether this involved conversion of agricultural land to urban land. Mr. Hahn replied that it did. He added that the land use inventories in this chapter will be updated to 2010 conditions when 2010 land use data for the watershed becomes available.

Mr. Hahn distributed copies of a SEWRPC publication, "Managing the Water's Edge, Making Natural Connections," to the Group. He explained that this publication summarizes much of the research results related to riparian buffers and noted that it will be included in the plan report as Appendix B.

[Secretary's Note: This publication is attached herein as Exhibit B.]

At Mr. Hahn's request, Mr. Owens reviewed the subsection on riparian corridor considerations. He explained that the analysis of buffers conducted for this plan builds from the analysis conducted as part of the 2007 SEWRPC regional water quality management plan update for the greater Milwaukee watersheds (RWQMPU), and that it results in delineation of the areal extent of the existing riparian buffers. He indicated that the Root River watershed was divided into 23 separate stream reach areas. He discussed the relationship between these stream reach areas and the water quality assessment areas presented earlier in Chapter IV.

[Secretary's Note: A revised version of Table IV-7B-2 is attached herein as Exhibit C. The revised table indicates the water quality assessment areas that are associated with each stream reaches.]

Mr. Owens noted that Figure IV-6B shows that the percentage of reach area in the mainstem reaches that is riparian buffer generally increases from upstream to downstream until Reach 23, which contains much of the City of Racine and the smallest percentage of riparian buffer in the watershed. Mr. C. Magruder commented that storm sewers in the Milwaukee County parkway sections often bypass the buffers and discharge directly to streams, reducing the effectiveness of the buffers. Mr. Hahn indicated that a description of that situation will be added to the Chapter IV text. Mr. Hahn added that as repairs were made to sewer outfalls, there may be an opportunity to reconfigure them to take advantage of the riparian buffers. He stated that this opportunity will be considered further in Chapter V "Targets and Alternatives". Ms. Greenfield noted that there are opportunities to treat more water on the landscape via best management practices in addition to the riparian buffers. Mr. Hahn indicated that such a treatment train approach can be very effective, but it is much easier to do in new development than as a retrofit to existing development.

[Secretary's Note: The following sentence was added after the seventh sentence in the first full paragraph on page 10:

"This benefit of the parkway system is tempered by the fact that many storm sewer outfalls passing through parkway lands discharge directly to the streams of the watershed, completely, or partially, bypassing the riparian corridor."]

Mr. Owens stated that Figure IV-6C shows riparian buffer areas on tributaries to the Root River. He noted that the 2010 color digital orthophotographs indicate the presence of more grassed waterways than are shown in the 2005 orthophotographs. He added that this is a positive trend. Mr. C. Magruder noted that in 2005 many farmers plowed right up to the waterway. Mr. Sampson indicated that many farmers have observed what others have done and want to emulate it. He added that his office has assisted in installing buffers and grassed waterways along streams. He also noted that there is currently no Federal farm bill, and as a result, the installation of conservation practices in Racine County is on hold. Mr. Sampson stated that he will provide SEWRPC staff with the specific areas in existing conservation practices in Racine County.

[Secretary's Note: The Commission staff sent an inquiry to Mr. Sampson via electronic mail for details on conservation projects related to riparian buffers. As of the date of these summary notes, staff is awaiting a response.]

Mr. Romeis indicated that the City of Franklin has a "no touch" zone within 75 feet on of the ordinary high water mark (OHWM) on navigable streams that applies to both sides of the stream. He noted this means that whatever exists in that 150 foot zone remains. He added that this is enforced through the City's zoning ordinance and that variances under the ordinance are considered. Mr. Owens pointed out that 75 feet on each side is the minimum buffer width recommended for good water quality and healthy ecosystems. Mr. Marek suggested that a performance-based standard would provide more flexibility for redevelopment than a dimensional standard such as a minimum 75-foot width. Mr. Romeis responded that performance-based standards are difficult to enforce, while the dimensional zone is measureable and more readily enforceable. Ms. Greenfield said that the Pike River restoration in Mount Pleasant included installation of a buffer wider than 500 feet. She added that it was recently discovered that the buffer is being used by a fox snake.

Mr. Owens described the additional analyses that will be conducted to evaluate the state of riparian buffers in the Root River watershed. He said that after the 2010 land use data become available, the SEWRPC staff plans to evaluate existing buffer areas in relation to the 75-foot minimum buffer width for water quality protection and healthy aquatic ecosystems, the 400 foot minimum core habitat width for wildlife protection, and the 900 foot optimal core habitat width for wildlife protection. He added that buffer areas will be overlain with groundwater recharge areas that were delineated as part of the regional water supply plan. Mr. Romeis requested a digital copy of the slides presented showing groundwater recharge areas in the City of Franklin. Mr. Owens stated that, in order to achieve greater resolution of individual reaches, the final plan will probably include oversize maps of the buffer analysis. Mr. Hahn noted that the environmental corridors included in Map IV-17 will also be included in the buffer analysis.

[Secretary's Note: Digital copies of the slides requested by Mr. Romeis were sent to him via electronic mail on November 9, 2012.]

At Mr. Hahn's request, Mr. Boxhorn reviewed the section on groundwater resources. He noted that the maps for this section were included in the materials for the September 5, 2012, Advisory Group meeting. He said Map IV-15 shows that most of the Root River watershed has moderate recharge potential. He added that northern portions of the watershed have low recharge potential. Mr. Yencha asked whether the low recharge is a result of impervious surface in this area. Mr. Boxhorn replied that while the two concepts are correlated, other factors such as land slopes and soil types also contribute to the low recharge potential.

Surface Water Quality

Mr. Boxhorn reviewed the section on surface water quality in the Root River watershed. He noted that information on additional water quality constituents in streams and on water quality data from lakes and ponds will be presented at a future meeting.

Mr. Boxhorn stated that the water quality analyses include data going back to 1964. He noted that data from the period 1964 to1974 were not included in the analyses in the RWQMPU. He indicated that the time periods evaluated in the surface water quality analyses are consistent with those used in the RWQMPU. He explained that Map IV-21 shows the sampling sites and noted that there is a good density of water quality monitoring sites in the Root River watershed, owing especially to efforts by MMSD and the City of Racine Health Department. Mr.

Boxhorn noted that water quality monitoring sites along streams were mapped to the nearest 0.1 mile along the length of the stream. He added that when two or more sites mapped to the same location, the data from these sites were combined and the sites were treated as a single sampling station for analytical purposes.

Mr. Boxhorn reviewed box plot concepts and noted that Figure IV-7 summarizes the information that is shown in a box plot.

[Secretary's Note: Figure IV-7 was revised to be specific to the Root River watershed. A copy of the revised figure is included herein as Exhibit D.]

Bacteria

Mr. Boxhorn reviewed the subsection on bacterial indicators of safety for human contact. He noted that both fecal coliform bacteria and *E. coli* are used as indicators of fecal contamination. He added that these two indicators are not directly comparable to one another. Mr. C. Magruder suggested adding the numerical values of the standards to the graphs that show bacteria concentrations. He also suggested adding a line to the graphs to indicate the location of the Milwaukee County/Racine County line. Mr. Boxhorn replied that these would be added.

[Secretary's Note: The numerical values for the applicable bacterial standards were added to the graphs in Figures IV-8 through IV-13. A vertical line indicating the location of the Milwaukee-Racine County line was added the graphs in Figures IV-8 through IV-27.]

Ms. Greenfield noted that it appears that the City of Racine tests for *E. coli* but does not test for fecal coliform bacteria. She asked whether there should be a change in which indicator is sampled by some of the monitoring agencies. Mr. Boxhorn replied that the ideal situation would be for all of the monitoring agencies to sample the same indicator; however, they would need to agree to this. He added that an impact of changing the indicator that is monitored is that there may not be historical data with which to compare sampling results. Mr. C. Magruder noted that MMSD collects both *E. coli* and fecal bacteria at some locations. Ms. Greenfield asked whether the plan will make recommendations for water quality monitoring. Mr. Boxhorn indicated that the plan will address this. Mr. Helker said that the Wisconsin Department of Natural Resources (WDNR) may shift to using *E. coli* for their standards. Mr. C. Magruder indicated MMSD may be shifting to *E. coli* as well for evaluation purposes.

Mr. Boxhorn reviewed Figure IV-9 in detail. He explained that *E. coli* concentrations near the Root River mouth may be lower than those upstream because of dilution from Lake Michigan water mixing with River water. He noted that the high variability in *E. coli* concentrations at sites in the City of Racine is not the result of combined sewer overflows, because the City separated its sanitary and storm sewers in the 1980s.

Mr. C. Magruder commented that Figure IV-9 shows a high concentration outlier at river mile 1.9 (RM 1.9). Ms. Wright responded that this may have been the result of an illicit discharge at Island Park. She added that this discharge has been fixed.

[Secretary's Note: The following sentences were added before the fourth sentence from the end of the paragraph beginning on page 19 and continuing onto page 20:

"The high maximum concentrations and high variability detected at this sampling station may have been the result of an illicit discharge near this site. The City of Racine has indicated that the discharge has been remedied."]

Mr. Boxhorn noted that *E. coli* concentrations in the City of Racine are quite variable, which suggests that high concentrations are related to storm events. Mr. Romeis asked if the levels in Figure IV-9 have been correlated with particular rain events. Mr. Boxhorn responded that both the rain gage and monitoring gage data make this correlation difficult because grab sample monitoring generally follows a regular schedule so it is often not conducted during or just after storms. Ms. Greenfield asked what would be indicated if the *E. coli* data were less variable. Mr. Boxhorn said that more consistent *E. coli* levels typically mean a direct connection to the sanitary sewer system. Mr. Chernik asked if the *E. coli* data indicate any variation over time. Mr. Boxhorn answered that the period of record of *E. coli* data set is not long enough and the data are too variable to allow us to discern any trends over time.

Mr. Boxhorn reviewed bacteria data from tributary streams shown in Figures IV-10 through IV-12. He noted that there was not as much data on the tributaries as on the Root River mainstem. He mentioned that along the East and West Branches of the Root River Canal, fecal coliform bacteria and *E. coli* concentrations generally decrease from upstream to downstream. He explained that this may be related to the presence of wastewater treatment plant (WWTP) discharges the upstream ends of these tributaries. Ms. Greenfield asked whether this decrease in bacteria concentrations is due to dilution. Mr. Boxhorn responded that dilution, settling, die-off, and consumption are the most likely causes of the reduction in downstream bacterial levels.

Mr. Boxhorn next reviewed the distributions of *E. coli* concentrations downstream of WWTPs on the East and West Branches of the Root River Canal as shown in Figure IV-13. He explained that these treatment plants are not required to disinfect their effluent before discharging it. He noted that the data show that the effect of the discharge on *E. coli* concentrations is mostly local and that the discharges appear to have little effect on the concentrations downstream. Ms. Greenfield asked if consuming fish caught downstream of the WWTPs is a problem. Mr. Boxhorn responded this was unclear but noted there probably are not any fish species that are likely to be eaten in these waters. Ms. Wright noted that the Racine County Health Department plans to do additional sampling on the canals next year after 72 hours without rain to eliminate bacteria sources other than the WWTPs. Mr. C. Magruder pointed out that human pathogens will not die off at the same rate as bacteria. Mr. Helker said that the water use objectives for the Root River canals are based on historical classifications and may change, but the applicable Administrative Rules are not likely to change anytime soon. Ms. Greenfield asked about the extent of the limited aquatic life use sections in the Root River Canals. Mr. Boxhorn responded that the East Branch Root River Canal is classified as limited aquatic life from its headwaters to STH 20 and that the West Branch Root River Canal is classified as limited aquatic life from its headwaters to CTH C. Ms. Warner commented that if the WWTPs on the canals were required to disinfect there would be minimal to no difference in *E. coli* farther downstream from the plants.

Mr. Marek asked whether the *E. coli* trends downstream of the WWTPs that are shown in Figure IV-13 correlate with drops in dissolved oxygen. Mr. Boxhorn answered that the *E. coli* trends suggest that there may be large swings in concentration at times, but the lack of continuous monitoring data makes this difficult to assess. Mr. Helker noted that the Root River Canals are listed as impaired on the State's 303(d) list for low concentrations of dissolved oxygen.

Mr. Boxhorn said that the data indicate there is a bacteria problem in the Root River watershed. Ms. Wright said that over the next two months the City of Racine Health Department plans to test for the presence of human-related *Bacteroides* at locations where *E.* coli concentrations greater than 1,000 cells per 100 ml have been observed.

Temperature

Mr. Boxhorn reviewed the subsection on stream water temperature. He stated that Figure IV-14 shows that water temperatures at the Grange Avenue station (RM 36.7) are unusually cold compared to those immediately upstream and downstream. Ms. Warner noted that the Grange Avenue site is a possible return flow location for the Waukesha Water Utility for Lake Michigan water. Mr. C. Magruder indicated two tributaries that drain Southridge Mall in the Village of Greendale enter the River near this location. He continued that runoff from parking lot snow piles at the Mall may be a factor affecting water temperatures this location. Mr. Helker also indicated that high temperatures at this location in summer may also be affected by the Mall pavement.

[Secretary's Note: Following the meeting, the Commission staff reviewed temperature data from the Grange Avenue sampling station. The last paragraph on page 22, continuing into page 23 was revised to read (text in bold is included here to indicated language change or added onto the text. Text will not be bold in the report):

“Figure IV-14 shows water temperatures at sampling stations at sites along the mainstem of the Root River. During the period 2005-2012, water temperatures in the mainstem of the Root River varied between -1.0 degrees Celsius (ºC) and 31.9ºC, with a median water temperature of 18ºC. Median water temperatures at individual sampling stations ranged from 13.8ºC at the station at Grange Avenue (RM 36.7) to 20.0ºC at the downstream station at Azarian Marina (RM 0.7). The median at the Grange Avenue station is unusually low and reflects the fact that this station in the only one in the upper reaches of the Root River for which sampling was conducted during the winter. When winter samples were removed from the analysis, the median water temperature at this station was 15.2ºC. This is still two to three degrees lower than the median water temperatures at other nearby sampling stations. **Examination of the data showed that water temperatures at this station during the early spring were colder than those at adjacent stations. During late spring, summer, and fall, the water temperatures at this station were similar to those observed at adjacent stations. This suggests that the lower average water temperatures at this site may result from meltwater from snow piles in the parking lots of the nearby Southridge Mall. It should be noted that a**n inventory of recent and historical information on springs in Wisconsin conducted in 2007 by the Wisconsin Wildlife Federation does not show any springs at or upstream from this site**.**[51]”**]**

Mr. Boxhorn noted that at some sampling stations on the East and West Branches of the Root River Canal there were not many samples for temperature. He also noted that it appears that discharges from the Union Grove WWTP on the West Branch Root River Canal are smoothing out water temperature variations.

Dissolved Oxygen
Mr. Boxhorn reviewed the subsection on dissolved oxygen. He explained that the hatching in Figures IV-17 through IV-19 indicated concentrations with poor water quality either because the concentration is below the applicable standard or because it is high enough for dissolved oxygen to be supersaturated at 14 degrees Celsius. He noted that Figure IV-18 shows that there appears to be a hot spot for supersaturation at RM 0.3 on the West Branch Root River Canal. He explained that this could result from dense aquatic plant growth at the site. Ms. Wright confirmed that there is excessive aquatic plant growth at this location.

Chloride
Mr. Boxhorn reviewed the subsection on chloride. He noted that MMSD does not sample in winter, thus the chloride data shown in Figures IV-23 and IV-24 are from March through November. He added that the data do not show instream concentrations during periods of road deicing applications. He indicated statistical analyses found that the concentrations shown in Figure IV-23 for the period 2005-2012 do not differ from those for the period 1998-2004. He said that this suggests that the efforts of the City of Franklin (RM 36.7-23.8) and other public works departments to more scientifically conduct road anti-icing and deicing appear to be having an effect in stemming the increase in chloride concentrations in streams, even as urban development increased over that period.

Mr. Boxhorn stated that the higher 2012 chloride concentrations for the mainstem Root River station at National Avenue (RM 41.0) as shown in Figure IV-23A are a result of the recent drought. He explained that since flows during this period were dominated by baseflow, the data indicate high chloride concentrations in groundwater. Mr. Yencha inquired about chloride concentrations in Lake Michigan. Mr. Boxhorn responded that the Lake Michigan concentrations are documented in SEWRPC Technical Report No. 39, *Water Quality Conditions and Sources of Pollution in the Greater Milwaukee Watersheds*, November 2007. Mr. C. Magruder added that overall concentrations in the Lake are low, but they show an upward trend with time. Mr. Yencha then asked whether promoting infiltration practices could add chloride to the aquifer, potentially increasing chloride levels in the Root River. Mr. Boxhorn responded that the number and location of any infiltration practices to be installed will need to be considered carefully. He added that it is unknown how long it takes to purge the shallow aquifer of chlorides. Mr. Yencha then asked about how water softeners may affect chloride levels. Mr. C. Magruder noted that most of Milwaukee County is supplied with Lake Michigan water and the use of water softeners in this County is minimal. Ms. Warner then asked about the potential Waukesha return flow and prevalence of water softeners in Waukesha County. Mr. Yencha commented that it would be appropriate for water softener use to cease if Lake Michigan water becomes the water source for Waukesha area residents. Ms. Warner commented that that may not be the case, and that an incentive for residents to discontinue their softener use may be required.

Ms. Greenfield asked if the City of Racine is testing for chlorides. Ms. Wright responded that they currently do not test for chlorides but do test for conductivity which can be used as a surrogate for chlorides. Mr. Boxhorn noted that the test for chlorides is very expensive.

Specific Conductance
Mr. Boxhorn reviewed the subsection on specific conductance. He indicated that specific conductance can be used as a surrogate test for chlorides, but additional work is needed to develop the chloride-specific conductance relationship for the Root River. Mr. Marek asked if the upstream spike in chloride concentrations that was observed is reflected in the specific conductance data. Mr. Boxhorn responded that higher specific conductance levels can be observed in the sampling stations in West Allis, Greenfield, and Greendale with lower and less variable levels occurring downstream in the City of Franklin.

Horlick Dam
Mr. Hahn distributed Figures IV-E through IV-N and Appendix C, both of which relate to section on Horlick dam. At Mr. Hahn's request, Ms. Kletti reviewed the section on Horlick dam.

Ms. Kletti briefly reviewed the history of the dam, noting that the official 1964 Public Service Commission denial of the 1962 abandonment request could not be found in either the County's records or the WDNR archives. She stated that it would be helpful to have this document, and asked the Group members to contact her if they knew where to obtain it.

> [Secretary's Note: Subsequent to the meeting, WDNR staff located a copy of the Public Service Commission's denial of the 1964 abandonment request. A copy of this decision is attached herein as Exhibit E.]

Ms. Kletti summarized the inspections and repairs for the dam. She indicated that these are listed in Appendix C. She noted that historical photos and plans appear to indicate that the 1975 dam was constructed immediately downstream of the deteriorated original dam. Mr. Osterman inquired whether there were any environmental or economic assessments completed before the 1975 reconstruction. Ms. Kletti responded that an assessment was completed by the WDNR prior to reconstruction. She added that a copy of this memorandum would be distributed to the Advisory Group.

> [Secretary's Note: The September 12, 1975 WDNR Intra-Department Memorandum regarding a Water and Shoreland Management Investigation for the dam was distributed via electronic mail to the Advisory Group and will be included as an Appendix to the watershed restoration plan. A copy of this memorandum is attached herein as Exhibit F.]

Mr. Boxhorn postulated that lamprey migration may have been a concern during the Horlick dam abandonment and reconstruction discussions. Ms. Greenfield commented that invasive species moving upstream is currently a concern and that American Rivers has been in discussions with the WDNR regarding invasive species migration and dam modifications or removal. In response to a question from Mr. Hahn, she stated that she will follow up with American Rivers to see whether documentation of their discussions regarding dams and invasive species is available. Mr. Helker noted that there a differing opinions within the WDNR on invasive species movement.

[Secretary's Note: The Commission staff sent an inquiry to Ms. Greenfield via electronic mail for documentation the discussions between American Rivers and WDNR. As of the date of these summary notes, staff is awaiting a response.]

Ms. Kletti reviewed the Horlick dam impoundment sediment quantity calculations that are shown on Map IV-B and in Figures IV-J and IV-K. She indicated that sediment volume calculations were done for the area 5,300 feet upstream from the dam, to approximately River Bend Nature Center. Ms. Kletti pointed out that the field data appear to indicate the presence of a rock shelf for the first 1,000 feet upstream of the dam. She noted that this shelf may be 178 years of debris buildup behind the dam or there may be a low flow channel cut that was missed during the field work. She indicated that it would be helpful to determine what this area consists of if possible. Mr. Osterman indicated that an underwater video was made during the replacement of the stop logs in 2011. He added that Racine County should have a copy of this video. Ms. Kletti responded SEWRPC staff will follow up.

[Secretary's Note: The SEWRPC staff contacted Racine County Engineer Mr. Jeffrey Katz about an underwater video for the Horlick dam. Mr. Katz indicated that no underwater video exists as it is too turbulent to obtain clear images immediately upstream of the dam.]

Ms. Kletti briefly reviewed the sediment water quality data shown in Table IV-A. Ms. Greenfield asked who conducted the sediment monitoring. Mr. Helker indicated that he collected the samples in 2001 and provided the additional details on the sediment cores included in the plan. Ms. Kletti commented that overall the sediment core sampling from the Horlick dam impoundment does not indicate any constituents of significant concern for potential impoundment alternatives. She noted that the 2001 cores were not evaluated for pesticides and suggested that they may need to be evaluated in future studies.

Ms. Kletti reviewed the Root River flows at the Horlick Dam that are summarized in Figures IV-L through IV-N. She noted that average daily baseflows on the River ranged from 66 cubic feet per second (cfs) to 1,150 cfs, with the higher baseflows occurring in the spring to early summer. She indicated that peak annual flows were predominantly below 4,500 cfs, with the June 2008 event being the exception at 8,050 cfs. She said that annual peak flows on the Root River at the Horlick dam are predominantly experienced in spring to early summer.

Ms. Kletti reviewed the list of threatened and endangered species for the Horlick dam area shown in Table IV-C. She noted that the special concern species listed have no protection with the State, so no action would be necessary if removal or modification of the dam were recommended and implemented. She emphasized that a letter of clearance is required from the WDNR for the threatened and endangered species once a proposed plan for the dam is selected. Ms. Warner indicated she has observed additional threatened and endangered species in the vicinity of Horlick dam. Ms. Kletti asked her to pass the information on those species to SEWRPC staff and stated that they will be documented in the plan.

[Secretary's Note: After the meeting Ms. Warner indicated that she has observed the plant *Viburnum prunifolium* (smooth black-haw) in Colonial Park which is in the area of concern for the Horlick dam. *Viburnum prunifolium* (smooth black-haw) was added to the plant group downstream of Horlick dam in Table IV-C.]

DATE AND TIME OF NEXT MEETING

Ms. Greenfield noted that the next meeting would be the Stakeholder Group meeting on November 28, 2012, from 9:00 a.m. to noon at the River Bend Nature Center. This meeting will include a field visit to the Horlick dam. Mr. Chernik commented that perhaps an evening meeting would be more convenient for stakeholders with full time jobs. Mr. Hahn offered that once the Horlick dam alternatives are further along next summer, an evening meeting, possibly including a visit to the dam site, could be revisited.

ADJOURNMENT

There being no further business, the meeting was adjourned by unanimous consent at 12:20 p.m.

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Exhibit A

Economics of Saturated Buffers

- For the Bear Creek site, we installed 1100 ft of 4 in. distribution tile at a cost of $2508 @ $2.28 per foot installed. The control box required to divert tile drainage water through the distribution lateral cost $1120 installed. Another $100 would typically be required for design work for the system. Assuming a 20yr life expectancy for the system at 4% interest would add about $1460. Thus, the total cost of the installation will be $5188 over 20 yr or $259 per year.
- Our first year monitoring at Bear Creek showed the system removed 91 kg of nitrate-N.
- Thus, the cost per kg N removed for this prototype system was $2.85 per kg nitrate-N removed. These prices are very competitive with estimates for other nitrate removal practices such as constructed wetlands ($2.91/kg) and fall planted cover crops ($6.77/kg).

Potential Impact

- •We estimate that there currently are 39,060 miles of riparian buffers adjacent to agricultural land in Iowa.
- •If we assume the nitrate removal rate found in the first year of the pilot study in Bear Creek (963 lbs N/mi/yr).
- •And assume only 20% of existing buffers are suitable for saturated buffers.
- •We calculate that potentially 15 million lbs N/yr could be removed from Iowa streams using existing saturated buffers.
- •This is equivalent to about 2.5% of the current N load in Iowa streams.
- •In addition, these riparian buffers would continue to serve a significant role in phosphorus, sediment, and pesticide removal and would benefit wildlife.

Saturate buffer at Bear Creek, IA after installation

CIG – Currently there is a national NRCS Conservation Innovation Grant (CIG) project for installing 9 new saturated buffers across MN, IA, IL, and IN to assess the efficacy of the practice for removing nitrate across a range of soil, landscape, and climate conditions.

CPS – NRCS is in the process of preparing an Interim Conservation Practice Standard (CPS) for vegetated buffer saturation and management for enhanced nitrate removal.

For more information about the practice contact:

Dan Jaynes, USDA-ARS, 515-294-8243, dan.jaynes@ars.usda.gov,
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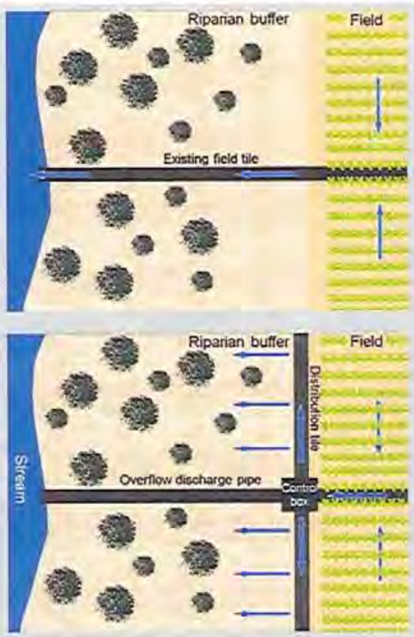
Saturated Riparian Buffers in Tile Drained Landscapes

Modifying Riparian Buffers to Enhance Nitrate Removal

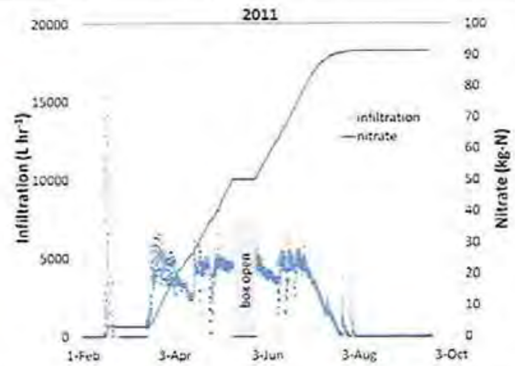
NLAE — LEOPOLD CENTER — Natural Resource Ecology and Management

Overview

Riparian buffers are a proven technology for reducing sediment, phosphorus, and nitrate contamination of surface waters. Riparian buffers reduce nitrate not only from surface runoff but also from shallow groundwater that flows through the buffer. Unfortunately, in tile-drained areas of the Midwest, buffers are not particularly effective in removing nitrate from shallow groundwater because most of the groundwater bypasses riparian buffers as flow in field tiles that discharge directly into surface waters. Thus, we can improve the efficacy of riparian buffers for removing nitrate by diverting a fraction of the tile drainage as shallow groundwater flow through the buffers. Within this shallow groundwater, both denitrification and uptake by riparian vegetation will remove much of the nitrate before it can enter the adjacent water body.



Schematic of a cropped field drained by field tile that passes through a riparian buffer before discharging directly into a stream (top) and (bottom) after creation of a saturated riparian buffer by installation of a control box used to divert some of the tile flow into a newly installed distribution tile across the top of the buffer.



The **left** figure is an overhead view of the saturated buffer installation at Bear Creek, IA showing the intercepted field tile, the control box used to divert the tile flow, and the newly installed distribution tile that introduces a fraction of the tile flow as shallow groundwater along the top of the riparian buffer. Groundwater flows from the distribution tile, through the buffer, to the creek.

The **right** figure shows the infiltration rate of tile water into the riparian buffer and the mass of nitrate removed by the buffer during the 1st year for the Bear Creek saturated buffer. The field tile ceased flowing in early August 2011.

Hydraulic Limitations of Saturated Buffers

- In most cases it is not desirable to induce surface flow when redirecting tile drainage through the buffers. Thus, the hydraulic loading rate will depend on the permeability (lateral hydraulic conductivity) of the buffer soil and its thickness. Along drainage ditches, most of the soils are moderately to moderately slow in permeability ($K_{lat} \sim 1\text{-}2$ in hr^{-1}). Permeability along natural streams may be as much as 10X greater as these soils are often layered with more permeable sands and loamy sands.
- Care must be used to prevent a seepage face from forming on the stream or ditch bank due to the raised water table. Seepage faces can result in increased sloughing and bank erosion. Thus, infiltration within the buffer should be restricted to prevent the formation of seepage faces.
- For a riparian buffer with a 3% slope to water, infiltration rates should not exceed 3% of the buffer soil's hydraulic conductivity, or from about 0.04 in hr^{-1} for moderately permeable soils to 0.4 in hr^{-1} for loamy sands. Assuming a 3 ft thick transmission zone, this computes to average infiltration rates of ~ 0.012 – 0.12 ft^2 per day per linear foot of buffer.

Biochemical Limitations of Saturated Buffers

- Denitrification in soil is usually limited by lack of an available carbon (C) source for the denitrifying bacteria. Typically, C is most plentiful in the surface layers of soil where plant roots are most prevalent. Thus, redirecting tile drainage within the buffer will be most effective for removing nitrate if the groundwater is near the surface – water flowing through low organic matter subsoils of the buffer will probably result in negligible removal or retention of nitrate.
- Before the saturate buffer at Bear Cr, there was no data on nitrate removal rates from redirecting tile drainage within buffers. A study by Mayer et al. (2004) summarized a number of natural riparian buffer studies for EPA and found nitrate removal rates between 0.091 to 0.212 mg N L^{-1} per linear foot of buffer. Whether or not reconstructed riparian buffers can sustain this rate of nitrate removal is unknown.
- Using this range of removal rates, it is estimated that an 82 ft wide buffer would remove all nitrate in tile flow when the input concentration is between 7.4 to 17.4 mg L^{-1} – a range commonly seen in tile drainage.

Exhibit B

Managing the Water's Edge

Making Natural Connections

Problem Statement:

Despite significant research related to buffers, there remains no consensus as to what constitutes optimal riparian buffer design or proper buffer width for effective pollutant removal, water quality protection, prevention of channel erosion, provision of fish and wildlife habitat, enhancement of environmental corridors, augmentation of stream baseflow, and water temperature moderation.

Southeastern Wisconsin Regional Planning Commission

Our purpose in this document is to help protect and restore water quality, wildlife, recreational opportunities, and scenic beauty.

This material was prepared in part with funding from the U.S. Environmental Protection Agency Great Lakes National Program Office provided through CMAP, the Chicago Metropolitan Agency for Planning.

Introduction

Perhaps no part of the landscape offers more variety and valuable functions than the natural areas bordering our streams and other waters.

These unique "riparian corridor" lands help filter pollutants from runoff, lessen downstream flooding, and maintain stream baseflows, among other benefits. Their rich ecological diversity also provides a variety of recreational opportunities and habitat for fish and wildlife. Regardless of how small a stream, lake, or wetland may be, adjacent corridor lands are important to those water features and to the environment.

Along many of our waters, the riparian corridors no longer fulfill their potential due to the encroachment of agriculture and urban development. This publication describes common problems encountered along streamside and other riparian corridors, and the many benefits realized when these areas are protected or improved. It also explains what landowners, local governments, and other decision-makers can do to capitalize on waterfront opportunities, and identifies some of the resources available for further information. While much of the research examined here focuses on stream corridors, the ideas presented also apply to areas bordering lakes, ponds, and wetlands throughout the southern Lake Michigan area and beyond. This document was developed as a means to facilitate and communicate important and up-to-date general concepts related to riparian buffer technologies.

Riparian corridors are unique ecosystems that are exceptionally rich in biodiversity

Contents

What Are Riparian Corridors? Riparian Buffer Zones?

The word riparian comes from the Latin word *ripa*, which means bank. However, in this document we use riparian in a much broader sense and refer to land adjoining any water body including ponds, lakes, streams, and wetlands. This term has two additional distinct meanings that refer to 1) the "natural or relatively undisturbed" corridor lands adjacent to a water body inclusive of both wetland and upland flora and fauna and 2) a buffer zone or corridor lands in need of protection to "buffer" the effects of human impacts such as agriculture and residential development.

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The word buffer literally means something that cushions against the shock of something else (noun), or to lessen or cushion that shock (verb). Other useful definitions reveal that a buffer can be something that serves to separate features, or that is capable of neutralizing something, like filtering pollutants from stormwater runoff. Essentially, buffers and buffering help protect against adverse effects.

Riparian buffer zones function as core habitat as well as travel corridors for many wildlife species.

Riparian buffers are zones adjacent to waterbodies such as lakes, rivers, and wetlands that simultaneously protect water quality and wildlife, including both aquatic and terrestrial habitat. These zones minimize the impacts of human activities on the landscape and contribute to recreation, aesthetics, and quality of life. **This document summarizes how to maximize both water quality protection and conservation of aquatic and terrestrial wildlife populations using buffers.**

What Are Riparian Corridors? Riparian Buffer Zones?

Buffers **can** include a range of complex vegetation structure, soils, food sources, cover, and water features that offer a variety of habitats contributing to diversity and abundance of wildlife such as mammals, frogs, amphibians, insects, and birds. Buffers can consist of a variety of canopy layers and cover types including ephemeral (temporary-wet for only part of year) wetlands/seasonal ponds/spring pools, shallow marshes, deep marshes, wetland meadows, wetland mixed forests, grasslands, shrubs, forests, and/or prairies. Riparian zones are areas of transition between aquatic and terrestrial ecosystems, and they can potentially offer numerous benefits to wildlife and people such as pollution reduction and recreation.

In the water resources literature, riparian buffers are referred to in a number of different ways. Depending on the focus and the intended function of a buffer, or a buffer-related feature, buffers may be referred to as stream corridors, critical transition zones, riparian management areas, riparian management zones, floodplains, or green infrastructure.

It is important to note that within an agricultural context, the term buffer is used more generally to describe filtering best management practices most often at the water's edge. Other practices which can be interrelated may also sometimes be called buffers. These include grassed waterways, contour buffer strips, wind breaks, field border, shelterbelts, windbreaks, living snow fence, or filter strips. These practices may or may not be adjacent to a waterway as illustrated in the photo to the right. For example, a grassed waterway is designed to filter sediment and reduce erosion and may connect to a riparian buffer. These more limited-purpose practices may link to multipurpose buffers, but by themselves, they are not adequate to provide the multiple functions of a riparian buffer as defined here.

U.S. Department of Agriculture, Natural Resource Conservation Service, Ohio Office.

Beyond the Environmental Corridor Concept

The term "environmental corridors" (also known as "green infrastructure") refers to an interconnected green space network of natural areas and features, public lands, and other open spaces that provide natural resource value. Environmental corridor planning is a process that promotes a systematic and strategic approach to land conservation and encourages land use planning and practices that are good for both nature and people. It provides a framework to guide future growth, land development, and land conservation decisions in appropriate areas to protect both community and natural resource assets.

Environmental corridors are an essential planning tool for protecting the most important remaining natural resource features in Southeastern Wisconsin and elsewhere. Since development of the environmental corridor concept, there have been significant advancements in landscape ecology that have furthered understanding of the spatial and habitat needs of multiple groups of organisms. In addition, advancements in pollutant removal practices, stormwater control, and agriculture have increased our understanding of the effectiveness and limitations of environmental corridors. In protecting water quality and providing aquatic and terrestrial habitat, there is a need to better integrate new technologies through their application within riparian buffers.

SEWRPC has embraced and applied the environmental corridor concept developed by Philip Lewis (Professor Emeritus of Landscape Architecture at the University of Wisconsin-Madison) since 1966 with the publication of its first regional land use plan. Since then, SEWRPC has refined and detailed the mapping of environmental corridors, enabling the corridors to be incorporated directly into regional, county, and community plans and to be reflected in regulatory measures. The preservation of environmental corridors remains one of the most important recommendations of the regional plan. Corridor preservation has now been embraced by numerous county and local units of government as well as by State and Federal agencies. The environmental corridor concept conceived by Lewis has become an important part of the planning and development culture in Southeastern Wisconsin.

Beyond the Environmental Corridor Concept

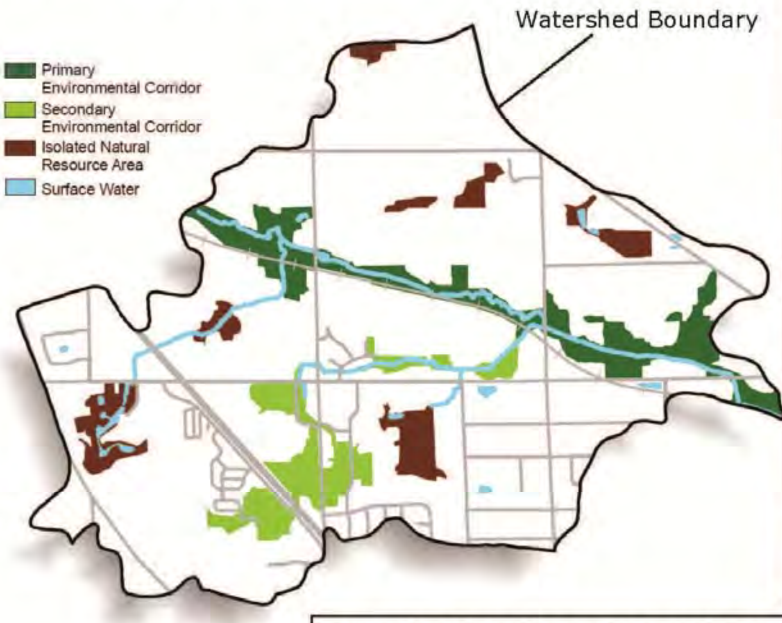
Environmental corridors are divided into the following three categories.

- **Primary environmental corridors** contain concentrations of our most significant natural resources. They are at least 400 acres in size, at least two miles long, and at least 200 feet wide.
- **Secondary environmental corridors** contain significant but smaller concentrations of natural resources. They are at least 100 acres in size and at least one mile long, unless serving to link primary corridors.
- **Isolated natural resource areas** contain significant remaining resources that are not connected to environmental corridors. They are at least five acres in size and at least 200 feet wide.

Key Features of Environmental Corridors

- Lakes, rivers, and streams
- Undeveloped shorelands and floodlands
- Wetlands
- Woodlands
- Prairie remnants
- Wildlife habitat
- Rugged terrain and steep slopes
- Unique landforms or geological formations
- Unfarmed poorly drained and organic soils
- Existing outdoor recreation sites
- Potential outdoor recreation sites
- Significant open spaces
- Historical sites and structures
- Outstanding scenic areas and vistas

Beyond the Environmental Corridor Concept

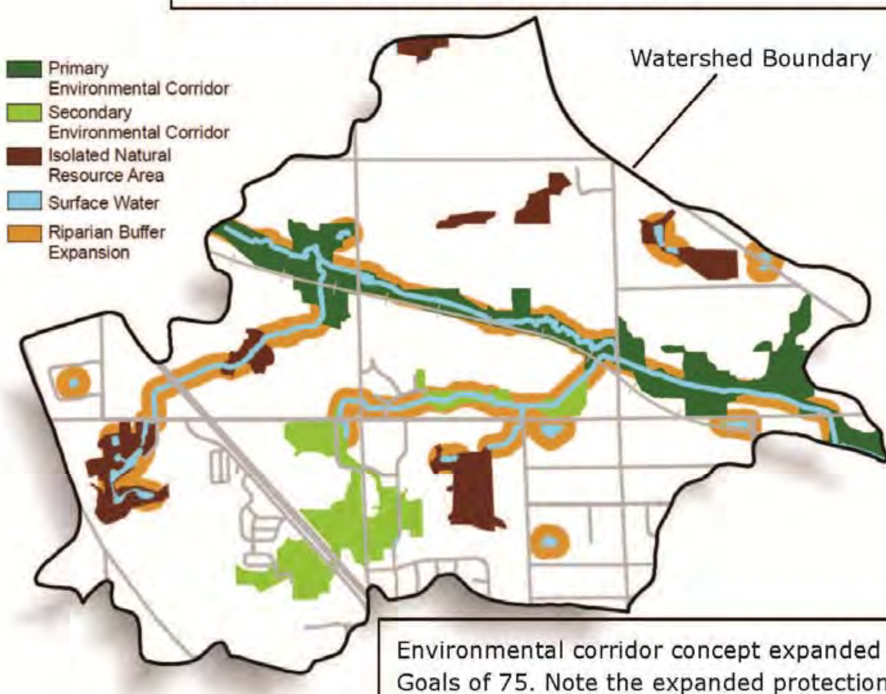


The Minimum Goals of **75** within a Watershed

75% minimum of total stream length should be naturally vegetated to protect the functional integrity of the water resources. (Environment Canada, How Much Habitat is Enough? A Framework for Guiding Habitat Rehabilitation in Great lakes Areas of Concern, Second Edition, 2004)

75 foot wide minimum riparian buffers from the top edge of each stream bank should be naturally vegetated to protect water quality and wildlife. (SEWRPC Planning Report No 50, A Regional Water Quality Management Plan for the Greater Milwaukee Watersheds, December 2007)

Example of how the environmental corridor concept is applied on the landscape. For more information see "Plan on It!" series **Environmental Corridors: Lifelines of the Natural Resource Base** at http://www.sewrpc.org/SEWRPC/LandUse/EnvironmentalCorridors.htm



Environmental corridor concept expanded to achieve the Goals of 75. Note the expanded protection in addition to the connection of other previously isolated areas.

Habitat Fragmentation—The Need for Corridors

Southeastern Wisconsin is a complex mosaic of agricultural and urban development. Agricultural lands originally dominated the landscape and remain a major land use. However, such lands continue to be converted to urban uses. Both of these dominant land uses fragment the landscape by creating islands or isolated pockets of wetland, woodland, and other natural lands available for wildlife preservation and recreation. By recognizing this fragmentation of the landscape, we can begin to mitigate these impacts.

New developments should incorporate water quality and wildlife enhancement or improvement objectives as design criteria by looking at the potential for creating linkages with adjoining lands and water features.

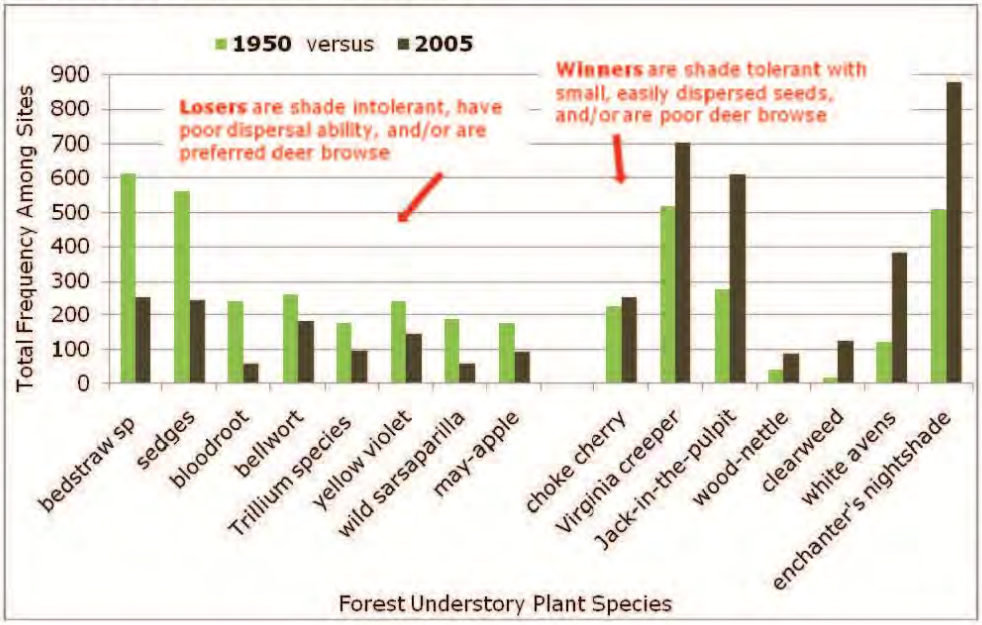
At the time of conversion of agricultural lands to urban uses, there are opportunities to re-create and expand riparian buffers and environmental corridors reconnecting uplands and waterways and restoring ecological integrity and scenic beauty locally and regionally. For example, placement of roads and other infrastructure across stream systems could be limited so as to maximize continuity of the riparian buffers. This can translate into significant cost savings in terms of reduced road maintenance, reduced salt application, and limited bridge or culvert maintenance and replacements. This simple practice not only saves the community significant amounts of money, but also improves and protects quality of life. Where necessary road crossings do occur, they can be designed to provide for safe fish and wildlife passage.

Overland travel routes for wildlife are often unavailable, discontinuous, or life endangering within the highly fragmented landscapes of Southeastern Wisconsin and elsewhere.

State Threatened Species: Blanding's turtle

Habitat Fragmentation—The Need for Corridors

Forest understory plant species abundance among stands throughout Southern Wisconsin

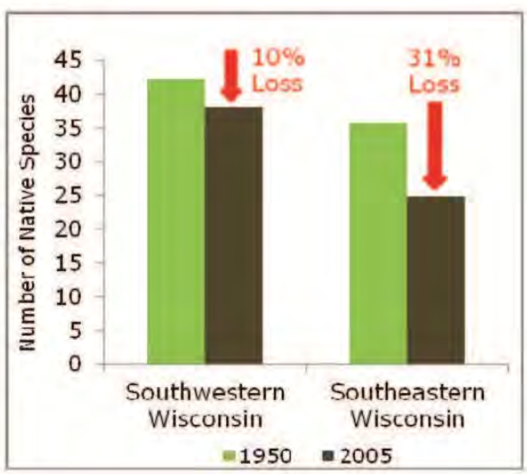


Forest fragmentation has led to significant plant species loss within Southern Wisconsin

(Adapted from David Rogers and others, 2008, Shifts in Southern Wisconsin Forest Canopy and Understory Richness, Composition, and Heterogeneity, Ecology, 89 (9): 2482-2492)

"...these results confirm the idea that large intact habitat patches and landscapes better sustain native species diversity. It also shows that people are a really important part of the system and their actions play an increasingly important role in shaping patterns of native species diversity and community composition. Put together, it is clear that one of the best and most cost effective actions we can take toward safeguarding native diversity of all types is to protect, enhance and create corridors that link patches of natural habitat."
Dr. David Rogers, Professor of Biology at the University of Wisconsin-Parkside

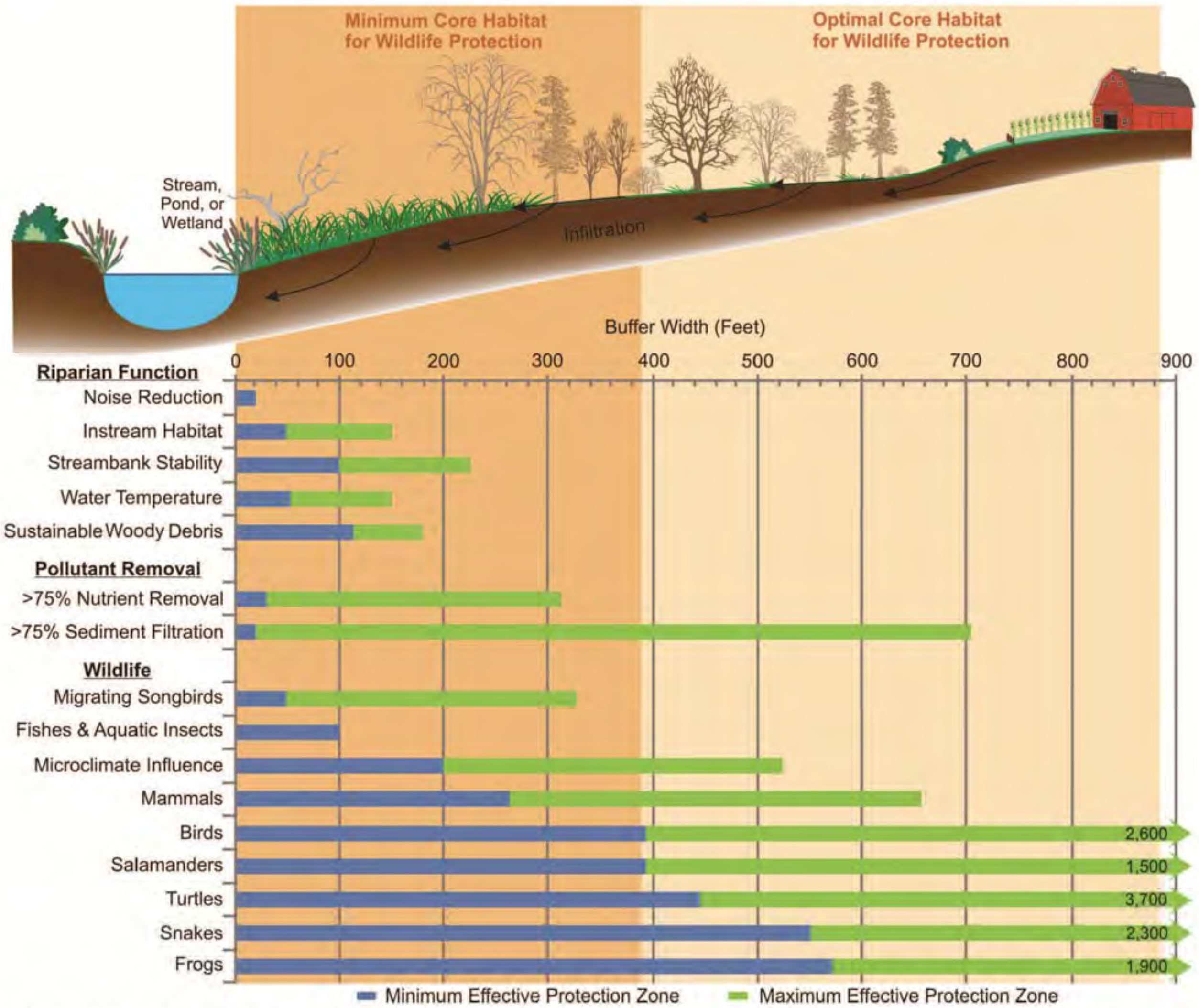
Since the 1950s, forests have increasingly become more fragmented by land development, both agricultural and urban, and associated roads and infrastructure, which have caused these forests to become isolated "islands of green" on the landscape. In particular, there has been significant loss of forest understory plant species over time (shrubs, grasses, and herbs covering the forest floor.) It is important to note that **these forests lost species diversity even when they were protected as parks or natural areas**.



One major factor responsible for this decline in forest plant diversity is that routes for native plants to re-colonize isolated forest islands are largely cut-off within fragmented landscapes. For example, the less fragmented landscapes in Southwestern Wisconsin lost fewer species than the more fragmented stands in Southeastern Wisconsin. In addition, the larger-sized forests and forests with greater connections to surrounding forest lands lost fewer species than smaller forests in fragmented landscapes.

Wider is Better for Wildlife

Why? Because buffer size is the engine that drives important natural functions like food availability and quality, access to water, habitat variety, protection from predators, reproductive or resting areas, corridors to safely move when necessary, and help in maintaining the health of species' gene pools to prevent isolation and perhaps extinction.



One riparian buffer size does not fit all conditions or needs. There are many riparian buffer functions and the ability to effectively fulfill those functions is largely dependent on width. Determining what buffer widths are needed should be based on what functions are desired as well as site conditions. For example, as shown above, water temperature protection generally does not require as wide a buffer as provision of habitat for wildlife. Based on the needs of wildlife species found in Wisconsin, the minimum core habitat buffer width is about 400 feet and the optimal width for sustaining the majority of wildlife species is about 900 feet. Hence, the value of large undisturbed parcels along waterways which are part of, and linked to, an environmental corridor system. The minimum effective buffer width distances are based on data reported in the scientific literature and the quality of available habitats within the context of those studies.

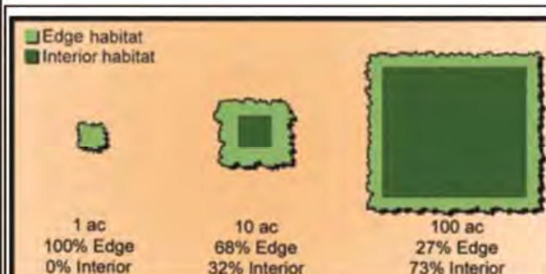
Wider is Better for Wildlife

Wildlife habitat needs change within and among species. **Minimum Core Habitat and Optimum Core Habitat distances were developed from numerous studies to help provide guidance for biologically meaningful buffers to conserve wildlife biodiversity.** These studies documented distances needed for a variety of biological (life history) needs to sustain healthy populations such as breeding, nesting, rearing young, foraging/feeding, perching (for birds), basking (for turtles), and overwintering/dormancy/hibernating. These life history needs require different types of habitat and distances from water, for example, one study found that Blanding's turtles needed approximately 60-foot-wide buffers for basking, 375 feet for overwintering, and up to 1,200 feet for nesting to bury their clutches of eggs. Some species of birds like the Blacked-capped chickadee or white breasted nuthatch only need about 50 feet of buffer, while others like the wood duck or great blue heron require 700-800 feet for nesting. Therefore, **understanding habitat needs for wildlife species is an important consideration in designing riparian buffers.**

Although *Ambystoma* salamanders require standing water for egg laying and juvenile development, most other times of the year they can be found more than 400 feet from water foraging for food.

Wisconsin Species	Mimimum Core Habitat (feet)	Optimum Core Habitat (feet)	Number of Studies
Frogs	571	1,043	9
Salamanders	394	705	14
Snakes	551	997	5
Turtles	446	889	27
Birds	394	787	45
Mammals	263	No data	11
Fishes and Aquatic Insects	100	No data	11
Mean	388	885	

This approach was adapted from *R.D. Semlitsch and J.R. Bodie, 2003, Biological Criteria for Buffer Zones around Wetlands and Riparian Habitats for Amphibian and Reptiles, Conservation Biology, 17(5):1219-1228.* These values are based upon studies examining species found in Wisconsin and represent mean linear distances extending outward from the edge of an aquatic habitat. The Minimum Core Habitat and Optimum Core Habitat reported values are based upon the mean minimum and mean maximum distances recorded, respectively. Due to a low number of studies for snake species, the recommended distances for snakes are based upon values reported by *Semlitsch and Bodie.*

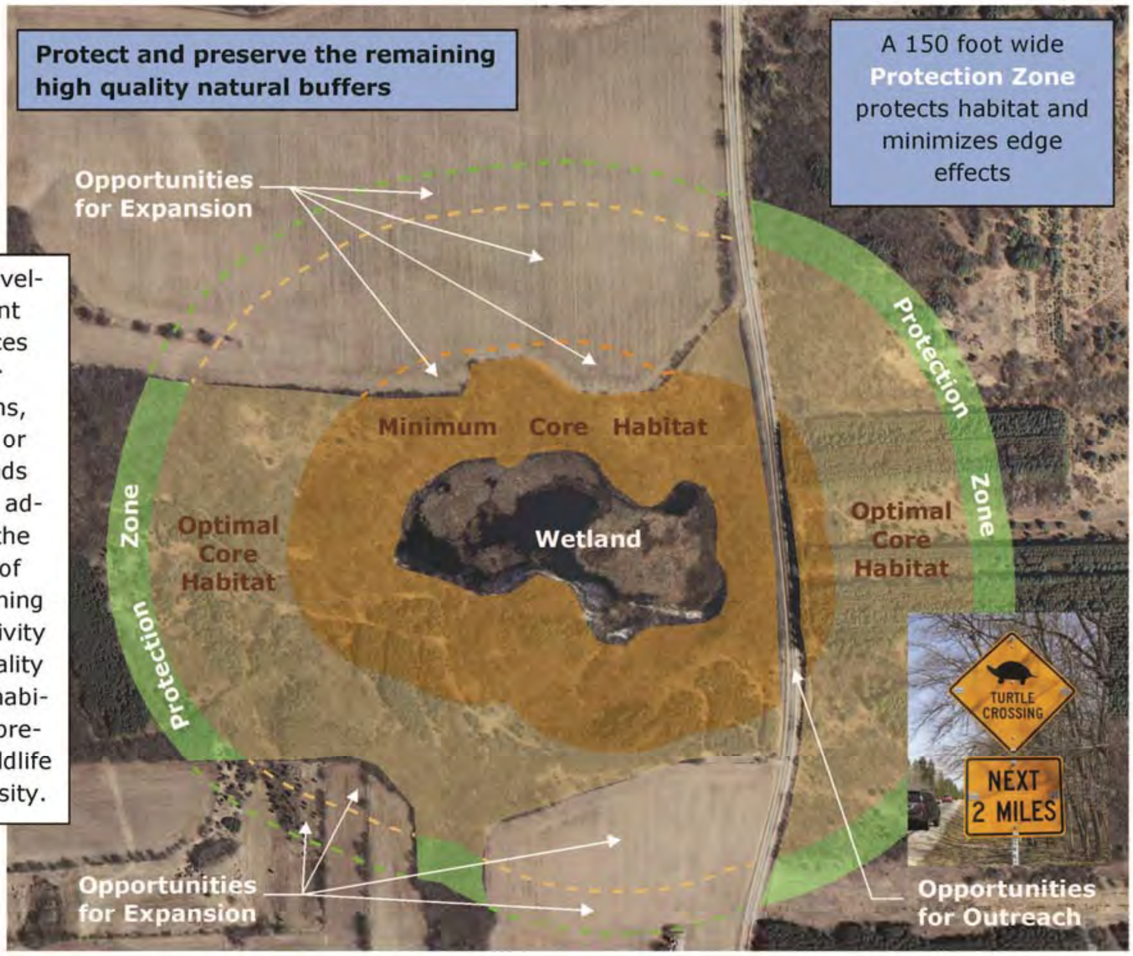


"Large patches typically conserve a greater variety and quality of habitats, resulting in higher species diversity and abundance." *Larger patches contain greater amounts of interior habitat and less edge effects, which benefits interior species, by providing safety from parasitism, disease, and invasive species.*

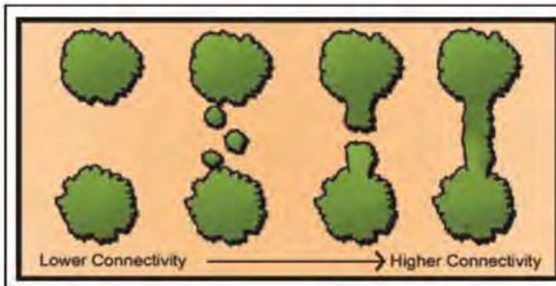
(Bentrup, G. 2008. Conservation buffers: design guidelines for buffers, corridors, and greenways. Gen. Tech. Rep. SRS-109. Asheville, NC: Department of Agriculture, Forest Service, Southern Research Station)

Maintaining Connections is Key

Like humans, all forms of wildlife require access to clean water. Emerging research has increasingly shown that, in addition to water, more and more species such as amphibians and reptiles cannot persist without landscape connectivity between quality wetland and upland habitats. Good connectivity to upland terrestrial habitats is essential for the persistence of healthy sustainable populations, because these areas provide vital feeding, overwintering, and nesting habitats found nowhere else. Therefore, both aquatic and terrestrial habitats are essential for the preservation of biodiversity and they should ideally be managed together as a unit.



Land development practices near streams, lakes, or wetlands need to address the issue of maintaining connectivity with quality upland habitats to preserve wildlife biodiversity.



Increasing connectivity among quality natural landscapes (wetlands, woodlands, prairies) can benefit biodiversity by providing access to other areas of habitat, increasing gene flow and population viability, enabling recolonization of patches, and providing habitat (Bentrup 2008).

Basic Rules to Better Buffers

Protecting the integrity of native species in the region is an objective shared by many communities. The natural environment is an essential component of our existence and contributes to defining our communities and neighborhoods. Conservation design and open space development patterns in urbanizing areas and farm conservation programs in rural areas have begun to address the importance of maintaining and restoring riparian buffers and connectivity among corridors.

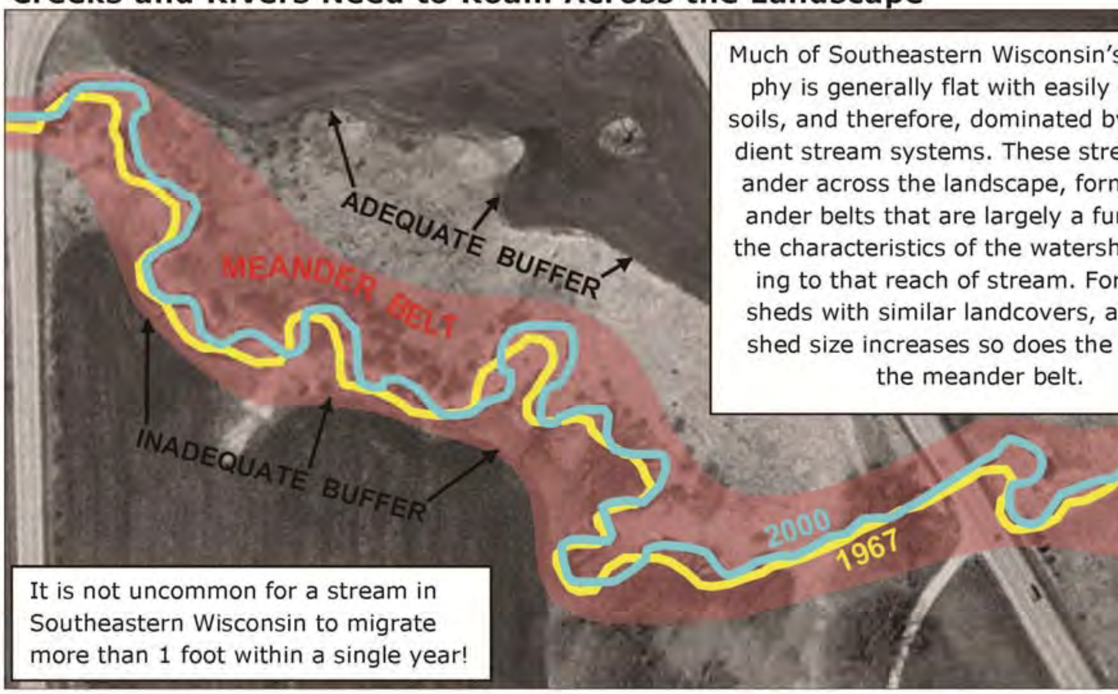
There are opportunities to improve buffer functions to improve water quality and wildlife habitat, even in urban situations

How wide should the buffer be? Unfortunately, there is no one-size-fits all buffer width adequate to protect water quality, wildlife habitat, and human needs. Therefore, the answer to this question depends upon the predetermined needs of the landowner and community objectives or goals.
As riparian corridors become very wide, their pollutant removal (buffering) effectiveness may reach a point of diminishing returns compared to the investment involved. However, the prospects for species diversity in the corridor keep increasing with buffer width. For a number of reasons, 400- to 800-foot-wide buffers are not practical along all lakes, streams, and wetlands within Southeastern Wisconsin. Therefore, communities should develop guidelines that remain flexible to site-specific needs to achieve the most benefits for water resources and wildlife as is practical.

Key considerations to better buffers/corridors:

- Wider buffers are better than narrow buffers for water quality and wildlife functions
- Continuous corridors are better than fragmented corridors for wildlife
- Natural linkages should be maintained or restored
- Linkages should not stop at political boundaries
- Two or more corridor linkages are better than one
- Structurally diverse corridors (e.g., diverse plant structure or community types, upland and wetland complexes, soil types, topography, and surficial geology) are better than corridors with simple structures
- Both local and regional spatial and temporal scales should be considered in establishing buffers
- Corridors should be located along dispersal and migration routes
- Corridors should be located and expanded around rare, threatened, or endangered species
- Quality habitat should be provided in a buffer whenever possible
- Disturbance (e.g. excavation or clear cutting vegetation) of corridors should be minimized during adjacent land use development
- Native species diversity should be promoted through plantings and active management
- Non-native species invasions should be actively managed by applying practices to preserve native species
- Fragmentation of corridors should be reduced by limiting the number of crossings of a creek or river where appropriate
- Restoration or rehabilitation of hydrological function, streambank stability, instream habitat, and/or floodplain connectivity should be considered within corridors.
- Restoration or retrofitting of road and railway crossings promotes passage of aquatic organisms

Creeks and Rivers Need to Roam Across the Landscape



Much of Southeastern Wisconsin's topography is generally flat with easily erodible soils, and therefore, dominated by low gradient stream systems. These streams meander across the landscape, forming meander belts that are largely a function of the characteristics of the watershed draining to that reach of stream. For watersheds with similar landcovers, as watershed size increases so does the width of the meander belt.

It is not uncommon for a stream in Southeastern Wisconsin to migrate more than 1 foot within a single year!

Healthy streams naturally meander or migrate across a landscape over time. Streams are transport systems for water and sediment and are continually eroding and depositing sediments, which causes the stream to migrate. When the amount of sediment load coming into a stream is equal to what is being transported downstream—and stream widths, depths, and length remain consistent over time—it is common to refer to that stream as being in a state of **"dynamic equilibrium."** In other words the stream retains its physical dimensions (equilibrium), but those physical features are shifted, or migrate, over time (dynamic).

Room to Roam

Riparian buffer widths should take into account the amount of area that a stream needs to be able to self-adjust and maintain itself in a state of dynamic equilibrium. ... These are generally greater than any minimum width needed to protect for pollutant removal alone.

Streams are highly sensitive, and they respond to changes in the amounts of water and sediment draining to them, which are affected by changing land use conditions. For example, streams can respond to increased discharges of water by increased scour (erosion) of bed and banks that leads to an increase in stream width and depth—or "degradation." Conversely, streams can respond to increased sedimentation (deposition) that leads to a decrease in channel width and depth—or "aggradation."

Why Should You Care About Buffers?

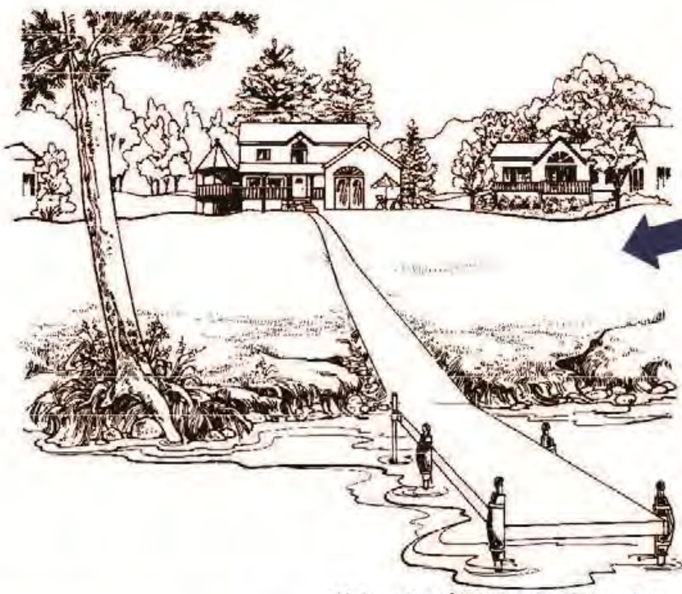
Economic Benefits:
- Increased value of riparian property
- Reduced lawn mowing time and expense
- Increased shade to reduce building cooling costs
- Natural flood mitigation protection for structures or crops
- Pollution mitigation (reduced nutrient and contaminant loading)
- Increased infiltration and groundwater recharge
- Prevented loss of property (land or structures) through erosion
- Greater human and ecological health through biodiversity

Recreational Benefits:
- Increased quality of the canoeing/kayaking experience
- Improved fishing and hunting quality by improving habitat
- Improved bird watching/wildlife viewing quality and opportunities
- Increased potential for expansion of trails for hiking and bicycling
- Opportunities made available for youth and others to locally reconnect with nature

Riparian buffers make sense and are profitable monetarily, recreationally, and aesthetically!

Social Benefits:
- Increased privacy
- Educational opportunities for outdoor awareness
- Improved quality of life at home and work
- Preserved open space/balanced character of a community
- Focal point for community pride and group activities
- Visual diversity
- Noise reduction

A Matter of Balance



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Although neatly trimmed grass lawns are popular, these offer limited benefits for water quality or wildlife habitat. A single house near a waterbody may not seem like a "big deal," but the cumulative effects of many houses can negatively impact streams, lakes, and wetlands.

All the lands within Southeastern Wisconsin ultimately flow into either the Mississippi River or the Great Lakes systems. The cumulative effects of agriculture and urban development in the absence of mitigative measures, ultimately affects water quality in those systems. Much of this development causes increases in water runoff from the land into wetlands, ponds, and streams. This runoff transports water, sediments, nutrients, and other pollutants into our waterways that can lead to a number of problems, including flooding that can cause crop loss or building damage; unsightly and/or toxic algae blooms; increased turbidity; damage to aquatic organisms from reduced dissolved oxygen, lethal temperatures, and/or concentrations of pollutants; and loss of habitat.

Riparian buffers are one of the most effective tools available for defending our waterways. Riparian buffers can be best thought of as forming a living, self-sustainable protective shield. This shield protects investments in the land and all things on it as well as our quality of life locally, regionally, and, ultimately, nationally. Combined with stormwater management, environmentally friendly yard care, effective wastewater treatment, conservation farming methods, and appropriate use of fertilizers and other agrichemicals, **riparian buffers complete the set of actions that we can take to minimize impacts to our shared water resources.**

Lakeshore buffers can take many forms, which require a balancing act between lake viewing, access, and scenic beauty. Lakeshore buffers can be integrated into a landscaping design that complements both the structural development and a lakeside lifestyle. Judicious placement of access ways and shoreline protection structures, and preservation or reestablishment of native vegetation, can enhance and sustain our use of the environment.

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Case Study—Agricultural Buffers

Agricultural nonpoint source pollution runoff continues to pose a threat to water quality and aquatic ecosystems within Wisconsin and elsewhere. In an effort to address this problem, the Wisconsin Buffer Initiative was formed with the goal of designing a buffer implementation program to achieve science-based, cost-effective, water quality improvements (report available online at http://www.soils.wisc.edu/extension/nonpoint/wbi.php).

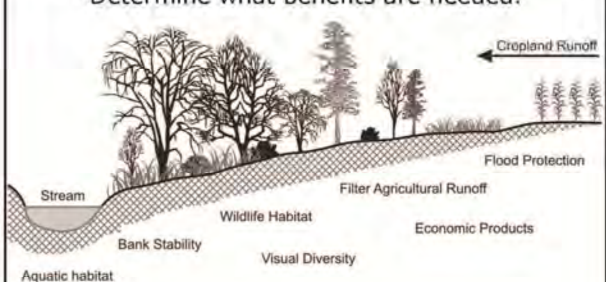
While it is true that riparian buffers alone may not always be able to reduce nutrient and sediment loading from agricultural lands, WBI researchers found that "...***riparian buffers are capable of reducing large percentages of the phosphorus and sediment that are currently being carried by Wisconsin streams. Even in watersheds with extremely high loads (top 10%), an average of about 70% of the sediment and phosphorus can be reduced through buffer implementation***." *(Diebel, M.J. and others, 2009, Landscape planning for agricultural nonpoint source pollution reduction III: Assessing Phosphorus and sediment reduction potential, Environmental Management, 43:69-83.)*.

Challenge:
Buffers may take land out of cultivated crop production and require additional cost to install and maintain. Cost sharing, paid easements, and purchase of easements or development rights may sometimes be available to offset costs.

Benefits:
Buffers may offset costs by producing perennial crops such as hay, lumber, fiber, nuts, fruits, and berries. In addition, they provide visual diversity on the landscape, help maintain long-term crop productivity, and help support healthier fish populations for local enjoyment.

Federal and state natural resource agencies have long recognized the need to apply a wide range of Best Management Practices on agricultural lands to improve stream water quality. Although there are many tools available in the toolbox to reduce pollutant runoff from agricultural lands, such as crop rotations, nutrient and manure management, conservation tillage, and contour plowing, riparian buffers are one of the most effective tools to accomplish this task. Their multiple benefits and inter-connectedness from upstream to downstream make riparian buffers a choice with watershed-wide benefits.

Determine what benefits are needed.



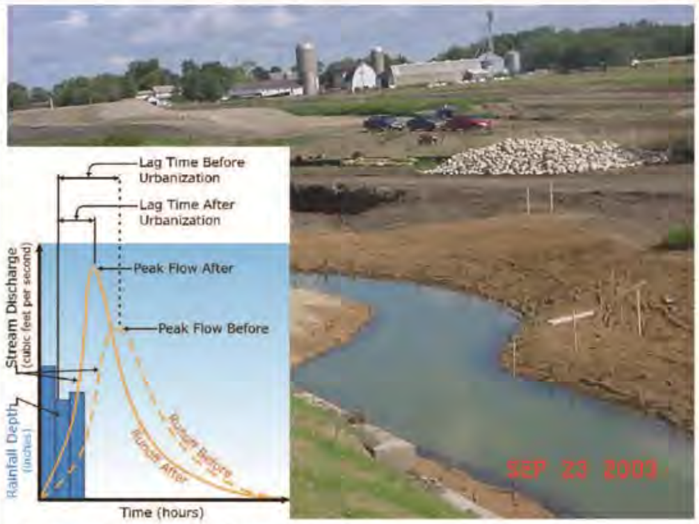
The USDA in *Agroforestry Notes* (AF Note-4, January 1997) outlines a four step process for designing riparian buffers for Agricultural lands:

1-Determine what buffers functions are needed
2-Identify the best types of vegetation to provide the needed benefits
3-Determine the minimum acceptable buffer width to achieve desired benefits
4-Develop an installation and maintenance plan

Drain tiles can bypass infiltration and filtration of pollutants by providing a direct pathway to the water and "around" a buffer. This is important to consider in design of a buffer system which integrates with other agricultural practices.

Case Study—Urbanizing Area Buffers

When development occurs near a waterbody, the area in driveways, rooftops, sidewalks, and lawns increases, while native plants and undisturbed soils decrease. As a result, the ability of the shoreland area to perform its natural functions (flood control, pollutant removal, wildlife habitat, and aesthetic beauty) is decreased. In the absence of mitigating measures, one the consequences of urban development is an increase in the amount of stormwater, which runs off the land instead of infiltrating into the ground. Therefore, **urbanization impacts the watershed, not only by reducing groundwater recharge, but also by changing stream hydrology** through increased stormwater runoff volumes and peak flows. This means less water is available to sustain the baseflow regime. The urban environment also contains increased numbers of pollutants and generates greater pollutant concentrations and loads than any other land use. This reflects the higher density of the human population and associated activities, which demand measures to protect the urban water system.



Comparison of hydrographs before and after urbanization. Note the rapid runoff and greater peak streamflow tied to watershed development. (Adapted from Federal Interagency Stream Restoration Working Group (FISRWG), Stream Corridor Restoration: Principles, Processes, and Practices, October 1998)

Mitigation of urban impacts may be as simple as not mowing along a stream corridor or changing land management and yard care practices, or as complex as changing zoning ordinances or widening riparian corridors through buyouts.

Challenge:

Urban development requires balancing flood protection, water quality protection, and the economic viability of the development.

Opportunities:

Buffers may offset costs by providing adequate space for providing long-term water quantity and water quality protection. In addition, they provide visual diversity on the landscape, wildlife habitat and connectedness, and help maintain property values.

Anatomy of an urban riparian buffer

The most effective urban buffers have three zones:

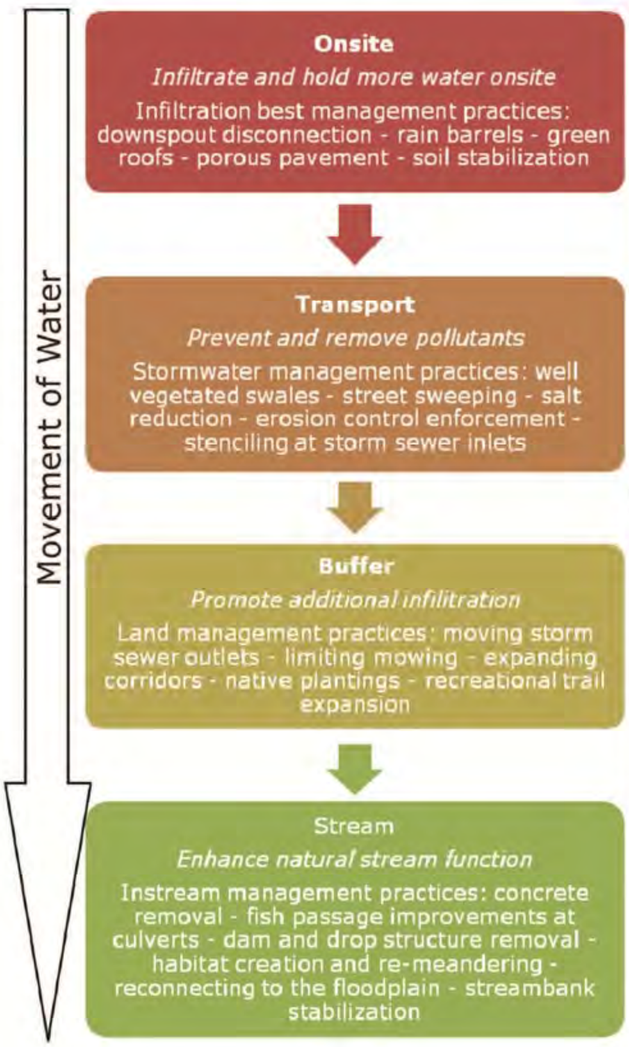
- **Outer Zone-**Transition area between the intact buffer and nearest permanent structure to capture sediment and absorb runoff.
- **Middle Zone-**Area from top of bank to edge of lawn that is composed of natural vegetation that provides wildlife habitat as well as improved filtration and infiltration of pollutants.
- **Streamside Zone-**Area from the water's edge to the top of the bank or uplands that provides critical connection between water, wetland, and upland habitats for wildlife as well as protect streams from bank erosion

(Fact sheet No. 6 Urban Buffer in the series Riparian Buffers for Northern New Jersey)

Case Study—Urban Buffers

Placement of riparian buffers in established urban areas is a challenge that requires new and innovative approaches. In these areas, historical development along water courses limits options and requires balancing flood management protection versus water quality and environmental protection needs. Consequently, some municipalities have begun to recognize the connections between these objectives and are introducing programs to remove flood-prone structures and culverts from the stream corridors and allow recreation of the stream, restoring floodplains, and improving both the quality of life and the environment.

In urban settings it may be necessary to limit pollution and water runoff before it reaches the buffer.



Challenge:

There are many potential constraints to establishing, expanding, and/or managing riparian buffers within an urban landscape. Two major constraints to establishment of urban buffers include:

1) **Limited or confined space to establish buffers** due to encroachment by structures such as buildings, roadways, and/or sewer infrastructure;

2) **Fragmentation of the landscape** by road and railway crossings of creeks and rivers that disrupt the linear connectedness of buffers, limiting their ability to provide quality wildlife habitat.

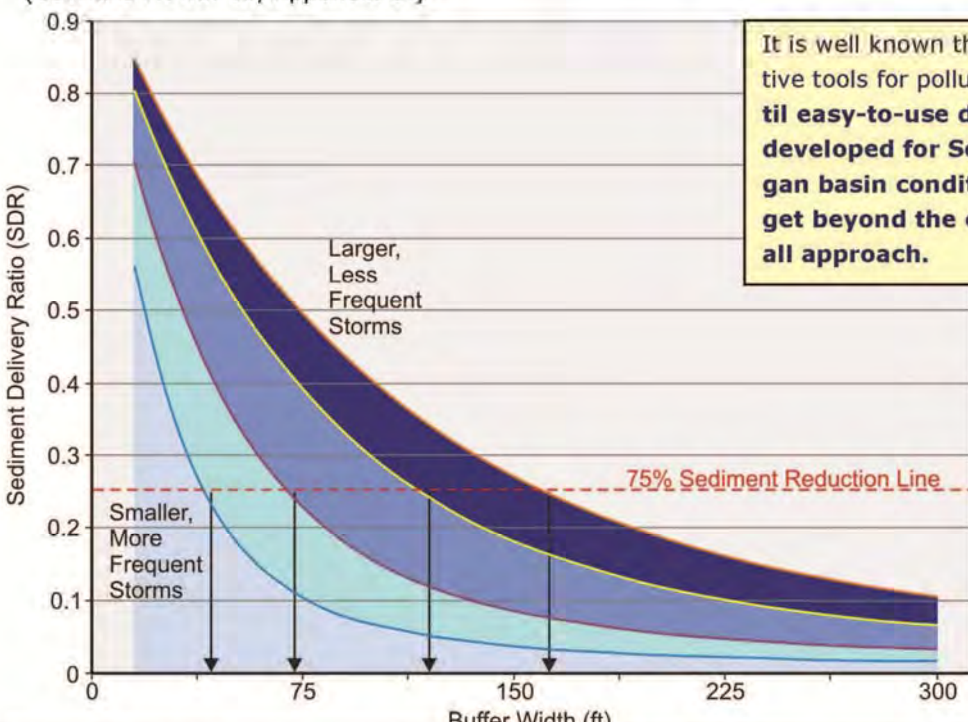
Much traditional stormwater infrastructure intercepts runoff and diverts it directly into creeks and rivers, bypassing any benefits of buffers to infiltrate or filter pollutants. This is important to consider in design of a buffer system for urban waterways, which begin in yards, curbsides, and construction sites, that are figuratively as close to streams as the nearest storm sewer inlet.

A Buffer Design Tool

Design aids are needed to help municipalities, property owners, and others take the "guesswork" out of determining adequate buffer widths for the purpose of water resource quality protection. While there are various complex mathematical models that can be used to estimate sediment and nutrient removal efficiencies, they are not easily applied by the people who need them including homeowners, farmers, businesses and developers.

To fill this gap, design aid tools are being developed using factors such as slope, soils, field length, incoming pollutant concentrations, and vegetation to allow the user to identify and test realistic buffer widths with respect to the desired percent pollutant load reduction and storm characteristics. By developing a set of relationships among factors that determine buffer effectiveness, the width of buffer needed to meet specific goals can be identified.

In the example below, 50-foot-wide buffers are necessary to achieve 75 % sediment removal during small, low intensity storms, while buffers more than 150 feet wide are necessary to achieve the same sediment reduction during more severe storms. Based on this information, decision-makers have the option of fitting a desired level of sediment removal into the context of their specific conditions. Under most conditions, a 75-foot width will provide a minimum level of protection for a variety of needs (SEWRPC PR No. 50, Appendix O.)



It is well known that buffers are effective tools for pollutant removal, but **until easy-to-use design aid tools are developed for Southern Lake Michigan basin conditions, we can never get beyond the current one size fits all approach.**

This generalized graph depicts an example of model output for an optimal buffer width to achieve a 75% sediment reduction for a range of soil and slope, vegetation, and storm conditions characteristic of North Carolina. *(Adapted from Muñoz-Carpena R., Parsons J.E.. 2005. VFSMOD-W: Vegetative Filter Strips Hydrology and Sediment Transport Modeling System v.2.x. Homestead, FL: University of Florida. http://carpena.ifas.ufl.edu/vfsmod/citations.shtml)*

Buffers Are A Good Defense

Today's natural resources are under threat. These threats are immediate as in the case of chemical accidents or manure spills, and chronic as in the case of stormwater pollution carrying everything from eroded soil, to fertilizer nutrients, to millions of drips from automobiles and other sources across the landscape. Non-native species have invaded, and continue to invade, key ecosystems and have caused the loss of native species and degradation of their habitats to the detriment of our use of important resources.

> ***"Riparian ecosystems are naturally resilient,*** *provide linear habitat connectivity, link aquatic and terrestrial ecosystems, and create thermal refugia for wildlife: all characteristics that can contribute to ecological adaptation to climate change."*
>
> *(N. E. Seavy and others, Why Climate Change Makes Riparian Restoration More Important Than Ever: Recommendations for Practice and Research, 2009, Ecological Restoration 27(3):330-338)*

A more subtle, but growing, concern is the case of stresses on the environment resulting from climate change. Buffers present an opportunity for natural systems to adapt to such changes by providing the space to implement protective measures while also serving human needs. **Because riparian buffers maintain an important part of the landscape in a natural condition, they offer opportunities for communities to adjust to our changing world.**

Well-managed riparian buffers are a good defense against these threats. In combination with environmental corridors, buffers maintain a sustainable reserve and diversity of habitats, plant and animal populations, and genetic diversity of organisms, all of which contribute to the long-term preservation of the landscape. Where they are of sufficient size and connectivity, riparian buffers act as reservoirs of resources that resist the changes that could lead to loss of species.

Refuge or protection from increased water temperatures as provided by natural buffers is important for the preservation of native cold-water, cool-water, and warm-water fishes and their associated communities.

Buffers Provide Opportunities

River, lake, and wetland systems and their associated riparian lands form an important element of the natural resource base, create opportunities for recreation, and contribute to attractive and well-balanced communities. These resources can provide an essential avenue for relief of stress among the population and improve quality of life in both urban and rural areas. Such uses also sustain industries associated with outfitting and supporting recreational and other uses of the natural environment, providing economic opportunities. Increasing access and assuring safe use of these areas enhances public awareness and commitment to natural resources. Research has shown that property values are higher adjoining riparian corridors, and that such natural features are among the most appreciated and well-supported parts of the landscape for protection.

We demand a lot from our riparian buffers!

Sustaining this range of uses requires our commitment to protect and maintain them.

Summary

The following guidance suggestions highlight key points to improve riparian corridor management and create a more sustainable environment.

Riparian corridors or buffers along our waters may contain varied features, but all are best preserved or designed to perform multiple important functions.

Care about buffers because of their many benefits. Riparian buffers make sense and are profitable monetarily, recreationally, aesthetically, as well as environmentally.

Enhance the environmental corridor concept. Environmental corridors are special resources which deserve protection. They serve many key riparian corridor functions, but in some cases, could also benefit from additional buffering.

Avoid habitat fragmentation of riparian corridors. It is important to preserve and link key resource areas, making natural connections and avoiding habitat gaps.

Employ the adage "wider is better" for buffer protection. While relatively narrow riparian buffers may be effective as filters for certain pollutants, that water quality function along with infiltration of precipitation and runoff and the provision of habitat for a host of species will be improved by expanding buffer width where feasible.

Allow creeks and rivers room to roam across the landscape. Streams are dynamic and should be buffered adequately to allow for natural movement over time while avoiding problems associated with such movement.

Consider and evaluate buffers as a matter of balance. Riparian buffers are a living, self-sustainable shield that can help balance active use of water and adjoining resources with environmental protection.

Agricultural buffers can provide many benefits. Riparian buffers in agricultural settings generally work well, are cost-effective, and can provide multiple benefits, including possibly serving as areas to raise certain crops.

Urban buffers should be preserved and properly managed. Though often space-constrained and fragmented, urban buffers are important remnants of the natural system. Opportunities to establish or expand buffers should be considered, where feasible, complemented by good stormwater management, landscaping, and local ordinances, including erosion controls.

A buffer design tool is needed and should be developed. Southeastern Wisconsin and the Southern Lake Michigan Basin would benefit from development of a specific design tool to address the water quality function of buffers. Such a tool would improve on the currently available general guidance on dimensions and species composition.

Buffers are a good defense. Combined with environmental corridors, riparian buffers offer a good line of defense against changes which can negatively impact natural resources and the landscape.

Managing the Water's Edge

MORE TO COME

Future editions in a riparian buffer planning series are being explored with the intent of focusing on key elements of this critical land and water interface. Topics may include:

- Information sharing and development of ordinances to integrate riparian buffers into existing land management plans and programs
- Integration of stormwater management practices and riparian buffer best management practices
- Application of buffers within highly constrained urban corridors with and without brownfield development
- Installation of buffers within rural or agricultural lands being converted to urban uses
- Utilization of buffers in agricultural areas and associated drainage systems
- Integration of riparian buffers into environmental corridors to support resources preservation, recreation and aesthetic uses
- Preservation of stream courses and drainageways to minimize maintenance and promote protection of infrastructure
- Guidance for retrofitting, replacement, or removal of infrastructure such as dams and road crossings, to balance transportation, recreation, aesthetic, property value, and environmental considerations.
- Protection of groundwater recharge and discharge areas
- Protection of high quality, sensitive coastal areas, including preservation of recreational potential

MORE INFORMATION

This booklet can be found at http://www.sewrpc.org/SEWRPC/Environment.htm . Please visit the website for more information, periodic updates, and a list of complementary publications.

* * *

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KENOSHA·MILWAUKEE·OZAUKEE·RACINE·WALWORTH·WASHINGTON·WAUKESHA
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May 7, 2010

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Exhibit C

Table IV-7B-2

EXISTING RIPARIAN BUFFER AREAS IN THE ROOT RIVER WATERSHED

Stream Reach[a]		Stream Reach Area (acres)[a]	Riparian Buffer Area (acres)	Percent Riparian Buffer Area In the Reach	Associated Water Quality Assessment Area[b]	Principal Streams, Lakes, and Ponds
Mainstem Root River Reach Areas	RR-1	2,339.9	126.6	5.4	Upper Root River Headwaters	Root River mainstem, Hale Creek
	RR-4	5,443.0	542.4	10.0	Upper Root River	Root River mainstem, unnamed tributaries
	RR-7	4,137.3	742.5	17.9	Middle Root River-Dale Creek	Root River mainstem, Dale Creek, Koepmier Lake, Scout Lake
	RR-10	1,757.8	257.3	14.6	Middle Root River-Legend Creek	Root River mainstem, unnamed tributaries
	RR-13	1,480.5	315.1	21.3	Middle Root River-Ryan Creek	Root River mainstem, Tuckaway Creek, unnamed tributaries
	RR-17	12,707.2	2,103.3	16.6	Middle Root River-Ryan Creek, Lower Root River-Caledonia	Root River mainstem, unnamed tributaries
	RR-22	3,589.5	741.7	20.7	Lower Root River-Johnson Park	Root River mainstem, unnamed tributaries
	RR-23	5,699.4	169.2	3.0	Lower Root River-Racine	Root River mainstem
Subtotal		37,154.8	4,988.2	13.5	- -	- -
Reach Areas Tributary to the Root River	RR-2	1,237.0	92.4	7.5	Upper Root River Headwaters	New Berlin Memorial Hospital Tributary
	RR-3	1,238.6	58.2	4.7	Upper Root River	Wildcat Creek
	RR-5	3,317.6	279.0	8.4	Whitnall Park Creek	Upper Kelly Lake Tributary, Whitnall Park Creek, Lower Kelly Lake, Upper Kelly Lake
	RR-6	6,270.8	944.8	15.1	Whitnall Park Creek	Tess Corners Creek, Brittany Lake, Monastery Lake, Whitnall Park Pond
	RR-8	2,557.1	334.4	13.1	Middle Root River-Legend Creek	Legend Creek
	RR-9	3,136.7	446.5	14.2	East Branch Root River	East Branch Root River Canal, Mud Lake, unnamed tributaries
	RR-11	3,860.4	819.2	21.2	Middle Root River-Ryan Creek	Ryan Creek, Dumkes Lake
	RR-12	2,034.2	312.2	15.3	Middle Root River-Ryan Creek	Unnamed tributaries
	RR-14	25,319.8	1,276.4	5.0	Upper West Branch Root River Canal, Lower West Branch Root River Canal	Raymond Creek, West Branch Root River Canal, Yorkville Creek
	RR-15	9,976.5	372.8	3.7	East Branch Root River Canal	East Branch Root River Canal
	RR-16	7,809.1	1,124.3	14.4	Root River Canal	Root River Canal, unnamed tributaries
	RR-18	2,053.0	221.8	10.8	Lower Root River Canal-Caledonia	Kilbournville Tributary
	RR-19	6,920.6	346.8	5.0	Lower Root River Canal-Caledonia	Husher Creek, unnamed tributaries
	RR-20	3,382.0	608.8	18.0	Lower Root River Canal-Caledonia	Crayfish Creek, unnamed tributaries
	RR-21	10,266.9	306.7	3.0	Hoods Creek	Hoods Creek, Ives Grove Ditch
Subtotal		89,380.1	7,544.2	8.4	- -	- -
Total		126,534.9	12,542.3	9.9	- -	- -

[a]*Mainstem and tributary stream reach areas are shown on Map IV-19A.*

[b]*Water Quality Assessment Areas are shown on Map IV-1.*

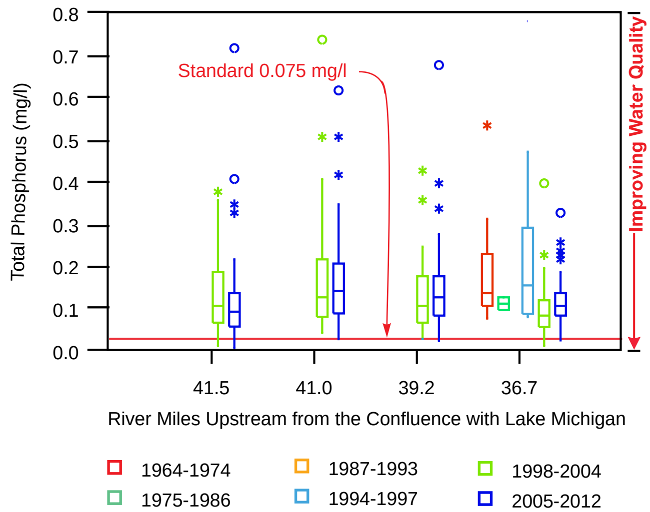
Source: SEWRPC.

#207820

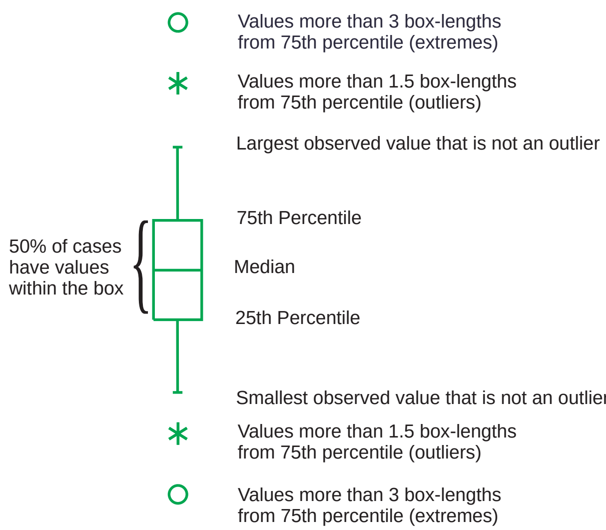
Exhibit D

Figure IV-7

EXAMPLE OF BOX-PLOT FIGURE SHOWING DISTRIBUTION OF WATER QUALITY CONCENTRATIONS AMONG STATIONS AND SPECIFIC TIME PERIODS FROM 1964-2012



LEGEND



Source: SEWRPC.

Exhibit E

D-7675.1

1962 MAR 16 AM 9 21

PUBLIC SERVICE COMM. OF WISCONSIN

March 14, 1962

Public Service Commission of Wisconsin
State Office Building
Madison 2, Wisconsin

Re: Horlick's Dam, Racine County, Wisconsin

Gentlemen:

Please consider this letter as an application for a permit to abandon Horlick's Dam across the Root River in the Town of Mount Pleasant in Racine County, Wisconsin. Ownership is presently listed under the names of Charles A. Horlick, 3620 Rapids Drive, Racine, Wisconsin, and Richard C. Horlick, 2600 Pavilion Road, Racine, Wisconsin.

This application is being made pursuant to Sec. 31.185 of the Wisconsin Statutes. It is our understanding that there are no official forms prescribed by the Commission. Other information which you may require for the purpose of enabling you to act on this application is that the Dam was originally built in 1834; it presently provides no commercial benefits; blasting operations conducted during the construction of the nearby highway may have weakened and damaged the Dam. Although the extent of damage and cost of repair and possible improvement is unknown, we are unable to restore, repair or maintain the Dam.

We have attempted to transfer the Dam to the City of Racine, Town of Mount Pleasant and the Town of Caledonia. The transfer was conditioned upon the approval of bid and payment between the parties. It provided that if the condition was not met that the agreement and conveyance be considered null and void and of no effect. Although we have not been officially advised to date that the bids have been disapproved or that payment has not been made or that the municipalities consider the conveyance null and void, information received today leads us to believe that the conveyance is null and void and therefore we hereby immediately apply for a permit to abandon.

Yours truly,

Charles A. Horlick
Charles A. Horlick

Richard C. Horlick
Richard C. Horlick

1962

1962

FILING

Racine
513

BEFORE THE

PUBLIC SERVICE COMMISSION OF WISCONSIN

Application of Charles A. Horlick and Richard C. Horlick for a Permit to Abandon Horlick's Dam in the Root River, Town of Mt. Pleasant, Racine County	2-WP-1626

FINDINGS OF FACT AND ORDER

Charles A. Horlick, 3620 Rapids Drive, and Richard C. Horlick, 2600 Pavilion Road, both in Racine, filed an application with the Commission on March 16, 1962 for a permit under section 31.185, Statutes (created by Chapter 568, Laws of 1961), to abandon Horlick's Dam in the Root River in the town of Mt. Pleasant, Racine County. Application denied.

Pursuant to due notice, hearing was held May 3, 1962 at Racine before Examiner Clarence B. Sorensen.

Appearances:

Charles A. Horlick in person and by

Harley Brown, attorney
Racine

As Interest May Appear:

Town of Mt. Pleasant, by

Harold Schink, supervisor
Racine

In Opposition:

Wisconsin Conservation Department, by

Huber Wheeler, conservation biologist
Madison

Francis Paulin, district fish manager
Waterford

Norman Wood, warden
Union Grove

Of the Commission Staff:

William Sayles, engineering department

The Commission deferred action on the application herein until this time because of the possibility that an application for a permit to transfer ownership of Horlick's Dam would be filed.

Findings of Fact

THE COMMISSION FINDS:

1. Horlick's dam in the Root River was originally constructed in 1838 for mill dam purposes. In its docket No. 2-WP-45 (dated May 24, 1932, 2 P.S.C.W. 544), the Commission fixed the minimum level of the pond created by the dam at elevation 93.8 feet (Public Service Commission datum).

2. At the present time the dam is not used for power purposes. The owner or owners have failed to maintain the structure. Part of the crest of the spillway has failed. At low flow the dam is incapable of maintaining the established minimum level of the pond.

3. The present owners of the dam, Charles A. Horlick and Richard C. Horlick, propose to abandon the dam leaving the existing structure in place. Applicants have attempted to transfer the dam to the city of Racine, the town of Mt. Pleasant, and the town of Caledonia without success.

4. The pool formed by the dam extends upstream for a distance of $3\frac{1}{2}$ miles. For the most part the pool is confined between the river banks. There is extensive residential and park development along the river in the reach of stream influenced by the dam.

5. In the notice of hearing and order for mailing and publication dated April 2, 1962 the applicants were directed by order of the Commission to mail a copy of the

notice of hearing to each person interested in any land affected by the proposed abandonment of Horlick's Dam. After review of an engineering firm's report entitled, "Backwater and Flood Conditions Upstream from Horlick's Dam on the Root River, Racine County" (item C of the record), it develops that there is a substantial number of upstream riparian owners whose land would be affected by the proposed abandonment of the dam. The affidavit of mailing submitted by applicants does not include all of them.

Conclusions of Law

THE COMMISSION CONCLUDES:

1. That proper and sufficient notice of hearing was not given to property owners affected by the proposed abandonment.

2. That an order should be issued dismissing the application herein, without prejudice.

Order

THE COMMISSION THEREFORE ORDERS:

That the application herein for a permit to abandon Horlick's Dam be and hereby is dismissed without prejudice.

Dated at Madison, Wisconsin, this 13th day of April, 1964.

By the Commission.

John D. Goetz

Acting Secretary

Exhibit F

FORM 3500-23

Department of Natural Resources
INTRA-DEPARTMENT
MEMORANDUM

SOUTHEAST DISTRICT
Station

Date 12 SEPTEMBER 1975

IN REPLY REFER TO: 3560
3-WR-1874

TO: Water Regulation Section

FROM: P. S. HAUSMANN

SUBJECT: Water and Shoreland Management Investigation, RACINE County

Location NW 1/4, NE 1/4, Sec. 6, T 3 N, R 23 (E)(W) CITY OF RACINE

Date of Investigation 12 SEPTEMBER 1975

Name of Water ROOT RIVER ( ) Lake ( ) Flowage (✓) Stream

Applicant's Name C. & R. HORLICK / C.W. KORNDOERFER Street Address 4025 NORTHWESTERN AVE. / 3333 MICHIGAN BLVD.

City & State RACINE, WI 53406/53403

Applicant contacted during inspection: Yes ____, No X

Water Mgt.: Trout: Yes __ No ✓ Species L. TROUT - SPECIES BELOW DAM TO LAKE MICHIGAN Class 1, 2, or 3
Muskie: Yes __ No ✓ Class A, B, or C (Circle One)
Other: (List and indicate relative abundance): FORAGE & ROUGH

Nature of Proposed Project: (Check one or more)

- ____ Channelization
- ____ Dam Construction
- ____ Dredging
- ____ Dugout Pond: Pond (is)(is not) within 500' of navigable water
- ____ Other (describe): TRANSFER & RECONSTRUCTION OF DAM
- ____ Diversion
- ____ Sand Blanket
- ____ Structure

Description of area prior to proposed alteration (adjacent to dugout pond):

LAKE ( ) FLOWAGE ( )

Surface area (acres) ____

Depth (ft.) Max. ___ Avg. ___

Depth (ft.) in area to be altered ___

Public access: (None) (Public Ramp)

(Nav. Water) (Proposed) Other: ___

If available, attach lake survey map showing area in detail to be altered.

STREAM:

Total length (miles) 32.6

Dimensions at site of proposed alteration:

Width 120 ft. Depth 2 ft. Length ___

Flow in cfs 8.4 Date 12 SEPT. 1975

Flow was: estimated - metered - floating chip (circle one) - U.S.G.S. STAGE RECORDER STATION 04087240

Navigable: Yes X No ___

If no, explain why: ____

10-74

FLOWAGES, LAKES AND STREAMS: (Data for area of proposed alteration)

Bottom types (%) UPSTREAM - SILT OVER ROCK OUTCROPPING DOWNSTREAM - ROCK OUTCROPPING

Vegetation (types and abundance) AQUATIC - NONE TERRESTRIAL - GRASSES, WILLOW, ELM, BOX ELDER, OAK, SHRUBS

Present public use (hunting, boating, etc.) BOATING & FISHING.

Game values (beaver, muskrat, ducks, etc.) DUCKS

Fish spawning area (list species) N.A.

Present land use (within 300 ft. of shoreline) COMMERCIAL - WEST BANK RESIDENTIAL - EAST BANK

Bank stability (✓) stable ( ) unstable - describe:

EITHER WELL STABILIZED AND VEGETATED EARTH BANKS OR VERTICAL ROCK WALLS.

Describe spoil deposition area if applicable: N.A.

Scientific Areas Preservation Council Interest: Yes ____ No X

State Historical Society Interest: Yes ____ No X

Aesthetic Values: (Describe setting of the area, its unique attractiveness, if any, and how this may be enhanced or damaged by the proposed project.)

AREA IS ADJACENT TO MOTEL AND S.T.H. 38 ON WEST BANK, RESIDENTIAL AND ENVIRONMENTAL CORRIDOR ON EAST BANK. PROJECT WILL CREATE LARGER DAM POOL THAN NOW PRESENT BUT SHOULD DAMAGE AESTHETICS OF THE AREA.

SPECIAL ENVIRONMENTAL CONSIDERATIONS: Consider the ecological diversity of the area and the contribution this diversity makes to the health and stability of the lake or stream involved. View the site of the proposed work as a part of a complex interrelated and interdependent system of production, consumption, purification, and decomposition and decide if and how the proposed alteration would affect this system and thus damage or enhance the biological life support system of the lake or stream, in part or whole.

THE PROJECT WILL CREATE A LARGER HEAD POOL THAN HAS EXISTED IN LAST DECADE. POND ~~WILL~~ MAY BECOME STAGNANT DURING LOW FLOW YEARS AND WILL ACT AS A SEDIMENT TRAP. INCREASED POND ELEVATION WILL FLOOD SOME SEMI-AQUATIC VEGETATION ON FORMERLY EXPOSED RIVER BOTTOM & BANKS. PROJECT AS WHOLE SHOULD NOT GREATLY EFFECT THE TOTAL HEALTH & STABILITY OF THE ROOT RIVER.

FLOOD PLAIN AND SHORELAND ZONING CONSIDERATIONS

Zoning classification of project site COMMERCIAL - RESIDENTIAL - PRINCE CORRIDOR

County - Town - City or Village permit (is) (is not) required.

There (is) (is not) a conflict with floodplain-shoreland development standards contained in Chapters NR 115 and NR 116, Wisconsin Administrative Code. (Explain)

FLOOD HAZARD MAPPING BASED ON DAM BEING RESTORED AS THIS PROJECT PROPOSES.

Additional Data Required:

____

____

REVIEW ORIGINAL APPLICATION FOR ACCURACY:

Name of water correct according to waters inventory report? YES

Legal description of project site correct? YES

Names of adjacent property owners complete? YES

Other errors or omissions observed in application - give details:

____

Permit required? Yes ✓ No ____

Any objection to proposal? Yes ____ No ✓

Specific objection, if any, in detail below with any other comments relevant to the proposal.

State opinions regarding impact of project as proposed on environment and adjacent property owners.

PROJECT SHOULD HAVE MINIMAL IMPACT ON ENVIRONMENT AND ADJACENT PROPERTY OWNERS. NEW LEVEL ON DAM WILL RECLAIM SOME RIVER BOTTOM AND BANKS WHICH HAVE NOT BEEN FLOWED IN YEARS.

Name of Investigator(s) S. Hausmann, R. Roden, H. Meier

By:

Area Fish Manager	Date	Area Warden	Date
Area Game Manager	Date	Water Mgt. Inv.	Date
		[signature] Hausmann	12 September 1975

Note: Submit one original and two copies to District Headquarters. Keep copies as needed for your files.