RECOMMENDATIONS OF VARIOUS WRITTEN REPORTS PERTAINING TO THE YAHARA LAKES

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INTRODUCTION

This document is intended to capture the recommendations of various reports, articles and guides that discuss the Yahara Chain of Lakes. In addition, key words are tabbed to the right of the recommendations as a quick reference for specific subjects. Keywords include: Aquatic plant; Bacteria (no instances found); Chloride; Erosion; Eutrophication; Fishery; Flooding; Groundwater; Infiltration; Invasive species; Manure management; Nonpoint source; Nutrients; Phosphorus; Rain garden; Road salt; Sediment; Stormwater; Street sweeping; Water clarity; Water levels; Water quality; and Wetland restoration.

Only the texts of the recommendations in this document were searched for the keywords.

Abbreviations:

Capitol Area Regional Planning Commission: CARPC

Dane County Regional Planning Commission (predecessor to CARPC): DCRPC

Madison Metropolitan Sewerage District: MMSD

United States Geological Survey: USGS

UW-Madison Gaylord Nelson Institute for Environmental Studies; Water Resources Management Workshop: WRM Workshop

Wisconsin Department of Natural Resources: DNR

Wisconsin Department of Agriculture, Trade & Consumer Protection: DATCP

Wisconsin Geological & Natural History Survey: WGNHS

As much as possible reports are organized with large-scale reports and plans listed first; for example, reports or plans mandated by federal legislation such as the Clean Water Act. More specific, focused reports are listed next; and finally, reports that I was unable to find online using a search engine. In addition, only the most recent version of reports that must be regularly updated are included; for example, the Dane County Water Quality Plan has been updated since 1979; only the most recent version is listed here.

Study Title & URL	Author, Agency, Date	Recommendations	Keywords
Dane County Water Quality Plan http://www.capitalarearpc.org/publications.htm	Kamran Mesbah, DCRPC, September 2004	Required by the federal Water Pollution Control Act of 1972; the first plan was adopted in 1979, and updated every five years since. It is the official area-wide water quality management plan for Dane County. Chapter 4 includes information on stream and shoreland management, lake management, and groundwater management. All units of government should be proactive in the preservation and conservation of aquatic natural resources while promoting environmentally sound development. **STREAM AND SHORELAND MANAGEMENT RECOMMENDATIONS** S–1: The environmental and open space corridors illustrated on the Regional Development Plan Map should be adopted and incorporated into the plans, land use controls, and resource protection programs of all units of government in Dane County. The corridor system should be adopted as the basic skeleton or framework to promote community-wide and countywide open space and resource protection networks, and should be expanded to include additional needed lands and resources. S–2: Wetlands, steep slopes, buffer strips, and wooded areas in or near water bodies should be protected from development or adverse impacts through regulation or acquisition. Restore these areas where possible. S–3: Management agencies should endeavor to increase or maintain functional values of wetlands regardless of size, especially in urban settings where they have multiple functions. Restore farmed or prior-converted wetlands where possible. S–4: Park and open space land acquisition policies in Dane County should continue to place priority on acquisition of water-oriented parks, water-related resource protection areas, and public access. S–5: Enhance and promote the role of woodlands and hillsides in protecting water quality and hydrologic functions, such as groundwater recharge, through woodland management and protection plans, and financial incentives. S–6: Adequate vegetative cover and buffer strips to protect and stabilize the shoreline and stream corridor functions should be included in land use and development plans, controls or regulations. S-7: Support the efforts of watershed and conservation groups to protect and improve water resources. S-8: Work with lake, watershed, and conservation organizations to promote and install conservation buffers along intermittent and perennial streams, wetlands, ponds, and lakes through easements, land acquisitions, and voluntary cooperation from land owners. S-9: Municipalities should take advantage of federal, state, and private funding opportunities to implement streambank and in-stream habitat restoration, as well as increase public access along surface water areas. S–10: An ongoing program of monitoring stream water quality conditions, use suitability and limitations, and corridor evaluation should be supported and conducted by the Wisconsin Department	Aquatic plant, flooding, groundwater, phosphorus, water quality

		of Natural Resources, Dane County, and local management agencies. S-11: Maintain and enhance the designation of all current Outstanding Resource Waters, Exceptional Resource Waters, Class I and Class II trout streams, and promote the improvement of impaired water bodies so they can be removed from the 303(d) list. S-12: Participate and support the development of a water body classification System for Dane County waters. S-13: Municipalities in which sewer service area boundary expansions are requested should review and revise existing floodplain zone maps to accommodate potential hydrologic modifications. S-14: Management agencies should endeavor to prevent development that would increase the potential for flood-related problems. Promote implementation of the Dane County Flood Mitigation Plan. S-15: Cities and villages should consider regulating their shoreland through conformance with county or model ordinances for shoreland protection – whichever are more protective – even though they are not required to regulate shorelands other than wetlands under NR 117. S-16: All units of government should be proactive in the preservation and conservation of aquatic natural resources while promoting environmentally sound development. **LAKE MANAGEMENT RECOMMENDATIONS** L–1: Dane County should continue to provide sufficient funds and personnel for mechanical weed harvesting and other environmentally sound aquatic plant management programs. Harvested weeds should continue to be recycled to land as mulch, fertilizer and soil conditioner rather than disposed in landfills. L–2: The use of chemicals for control of aquatic plants should continue to be limited to shallow water areas where other suitable management alternatives do not exist, and should be supervised by the Wisconsin Department of Natural Resources. Chemical treatment should be prohibited in sensitive lake areas identified by the DNR. L–3: Dane County should research and evaluate flow and lake level management strategies for the Yahara River lakes as a series of multipurpose reservoirs, and develop optimal operating and outflow/lake level control rules for the entire Yahara River system. L–4: Dane County should work with other units of government to finance and develop a Yahara River Watershed rainfall/runoff model to help mitigate the impact of flooding and drought conditions. L–5: Dane County should conduct a countywide study of dredging needs and associated problems of recreational navigability. L–6: Dane County should continue to develop and maintain active shoreline cleanup, improvement and maintenance programs aimed at reducing shoreline erosion and loss of riparian lands, and improving the aesthetics and stability of shorelines. Dane County should	

		continue to coordinate an annual volunteer lakeshore cleanup event on all the Yahara River lakes and other county lakes where interest exists. L–7: Dane County should continue the long-term program of monitoring indicators of lake conditions on the major lakes in Dane County. L–8: Management agencies responsible for lakeshore parks and beaches should continue to conduct frequent monitoring at beaches throughout the swimming season to ensure conditions are safe for water-contact recreation. L–9: Continue to explore, evaluate, and promote promising in-lake management techniques such as biomanipulation of the food chain, improved fisheries and lake level management, phosphorus inactivation, hypolimnetic pumping, re-establishment and management of more desirable and diversified aquatic plant communities, lake drawdown, dredging, etc. L–10: Conduct information and education about lake management and water quality issues along with other water quality information and education programs aimed at landowners, residents, citizens, and lake users. L-11: Educate and inform water users in Dane County about the threats by invasive and exotic aquatic species. L–12: Participate with other public agencies and private environmental and conservation groups to implement the recommendations contained in the Yahara Lakes Advisory Group (YLAG) Report. **GROUNDWATER MANAGEMENT RECOMMENDATIONS** G–1: All land use and siting decisions in Dane County should include evaluation of potential groundwater and hydrologic impacts. Incorporate and use the information, tools, criteria, and guidelines identified in the Dane County Groundwater Protection Plan, and coordinate with local agencies. Applicants for land use or siting approvals, such as zoning or subdivision approvals, site or development plan approvals, urban service area additions, or state, federal, or local land disturbance or discharge permit approvals, should provide sufficient information to allow the regulatory agency to evaluate the potential groundwater and hydrologic impacts of the proposed activity or development. Evidence of significant unaddressed or unmitigated groundwater or hydrologic impacts should provide the basis for withholding approval for the requested activity or development, or for requiring additional information to be submitted by the applicant before approval is granted. Compliance with state surface water and groundwater standards should be included in the evaluation along with hydrologic impacts. The guidelines and criteria listed in the table on page 62 should be used in conjunction with the groundwater contamination risk maps for preliminary screening and evaluating the potential impacts. G–2: State and local agencies should work cooperatively to develop wellhead protection programs to protect municipal water supplies, including adopting more stringent siting and land use regulations for potentially polluting activities in wellhead protection zones. The guidelines and criteria for using the groundwater contamination risk maps in the table on page 62 can provide a basis for these more	

		stringent land use and siting criteria in well protection zones. G–3: Conduct additional groundwater quality monitoring related to the impacts of closed landfills, barnyard and livestock waste storage, agricultural fertilizer and pesticide use, unsewered subdivisions, and land application of septage. G–4: Underground and above-ground storage tank monitoring and testing programs, and emergency spill response and cleanup programs should continue to be developed. G–5: Dane County should conduct an aggressive public information and education program to inform rural homeowners of proper use and maintenance of on-site waste disposal systems, along with information on well protection and disposal of household hazardous wastes. G–6: Inform and educate farmers, homeowners, and commercial businesses on safe handling of chemicals, including the vulnerability of groundwater to contamination and the tremendous difficulty and expense of restoring it to its original condition. Proper on-farm storage of fuel, pesticides, and fertilizers should receive greater emphasis. G–7: Provide rural homeowners information, guidelines, and contacts for testing their wells and drinking water supplies. G–8: Develop a strategy for the proper abandonment of unused wells. G–9: Measures should be taken to protect groundwater recharge areas and springs. Especially in urban areas, the adverse impacts of development on groundwater, including diversion through pumpage and sewerage, as well as loss of recharge due to expanded impervious area, are significant and should be mitigated to the maximum extent practical. G–10: State and local agencies should work together to develop a comprehensive groundwater information and education program.	
DANE COUNTY WETLANDS RESOURCE MANAGEMENT GUIDE http://www.capitalarearpc.org/publications.htm	Michael Kakuska, CARPC, May 2008	Groups wetlands into five categories (based on Bedford & Zimmerman, 1974, bottom) and provides wetland management strategies and tools to wetland losses and regain wetland function. Only two recommendations are mentioned: • Recommendations may also be included to maximize infiltration of rainfall in order to offset loss of groundwater recharge. • [Referring to ditch plugs] Current recommendations are to plug at least 150 feet of ditch if the soils are organic and 100 feet if soils are mineral.	Groundwater, infiltration
VISION 2020 LAND USE & TRANSPORTATION PLAN Part of the regional master plan for Dane County http://www.co.dane.wi.us/vis2020/2020home.htm	DCRPC, 1997	Includes numerous recommendations, most of which relate to land use and transportation issues. While important to water quality, these recommendations are not central to this document and are not copied here. In particular, see Chapter 5, Implementation Recommendations for additional information: http://www.co.dane.wi.us/vis2020/pdf/2020c5.pdf	Water quality
TRANSIT SUPPORTIVE LAND USE STUDY ("TRANSPORT 2020")	City of Madison Planning, Dane County Planning, Wisconsin	Includes numerous recommendations, most of which relate to land use and transportation issues. While important to water quality, these recommendations are not central to this document and are not copied here. For additional information:	Water quality

http://www.transport2020.net/publications.html	Department of Transportation, 2007	http://www.transport2020.net/publications/LU_Report.pdf	
DANE COUNTY GROUNDWATER PROTECTION PLAN [Referred to as Appendix G of the Water Quality Plan (above); not available online.]	DCRPC, 1999	Describes existing groundwater quality data, identifies sources of concern, describes existing management activities and recommends additional strategies to protect groundwater quality. The Water Quality Plan (above) includes these recommendations (in essence, if not specific wording).	Groundwater, water quality
DANE COUNTY REGIONAL HYDROLOGIC STUDY The 2004 Modeling and Management Program http://www.capitalarearpc.org/publications.htm	DCRPC, MMSD, various towns, villages & cities, and WGNHS, 2004	The first Dane County Regional Hydrologic Study was started in 1992 and completed in 1997. This report summarizes groundwater monitoring and modeling results for 2004. This inter-agency management program allows local management agencies to annually update the groundwater database, to refine and improve the ground and surface water computer models, and to use the models for water resources management and impact evaluations. (*Study*, p. 1)	Groundwater
SIMULATION OF THE RECHARGE AREA FOR FREDERICK SPRINGS, DANE COUNTY, WISCONSIN http://wi.water.usgs.gov/pubs/wrir-00-4172/wrir-00-4172.pdf	R.J. Hunt and J.J. Steuer, USGS, 2000 (USGS Water-Resources Investigations Report 00–4172)	Frederick Springs is a large spring complex that feeds into Pheasant Branch Creek within a mile of its outlet into Lake Mendota. This study modeled the spring recharge area using 200 model runs of a telescopic mesh refinement (TMR) model. The model runs indicate that the groundwater shed and surface watershed do not coincide.	Groundwater
DANE COUNTY WATER BODY CLASSIFICATION STUDY PHASE I **HTTP://WWW.DANEWATERS.COM/MANAGEMENT/WATER_BODY_CLASSIFICATION.ASPX**	Michael Kakuska, DCRPC, March 2005	Goals and objectives identified for the first phase of the Water Body Classification Study: - Provide the scientific basis for developing a mix of regulations, incentives, education, cost-sharing, acquisition and other policy approaches appropriate for each water body type, quality of the resource, level of urbanization and potential land use impacts - Provide basic information about the types, vulnerabilities, condition and restoration potential of the navigable waters in Dane County - Coordinate with the county's Comprehensive Plan development - Provide the basis for fair and consistent treatment of riparian landowners under different jurisdictions Promote a deeper understanding of the current condition of Dane County waters and provide for more effective management to improve water quality, natural habitat, the ecological health of Dane County waters, and shorelands	Water quality

DANE COUNTY WATER BODY CLASSIFICATION STUDY PHASE II (Shoreland and Riparian Management Plan) http://www.danewaters.com/management/water_body_classification.aspx	Michael Kakuska, CARPC, **January 2009 DRAFT**	**Rural Waters Recommendations** a) Goals & Objectives (1) Protect existing natural resources and their ecological function. Supporting objectives: (a) Maintain pre-development diversity and protect endangered and threatened species. (b) Maintain pre-development hydrology and recharge (c) Preserve or restore high quality, native vegetative buffers of at least 100 feet in width for each rural water body, or provide for equivalent protection of native riparian habitat. (2) Maintain Rural Waters conditions over the long term. Supporting objectives: (a) Seek to prevent future reclassification of Rural Waters into Developing or Urban categories based on changes in development. (3) Minimize human impacts to prevent degradation. Supporting objectives: (a) Mitigate 100% of the sediment and infiltration impacts of new impervious surfaces within 1000 feet of rural lakes & ponds, and within 300 feet of rural rivers and streams. (b) Minimize runoff from existing and new developments. (c) Reduce pollution and runoff associated with development. (d) Reduce pollution and runoff associated with agricultural uses. (4) Provide for low-impact, sustainable recreational use and aesthetic enjoyment. Supporting objectives: (a) Provide opportunities for recreational use, such as fishing, low impact motorized and nonmotorized boating, hunting, hiking and wildlife observation. (b) Establish design and landscaping guidelines that minimize visual intrusions into natural landscape. **Developing Waters Recommendations** a) Goals & Objectives for Developing Waters: (1) Protect and enhance existing natural resources. Supporting objectives: (a) Protect highest quality watershed elements of each waterbody. (b) Restore or re-establish fully functioning ecological systems, where possible. (c) Protect or re-establish a predominately native buffer of at least 75 feet in width for each Developing Water body, or provide for equivalent protection and restoration of riparian habitat. Vegetative buffers should consist of non-invasive and predominately native species and include only limited breaks in the buffer necessary for viewing and riparian access to the water. (d) Maintain, restore or enhance infiltration, recharge and hydrology to maintain or improve current conditions. (2) Maintain or improve Developing Waters conditions over the long term. Supporting objectives:	Flooding, infiltration, sediment, stormwater, water clarity, water quality

		(a) Seek to prevent future reclassification of Developing Waters into Urban Waters based on changes in development. (b) For Developing Waters that have been identified as "potentially restorable," take active steps to work with private and public riparians to re-establish or enhance Rural Waters conditions, where possible. (3) Reduce or mitigate human impacts to: • prevent further degradation; • improve conditions, where possible, and; • prevent downstream impacts to Rural Waters. Supporting objectives: (a) Maintain and retrofit, as necessary, to meet current county stormwater standards for new residential development. (b) Rehabilitate specific environmental or ecological functions, addressing the most serious impacts first. (c) Limit new impervious surfaces and find opportunities to remove existing impervious cover. (d) Manage and reduce specific impacts of rapid development and urbanization, including: • Increased pollution and sediment loading; • Changes to and variability of runoff volume; • Loss of infiltration; • Reductions in baseflow, and; • Loss of in-stream, shoreland and watershed habitat. (e) Reduce pollution and runoff associated with agricultural uses. (4) Provide for appropriate, sustainable recreational use and aesthetic enjoyment Supporting objectives: (a) Increase amenity value and provide opportunities for appropriate recreational use, such as sport fishing, swimming, non-motorized and low-horsepower boating, hiking, picnicking, etc. (b) Establish design and landscaping guidelines that result in development that harmonizes with natural elements of the landscape and protects significant viewsheds. **Urban Waters Recommendations** a) Goals & Objectives (1) Improve water quality and near-shore habitat. Supporting objectives: (a) Enhance ecological function where possible. (b) Manage to restore or emulate lost environmental functions and values where feasible. (c) Maintain, restore or enhance infiltration, recharge and hydrology to maintain or improve current conditions. (2) Reduce or mitigate human impacts to: prevent further degradation, improve conditions (where possible) and prevent downstream impacts to rural or developing waters.	

		Supporting objectives: (a) Maintain and retrofit, as necessary, to meet current county and NR 151 stormwater standards. (b) Prevent flooding, reduce flood damage and reduce water quantity impacts. (c) Encourage development meeting or exceeding existing stormwater and shoreland zoning standards to reduce water quality impacts. (d) Rehabilitate specific environmental or ecological functions to the extent possible, addressing the most serious impacts first (e) Reduce pollution and runoff associated with development (f) Find opportunities to replace existing impervious cover with pervious substitutes. (3) Manage waters and public shorelands for multiple, appropriate, sustainable recreational uses. Supporting objectives: (a) Minimize conflicts among, and reduce environmental impacts of, multiple recreational uses. (b) Promote and develop land-based recreational use along waterway corridors, such as bike paths, linear parks, etc. (4) Improve aesthetics and amenity value. Supporting objectives: (a) Preserve shoreland parks and ensure visual and functional integration of urban and recreational development with the natural landscape. (b) Protect significant viewsheds and minimize visually disruptive or intrusive uses near the shore. (c) Create and enhance relationships between waters and residents, develop urban waterfronts and water-related recreation in appropriate locations, and establish attractive pedestrian connections from neighborhoods to activities in or near shorelands. (d) Reduce solid waste and odors, eliminate artificial mosquito habitat, encourage mosquito predators and improve water clarity. In addition, this report includes recommendations for watershed management, public land acquisition & management, public infrastructure, an incentive program, and education & outreach.	
THE LOWER ROCK RIVER WATER QUALITY MANAGEMENT PLAN ***HTTP://DNR.WI.GOV/ORG/GMU/LOWERROCK/SURFACEWATERFILES/WATERSHEDS.HTML*** ***INCLUDES FIVE WATERSHEDS THAT ARE INCLUDED IN THE YAHARA LAKES LEGACY PARTNERSHIP PROJECT AREA: SIX MILE/PHEASANT BRANCH, YAHARA RIVER/LAKE MENDOTA, YAHARA RIVER/LAKE MONONA (INCLUDING LAKES WINGRA AND WAUBESA AND UPPER MUD LAKE), YAHARA RIVER/LAKE KEGONSA (INCLUDING LOWER MUD LAKE), AND BADFISH CREEK. MAIN AUTHOR, RUTH JOHNSON, DNR, 2001***			
THE YAHARA RIVER/LAKE KEGONSA WATERSHED (LR06) http://www.dnr.state.wi.us/org/gmu/lowerrock/surfacewaterfiles/watersheds/yaharakegonsa.pdf	Ruth Johnson, DNR, 2001	**RECOMMENDATIONS** The recommendations for the Yahara-Kegonsa watershed were developed using previous DNR and other planning agency plans, which were reviewed and augmented through a public participation meeting in Stoughton on Nov. 29, 2000 (Appendix D). The recommendations are grouped according to	Erosion, sediment, stormwater, water clarity, water quality, wetland

		the four objectives of the DNR: making people our strength, sustaining ecosystems, providing outdoor recreation, and protecting public health and safety. **Making People Our Strength** 1. The Lower Rock River Team should expeditiously seek to resolve the Stebbinsville Dam issue and if appropriate, restore the millpond and include fish passage in the dam if it is repaired. 2. The Lower Rock River Team should work with the Dunkirk Lake District. 3. The Lower Rock River Team should work with the Dunkirk Dam Association to cooperatively put fish passage in the Dunkirk Dam. 4. The Department should work with local groups, drainage districts, and Dane County to evaluate existing drainage through Door Creek, especially at the mouth of the Creek and take appropriate measures to maintain drainage. 5. The Lower Rock River Team should increase public education on fertilizers and non-point source pollution. 6. The Lower Rock River Team should proactively advise property owners in the watershed of federal conservation programs such as the Wetland Reserve Program. 7. The Lower Rock River Team should work with local municipalities to ensure that conservation erosion ordinances are followed. 8. The Lower Rock River Team should promote coordination of municipalities in the watershed. 9. The Lower Rock River Team should work with municipalities within the watershed to establish a hotline for runoff problems. 10. The Lower Rock River Team should work with the Dane County Land Conservation Department (LCD) to minimize soil runoff from agricultural fields and construction sites. 11. The Lower Rock River Team should work with municipalities to and government programs to establish protective buffers around lakes and streams in the watershed. 12. The Department should work with municipalities to implement Smart Growth legislation. 13. The Lower Rock River Team should work with engineering firms and planners to implement innovative stormwater controls in the watershed. 14. The Friends of Lake Kegonsa, with the assistance of the DNR, Dane County Lakes and Watershed Commission and Dane County Regional Planning Commission, should continue to apply for Lakes Management Grants to investigate and abate sediment and nutrient loading to the lake. This effort should be concentrated along the west and north shores, and to evaluate the impacts of the loadings on water quality and recreational uses in Lake Kegonsa. **Sustaining Ecosystems** 15. The Lower Rock River Team should re-evaluate the water level for Lake Kegonsa to balance the needs of recreational, biological and drainage interests in the watershed. 16. The Lower Rock River Team should re-evaluate the water level orders on the Yahara River Dams to	restoration

		ensure coordinated flow and water level regime in the watershed. 17. The Lower Rock River Team should study the dams in the watershed. 18. The Lower Rock River Team should work with Dane County to implement the Door Creek Wetland Protection Plan. 19. The Department should remove the berms between the Door Creek channel and the wetlands. 20. The Lower Rock River Team should evaluate the flora and fauna and identify Endangered and Threatened Resources. 21. The Lower Rock River Team should ensure that fish passage occurs throughout the watershed. 22. The Lower Rock River Team should improve fish habitat structures within the watershed. 23. The Lower Rock River Team should promote commercial harvesting of rough fish in the watershed. 24. The Lower Rock River Team should promote increased forest and grassland acreage in the watershed. 25. The Lower Rock River Team should promote conservation of groundwater in the watershed. 26. The Lower Rock River Team should promote protection of groundwater recharge through land use planning. 27. The Lower Rock River Team should improve water quality in Lake Kegonsa, Door Creek, and Little Door Creek. 28. The Department should promote self-help monitoring in the watershed, especially on Lake Kegonsa. Water clarity of the two main bays along the west shore and the central part of the lake should be monitored on Lake Kegonsa. 29. McFarland and Stoughton should aggressively enforce construction site erosion control ordinances. 30. The Lower Rock River Team should evaluate returning MMSD diversion to the Upper Yahara River. 31. The Lower Rock River Team should improve water quality in the watershed. 32. The Lower Rock River Team should acquire lands for waterfowl production and wetland restoration. 33. The Lower Rock River Team should conduct appraisal monitoring of Gibbs Lake and its watershed to assess specific sources of runoff pollution contributing to water quality problems. 34. The Lower Rock River Team should do a stream classification study on Door Creek to determine its formal stream classification and existing biological uses. **Providing Outdoor Recreation** 35. The Lower Rock River Team should work to assure that there is adequate parking adjacent to public lands. 36. The Lower Rock River Team should work with the Lakes and Watershed Commission and Dane County to support no-wake opportunities on the lakes and rivers in the watershed. 37. The Lower Rock River Team should promote non-invasive public access such as bike paths when lands are acquired.	

		38. The Lower Rock River Basin Team and other DNR staff should work with the Dane County Regional Planning Commission to evaluate acquisition of additional wetlands adjacent public holdings in the Door Creek wetlands area. This effort is consistent with a recently awarded lakes planning grant for a comprehensive Door Creek Wetlands Resource Protection Plan. 39. The Lower Rock River Team should assist other agencies in providing public access along the north shore of Lake Kegonsa, linking Fish Camp Launch with Lake Kegonsa State Park. **Protecting Public Health and Safety** 40. The Lower Rock River Team should conduct trend monitoring for toxicants in fish in Lake Kegonsa. 41. The Lower Rock River Team should undertake sediment monitoring for toxicants in the flowage above the Dunkirk Dam on the Yahara River. 42. The Lower Rock River Team should promote wellhead and source water protection planning. 43. The Lower Rock River Team should promote proper well abandonment. 44. The Lower Rock River Team should promote proper nutrient and pest management.	
BADFISH CREEK WATERSHED (LR07) http://www.dnr.state.wi.us/org/gmu/lowerrock/surfacewaterfiles/watersheds/lr07.pdf	Ruth Johnson, DNR, 2001	**RECOMMENDATIONS** 1. The Madison Metropolitan Sewerage District (MMSD) should continue its monitoring program in upper and lower reaches of Badfish Creek, the Yahara and Rock rivers. 2. The Lower Rock River Basin Team and Dane County Land Conservation Department should conduct water quality monitoring and land use appraisal in the Rutland Branch sub-watershed to determine the source(s) of pollution. 3. WDNR and stakeholders should work together to purchase, with the Stewardship Fund or other sources, the major springs of the Rutland (Anthony) Branch to protect its high water quality and regionally unique trout habitat. 4. The Lower Rock River Basin Team with the U.S. Fish and Wildlife Service, Dane County, and conservation groups, should evaluate the land in the Frogpond Creek headwaters for purchase under the Stewardship Fund to enlarge and protect the stream's buffer areas (via Waterfowl Production Areas) and adjacent land. 5. The Department of Corrections should work with the Lower Rock River Basin Team to apply for a Lakes Program Protection Grant to purchase and construct fencing to eliminate shoreline grazing around Lake Barney, which would enhance water quality and protect habitat. 6. The Department of Corrections should work with the Lower Rock River Basin Team to restore riparian vegetation and develop nesting boxes on lake in conjunction with wildlife management on Lake Barney. 7. The Lower Rock River Basin Team with the cooperation of Dane County and local conservation groups, should evaluate the Lake Barney wetlands complex for purchase under the Stewardship Fund or a Lakes Protection Grant.	Stormwater, Water quality

		8. The Lower Rock River Basin Team should evaluate property along Spring Creek for possible easements or purchase under the priority watershed project. 9. WDNR should designate Hook Lake as an Exceptional Resources Water. 10. The Lower Rock River Basin Team should evaluate additional land around Hook Lake for possible purchase under the Stewardship Fund or a Lake Program Protection Grant to buffer and preserve this significant wetland complex. 11. WDNR should consider reclassifying Spring Creek if proposed stream classification guidelines are passed. 12. The Village of Oregon should upgrade their ordinance to be consistent with the technical provisions of the Dane County Ordinance Chapter 14. 13. WDNR Division of Water staff should not issue new permits that would negatively affect the Rutland Branch springs system. 14. The Village of Oregon, with the assistance of Dane County Regional Planning Commission, Dane County Land Conservation Department and WDNR should develop a comprehensive stormwater management plan and ordinance.	
THE YAHARA RIVER/LAKE MONONA WATERSHED (LR08) http://www.dnr.state.wi.us/org/gmu/lowerrock/surfacewaterfiles/watersheds/lr08.pdf	Ruth Johnson, DNR, 2001	**RECOMMENDATIONS** *Dane County Regional Planning Commission has developed specific nonpoint recommendations for communities in Dane County in the Yahara Monona Priority Watershed Project Plan (1992). This list should also be considered by communities when planning water quality work and budget items.* 1. The Lower Rock River Basin Team should conduct fish monitoring in Lake Waubesa, the Yahara River, and Lake Monona for mercury. 2. The Lower Rock River Basin Team should monitor carp in the watershed for PCBs. 3. The Lower Rock River Basin Team should conduct additional sediment core sampling in Lake Monona and Lake Waubesa to identify possible trends in PCB contamination. 4. The Lower Rock River Basin Team should conduct a more complete assessment of inplace pollutants in Monona Bay by expanding sediment sampling to areas not previously sampled. 5. The Lower Rock River Basin Team, Dane County, the cities of Madison and Monona, and the village of McFarland should consider a project to supplant exotic rooted aquatic plants with native species in Lakes Monona and Waubesa. 6. The cities of Madison, Monona and Fitchburg, and Dane County, should improve enforcement of their construction site erosion control ordinances. 7. Dane County should work with WDNR to establish water levels that accommodate northern pike spawning habitat and improved water quality on tributaries to the Madison Lakes. 8. Dane County and the city of Madison should expand upon Dane County's existing 200-foot no wake ordinance for Upper Mud Lake's open water and wetlands areas to improve water quality and maintain wetland functional values. 9. All communities in the watershed should develop and implement comprehensive stormwater	Aquatic plant, erosion, sediment, stormwater, water levels, water quality

		management plans that emphasize conservation design stormwater principles. 10. WDNR's Long-Term Trend lake sampling protocol should be used in the monitoring of lakes Monona and Waubesa. 11. The city of Fitchburg, with the assistance of the Dane County Regional Planning Commission, WDNR, the Wisconsin Geological and Natural History Survey, and the U.S. Geological Survey, should identify local groundwater recharge areas supporting the springs and seeps in the Nine Spring wetlands and develop strategies to protect these areas. 12. Dane County, the cities of Madison and Monona, and the village of McFarland should take advantage of federal, state and private funding opportunities to acquire additional public access and lands on Lake Monona, Upper Mud Lake and the Yahara River.	
YAHARA RIVER/LAKE MENDOTA WATERSHED (LR09) http://www.dnr.state.wi.us/org/gmu/lowerrock/surfacewaterfiles/watersheds/lr09.pdf	Ruth Johnson, DNR, 2001	**RECOMMENDATIONS** *Dane County Regional Planning Commission has developed a set of specific nonpoint recommendations for communities in Dane County. This list should be considered by communities when planning water quality work and budget items.* 1. The Lower Rock River Basin Team should make available nonpoint source funds, stewardship funds or Lake Protection Program grants to acquire wetlands, ephemeral ponds, and farmed and prior-converted wetlands to groups and communities in the DeForest and Arlington areas of the Yahara-Mendota Watershed. 2. The Lower Rock River Basin Team should work with Dane County to develop an aquatic plant management plan for Lake Mendota similar to efforts done on Lakes Waubesa and Monona. 3. The Lower Rock River Basin Team, Dane County, the Cities of Madison and Middleton, and the Villages of Maple Bluff and Shorewood Hills should consider planting rooted aquatic plants to speed up recolonization of native aquatic plants in Lake Mendota. 4. The Cities of Madison, Sun Prairie and Middleton and the Village of Deforest should upgrade their existing erosion control ordinances to be consistent with the technical provisions of the Dane County ordinance Chapter 14. 5. The City of Middleton should conduct comprehensive stormwater management planning. 6. Communities in the watershed should take advantage of Urban Riverway and other Stewardship Fund sources to acquire public lands along streams and lakes. 7. The Lower Rock River Basin Team, City of Sun Prairie and Dane County should develop a comprehensive plan to protect Token Creek Springs. This effort should address stormwater flows and identify, and recommend means to protect groundwater recharge areas that feed the springs. 8. The City of Middleton should develop a comprehensive stormwater management plan. 9. Dane County, the Cities of Madison, Middleton, and Sun Prairie and the Villages of DeForest and Waunakee should take advantage of federal, state and private funding opportunities to acquire additional public access and lands on Lake Mendota, Pheasant Branch Creek and wetlands, Sixmile Creek and wetlands, Token Creek and the Yahara River.	Aquatic plant, erosion, groundwater, nonpoint source, stormwater, water quality
SIX MILE & PHEASANT BRANCH CREEKS	Ruth Johnson, DNR,	**RECOMMENDATIONS**	Erosion,

WATERSHED (LR10) http://www.dnr.state.wi.us/org/gmu/lowerrock/surfacewaterfiles/watersheds/lr10.pdf	2001	*Recommendations for Lake Mendota will be found under the Yahara-Mendota watershed above. The Dane County Regional Planning Commission has developed a set of specific recommendations for polluted runoff abatement in Dane County communities. This list should also be considered by the communities when planning their water quality work and budget items.* 1. The University of Wisconsin should maintain responsible manure management on its campus and farms in the watershed. 2. The Lower Rock River Basin Team, with the assistance of the city of Madison, the village of Shorewood Hills, and the University of Wisconsin, should undertake sediment monitoring in Lake Mendota at the mouth of Willow Creek to determine if any toxic substances enter the lake via this stormwater channel. 3. The city of Middleton or a private group should do Self-Help monitoring on Stricker's, Tiedeman's and Graber ponds as a first step toward addressing water quality problems due to urbanization. 4. The Lower Rock River Basin Team, Madison, Middleton, and Dane County should develop a comprehensive watershed stormwater management plan for the Pheasant Branch drainage area. 5. Madison, Middleton and Dane County should improve enforcement of their construction site erosion control ordinances. 6. Madison, Shorewood Hills and the University of Wisconsin should work together to address the stormwater management concerns and problems in the Willow Creek drainage area. 7. The village of Waunakee and Dane County should vigorously enforce erosion control ordinances to protect the water quality of Six Mile Creek, particularly in the reach from and including Waunakee Marsh to Governor Nelson State Park. 8. The Lower Rock River Basin Team, city of Middleton and Dane County should develop a comprehensive plan to protect the Frederick Springs and Pheasant Branch Marsh. This effort should address stormwater flows and identify, and recommend means to protect, groundwater recharge areas which feed the springs.	groundwater, manure management, sediment, stormwater, water quality
DANE COUNTY LAND AND WATER RESOURCE MANAGEMENT PLAN http://www.countyofdane.com/landconservation/lwrmpubspg08.htm	Dane County Land Conservation Committee and Land Conservation Division, 2008	Provides resource assessment, goals, objectives and action items for Land Conservation Division; basically a strategic plan for division operations. Is required by Wis. Stats. §92.10 to receive staffing grants and cost-share funding from the DATCP Soil & Water Resource Management program.	
COMMUNITY MANURE MANAGEMENT FEASIBILITY STUDY http://www.countyofdane.com/landconservation/manurepg.htm	Strand Associates 2008	Examined the feasibility of community or individual farm based manure management alternatives for the area north of Lake Mendota. The following recommendations are provided to indicate what additional steps should be taken to further define how best to implement such a project. 1. Continue discussions and information exchange with area Dane County farmers to assess on-going interest and promote community solutions. 2. At the County level, determine what level of financial commitment is reasonable to invest in the additional planning, design, and ultimate construction of a manure management strategy.	Manure management

		3. At the County level, discuss and determine whether such a facility could or should be owned and operated by the County. This may be affected by the level of interest in ownership among farmers. 4. Conduct a Facility Planning Study to further refine and develop the scope of select alternatives and strategies included in this report with a focus on the alternatives that appear most viable (C-2W, C-3W, and C-5W). This includes identifying potential site locations, verifying manure quantities and other potential feedstocks, working with system vendors to develop preliminary layout(s) of alternatives and more accurate cost opinions (capital and O&M), and conducting a detailed analysis of overall manure management practices on the affected farms. The output of this study would include an overall recommended manure management strategy and associated costs, which could then be used to better define potential ownership of the facility, operation of the facility, and funding programs that could help finance a project to construct the facility. The Facility Planning Report would provide much better definition of the project and costs to provide to interested third-party technology developers, farmers, and County officials. 5. Define agronomic and related crop management impacts that would result from a manure management facility, and include such impacts in the facility planning analyses. 6. Continue to investigate funding and financing opportunities for manure management facilities. 7. Investigate potential GHG emission reduction credits in more detail and determine what additional steps are needed to obtain maximum credit for such a project. 8. Evaluate the capital and O&M costs from actual full-scale operations in the United States, and estimate how those costs may translate to a similar operation in Dane County.	
NONPOINT SOURCE CONTROL PLAN FOR THE LAKE MENDOTA PRIORITY WATERSHED PROJECT http://www.co.dane.wi.us/landconservation/papers/Lmw.pdf	DNR, DATCP, Dane County Land Conservation Department and Columbia County Land Conservation Department , 2000	Approved in 1997, this plan describes then-current conditions and practices in the watershed and lays out an overall goal of reducing phosphorus loading by 50% during the priority watershed period, ending in 2008. **Project Goals** The overall goal of the Lake Mendota Priority Watershed project is to protect, enhance, and restore the water quality of the streams, lakes, groundwater and wetlands in the 230 square mile drainage area. ***Lake Mendota Objective*** The water quality goal for Lake Mendota is to reduce the concentration of spring total phosphorus in the lake to less than 0.074 mg/L. Modeling results indicate that this concentration will result in a decrease in the concentration of blue-green algae to less than 2 mg/L during the summer months. This algal concentration generally represents the point at which algae form nuisance blooms (unsightly green water or surface scums). To achieve this goal, phosphorus input loading to the lake from its watershed must be reduced by about 50%, or 37,000 pounds annually. Given the current annual phosphorus loading, the likelihood on any given summer day of a nuisance algae bloom occurring is 50% of the time, or 1 out of every 2 days on average over a number of summers. With a 50% reduction in annual phosphorus loads to the lake, the likelihood of a nuisance algae bloom occurring is reduced to 20% of the time, which translates to no nuisance algae blooms 4 out of 5 days on average over a number of summers. In a year with high precipitation and hence high runoff into the lake, nuisance	Erosion, fishery, groundwater, manure management, nonpoint source, phosphorus, sediment, stormwater, street sweeping, water quality

		algal blooms would be more likely that summer, even with the implementation of recommended best management practices (BMPs). ***Sediment Objective*** To reduce overall sediment delivered to Lake Mendota from all sources by 50 percent. The following will need to be achieved: • Reduce sediment delivered to the lake from agricultural uplands by at least 1,648 tons, or 32 percent of the existing contribution from uplands. At a minimum, all landowners should reduce or maintain soil erosion on all cropland to tolerable ("T") soil loss rates, as calculated by the Universal Soil Loss Equation (USLE). All fields that are already at "T" may initiate a water management system to further reduce erosion rates. • Reduce streambank erosion by 50 percent through the implementation of streambank protection practices such as riprap, fencing, and shaping and seeding. Additionally, efforts will be used to maintain or develop stream woodland and grassland corridors by developing buffers that provide wildlife habitat, canopy, bank stabilization, and sediment reduction. • Reduce -sedimentation contributions from -existing urban areas by 40 %, from transitional areas by 70%, and from future urban areas by 80%. These reductions will be achieved by increased good housekeeping practices, such as street sweeping, and through the adoption of uniform construction site erosion control ordinances across all municipalities in Dane County. ***Phosphorus Objective*** To reduce overall phosphorus delivered to Lake Mendota by 50%, the following will need to be achieved: • Reduce phosphorus runoff from barnyards in the watershed by about 67 percent through clean water diversion and/or complete system improvement. • Promote nutrient management as an economically and environmentally sound practice within the watershed. • Reduce the phosphorus delivered to streams and ultimately the lake in the watershed from soil erosion in agricultural uplands by at least 32 percent. This can be achieved by reaching the sediment reduction objective. • Reduce phosphorus from existing urban areas by 20%, from transitional areas by 70%, and from future urban areas by 70% through practices used to reduce sediment loads to the lake. ***Groudwater Objective*** To protect and enhance the groundwater resource in the Lake Mendota watershed, the following objectives will need to be achieved: • Use nutrient management plans to reduce the over-application of commercial fertilizer and manure and the application of winterspread manure on unsuitable cropland. • Implement BMPs as appropriate to protect and enhance groundwater quality. The highest priorities for protecting groundwater resources from runoff pollutants are where wells exceed the	

		nitrogen standard of 10 mg/L. • Encourage proper abandonment of unused wells per NR 120 and NR 812, Wis. Admin Code. • Reduce over-application of pesticides. • Provide landowners with extensive informational and educational materials to promote awareness and to instill responsibility for the groundwater resource. • Use water conservation techniques to help decrease the flow of water out of the deeper aquifer and -over-use of the upper aquifer which may be more susceptible to contamination. **Restoration Objective** To restore or enhance streams and wetlands for fish and wildlife, the following have been identified as highest priorities in the watershed: • The wetland complex in the Pheasant Branch Creek Resource Protection Area. This resource should be enhanced as a northern pike spawning and rearing area. • The unnamed tributary of Token Creek that originates in Windsor Township and enters into Token Creek in Burke Township. This tributary has the potential of being restored from a Class III to Class H cold water fishery. • The reach of the Yahara River from Windsor Road upstream to the Village of DeForest. This section of the Yahara River is a priority for enhancement and protection of a warm water sport fishery. • Goose Pond, which should be enhanced and restored as a shallow lake and wetland system. • Token Creek which currently has a dam. If the dam is removed, the objective will be to restore the wetlands around the old lake bed to insure a water view shed for the all adjacent riparians, to trap sediment, and to provide habitat for nesting waterfowl and other wetland species. The numerous springs in the area should be protected to preserve the wetland complex. Native brook trout of a local genetic strain could be stocked which should thrive in the restored stream with its large amount of cold spring water. A minnow species that would originally have been found in the creek and would have been associated with the brook trout population could also be re-introduced • Establish or restore wetlands in 27 other priority areas as delineated in the inventory. **Community Education and Action Objective** To foster understanding of runoff pollution problems and promote participation in resource protection within the Lake Mendota watershed, the following will need to be achieved: • Translate the project goals into action items by identifying target audiences and designing a program to meet those goals by working with that audience. Target audiences are: the general audience--those who must act, those who can support, and future actors and supporters. The urban transition and established urban audiences are those involved directly in planning and developing the site, those involved-during implementation of the plan, and those that can support the development of the erosion control/stormwater management plans. The rural audiences are those involved directly with land management, those involved directly with livestock animals and manure management, those who work with landowners/operators and livestock operators, and	

		those involved in conservation courses/activities.	
DANE COUNTY PARKS AND OPEN SPACE PLAN 2006-2011 http://www.countyofdane.com/lwrd/parks/planning.aspx#open_space_plans	Dane County Parks and Open Space Advisory Committee 2006 (updated every 5 years since 1970)	This plan guides land acquisition and development, including trails. Plan recommendations are organized under these topic headings (only "Stream Corridor Protection & Management" recommendations are included here): • Regional Resource Protection Initiatives • Partner Projects • Recreation Parks • Natural Resource Areas • Forests • Regional Trails • Scenic Driving Corridors • Historical/Cultural Sites • Prairie and Oak Savanna Sites • Stream Corridor Protection and Management • Stream Eligibility and Designation Two stream categories were designated for inclusion into this plan, Tier I and Tier II. Streams were categorized using varying sets of criteria based on the designated biological use, current level of protection or enhancement and the likelihood of establishing conservation within the stream corridor. Tier I streams have one or more of the following attributes/designations: • Coldwater-high value from a biological and recreational standpoint. They support cold-water fish communities, and flow is supplied primarily from spring discharge. • Streams which have been enhanced or protected through an existing conservation program. Restoration or enhancement programs may include but are not limited to: Priority Watershed Projects, Targeted Resource Management, WDNR Habitat Projects, Natural Resource Conservation Service, and other nonprofit or conservation organization work. Most if not all have existing easements on them. Priority may be given to those streams/segments where easements have expired or will expire soon. • Streams which have been identified under the 303(d) designation resulting from non point source pollution or habitat degradation. • Streams classified as Outstanding Water Resources (OWR) or Exceptional Water Resources (EWR) by WDNR. • Streams identified as sensitive in the Dane County Water Body Classification Study. • Streams within the boundary of an approved Dane County Resource Protection Area Plan. Tier II streams have one or more of the following attributes/designations:	

		• Warm water streams that may exhibit a sensitivity to development or have the ability to be restored or enhanced through management actions. • Streams within the boundary of an approved Dane County Resource Protection Area Plan. • Streams identified in WDNR Basin Plans with "high" or "medium" designations for habitat improvement. **Program Area Recommendations** • Adult Conservation Team • Lussier Family Heritage Center • Cooperative Management Programs • Park Planning • Land Acquisition • Operations and Maintenance	
EVALUATION OF STREET SWEEPING AS A STORMWATER-QUALITY-MANAGEMENT TOOL IN THREE RESIDENTIAL BASINS IN MADISON, WISCONSIN http://www.cityofmadison.com/engineering/stormwater/documents/FinalReport1.pdf	William R. Selbig (USGS) and Roger T. Bannerman (DNR), 2007	**Summary & conclusions** As part of fulfillment of the Environmental Protection Agency National Pollution Discharge Elimination System (NPDES) Phase II permit, many cities nationwide will be required to reduce the amount of sediment entrained in runoff from entering receiving water bodies. Many structural controls, such as detention ponds, are available to help environmental managers meet the NPDES permit requirements. However, these practices typically require large tracts of land that may be expensive or simply unavailable in an urban setting. Street sweeping is a nonstructural control that could be used to remove sediment and sediment-associated constituents from street surfaces before they become entrained in runoff. Because most cities already have some sort of street-sweeping program, it is important to understand the stormwater-quality benefits of existing or modified programs. More information is especially needed about the street-dirt removal capabilities of newer street-sweeper technologies. To this end, the U.S. Geological Survey, in cooperation with the City of Madison and the Wisconsin Department of Natural Resources evaluated the performance of three street-sweeper technologies from 2002 through 2006. Specifically, this study examined the street-dirt-removal efficiencies and subsequent changes in stormwater-quality loads from basins where regenerative-air, vacuum-assisted, and mechanical-broom street sweepers operated on a frequency of once per week (high frequency). An additional mechanical-broom sweeper operating on a frequency of approximately once per month (low frequency) was also evaluated for street-dirt removal only. A paired-basin study design was used to compare street-dirt and stormwater quality samples during a calibration period (no sweeping) and a treatment period (weekly sweeping). The basis of this paired-basin approach is that the relation between paired street-dirt yields and stormwater-quality loads for the control and test basins is constant until a major change is made at one of the basins. At that time, a new relation will develop.	Sediment, stormwater, street sweeping, water quality

		Results show there is little probability that street sweeping, regardless of street-sweeper type, had any measurable affect on the quality of runoff. Street sweeping as a stormwater-quality-management tool appears to be limited by the extreme variability in stormwater quality loads. It might be difficult to isolate any changes in stormwater quality as a result of street sweeping because other factors might be affecting the movement and supply of constituents in the watershed. Examples of factors that might contribute to the high variability include the amount of sediment delivered from other source areas such as lawns and driveways, the efficiency of sediment delivery n the storm-sewer system, and the changes in the amount of sand applied to enhance vehicle traction each winter. With high variability in stormwater-quality loads, a much larger number of water samples would have to be collected in order to detect any significant change due to street sweeping. For example, an estimated 200 paired stormwater quality samples would have been required to detect a 25-percent change between the calibration and treatment periods. Only about 40 paired stormwater-quality samples were collected during this study. Although a significant change was not observed for most of the constituents, a significant change (at the 10-percent significance level) was detected for ammonia-nitrogen for the vacuum-assist sweeper in the air-sweeper basin. When the vacuum-assist sweeper was used, an increase in ammonia-nitrogen load of 63 percent was measured. Variability in street-dirt yields was not as great as that for stormwater-quality loads. The ability to physically reduce the amount of dirt present on a street surface, described in this study as sweeper efficiency, was measured by comparing street-dirt yields after a sweeper cleaned the streets in a basin to those measured before sweeper cleaning. Both the regenerative-air and vacuum-assist sweepers averaged removal efficiencies of 25 and 30 percent, respectively. . . The majority of street-dirt yield was measured during April and May of each study year. So in the spring, when the streetdirt yield was the highest, the street sweepers were somewhat more efficient. Street dirt during spring also appeared to be more uniformly distributed across the street surface than during the rest of the year. This is most likely due to residue from winter sand application. During the summer, 75 percent of the street-dirt yield is within 3 feet of the curb face. Therefore, street sweeping in spring might be more effective if the entire street is cleaned and not just the areas near the curb. . . Differences in sweeper-removal efficiencies could be attributed to the advancements in technology incorporated into each sweeper. . . Use of the regenerative-air and vacuum-assist sweepers resulted in the greatest reductions in average basin street-dirt yield of 76 and 63 percent, respectively. Use of the mechanical broom sweeper at high frequency resulted in a 20-percent reduction in average basin street-dirt yield. . .	

		If the amount of solids washed off the street is increased by the action of the street sweepers, the reduction in basin streetdirt yield could be a function of both the street sweepers' pickup efficiency and the increased effect of rainfall. The effect of rainfall is not considered when determining a sweeper's pickup efficiency. Furthermore, changes in washoff characteristics of street dirt could also have added to the difficulty in detecting any stormwater-quality benefits of street sweeping. One possible reason for this may be the mechanical action of the gutter brooms increasing the amount of fine particles on the street due to abrasion and the breakdown of larger particles. Because rain can more effectively remove small particles from the street rather than large particles, the amount of solids washed off the street may increase, negating any stormwater-quality benefits from street sweeping.	
STARKWEATHER CREEK MASTER PLAN 2004 UPDATE http://www.cityofmadison.com/engineering/stormwater/documents/starkweatherplan.pdf	City of Madison Engineering Division, Parks Division, 2005	**Summary of Recommendations** Bikepaths These recommendations pertain primarily to paved bike paths (typically 10-feet wide, conforming to established geometric and ADA standards). Paved walkways, intended mainly for pedestrians, are narrower than bike paths, and generally conform to sidewalk standards. Backbone Bike Path Routes Bike path planning in the watershed should focus on two "backbone" routes: West Branch path, beginning at the existing East Rail path near Wirth Park and extending 1.0 mile to the existing Starkweather path; and East Branch path, beginning in the same location and extending 3.5 miles to City View Drive, just east of I- 90. Both routes can be built in phases. [See plan update for specific recommendations] On Street Routes and Connectors On-street routes connect paths and provide bike connections to neighborhoods and important employment, recreational and educational destinations. Recommend further study of need for marked bike lanes and other safety measures, particularly as traffic increases. [See plan update for specific recommendations] Long Range Future Routes Recent coordination with Dane County Regional Airport indicate that there is not a feasible corridor for an off-street path west or north of the airport. Recommend additional planning to identify a combination of on-road improvements and separate path that would connect CTH CV with destinations north and east of the airport. Plans should include a future path between Hanson Road at USH 51 and Hoepker Rd. at I-90 (3E). Efforts should focus on preserving the corridor and constructing segments of the path in conjunction with private development. Parks Hiking Trails Natural Landscape Improvements Paved Walkways Olbrich Gardens from Atwood Ave. to OB Sherry Park: Build in conjunction with development of the Garver property including a pedestrian bridge into OB Sherry Park. Recommend exact location be	Infiltration, rain garden, sediment, stormwater

		determined by Parks as part of overall development plan for the park. East /West Branch confluence in O.B. Sherry Park to Dixon greenway: Recommend the walkway be located along the northeast bank of the West Branch in order to preserve the park and MG&E lands along the southwest bank for walking trails and habitat restoration. Major hurdle is the railroad crossing as there is not sufficient freeboard between the creek and the tracks to construct an underpass. Recommend short-range efforts to preserve the corridor Water Resources The most important aspect of this project is the need to build a coalition to support 15-20 years of improvements to the creek. City staff are strongly recommending that we continue to work with public interest groups, like the Friends of Starkweather Creek and the East Isthmus Neighborhood Planning Council, to ensure that this new master plan is implemented. The following list of non-monetary or low-cost initiatives were selected after evaluating the comments and priorities gathered at the public meetings and at interviews with elected officials, the Friends of Starkweather Creek and the East Isthmus Planning Council: 1. Promote residential and commercial rain gardens in the watershed. 2. Start discussions with J.C.Penney Company and East Towne to voluntarily improve wetlands adjacent to their properties. 3. Keep the stream natural looking. Begin discussions with adjacent residential/commercial pro owners to plant shrubs and trees provided by the City. 4. Meet with the DNR to see if the law has changed to allow water resource improvement meanders, dredging, etc., which are highly regulated or banned. 5. Research and write grants to be able to expand the program. 6. Meet with MG&E to discuss funding of potential wetland improvements on their two properties. 7. Attempt to increase the number of creek clean-up days and improve litter control/educ programs. 8. Install trash traps at storm sewer outlets and work with volunteers to maintain them and keep costs low (try pilot-scale project). 9. Promote better infiltration planning. Review and evaluate current regulations with the DNR and Planning Dept. 10. Emphasize the existing erosion control/enforcement program in this water shed (publicize existing program, publish the enforcement phone number). 11. Remove sediments in the Olbrich Park ditch with the existing landfill program remediation o area. 12. Meet with Sewerage District to look into low-cost options for odor control of the sanitary sewe lift station at Olbrich Park. Early projects were selected so that work will be started on both branches of the creek and so that every major interest group will have at least one of their projects chosen. Emphasis was also given to selecting one type of each shoreline improvement so that the education and outreach effort would	

		have examples to use with their activities. The first water resource projects, to be built in 2005-2007, will be selected to emphasize the following designs: 1. Remove and replace the sheet metal retaining walls along the creek from East Washington Ave. to Fair Oaks Ave. 2. Install bioengineered slopes were feasible. 3. Install natural looking stream banks. 4. Install low-profile riprap when a bank revetment is required due to high water velocity and scour. 5. Improve wetlands and remove canary grasses. 6. Landscape stream banks with native plantings 7. Attempt to dredge the stream to remove obstacles so that more of it is opened to canoeists. 8. Attempt to add meanders, or littoral shelves if meanders are not allowed by the DNR. 9. Install sedimentation control devices at storm sewer outfalls. 10. Evaluate more opportunities to promote infiltration in developing areas. 11. Promote more wildlife use of the stream corridor. 12. Attempt to maintain or increase stream base flow. The specific size, location and cost of each project is listed in the tables in Appendix E.	
THE FISHERY OF THE YAHARA LAKES http://digicoll.library.wisc.edu/cgi-bin/EcoNatRes/EcoNatRes-idx?id=EcoNatRes.DNRBull181	Lathrop, Richard C.; Nehls, Susan B.; Brynildson, Clifford L.. Les, Betty, Editor, DNR, 1992	**Research Recommendations** In past years, distinctions have been made between the type of research that is best suited for the UW and for the DNR. University research has been considered basic, whereas DNR research has been applied. In the context of research recommendations for the Yahara lakes' fishery, basic research would focus on furthering our understanding about the ecology of important fish species, their food organisms, and important habitat requirements for sustaining abundant harvestable populations. The research would elucidate important community interactions that need to be understood for sound fishery management. Applied research would be geared more to solving problems that affect the day-to-day management of the Yahara lakes' fishery. Obviously, the 2 types of research are not mutually exclusive. The UW/DNR collaborative research projects currently being conducted on Lake Mendota's pelagic and littoral zone food webs indicate that the distinction between applied and basic research is less clear. The presence of the UW Center for Limnology on the shores of Lake Mendota and the long-term involvement and experience of the UW in fishery	Eutrophication, fishery, sediment, water clarity, water quality

		research on that lake add weight to using Lake Mendota as a study site for additional research on its fishery. Continued collaboration is recommended. 1. While a significant amount of research has been conducted on a few major fish species in Lake Mendota (i.e., yellow perch, cisco, and white bass), relatively little is known about the other major fish species in the lake. We recommend that research on the other major predator fish, panfish, rough fish, and forage fish species in Lake Mendota be conducted. This research would focus on the ecological role of these species and would include bioenergetics modeling as a major component of the project. Of particular importance would be research on reasons for the variable year class strength of all the major fish species, particularly yellow perch and cisco. Because of the complexity of the fish community in Lake Mendota, this research should be a long-term effort of at least 10 years. Further refinement of techniques to assess fish population abundance also should be conducted as part of this long-term study. This standardized sampling could then be used on the 3 lower lakes as well. 2. Stocking of fish in the Yahara lakes has been done in the past without a clear understanding of how it affects the fishery. If stocking is continued as a management tool, research is needed to assess the effectiveness of stocking predator fish; techniques for improving the survivorship of stocked fish also should be researched and developed. 3. Research is also needed on the effects of weed harvesting and weed spraying on fish populations in the Yahara lakes. Appropriate management guidelines should be developed, and optimum plant densities for fish should be recommended. 4. Research should be conducted on the reasons for the dramatic loss of benthic macroinvertebrates in Mendota's profundal sediments. If the main reason is that the sediment environment has been degraded because of lake eutrophication, then reversing conditions may not be possible. If, on the other hand, an increase in benthivorous fish populations contributed to the decline, then future action may be possible. **Management Recommendations** DNR Fisheries Management 1. Develop and implement standardized index sampling to provide information on	

		relative densities and size structure of fish species. This would include expanding boom shocking to sample all encountered fish species for a period of time along certain shorelines in each of the 4 lakes. Index sampling for pelagic species is also needed. This increase in sampling effort should provide quantitative data about the more abundant panfish and rough fish species as well as predator fish species. 2. Continue evaluating the importance of lake level changes on spawning fish populations, including but not limited to northern pike. 3. Regularly conduct a creel survey, winter and summer, on all 4 lakes. Such surveys should include the recording of length-weight data on a random subsample of fish. Ongoing creel surveys would require the long-term funding of a part-time LTE or seasonal employee. 4. Because of the importance of the fishery of the Yahara lakes, we recommend focusing more management attention on these resources. Establishing a Yahara lakes fishery management coordinator could serve as a catalyst for developing new initiatives and would ensure that work among various bureaus, groups, and agencies would be optimized. 5. Develop a management strategy for removing ciscoes when they are abundant and monitor the cisco population. Abundant ciscoes play a key role in preventing the larger-bodied Daphnia pulicaria from dominating in Lake Mendota as opposed to the smaller-bodied D. galeata mendotae. High numbers of D. pulicaria have been linked to enhanced water clarity. 6. Take a closer look at largemouth and smallmouth bass populations and habitat in all 4 lakes. If their populations are considered too low for available habitat, techniques for increasing their populations may be important. 7. Support the collection of routine, long-term water quality data on the Yahara lakes and the completion of regular macrophyte surveys. Shared funding could be sought from other DNR programs and local governmental agencies. 8. Periodically summarize results of routine surveys. During our search of files containing unpublished materials, we found numerous memoranda describing individual surveys. The value of these records would be enhanced if the results of similar surveys could be summarized -- and distributed -- every few years. 9. Continue to collaborate with UW on long-term fisheries research on the Yahara lakes. As results of the Lake Mendota study are obtained, reconsider regulations	

governing the harvest of predator fish. Reduced bag limits and increase legal minimum size restrictions may be needed to maintain desired densities of larger fish. Overharvesting of panfish such as yellow perch may require reduced bag limits.

10. Archive the remaining original daily records of rough fish removal for all affected lakes. The State Historical Society would be an excellent repository for such records.
11. Collect all future fisheries data in metric units. This would allow easier comparisons with studies at UW and elsewhere. In popular summaries for the general public, measurements could be converted to English units.

Dane County

1. The Dane County Public Works Department should continue to maintain complete records on its weed harvesting program and should begin recording information on harvesting hours so that harvesting effort data can be obtained (e.g., tons of weeds removed per hour of harvesting). In addition, this agency should work closely with the DNR Bureau of Fisheries Management on maintaining adequate spring lake levels to enhance spawning of northern pike.
2. The newly formed Dane County Lakes and Watershed Commission has as one of its missions to improve the water quality and recreational value of all county water bodies. For the Yahara watershed, the commission should work to decrease the nutrient inputs to the lakes and to preserve wetland habitat around the lakes.

Local Fishing Clubs

Last but not least of the managers of the Yahara lakes are the many local fishing organizations. Some, such as the Lake Mendota Fishing Association and the Yahara Fisherman's Club, are unique to the Madison vicinity. Others, such as the Capital City Chapter of Muskies Inc. and the 4 Lakes Bassmasters, are local chapters of statewide or national organizations.

Together these local groups can improve the fishery of the Yahara lakes in many ways. They can promote education on proper fish release techniques and promote catch-and-release fishing. They can express their support for implementing the research and management recommendations outlined in this report. They can continue their assistance and cooperation with the DNR Bureau of Fisheries

		Management in stocking predator fish, preserving or restoring habitat, and instituting stricter bag limits and minimum size restrictions. As state dollars and available labor are stretched thinner, contributions by local groups become more important. Well-kept and accurate personal fishing diaries and other records of fish caught would enhance the long-term assessment of changing fish populations and abundance. If fishing contests are held, good records can help document changes in fish populations. The long-running Percharee, for example, could record the average aggregate weights of all fish submitted from each lake and the length/weight data of selected fish.	
The US Geological Survey has a program titled "DANE COUNTY WATER QUALITY PROGRAM" that includes U.S. GEOLOGICAL SURVEY Professional Paper 1754 Version 1.0: Nutrient Concentrations and Their Relations to the Biotic Integrity of Nonwadeable Rivers in Wisconsin http://pubs.usgs.gov/pp/1754/	Dale M. Robertson, Brian M. Weigel, and David J. Graczyk, USGS, 2008	Research Summary: Excessive nutrient [phosphorus (P) and nitrogen (N)] input from point and nonpoint sources is frequently associated with degraded water quality in streams and rivers. Point-source discharges of nutrients are fairly constant and are controlled by the U.S. Environmental Protection Agency's (USEPA) National Pollutant Discharge Elimination System. To reduce inputs from nonpoint sources, agricultural performance standards and regulations for croplands and livestock operations are being proposed by various States. In addition, the USEPA is establishing regionally based nutrient criteria that can be refined by each State to determine whether actions are needed to improve water quality. More confidence in the environmental benefits of the proposed performance standards and nutrient criteria would be possible with improved understanding of the biotic responses to a range of nutrient concentrations in different environmental settings. To achieve this general goal, the U.S. Geological Survey and the Wisconsin Department of Natural Resources collected data from 282 streams and rivers throughout Wisconsin during 2001 through 2003 to: (1) describe how nutrient concentrations and biotic-community structure differ throughout the State, (2) determine which environmental characteristics are most strongly related to the distribution of nutrient concentrations and biotic-community structure, (3) determine reference conditions for water quality and biotic indices for streams and rivers in the State, (4) determine how the biotic communities in streams and rivers in different areas of the State respond to differences in nutrient concentrations, (5) determine the best regionalization scheme to describe the patterns in reference conditions and the corresponding responses in water quality and the biotic communities (primarily for smaller streams), and (6) develop algorithms to estimate nutrient concentrations in streams and rivers from a combination of biotic indices. The ultimate goal of this study is to provide the information needed to guide the development of regionally based nutrient criteria for Wisconsin streams and rivers. In this report, data collected, primarily in 2003, from 42 nonwadeable rivers are used to describe nutrient concentrations and their relations to the biotic integrity of rivers in Wisconsin. In a separate report by Robertson and others (2006a), the data collected from 240 wadeable streams are used to	Nonpoint source, nutrients, phosphorus, water quality

		describe these relations in streams in Wisconsin. Distributions of water quality and biotic indices for nonwadeable rivers, in general, were similar to those found for wadeable streams, with best conditions in the northern (forested) part of the State. The main differences between wadeable streams and nonwadeable rivers include: nonwadeable rivers had a smaller range in nutrient concentrations (less extreme concentrations, especially lower maximum concentrations), although median concentrations were similar; nonwadeable rivers had higher percentages of P and N in particulate forms; nonwadeable rivers had SCHL concentrations that were higher and had a stronger relation with nutrient concentrations; most biotic indices in nonwadeable rivers were more strongly related to nutrient concentrations; most biotic indices in nonwadeable rivers had a less consistent wedge-shaped response to changes in nutrient concentrations (the wedge-shaped response in wadeable streams resulted from biotic indices that ranged widely at low nutrient concentrations, but were consistently poor at high nutrient concentrations); and the biota in nonwadeable rivers had a slightly larger range in the thresholds in the responses to changes in TP concentrations.	
The US Geological Survey has a program titled "NESBITT POND" which is determining whether incorporated best management practices (BMPs) are working according to their design. No publications are yet available. http://wi.water.usgs.gov/water-quality/9kp49/index.html	David Owens, Brett Esser, USGS, ongoing		

CONTROLLING AQUATIC NUISANCES IN SHORELINE AREAS OF DANE COUNTY	DCRPC, 1985	Not available online, but a related publication, "Aquatic Plants in Dane County Waters," http://www.danewaters.com/pdf/20030811_aquatic_lake_mgmt.pdf describes the aquatic plant harvesting program, and makes recommendations for property owners & boaters:
		What can property owners do to help manage aquatic plants?
		• To manage excessive plant growth on your shoreline:
		  ○ Use a water rake to pull Eurasian water milfoil or other exotic plants in to shore and compost them away from shore.
		  ○ Don't leave plants in a heap on the shore; they will smell and nutrients can run back into the lake.
		  ○ It is better to spread them out to let them dry; the plant piles quickly shrink and become easy to use as mulch and compost.
		• Use only native plants in backyard water gardens. Exotics have a habit of ending up in our natural waters.
		  ○ Many nursery catalogues sell exotic water lilies; they may also have other exotics attached.
		  ○ Buy plants locally; there are many wonderful native species.
		• Leave a tall thick vegetated shoreline buffer, including tall native grasses and leaf litter, to provide
			Aquatic plant, erosion, nutrients, sediment, stormwater

		habitat for overwintering native weevils that attack Eurasian water milfoil.
		• Reduce sedimentation and filling of the lake from stormwater by reducing soil erosion and reducing transport of tree leaves and other fine debris from our yards and streets.
		What can boaters do to help?
		• Help stop the spread of exotics:
		  ○ Clean off boats and trailers when leaving a lake or river. It's not only a good idea—it's the law.
		  ○ Cleaning off the plants has an additional benefit because zebra mussels are often carried on plants from lake to lake.	

LOWER MUD LAKE RESOURCE PROTECTION PROJECT PLAN	DCRPC, 1992	This plan is not online; however, Applied Ecological Services has a project summary of their part in the project online. Applied Ecological Services "conducted an ecosystem health and land-use assessment for the LML project site for the Dane County Parks Department, Madison, Wisconsin. Existing ecological conditions of selected public and private lands were evaluated during extensive field investigations focusing on species diversity of plant and animal communities, and identification of ecological restoration and management needs resulting from natural and human-induced disturbance. A vegetation/land cover type map and ranking system were developed as a guide for prioritizing future land acquisitions, and for developing restoration and land management programs for the LML system. http://www.appliedeco.com/Projects/LMudLake.pdf	
YAHARA RIVER LAKES WATER RECREATION STUDY	DCRPC, 1995	Also done in 1993. Study is not online.	
AQUATIC PLANTS IN LAKE MONONA: Their Status and Implications for Management (also prepared for Lake Waubesa)	DNR, 1993	Report is not online. Focused on the management activities carried out by Dane County, these reports seek to create realistic long-term objectives for aquatic plant management and recommend practices to enhance the recreational value of the lakes.	Aquatic plant
SIMULATION OF THE EFFECTS OF OPERATING LAKES MENDOTA, MONONA, AND WAUBESA, SOUTH CENTRAL WISCONSIN, AS MULTIPURPOSE RESERVOIRS TO MAINTAIN DRY-WEATHER FLOW http://wi.water.usgs.gov/pubs/open_file_reports.htm (report is in DJVU format; free download plug-in available)	USGS, 1999	A model was used to simulate the operation of Lakes Mendota, Monona, and Waubesa for various levels of minimum release. 25 years of records (1970-1994) were used in model simulation. The amount of water available to maintain streamflow and lake levels during dry periods has declined because of extensive groundwater pumping for municipal use and the diversion of effluent (68 cfs in 1993) around the lakes. The goal of the simulation was to determine whether using the lakes to maintain flow during periods of low flow would appreciably lower lake levels. The model results indicated that it would be possible to maintain a minimum flow of 36 cubic feet per second in all but the driest years without lowering lake levels more than they have been under current operating conditions. Maintaining minimum flow would require detailed computations to guide operation of the dams during the year. [Note: USGS data indicates median flow is 182 cfs and mean is 199 cfs at McFarland gage. Minimum was 15, in 1982; maximum was 578 in 2008; from http://waterdata.usgs.gov/nwis/uv?05429500 on 11 May 09]	Groundwater, water levels

MADISON RAIN GARDEN STUDY (ONGOING)	William Selbig, USGS, forthcoming	[From memo dated September 8, 2008]: This study is currently investigating two locations within the City of Madison where rooftop runoff has been equally divided and directed into adjacent rain gardens. One location . . . contains mostly sandy soils and represents an ideal setting for infiltration devices. A second location. . . contains mostly clay soils and prior to installation of rain gardens was not considered an ideal setting for infiltration devices. This study was designed to test what most homeowners may face when implementing rain gardens on their property across the state. Both locations have two individual rain gardens constructed side-by-side that receive equal amounts of rooftop runoff from an adjacent building. One rain garden was planted with turf grass and the other with prairie vegetation. Each rain garden was sized such that the contributing drainage area to receiving rain garden area was 5 to 1. . . . Over 120,000 gallons of runoff have been received by each of the rain gardens at Old Sauk since monitoring began in December 2003 through September 2007. While the prairie rain garden was able to retain and infiltrate 100 percent of all runoff, the turf grass rain garden recorded slightly more than 10,000 gallons (8%) of runoff leaving the rain garden as effluent during that period. Retention, in this case, is defined as the volume of water in a rain garden that infiltrated into the ground in addition to losses to the atmosphere via evapotranspiration. Given the proximity to one another, and the similar underlying soil structure, the ability of the prairie rain garden to retain all of the influent runoff might be attributed to the deep-rooted nature of prairie vegetation, as opposed to a shallow root mass found in turf grass. Similarly, rain gardens constructed in a sandy soil at Owen were effective at retaining rooftop runoff. The turf grass and prairie vegetation rain gardens each received over 25,000 gallons of runoff from October 2003 through September 2007. Both rain gardens were able to retain and infiltrate 100 percent of runoff. Infiltration rates for rain gardens in a clay soil did not perform as well as those in a sandy soil. However, there was dramatic improvement when compared to infiltration rates before the rain gardens were constructed. . . . tests performed at Old Sauk prior to rain garden construction determined infiltration rates to be less than 0.10 inches/hour. After construction was complete and vegetation was established, a flood test was performed in June 2007 to estimate infiltration rates of each rain garden. Resulting infiltration rates for the turf grass and prairie rain gardens were approximately 0.6 and 1.1 inches/hour, respectively. While a similar pump test was not performed for the sand soil rain gardens (Owen), an estimate of infiltration rates was computed based on the rate at which water receded in each rain garden after a storm event. The rates of infiltration depend on the depth and duration of overlying water. Resulting infiltration rates ranged from 1.2 – 5.4 inches/hour for the turf grass rain garden and 1.2 – 6.3 inches/hour for the native rain garden.	Infiltration, rain garden
UPPER YAHARA RIVER STUDY GROUP FINAL REPORT	Ken Koscik, Mindy Habecker, Sue Jones, 2000	Report is not online. A study of the navigability, water quality, fiscal responsibility and safety interests along the Upper Yahara including an evaluation of lake levels, channel depth and boat numbers among other things.	Water quality

DOOR CREEK WETLANDS RESOURCE PROTECTION PLAN	DCRPC, 2000	Report is not online. Referenced in the "Dane County Parks & Open Space Plan" and "Dane County Wetlands Resource Management Guide."	
YAHARA LAKES ADVISORY GROUP FINAL REPORT http://www.danewaters.com/management/ylag.aspx	Mindy Habecker, Dane County UW-Extension 2002	Lakes Management & Operations 1. All control structures from Lake Mendota to below the Stebbinsville Dam be unified under a coordinated and recordable management strategy based on a Yahara River System management plan to be developed which would be able to articulate responses to various scenarios such as development of the basin. 2. Evaluate methods such as modification of bridge constrictions, aquatic plant modification, dredging, channel modification, etc. to increase flow conveyance. 3. Operations rules for the lakes must provide for stable and predictable lake levels that are protective of public and private properties, wetland, shorelines, fisheries, water quality and recreational users. 4. Design orders to address all four seasons, not just summer maximum and winter minimum. 5. Develop lake and shoreline regulations affecting all riparians, both public and private, in a uniform way. 6. Establish a structure and process for planning and funding capital improvement and maintenance of flood control and navigation structures on the Yahara River system (i.e. locks, dams, conveyance channels). 7. Establish specific processes for responding to flooding that set specific standards for use restriction on recreational users necessary to protect property and the environment. 8. Consider property values and uses in adjusting lake levels. 9. A flood management plan shall be developed with shoreline protection elevations. 10. Dane County Public Works and DNR fisheries should coordinate lake levels in the Yahara River system and particularly Lake Mendota must remain high enough from March 15 to mid-May to allow fish to spawn, young fry to grow to sufficient size to survive once water levels are lowered. 11. Reevaluate user fees to finance operations and maintenance of boat launch facilities and locks. 12. When the level of Lake Mendota rises above the OHWM (850.7 MSL)* a state of high flow shall be declared. This state of high flow will remain in effect until all the lakes in the chain are at or below their maximum summer operating level. [the report includes additional specificity] *recommended levels to be reviewed and finalized later based on further studies and public and expert input 13. Evaluate the need to renovate Tenney, Babcock and LaFollette lock and dams. The evaluation should include the possibility of automating the gates at one or all of the dams. Monitoring/Modeling 1. Maintain an active monitoring program on the lower Yahara River to obtain accurate data on channel hydraulics.	Aquatic plant, flooding, groundwater, infiltration, rain garden, sediment, stormwater, water levels, water quality, wetland restoration

		2. Reconvene Yahara Lakes Advisory group or modified group to evaluate and act on the flow measurements, data, provide education, and monitor progress of recommendations after one year. 3. Use the calibrated USGS Yahara Lakes model currently under development to optimize management of Yahara Lake system and to achieve multipurpose objectives. 4. Promote and continue development of a state-of-the-art hydrologic monitoring network (i.e. rain gages, lake level recorders, river flow gages) for the Yahara River system. 5. Survey and evaluate the recreational trends, and uses, and economic impacts by various user groups of the Yahara River System. 6. Promptly develop and apply a continuous hydraulic/hydrologic/water quality model of the watershed including the lakes and connecting channels that can account for present and potential land use conditions and land management practices in the watershed and the potential modification of control structures and channels. Land Use 1. A standard watershed-wide legal ordinance be instituted to infiltrate runoff from impervious surfaces at a target level. 2. Low-lying riparians be invited to voluntarily provide right-of-first refusal for future ownership of their property in order to revert it to public ownership. 3. Opportunities to significantly increase the infiltration of stormwater and snow melt into the groundwater should be identified and emphasized to all areas that significantly impact lake levels. 4. Commercial, industrial and residential development north of Lake Mendota, should if necessary, be restricted by zoning to minimize the impact of stormwater runoff caused by development into the Yahara River system. 5. Planning and new laws be introduced to reduce stormwater volumes delivered to the Yahara River system. 6. Where possible we should encourage reestablishment of natural vegetation along public and private lake frontage. 7. Control the inflow of sediment, animal waste, pesticides, fertilizer and other pollutants into the Yahara River system. 8. Stop the draining of wetlands for either farming or possible future development within the Yahara River System. 9. Ensure new developments adhere to current standards of control to prevent sediment and erosion into the Yahara River system 10. Strengthen county stormwater ordinance to control floodwater from the real 100-year rain event using current rainfall information 11. Preserve and restore wetlands to improve lake quality, natural habitat, and flood storage within the Yahara River System.	

		12. Develop better county internal coordination between Land Conservation Department, Lakes and Watershed Commission and Parks Department. 13. Setup a purchase and/or transfer development rights program to reduce the future development footprint north of the lakes in the entire floodplain. 14. Update the 100-year flood maps and end new building in 100-year floodplain area. 15. Identify and target sites for wetland restoration that offer the greatest promise for preventing future increases in flooding in the Yahara lakes. 16. Create an account and increase support to fund watershed restoration and improvement work. Education & Other Efforts 1. Create educational programs focusing on increasing awareness of lake and watershed issues among the general public. 2. Communicate all key recommendations to officials and the general public via e-mail, brochures, newsletter and other educational efforts. 3. Encourage the development and real estate industry to go beyond minimum water quality best management. 4. Investigate and implement more efficient public access to Yahara lakes information on the Internet. 5. Implement demonstration practices (i.e. Rain gardens, shoreline habitat, stormwater detention, aquatic vegetation control) and evaluate their effectiveness.	
A GUIDE TO LAKE WINGRA WATERSHED REGULATIONS, POLICIES AND MANAGEMENT PRACTICES	David Schiffert, Friends of Lake Wingra Watershed Coordinator 2003	Summarizes all city, county and state ordinances and rules related to anything connected to Lake Wingra, from boating restrictions to fertilizer application.	
LAKE WINGRA CITIZEN STEWARDSHIP PLAN http://lakewingra.org/library/plans/citizen_stewardship_plan.php	Friends of Lake Wingra 2003	**Goals for Citizen Stewardship** One of the cornerstones of the Friends of Lake Wingra's Strategic Plan (created in 2001, updates in 2003) is to develop present and future generations of watershed stewards by actions that address the following goals: 1. Increase citizens' awareness of the Lake Wingra watershed and its ecological, economic, recreational, and cultural value to the community. 2. Enhance citizens' ability to understand, evaluate and advocate for policies and practices that protect and enhance Lake Wingra. 3. Assist homeowners, businesses, and government in adopting property management practices that protect and improve the environmental quality of the lake and watershed. 4. Create a communication network of volunteer liaisons with neighborhood associations and interest groups to distribute and exchange information on resources, best lawn and garden practices, volunteer opportunities, and events. 5. Connect students from the grade school through college levels to opportunities to participate in	

		research, service, and learning. 6. Connect the Lake Wingra watershed community to other watershed communities throughout the Dane County area and the Rock River basin.	
LAKE WINGRA WATERSHED MANAGEMENT PLAN – INVASIVE SPECIES http://lakewingra.org/library/management_plans_and_reports/invasive_species_plan.php	Friends of Lake Wingra 2003	**Site-specific recommendations for possible actions** 1. Odana Ponds/SW Bike Path drainage way (immediate action) Recommendation: All purple loosestrife plants should be eradicated. Public land management agencies should be encouraged to mow the swale at least once a year to prevent invasive plants from setting seed. A vegetation management plan for the drainage way should be written. The plan should include target population levels for the most troublesome invasive species and a strategic and tactical work plan for achieving the goals. **2. The Edgewood Marsh (immediate action)** Recommendation: Edgewood College, in cooperation with the DNR purple loosestrife bio-control program, develop target purple loosestrife population levels, and a range of acceptable variation around these targets, for the marsh. Edgewood managers should continue to use predatory beetles in the main body of the densest loosestrife population. Within this containment zone, managers may choose to remove the flowers but leave the plants to support the beetle populations. A rigorous monitoring program should be established to evaluate the success of the control program and to inform management decisions. A systematic, rigorous surveillance program, perhaps using watershed volunteers should be enough to keep tabs on the fringe areas. Here again, a set of target population levels should be established; fluctuations around this target level will trigger management action. The exact management action will depend upon the time, energy and resources available to managers and to the degree of threat posed by the population. Precautions should be taken to ensure that as little harm as possible is done to the marsh during the efforts to control purple loosestrife. Steps should be taken to minimize walking in the marsh, soil disturbance, dispersal of seeds and trampling of native vegetation during monitoring and control. Managers might consider such things as temporary, “floating” walkways or small, portable lookout platforms as ways to avoid or lessen impact on the marsh. **3. SW Bike Path and Glenway (mid-term action)** **Recommendation:** Work with the Friends of the SW Bike/Pedestrian Path to help them build their organizational capacity; help the group develop habitat restoration and invasive species management plans; help organize community efforts to control pest plants and restore native habitat. Build on the already strong relationship with City agencies and develop partnerships with other land managers such as utility companies. **4. Lake Wingra Marshes (mid-term)** **Recommendation**: Support recommendations of FOLW storm water management plan. Encourage development of restoration plans for the marshes. Coordinate with UW-Madison Arboretum on development of a comprehensive storm water management plan and support efforts to develop	Aquatic plant, infiltration, invasive species, nutrients, phosphorus, stormwater

		innovative solutions such as infiltration to handling storm water flows. **Recommendations for Nuisance Waterfowl** Canada geese (Branta canadensis) (immediate action) Recommendation FOLW recommends that the giant Canada goose populations in the watershed be managed to reduce their impact on the lake and watershed. These steps should be taken: Recommendation FOLW recommends that the giant Canada goose populations in the watershed be managed to reduce their impact on the lake and watershed. These steps should be taken: Set desired population levels for Vilas Park and other locations in the watershed. Experiment with management/control strategies to reduce geese and mallard populations. Enforce existing regulations that prohibit the feeding of geese and mallards. Restore shoreline vegetation to stabilize banks, reduce erosion and discourage flocks of these two species. Friends of Lake Wingra support the work of the Madison City Parks Department and its partners in their efforts to find an integrated approach to urban goose management. **Recommendations for In-lake Management** **1. Zebra mussel (*Dreissena polymorpha*) (immediate action)** Zebra mussel veligers (immature stages) were observed in a sample from Lake Wingra in September 2003 (Wisconsin DNR, personal communication). . . It is not known whether or not Lake Wingra provides suitable habitat for a successful invasion. This very recent observation for Lake Wingra is disturbing and warrants immediate, continued monitoring. **2. Common carp (long term action)** **Recommendations:** Friends of Lake Wingra support an integrated approach to reducing the impact of carp. **Outreach**--The fact that carp are over-abundant in Lake Wingra and the specific consequences of this for water and habitat quality need to be effectively communicated to the public as part of ongoing outreach that identifies community goals for the lake. In the long run, the watershed community will have to weigh the alternatives and decide what control measures might be acceptable or desirable. **Research**--We support proposals to study the recovery of native macrophytes and fish species through the use of carp-proof exclosures that are compatible with other lake uses. This might provide the community with a pilot demonstration of what the lake could be like without carp. **Eradication**--At this point in time, maintaining a carp-free environment over the long term does not seem feasible because the occasional inundation of the Wingra dam provides access to the Lake by other carp populations. This view may change and in the future, with new information, eradication may become more feasible. Furthermore, the methods required for eradication -- wholesale poisoning of all fish species, with subsequent reintroduction of those deemed beneficial -- may not be compatible with the community's vision of lake stewardship. In addition, carp removal may be a necessary step but will	

not be sufficient to allow native aquatic plants to re colonize if they are not already present in the lake.

Population suppression--FOLW supports efforts to suppress the carp population through methods that do not threaten other fish and plant species. These methods might include:

- Periodic commercial seining to remove large numbers of carp. This can be timed for minimum impact on macrophyte populations and provide a way to monitor trends in carp population.
- An on-going cash bounty on carp taken from the lake by hook and line, or bow and arrow. This approach engages the community, provides incentive for sport fishing and maintains continued pressure on declining carp population with no damage to other fish species.
- Consideration of proposals to study the recovery of native macrophytes and fish species through the use of carp-proof exclosures that are compatible with recreational use of the lake. This approach might provide the community with a pilot demonstration of what the lake could be like without carp.
- Continued assessment of the obstacles to suppression or eradication. These include how to prevent reintroduction of carp from Wingra Creek and Lake Monona, and the complex controversy that any approach that involves poisoning would bring.
- Further study and community discussion and agreement on goals and actions.

3. Eurasian milfoil (*Myriophyllum spicatum*) (mid-term action – Vilas lagoons)

RECOMMENDATION

FOLW SUPPORTS THE DEVELOPMENT OF AN INTEGRATED APPROACH TO THE CONTROL OF EURASIAN MILFOIL IN VILAS LAGOONS. THE DEVELOPMENT OF A NATURAL RIPARIAN ZONE AROUND THE SHORELINE OF THE LAGOONS, COUPLED WITH THE ELIMINATION OF ROUTINE HARVESTING, COULD ESTABLISH NATURAL BIOLOGICAL CONTROL OF THE EXCESSIVE MILFOIL GROWTHS.

Invasive species and human health in Lake Wingra

Until recently, it was believed that invasive species in the Lake Wingra watershed do not have direct affects on human health. This view changed when Long Term Ecological Research samples from Lake Wingra uncovered high concentrations of the toxic algae *Cylindrospermopsis raciborskii* (Cylindro). Cylindro is a sub-tropical species of blue-green algae that has been migrating northward from Brazil and in recent years has been found in several southern states as well as in Illinois, Little is known about Cylindro and its effects, although the available scientific literature suggests that it differs from other blue-greens in that it may produce more toxins more frequently than the blue-green algae species commonly found in Wisconsin lakes" (News Release, WDNR, August 6, 2003).

Scientists at DNR and the UW-Madison continue to study Cylindro's ecology and its ability to produce toxins under different bloom conditions in Lake Wingra and other southern Wisconsin lakes.

Recommendation: Specific FOLW recommendations will follow the analysis and reporting on these studies.

General recommendations include the continued implementation of management practices that

		prevent blue-green algae blooms of all types in Lake Wingra: Reduced nutrient (especially phosphorus) inputs from stormwater runoff in the watershed Restoration of healthy populations of native aquatic plants which compete with algae for available nutrients STEPS TO IMPLEMENT FOLW INVASIVE SPECIES MANAGEMENT RECOMMENDATIONS 1) Continue to inventory the watershed • Document all new outbreaks of invasive species. • Identify specific, high-leverage opportunities for controlling invasive species or reducing their impact. • Support efforts to develop site-specific invasive species management plans. 2) Develop an implementation strategy • Prioritize management recommendations to guide funding and implementation over the next five years. • Set objectives for each site that are specific, measurable and achievable over a specific period of time. • Work to manage invasive species at specific sites that have particular problems and/or opportunities and where such changes will have significant positive impacts on the watershed. • Encourage stakeholders to restore native habitat in areas degraded by invasive plants and animals. 3) Educate stakeholders • Help public and private partners build capacity for developing invasive species management and implementation plans. • Sponsor training sessions on pest species identification and control techniques. • Create educational and outreach programs that help build ecological literacy. 4) Continue research on effective invasive species control techniques and impacts of invasive species on the watershed ecosystems. 5) Promote coordination of invasive species management planning among public agencies and private partners. 6) Evaluate impacts of efforts through monitoring of invasive populations and ecosystem recovery.	
LAKE WINGRA WATERSHED MANAGEMENT PLAN – STORM WATER http://lakewingra.org/library/stormwater/storm_water_management_plan.php	Friends of Lake Wingra 2003	**Watershed-Wide Management Recommendations** Fulfilling the vision of the FOLW storm water management plan will require many years of concerted effort by citizens, businesses and government. FOLW believes that building citizen stewardship is the only way to transform these planning efforts into sustainable action. The following watershed-wide recommendations will require education and organization to succeed. Our longer-term goals include: • Reducing or Eliminating Storm Water Problems at the Source - by promoting residential, commercial, and municipal rain gardens and other infiltration techniques; discouraging unnecessary application of lawn fertilizer, pesticide and road salt to reduce pollutant loading to the Lake; and implementing more effective leaf collection and street sweeping practices to collect solids before they enter the storm water conveyance system. • Mitigating the Impacts of Existing Storm Water Management Practice - by controlling storm water	Infiltration, nutrients, rain garden, road salt, stormwater, street sweeping

		runoff flows to reduce volume and velocity; redesigning street drainage systems to promote curbside infiltration; and restoring the subsurface hydrology of the area with engineered upland storm water infiltration. • Treating Storm Water Before it Reaches the Lake - by maintaining and improving detention basins to ensure effective solids removal; redesigning storm water outfalls to reduce their impact upon Lake Wingra and Wingra Creek wildlife habitat; and adding storm water treatment technologies to the Watershed infrastructure as needed to remove residual solids, nutrients and other contaminants.	
VOICE OF OUR WATERS WORKSHOP BRAINSTORMING RESULTS http://partnersinplace.com/work/docs/1118010928-List_of_Topics_ver_3.pdf	Partners in Place, LLC 2004	Summarizes the ideas that came out of the workshop and connects them to the Dane County Comprehensive Plan. **I. Ground Water Quality and Quantity** a. Reverse the current trend of regional water table draw-down by 2045. b. Map areas of high infiltration, soils, known recharge areas & areas suitable for wetland restoration. c. Incorporate stormwater management practices, such as detention and infiltration, in new urban development to maintain or improve groundwater recharge. d. Implement a policy of no-net-loss of groundwater recharge, compared to the infiltration rate of native ecosystems, for all new development. **II. Surface Water Quality and Quantity** a. Preserve the role of wetlands, woodlands and streambank buffers as essential components of the hydrologic system as well as valuable wildlife habitat and to restore degraded wetland resources and streambank buffers where possible. b. Increase vegetative cover within urban areas. c. Manage crop nutrients in an economic and environmentally sound manner. d. New urban and suburban development will incorporate utilization of natural drainage patterns and measures to minimize or entrap pollutants before they enter surface waters. e. Protect shoreland and floodplain areas throughout the County, in both incorporated and unincorporated areas, and emphasize their value to the community as potential focal points of natural beauty and recreation. f. Coordinate water quality monitoring. g. Mitigate and encourage new technologies to improve quality and reduce quantity of urban stormwater runoff. **III. Watershed Approach** a. Use watersheds as geographic units of analysis to evaluate the impacts to water bodies of both current land uses and proposed changes in land use. b. Encourage integration and coordination of public agencies and local units of government within every watershed to achieve improvement to the quality of all water bodies in Dane County.	Groundwater, infiltration, invasive species, nutrients, stormwater, water quality, wetland restoration

		c. Institutionalize partnerships with water resource-oriented citizen's groups to involve them in each stage of watershed planning and decision-making. d. Educate local elected officials and members of local planning and zoning commissions about critical water resource issues within their watershed, by having watershed-based training workshops at two years intervals, and other educational efforts as appropriate. e. By 2010, Dane County staff, working with local units of government and local residents, shall create a land use plan for each watershed in the county, focusing on issues of infiltration, wetland preservation, recommended development phasing and stream buffers over a 50 year timeline. These watershed plans, when completed, shall become a part of the water resources component of the Dane County Comprehensive Plan. **IV. Species and Habitat Diversity (and Exotic/Invasive Species)** a. Permanently protect key sensitive and critical environmental resources, including, but not limited to: infiltration areas, riparian habitat, in-stream habitat, wetland habitat, wetlands, groundwater recharge areas, open space corridors, spawning grounds, shore cover, and headwater areas b. Establish program priorities for species and habitat protection. c. Discourage landscaping with ecologically invasive species, and encourage the use of native plants in landscaping, where appropriate. d. Promote local government and general public awareness and education about invasive species that may present environmental, economic, or social risks. **V. Public Access to Surface Waters** a. Provide access to lakes and streams and water-based recreation trails. These water-based trails would be designed for use by canoes, kayaks, and similar watercraft.	
DANE COUNTY FLOOD MITIGATION PLAN http://www.danewaters.com/management/floods.aspx	Dane County Department of Emergency Management, Lakes & Watershed Commission, 2004 (currently being updated)	**Key Recommendations** There are five basic elements of the County's strategy to reduce flood losses: mitigation, response, prevention, coordination, and education. These elements fall into two broad categories, 1) mitigation and response are aimed at reducing the impact of flooding on existing structures and facilities and 2) prevention, coordination, and education are intended to avoid increasing problems or creating new flood hazards. Recommendations include: Mitigation 1. Implement a voluntary program of property acquisition and relocation for high-risk residences. 2. Implement a voluntary program of flood protection for high-risk residences. 3. Determine the feasibility of reducing the flow of floodwaters over roads by evaluating road elevation and culvert sizing standards for construction and upgrade for all County roads, but especially for roads in low lying or flood prone areas. 4. Develop road shoulder, ditch, and bridge maintenance and upgrade standards to prevent floodwater and stormwater from damaging or washing-out roads and making them impassible. 5. Formalize a process for considering water flow along and under roadways as one component of	Aquatic plant, flooding, groundwater, infiltration, stormwater

		the overall water conveyance system. Response 6. Assist local units of government in developing local flood response action plans. 7. Improve the flood warning system for areas of the County where floodwaters rise rapidly or impact large numbers of people. 8. Improve the communication system between the County and local units of government when floods occur or are likely to occur. **Goal 3: Prevention** 9. Develop comprehensive water management policies for Dane County, considering the connections between land-use, urban growth, and surface water, and ground water issues. 10. Discuss formation of a policy that guides or further restricts development around flood prone areas and areas of high flood mitigation value; support policy consistencies between the comprehensive plan and the flood mitigation plan. Lands of potential flood mitigation value are wetlands, floodplain corridors, upland storage, closed depressional basins, and areas of high infiltration potential. 11. Discuss urban development around small closed depressional basins that addresses special flooding and stormwater related issues that are unique to these areas. 12. Assist in the development of watershed-scale stormwater management plans that make possible coordinated management of locally-derived runoff. 13. Evaluate the County's and other units of governments' erosion control and stormwater management, floodplain zoning, and shoreland zoning ordinances, and NFIP status to determine regulatory deficiencies, necessary improvements, enforcement shortcomings in order to bring governments into compliance and to strengthen and maximize the benefits of current regulations. 14. Identify and map areas in the County that have potential flood mitigation value. 15. Establish flood mitigation as a criterion for land acquisition and environmental restoration where it would aid in the achievement of flood-reduction goals and conserve and restore land that meets the criteria. 16. Ensure that the Department of Natural Resources affords flood risk as high priority when evaluating the public interest in the lake level orders for the Yahara chain of lakes. 17. Maintain the levels of the Yahara lakes at the lower limit of the DNR's set operating range as part of a comprehensive strategy that addresses flood risk and the needs of fisheries, recreational interests, agricultural interests and lakeshore property owners. 18. Develop a coordinated management strategy and a unified plan of operation and maintenance for all control structures on the Yahara River from Tenney Dam to the Stebbinsville Dam. Assure that the responsible agency has the technical expertise and resources to operate and maintain the control structures within the parameters of the plan. 19. Improve monitoring and modeling of the Yahara River and chain of lakes to develop a better understanding of how the system can be more effectively managed. Include a study of the	

		likelihood and potential impact of a significant weather event to cause Lake Mendota to rise over the top of Tenney Dam. 20. Evaluate methods such as modification of bridge constrictions, aquatic plant removal, dredging, and channel modifications to increase flow conveyance, while respecting in-stream natural and cultural resources. **Goal 4: Coordination** 21. Identify hot spots or high priority projects involving multiple jurisdictions where watershed level solutions could be applied. 22. Coordinate funding opportunities to carry out the objectives of the flood mitigation plan including, but not limited to mitigation, land acquisition, regional projects, and flood response activities. **Goal 5: Education** 23. Launch and update when necessary, and educational program to provide local units of government with important flood-fighting information. 24. Improve citizen and local elected officials understanding of floodplain maps and floodplain regulations, floodproofing options, development and stormwater management considerations, and other information to assist in good decision-making. 25. Develop and use a flood risk map based on hydric soils, wetlands, and areas of past damage. Consider incorporating a buffer area of 1 foot in elevation above the mapped 100-year floodplain on FIRM maps as an advisory tool. Use the map as an educational tool, and also share with real estate agents and local units of government.	
LAKELINE – MADISON LAKES ISSUE http://www.nalms.org/Publications/LakeLine/ListArticles.aspx?publication_id=1	North American Lake Management Society 2005	Includes articles on developing a practical vision for the lakes, responses to urbanization, improving Lake Mendota and Lake Wingra, beaches, aquatic plants, fish and local efforts and partnerships to protect the lakes.	Aquatic plant
CLEAN LAKES AND BEACHES: A WATER QUALITY PLAN 2005-2006 http://www.cityofmadison.com/engineering/stormwater/documents/CleanLakes_FinalReport_2005-2006.pdf	City of Madison 2005	Includes recommendations developed in WRM Workshop 99 (Lake Wingra Watershed: A New Management Approach; see below) The report also noted the recent formation of a road salt subcommittee by the Committee on the Environment. In addition, the report includes recommendations from an ad hoc waterfowl management committee. **MANAGEMENT OF URBAN WATERFOWL** In 2002, an Ad Hoc committee was formed to address concerns about the number of waterfowl, specifically Canada Geese, on public land throughout the city. The intention of the committee was not to eradicate any species, but to address the problems created by such a large number of waterfowl. The following list of recommendations were made by the Ad Hoc Committee on Integrated Waterfowl Management, based on information from the WDNR, US Fish and Wildlife Service, and citizen comments: 1. The Parks Division, working with other outside agencies, will develop and implement a protocol for the documentation of bird counts, feces quantity, locations, numbers of nesting pairs, and survival rates of hatchlings. The protocol will cover the collection and analysis of data in a scientifically	Road salt, stormwater, water quality

		sound manner. 2. The Parks Division will make the data it collects available for the purposes of facilitating discussions with adjoining communities of urban waterfowl management. Discussions would include identifying acceptable locations for nesting as well as acceptable population numbers. 3. An informational brochure will be created and distributed to neighborhood associations and the general public on the problems associated with feeding waterfowl. Parks staff will assist in the distribution of the brochure to citizens who are feeding waterfowl within the city limits. 4. Initially implement the use of a herding dog(s) at the Yahara Hills Golf Course under the care, custody and control of Parks Division personnel, provided the user groups at Yahara contribute 50% of the costs associated with the purchase, feeding and maintenance of the dog(s). This technique will be evaluated for overall costs and benefits. A protocol will be established for the possible expanded use of dog(s). 5. If dog control proves to be insufficient or impractical, then the Parks Division, under the supervision of USDA Wildlife Services, could employ reproductive control techniques, such as oiling or addling eggs. 6. Practical shoreline modifications and vegetative modifications should be considered.	
REPORT OF THE SALT USE SUBCOMMITTEE TO THE COMMISSION ON THE ENVIRONMENT ON ROAD SALT USE AND RECOMMENDATIONS http://www.cityofmadison.com/engineering/stormwater/documents/SaltUseReduction.pdf	City of Madison Commission on the Environment 2006	**Short Term Recommendations & Estimated Costs** ***City Of Madison Streets Division*** The items listed below are recommendations that should provide useful tools or procedures to reduce the amount of salt being used to treat public streets in the City of Madison. Anticipated cost estimates are included as rough estimates; additional cost analysis should be performed by knowledgeable staff (both Streets and Accounting) prior to acting on most of these recommendations. Provide weather/temperature monitoring station on southwest side The initial cost of a weather monitoring station (RWIS) would be $30,000 to $50,000, depending upon the type of station (full weather station or pavement temperatures only) and access agreements to RWIS information. Yearly operating and maintenance costs for a station are $2,200 to $2,400. More detailed information can be obtained from the WisDOT RWIS program manager if this recommendation is pursued. Demonstrate anti-icing technique with County equipment and salt brine *(For example: Odana Golf Course pond drainage area)* Estimated cost to the City of Madison for this demonstration is $5,000-$10,000 for a single “winter season”. These costs would be impacted by the size and scope of the demonstration, any agreements made with the County and possibility the cost of the	Chloride, groundwater, road salt, stormwater

		salt brine used in the demonstration. Provide more City Employee snowplow driver training Training to stress the importance of salt reduction while still maintaining necessary safe driving conditions. In-house training costs would include the employee's/supervisor's time involved plus minor expenses for training aides. Outside training through the UW- Extension offices would involve the time of the employee(s), the cost of the trainer (approximately $500 per training session) plus minor expenses for handouts. Reduce salt content of sand Reduce salt content of sand from 20% to 10% or 5% or even lower (i.e. the lowest percentage that still provides for freeze protection). This can be done by using updated mixing equipment (possible rental units). Reducing salt content from 20% to 10% would reduce material costs by about $330 per 100 tons of sand. If reduced from 20% to 5% the material costs would be reduced approximately $500 per 100 tons of sand. Lower average road salt use per lane mile Lowering average road salt use to 100 lbs. per lane mile, provided traffic safety can be maintained, would need to be implemented as a pilot study to determine effectiveness and safety. By reducing the average road salt use per lane mile by 50 lbs. per lane mile, in conjunction with the pre-wetting of road salt and the use of the anti-icing techniques within the test area, a drop in salt usage of 25-30% is expected. In an average winter (9,000 tons of salt used citywide) this could amount to a citywide material cost savings of $75,000-$90,000 GPS AVL technology to track trucks and collect accurate material usage The cost savings from this item stems from improved efficiency in truck and material usage. The City Streets Division has budgeted to start installing these tracking units in its trucks starting in the 2006 season. Review accuracy of weather forecasting Costs incurred by this item would be from staff time used to obtain and review data. Assistance from the WisDOT RWIS program manager may be possible. Until the scope of such a review is determined costs cannot be estimated.	

		Onboard infrared pavement/air temperature sensors on vehicles Providing sensors on supervisor vehicles or snowplows would cost $400-$800 each, depending on the model selected. The City Radio Shop could install the units. Convert “street miles” to “lane miles” in reports related to the use of road salt This project would require staff time from both the Streets Division and the Engineering Mapping Section. No time or cost estimate was available at the time of this report. Sampling program with conductance monitors Provide monitoring program during critical runoff times to better define acute problem areas. Discuss road salt use and impacts with regional groups Work with other regional groups and government agencies such as the Dane County Lakes & Watershed Commission and the Madison Areas Municipal Storm Water Partnership to expand the awareness of salt use and its impacts. ***Private Operators And Property Owners*** The items listed below are recommendations that should provide useful tools or procedures to reduce the amount of salt being used to treat private streets, parking lots and sidewalks in the City of Madison. Education *Provide educational material and training for private applicators* A salt reduction training program has already begun for private applicators in the Twin Cities. Development of the training program was paid for by the MNPLC. Response to the training has been very positive. We recommend the City of Madison sponsor training opportunities for private applicators. Calibration *Calibrate private operator equipment* Homeowners *Provide educational materials to homeowners* Reporting Track salt use and promote voluntary reporting on an annual basis. Possible	

		coordination through the Public Health Department for tracking and inclusion in their annual report. **Long Term Recommendations** The items listed below are recommendations that should provide useful tools or procedures to reduce the amount of salt being used in both the private and public sector. These recommendations involve greater planning, funding and/or public involvement than those listed in the short-term sections. Ordinances Develop ordinances for regulating both private and public salt use including training, certification and reporting requirements. Do additional demonstrations of alternatives to chloride-containing deicers and anti-icers. . . Modeling Determine future levels of chlorides in Madison lakes and streams (estimate impact on environment) by computer modeling. Driver Alert Program Develop an advisory alert program for classifying winter weather and road conditions to be used to inform the public on expected driving conditions in the City of Madison. Monitoring Conduct extended monitoring of sodium and chloride levels in storm water runoff, lakes, and groundwater to provide sufficient data for expanded modeling program. Reporting Recommend the City of Madison report back to the COE on an annual basis regarding the implementation of salt reduction recommendations and programs.	
REPORT OF THE INFILTRATION TASK FORCE OF THE DANE COUNTY LAKES AND WATERSHED COMMISSION http://www.danewaters.com/pdf/2006StormwaterReport.pdf	Dane County Lakes and Watershed Commission 2006	The Dane County Stormwater Infiltration Task Force (SITF) was created to further evaluate stormwater infiltration requirements, including caps on the area required to be devoted to infiltration as well as other approaches, and to make recommendations for possible changes in these standards. The 16-member SITF met 10 times between September 2005 and May 2006. In addition, subgroups met several times to focus on specific issues and conduct technical analyses. As a result of this work, the SITF agreed unanimously on a number of recommendations for improving infiltration standards and practices in Dane County. These recommendations fall under five categories:	Groundwater, infiltration, stormwater

		1. **Chapter 14 infiltration standards**: amend ordinance language to provide an option for developers to meet specific groundwater recharge goals in lieu of exceeding caps on the percentage of land required for infiltration devices. If a development would require more than 1% (residential) or 2% (non-residential) of the site to meet NR 151 infiltration standards, developers may choose to satisfy the Dane County infiltration standard by designing infiltration practices that (in addition to meeting minimum NR 151 standards) meet a recharge rate of 7.6 inches/year, which is the estimated county-wide predevelopment groundwater annual recharge rate. This option also requires mitigation of the effects of compaction on disturbed open areas. 2. **Information and enforcement**: provide guidelines for the use of computer models for infiltration calculations that are part of the approval process; work with stakeholders to provide short courses, workshops, and other programs for installers of infiltration devices, to ensure effective practices; require and enforce "as-built certification" of installed infiltration devices. 3. **Monitoring effectiveness of infiltration practices**: place a high priority on testing the effectiveness of installed infiltration practices to determine what works and what does not work, and why. 4. **Hydrological research and management**: establish appropriate groups to make recommendations about the status of, and future needs for, hydrological research and management in Dane County. 5. **Resource needs**: provide funds for research and for additional staff for training, permit review, monitoring effectiveness of installations, and on-going review of infiltration standards.	
DANE COUNTY WATERS ACTION PLAN (A GAP ANALYSIS)	Dane County Lakes and Watersheds Commission, 2006	Plan is not online. Summarizes current activities, who is the lead agency or organization working on those activities, their status and priority needs and next steps	
AQUATIC PLANT MANAGEMENT PLANS (FOR LAKES MENDOTA, WINGRA, KEGONSA AND LOWER MUD LAKE)	Dane County Land and Water Resources Department and	In 2006 and 2007, the Office of Lakes and Watersheds and other Land and Water Resources Department staff worked with consultant Underwater Habitat Investigations LLC to prepare aquatic plant management plans for lakes Mendota, Kegonsa, and Wingra; and Fish, Crystal, Indian, and Lower	Aquatic plant, water clarity

All plans available at http://www.danewaters.com/management/AquaticPlantManagement.aspx	Underwater Habitat Investigations, LLC.2007	Mud lakes. These aquatic plant management plans were approved by the Dane County Lakes and Watershed Commission and Wisconsin Department of Natural Resources in March and April 2007. **Recommendations for Lake Mendota:** 1. Conduct large-scale mechanical harvesting in areas not designated as Sensitive Areas under Wisconsin Administrative Code NR 107.05(3-i) where Eurasian water milfoil inhibits boating access and recreation. 2. Prohibit chemical herbicide treatments and mechanical harvesting within Sensitive Areas. Sensitive Areas are undeveloped areas supporting coarse woody debris, floating-leaf plants including American lotus (*Nelumbo lutea*) and white water lily (*Nymphaea odorata*) and submersed native plant species including clasping-leaf pondweed (*Potamogeton richardsonii*), sago pondweed (*Struckenia pectinatus*), leafy pondweed (*Potamogeton foliosus*), flatstem pondweed (*Potamogeton zosteriformes*), water stargrass (*Heteranthera dubia*), wild celery (*Vallisneria Americana*), muskgrass (*Chara*), and horned pondweed (*Zannichelia palustris*). 3. Chemical herbicide treatments should focus on the selective control of Eurasian water milfoil – EWM (*Myriophyllum spicatum*) since several native pondweeds and other valuable native species have increased in the lake. 4. Consider options for reducing motorboat impacts to floating-leaf plants (American lotus and white water lily) in University Bay and Governor's Island sheltered coves. 5. Consider expanding floating-leaf plant beds and introducing high value species (historically found in the lake) within proposed Sensitive Areas, University Bay and Governor's Island sheltered coves. **6.** Dane County mechanical harvesting crews should continue to take steps to prevent the spread of exotic invaders across Dane County lakes. These steps include removing any visible plants, mud, debris, water, fish or animals from the machinery and thoroughly washing the equipment. **Recommendations for Lake Wingra:** 1. Mechanical harvesting should focus on Eurasian watermilfoil control, in areas where this exotic plant impedes lake access or if open water is needed for special events such as competition rowing or swimming. 2. Mechanical harvesting should avoid nearshore areas to protect the diverse plant community. 3. Chemical treatments are not recommended and may undermine the ecologically diverse plant community in the lake. (Lake Wingra has not been chemically treated in the recent past and Eurasian watermilfoil declined significantly due to ecological factors and not intensive management). 4. Ecologically acceptable methods to remove carp from Lake Wingra are recommended since both water clarity and native plant distribution will likely improve. 5. Consider sampling nearshore nongame fish populations to assess the ecological health of Lake Wingra. 6. Publicly owned shorelines should be designated as Sensitive Areas [NR 107.05(3i)] due to the presence of high value native species identified under NR 107.08(4). Aquatic plant management	

		activities within the Sensitive Areas would be restricted to protect the important habitat functions. The public beach and boat ramp would not be included in the proposed Sensitive Areas. 7. Dane County mechanical harvesting crews should continue to take steps to prevent the spread of exotic invaders across Dane County lakes. These steps include removing any visible plants, mud, debris, water, fish or animals from the machinery and thoroughly washing the equipment. **Recommendations for Lake Kegonsa:** 1. Conduct large-scale mechanical harvesting if Eurasian watermilfoil significantly expands in the lake. Low density of the exotic plant and other species did not warrant significant management in 2006. 2. Chemical treatments should be limited due to low Eurasian watermilfoil densities found within nearshore areas. The sparse plant beds in nearshore areas likely reflected the scoured sandy substrates and low water clarity. 3. Consider experimental plantings of white or yellow water lilies along protected shorelines given the relative dearth of high value plant beds in the lake. 4. Sensitive Areas should include undeveloped portions of the lake including Fish Camp, Lake Kegonsa State Park and the Door Creek wetlands. 5. Dane County mechanical harvesting crews should continue to take steps to prevent the spread of exotic invaders across Dane County lakes. These steps include removing any visible plants, mud, debris, water, fish or animals from the machinery and thoroughly washing the equipment. **Lower Mud Lake Recommendations:** 1. Conduct large-scale mechanical harvesting to maintain flow between the inlet and outlet of Lower Mud Lake. 2. Limit the harvesting of wild celery in the river between Lower Mud Lake and Lake Kegonsa except during emergency high water and flood conditions. Cutting should continue to be confined to the deepest portion of the channel in an effort improve flow while historical structures are avoided. 3. Chemical treatments should not be conducted in the lake given the general lack of riparian development. Uses within the natural shoreline eliminate the need for treatments typically used to clear swimming areas and piers. 4. The Sensitive Areas designation should include the entire shoreline given the relatively undeveloped condition. The habitat functions in Lower Mud Lake may benefit Lake Kegonsa where critical aquatic plant habitats were scarce. 5. Dane County mechanical harvesting crews should continue to take steps to prevent the spread of exotic invaders across Dane County lakes. These steps include removing any visible plants, mud, debris, water, fish or animals from the machinery and thoroughly washing the equipment.	
YAHARA RIVER WATERSHED RAINFALL-RUNOFF MODEL FINAL REPORT	W.F. Baird & Associates Ltd.2007	Describes the numerical modeling tool to be used to manage lake levels and to evaluate the impacts on lake level from land use and management changes, changes to control structures and channel capacity and alternative strategies for lake level management	
PERSPECTIVES ON THE EUTROPHICATION OF THE	Richard Lathrop, DNR, 2007	No recommendations, but describes lake and watershed characteristics, lake monitoring data sources, and traces the history of lakes management from the 1800s to the present.	Eutrophication

YAHARA LAKES http://www.dnr.state.wi.us/org/water/fhp/lakes/Lathrop2007LakeandReservManageVol23p345-365.pdf			
FLOW ANALYSIS THROUGH RAILROAD BRIDGE BETWEEN UPPER MUD AND WAUBESA LAKES	UW 2008	This report is not online.	
HEALTH GOALS FOR LAKE WINGRA http://lakewingra.org/index.php?option=com_content&view=article&id=2:lake-health-goal-and-coordinated-watershed-planning&catid=3:projects&Itemid=4	Friends of Lake Wingra Forthcoming (2007 draft referenced here)	**Management Strategies: How We Can Get There** *After the Friends of Lake Wingra completes a review of the above goals by citizens and partner groups, the next step will be to develop concrete strategies and measurable outcomes. These will include strategies that address both ecological management and social/political management. Many of these strategies have already been developed in existing Storm Water, Invasive Species, and Citizen Stewardship management plans (see FOLW Library at http://lakewingra.org).* **Ecological Management** includes attention to surface & groundwater hydrology, stormwater, ecosystem services, invasive species, and Wingra Creek restoration. **Social and Political Management** includes attention to urban redevelopment, coordinated leadership, planning and action (government, business, and nonprofits), citizen stewardship, schools (curriculum development, action learning), and regional land use and transportation.	Groundwater, invasive species, stormwater
WATER QUALITY OF AN URBAN WET DETENTION POND IN MADISON, WISCONSIN, 1987–88: U.S. GEOLOGICAL SURVEY OPEN-FILE REPORT 93–172, 57 P. http://pubs.er.usgs.gov/djvu/OFR/1993/ofr_93_172.djvu	Leo D. House, R. J. Waschbusch & Peter E. Hughes, USGS, 1993	A wet detention pond was monitored to determine its effect on the water quality of urban runoff. The pond has a drainage area of .96 square kilometers, primarily single-family residential land use. Event-mean concentrations (EMC) were collected and compared for sediments, nutrients & metals at the pond's inflow & outflow sites for 64 runoff events, from February 1987 to April 1988. In general, the pond decreased EMC of sampled constituents at the outlet compared to the inlet. Suspended solids decreased 88%, chemical oxygen demand decreased 60%, total phosphorus decreased 43%, total Kjeldahl nitrogen decreased 39%, total nitrite plus nitrite decreased 65%, and total lead decreased 71%. However, the EMC of chloride was generally higher for outflow than for inflow.	Chloride, nutrients, phosphorus, sediment, water quality
YAHARA RIVER LAKES ACTION PROGRAM 1987-92	DCRPC, 1988	Report is not online.	
SURFACE WATER RESOURCES OF DANE COUNTY	DNR, 1985	Report is not online. Basic background on all water bodies in Dane County including physical characteristics (size, depth, location, gradient, stream order etc), history and threats	

		(Appears to have been superseded by other publications on this list)	
THE WETLANDS OF DANE COUNTY, WISCONSIN	R.L. Bedford, E.H. & J.H. Zimmerman, DCRPC, 1974	Report is not online. Dated, but the only systematic qualitative evaluation of Dane County wetlands available. Wetlands are grouped based on their present or potential biological condition, scientific value, public use, extent of degradation, and immediate or long range threats.	
UW-MADISON GAYLORD NELSON INSTITUTE FOR ENVIRONMENTAL STUDIES; WATER RESOURCES MANAGEMENT WORKSHOP STUDIES			
RESTORATION OF THE ARBORETUM'S EASTERN WETLANDS http://www.nelson.wisc.edu/wrm/workshops/2007/arb/	WRM Workshop, 2007	**Stormwater Management** The first, and arguably most important, step is to improve stormwater management in Southeast Marsh by rebuilding Pond 4 and repairing Pond 3. Thus, we support the 2006 recommendations of the Arboretum Stormwater Committee to enlarge Pond 4 and renovate Pond 3 by dredging the sediment and fixing the outfalls. Additionally, we recommend adjusting the design of Pond 4 to facilitate adaptive restoration (experimentation with water depths and planting of native species). To reduce the volume of stormwater flowing from the upstream neighborhood into Southeast Marsh, we suggest utilizing the potential for infiltration and ponding in the Arbor Hills Greenway and rain gardens at Leopold Elementary School. Our community-based marketing survey documents strong public support for an infiltration swale where native plant species could grow—these opinions of the Arbor Hills neighborhood should prove useful to engineers in re-designing the Greenway. In the survey, Arbor Hills residents favored changes to the current Greenway using native plants, but did not support creating ponds. The Arboretum should encourage and support upstream efforts to reduce runoff and improve infiltration, as this will ultimately benefit the wetlands.	Infiltration, rain garden, sediment, stormwater
ENHANCING AN URBAN RESOURCE: WATERSHED ASSESSMENT AND MANAGEMENT PLAN FOR MONONA BAY, MADISON, WISCONSIN **http://www.nelson.wisc.edu/wrm/workshops/2006/**	WRM Workshop, 2006	**CHAPTER 7. RECOMMENDATIONS** A summary of the recommendations including the purpose of each recommendation and possible implementing partners is provided. In making specific recommendations, we considered funding availability and other factors that can limit implementation. However, in an effort to increase the dialogue about innovative options to explore in the future, we included some ideas that could be a part of longer-term plans, even if current barriers to implementation have been identified. **7.1 Stormwater-Management Recommendations** We recommend the following activities, tools, and management strategies to address stormwater problems affecting the bay, including reduced infiltration of runoff resulting in diminished groundwater baseflow to the bay, accumulation of toxic substances in the bay's sediments, nutrient loading, sedimentation, and trash inputs to the bay. **7.1.1 Water-Quality Activities** The City of Madison and the UW–Madison improve stormwater quality by performing street sweeping and trash collection, and the WNDR and Department of Commerce regulate construction site runoff	Aquatic plant, erosion, eutrophication, groundwater, infiltration, invasive species, phosphorus, rain garden, sediment, stormwater, street sweeping, water clarity, water quality

		and erosion. These programs could be complemented and improved upon by the following recommended activities: • Create an erosion-control hotline and require posting at construction sites. • Expand promotion of pollution prevention. • Expand and enhance litter prevention and cleanup programs. • Expand and enhance street sweeping. • Expand stormwater outfall maintenance. **7.1.2 Stormwater Treatment Devices and Low-Impact Development Techniques** We evaluated a variety of stormwater-treatment devices (including catchbasins/ catchbasin inserts, continuous deflective separation devices, filtration devices, combination devices, and trash-removal devices) and low-impact development techniques (including porous pavement, green roofs, rain gardens, rain barrels, and comprehensive LID case studies). These devices and techniques hold a great deal of promise for improving conditions in Monona Bay by removing trash, sediment, and other pollutants from stormwater before it enters the bay and by increasing stormwater infiltration. Many opportunities exist for the implementation of these tools in the watershed, including in the parking lots of businesses and institutions, such as churches, on private residential properties, and throughout the public stormwater system. **7.1.3 Policy Tools** Due to the expense associated with purchasing, installing, and maintaining stormwater-treatment devices and with implementing LID techniques, these devices and techniques are most cost effective when used as a part of a long-term strategy for improving stormwater quality. ***7.1.3.5 Expand UW-Madison's We Conserve Program into a Comprehensive Environmental Sustainability Program*** Expand the We Conserve program at UW–Madison into a comprehensive environmental sustainability program similar to the comprehensive Environmental Policy at Duke University, committing the university to leadership in three areas: • environmental research and education, • environmentally responsible operations, and • environmental stewardship in the community. The policy would bring together all efforts for reducing the impact of UW–Madison's operations on the environment. ***7.1.3.6 Develop a Stormwater-Treatment Device Testing Protocol for Wisconsin*** • Develop a statewide technology verification program, targeting commercially available technologies and public domain practices. • Create a data-sharing network to make data available across the state. • Begin requiring developments to use only verified stormwater treatment technologies to meet pollutant removal standards.	

7.2 Shoreland-Restoration Recommendations

Monona Bay is better suited to an active restoration approach than a passive restoration approach because of the significant populations of invasive plants and lack of native plants along the shore. . .

However, there are areas within Brittingham Park and along privately owned shoreland that would be excellent places to begin an active restoration program. We recommend restoration of Brittingham Park's shoreland environment to a low-profile, wet prairie buffer, with plants up to 4 ft in height. The restored buffer would be composed of native vegetation, such as short prairie grasses, sedges, rushes, and wildflowers. Similar to the shoreland restoration conducted by Friends of Lake Wingra, this restoration project will ideally "promote an active watershed community by engaging neighbors, park users, students, and park managers in collaborative planning, planting, and maintaining of the shoreline habitat restoration site" (Friends of Lake Wingra, 2003). The restoration project would serve as a model for individual shoreline property owners who are interested in restoring their shoreland to native prairie.

We do not recommend vegetated riprap banks for inclusion in the shoreland restoration. The dense stands of willows or cottonwoods that would grow from a vegetated riprap effort are not suitable for the bay's location because they would likely block views of the bay from shore as well as make access to the water difficult.

7.3 Aquatic Plant Management Recommendations

We recommend balancing the needs of recreational users with the quality of fish and wildlife habitat and the overall ecological health of the bay. The bay's current stable, clear water, plant-dominated state should be maintained; excessive aquatic plant removal that would switch the bay to a turbid water, algae-dominant state should be avoided. Although the dense aquatic plant community can be a nuisance to recreational activity, it helps to maintain water clarity and provides important aquatic habitat. Therefore, the primary focus of aquatic plant management should be to shift species composition from canopy-forming invasives that interfere with recreational use to a more desirable mix of native species.

7.3.1 General Recommendations

- Control stormwater runoff and reduce external nutrient loading to the bay to minimize algae blooms and nutrient accumulation.
- Continue water-quality monitoring to identify ecosystem changes.
- If native species do not return, proceed with establishing founder colonies using mature native plants with well developed shoots and leaves that are planted in protected enclosures. Continue to protect the plants against waterfowl, muskrats, carp, waves, and boats until they become established and begin spreading using a variety of exclosures.
- Closely monitor the results of the founder colonies to determine their effectiveness, which natives naturally repropagate, and whether the resultant plant community also grows to nuisance levels that still require periodic harvesting.
- If the colonies appear established, expand planting the subsequent year, following the same

protective measures.

- If the treated areas are regularly repopulated by invasive species, and natives are not reestablishing, abandon this approach and focus on harvesting.

7.4 Water-Quality Recommendations

Because Monona Bay is in a highly urbanized environment, the collection of chemical and physical data is critical to understanding how this shallow water body is influenced by its surrounding watershed. Long-term data collection can allow lake managers to track water quality trends and the success of various management practices over time.

7.4.1 Primary Recommendation

If adequate funding is available, the following components of a water-quality monitoring program in Monona Bay are recommended:

- Continue water-quality monitoring in the bay at the same frequency, at the same sampling sites, and for the same list of chemical and physical parameters as begun in 2005 by the City of Madison. This also includes weekly monitoring for blue-green algae at five sites within the bay. The recommended sampling regime includes the following parameters: total phosphorus, orthophosphate, nitrate-ammonia, total Kjeldahl-nitrogen, chlorophyll-a, silica, Secchi depth, pH, dissolved oxygen, temperature, and blue-green algae.
- Calculate the TSI for Secchi depth, chlorophylla, and total phosphorus on an annual basis and graph these results to compare with previous years. Such an index allows for the classification of nutrient enrichment or eutrophication of a lake over time.
- Provide TSI data online for public access.

7.4.2 Secondary Recommendation

If funding for water-quality monitoring in Monona Bay will not support the primary recommendation, our secondary recommendation is provided to guide a minimum level of monitoring. At a minimum, the following water-quality parameters are recommended for monitoring at the same frequency and for the same sites as begun in 2005 by the City of Madison in the bay (collection from the triangles may be omitted if resources are limited):

- total phosphorus,
- chlorophyll-a,
- Secchi depth,
- pH,
- dissolved oxygen, and
- temperature.

7.5 Education and Outreach Recommendations

Education and outreach can improve the way stakeholders use and view the bay, creating behavioral changes that improve bay conditions as well as creating motivation for public support of projects to enhance the bay.

		7.5.1 Current Activities The FOMB, the Dane County Lakes and Watershed Commission, and the WDNR support and sponsor valuable education and outreach activities. We recommend that these actions continue: • Citizen Lake Monitoring Network Water Quality Monitoring, • [Document is missing next page]	
STARKWEATHER CREEK WATERSHED: CURRENT CONDITIONS AND IMPROVEMENT STRATEGIES IN AN URBAN CONTEXT http://www.nelson.wisc.edu/wrm/workshops/2005/	WRM Workshop, 2005	**Recommendations have been summarized:** **Educational recommendations:** • *Infiltration campaign.* Municipal groundwater pumping and reduced infiltration are the two largest contributors to the low baseflow and resulting poor water quality conditions of Starkweather Creek. To address these impacts, an ideal education campaign would motivate the Starkweather Creek watershed community to conserve water and reduce stormwater runoff using rain barrels and rain gardens. We recommend a rain-barrel campaign that focuses on encouraging homeowners to understand stormwater issues, conserve water, and gain a greater appreciation for the watershed. We also recommend rain-garden campaigns, which would extend beyond home owners to larger audiences: schools, businesses, and places of worship. • *North Platte conceptual plan.* As planning of the North Platte (next to Olbrich Botanical Gardens and the Starkweather Creek confluence) unfolds, a unique opportunity for providing substantial watershed education about human impacts upon the landscape is presented. Therefore, we recommend developing the North Platte of Olbrich Botanical Gardens as an educational tool to promote watershed awareness, illustrate the historical pattern of watershed degradation in Madison, enhance the community value of the area, and to allow citizens to experience restoration efforts in their community. Our comprehensive conceptual plan can provide a framework for future dialogue on the development of the North Platte. • *Citizen stewardship map.* We created a map of the Starkweather Creek watershed that illustrates some of the key attributes of the watershed as a tool to spearhead a citizen stewardship campaign. Accompanying text discusses highlights and problems facing the watershed, and gives ideas to citizens wishing to take action. **Phosphorus Management and Recommendations** Although more studies are required to evaluate the different challenges facing a project of this magnitude, we have several recommendations on the basis of this preliminary analysis of the feasibility of introducing treated wastewater effluent into Starkweather Creek. These recommendations are based on the assumption that a tertiary treatment Starkweather Creek Watershed facility will be constructed by MMSD north of Lake Mendota and that policy makers for the Yahara Lakes will look at the management of the lakes from a watershed-management perspective. The following scenario is proposed as one alternative: • Tertiary wastewater-treatment plant designed for ultra phosphorus removal constructed north of	Groundwater, infiltration, phosphorus, rain garden, stormwater, water quality

		Lake Mendota delivers effluent with total phosphorus (TP) concentrations reduced to 0.01 mg/L. • Transmission lines to transport a maximum of 5 to 10 cfs of treated effluent laid next to the current northeast sewer system interceptor. Discharge of 2 to 5 cfs into the West Branch at the airport, by County Road CV or by Highway 51. Continuation of the transmission line following the existing sewer system pipelines for a discharge of 3 to 5 cfs into the East Branch by the interstate 90/94. • Each discharge point designed with a natural-looking aerator with capacity of 5 to 6 mg/L of dissolved oxygen. • Management of the discharge regimes to be conducted so that discharge can be reduced or eliminated at times of the year when monitored TP concentrations in Lake Monona are at a maximum. Total discharge to be managed so that TP loading in Lake Monona will not exceed required limits set by the WDNR. Other alternatives need to be investigated so the best overall solution can be achieved for all concerned, including local citizens, resource agencies, and effected ecosystems. In the future, increased pressure could be placed on local and state authorities to integrate management of the Yahara Lakes and their tributaries. The option of using treated effluent to improve the quality of Starkweather Creek can be implemented if enough political will is available. **Lien Marsh Restoration Recommendations** As a result of the varying site conditions in the Lien Marsh, we propose subdividing the area into five ecological units: 1. The fen including the groundwater pond, ***Comprehensive Approach to Restoration*** • Restore the hydrologic integrity of the fen. • Reverse reed canary grass and cattail dominance. • Enhance plant diversity in the fen. ***Minimized Approach to Restoration*** • Stop further spread of reed canary grass and cattail. • Enhance plant diversity in the fen remnant. 2. The area receiving stormwater from the detention pond, which we refer to as the stormwater wetland, ***Comprehensive Approach to Restoration*** • Mitigate altered wetland hydrology. • Minimize nutrient flux. • Control invasive species and enhance plant diversity. ***Minimized Approach to Restoration***	

		• Control invasive species and enhance plant diversity. 3. The area bordered by Lien Road and the Target property, which we refer to as the wet prairie, ***Approach to Restoration*** • Establish a native wet prairie plant community. 4. The creek corridor, ***Approach to Restoration*** • Enhance flow conditions. 5. The area east of the creek, which we refer to as the Triangle Marsh. ***Comprehensive Approach to Restoration*** • Remove hydrologic alterations. • Suppress invasive species and improve native sedge meadow community. • Purchase small wetland area connecting to Triangle Marsh. **North Platt Driveway and Parking Recommendations.** Additional parking and vehicle access necessary for the development of the North Platte should be placed and installed only on an as-needed, low-impact basis. Prior to construction of additional paved areas, a proposed-use study could be conducted to determine the daily and special event parking and vehicle access needs of the North Platte and Olbrich Gardens. If additional parking is determined necessary, other parking lots located within walking distance could be considered prior to construction of any new parking facilities. Three parking lots, consisting of approximately 330 total parking spaces, are adjacent to Olbrich Park and the boat-launch facilities, all within approximately 1,000 to 2,500 feet from the existing main entrance of Olbrich Gardens. As noted on the North Platte conceptual plan, existing parking for Olbrich Park and the Olbrich boat launches could be used during special events when additional parking is occasionally needed. If future gardens are placed where proposed, proposed parking locations will be very close to the new garden areas. If distance from the garden entrance is still a concern, a shuttle service could be established for special occasions. Low-impact development criteria could be implemented when determining the appropriate size, location, and type of materials for constructing any new parking lot. To minimize impacts to existing natural areas, new parking facilities should be positioned outside of any established creek buffer area and away from other environmentally sensitive areas, such as wetlands, woodlands, or prairies (Schueler and Brown, 2004). A few possible appropriate locations for new parking have been noted on the North Platte site plan. Because parking facilities constitute such expansive areas, constructing additional parking using pervious pavement or porous concrete should be strongly considered. A number of studies have shown that pervious pavement significantly reduces runoff volumes and pollutant loading when compared to	

		traditional installations of impervious surfaces. Construction of a parking lot using porous material does cost somewhat more than traditional impervious applications; however, the net environmental benefit received by adjacent waterways, in particular Starkweather Creek, and the reduced need for additional stormwater-control systems, could significantly offset installation and annual maintenance costs. Construction design manuals should be used to determine whether the proposed site is suitable for porous pavement, how to properly install and maintain porous pavement, and what the estimated cost will be. Interpretive signs discussing the benefits of pervious pavement and other low impact parking measures could be located adjacent to these areas in an effort to further educate the public. **Walking Trails.** In the Starkweather Creek Master Plan 2005 update, the City of Madison Parks Division outlined a concept for the Garver Area and North Platte that included a number of walking trails that would connect Olbrich Gardens, O.B. Sherry Park, and the Dixon Greenway and serve as a framework for native restoration. On the basis of that recommendation, we propose that a walking-trail system be developed to guide North Platte visitors through the educational interpretive displays that we propose in this report.	
A WATERSHED APPROACH TO WETLAND SERVICES: PRIORITIZING WETLAND RESTORATION IN THE UPPER ROCK RIVER BASIN http://www.nelson.wisc.edu/wrm/workshops/2004/	WRM Workshop, 2004	Developed a watershed-based strategy for wetland restoration considering ecological services (hydrologic support, water-quality improvement, and biodiversity enhancement) as well as investigating a means to implement such a strategy for the Upper Rock River Basin. **Recommendations for implementation** Restoration techniques suggested by the scientific community may be difficult or impossible to implement. Politics, institutions, and economics interact in ways that consistently frustrate the best intentions of scientists. We foresee the largest barriers to achieving successful implementation of our watershed-based strategy to include a lack of basinwide coordination and adaptive management. Although restoration many times has proved useful in protecting and conserving important water resources at individual project sites, future efforts must fully take into account ecosystem interactions on a landscape scale. Any attempt to coordinate efforts on basinwide scales throughout the state would have to include innovative, multifaceted approaches that effectively bring people with varying interests together. Over the last several decades, societal values on the environment have been expressed through a general increase in regulatory actions. The debate over the appropriate degree of implementing environmental regulation has helped divert attention away from the fact that the basic goals expressed in the Clean Water Act are fully engrained in our society and governmental institutions. “Fishable, swimmable, drinkable waters” are goals that are increasingly talked about when referring to finite water resources	Nonpoint source, water quality, wetland restoration

		continuously threatened by increasing urban populations and conflicting land uses. In the relative long term, our society will most likely favor stricter regulation of non-point source pollution—much like point source pollution before it. We will not speculate on whether this would become reality through the implementation and enforcement of current legislation or the passage of further legislation. But as greater pressures are placed on our water resources over time, nonpoint source pollution will increasingly become a focal point and the measure by which we evaluate our efforts to protect water resources. The successful implementation of our strategy must occur over a relatively long period of time. Efforts to coordinate a wetland-restoration strategy are not something that would occur overnight. We propose the incorporation of our strategy within the institutional framework of the Upper Rock River Basin and the State of Wisconsin by considering current and long-term regulatory environments. [Recommendations were in text form; section headings indicate general categories of recommendation, rather than specific recommendations.] *Implementation under potential future regulatory requirements* *Preemptive implementation within the current institutional framework* Collaboration Initiating coordination Identifying restoration objectives Prioritization Outreach and education Participatory incentives Monitoring and adaptive management Interagency coordination of data management Additional opportunities to implement strategy within the Upper Rock River Basin • Combine efforts to improve water quality and restore wetlands • Invest a specified percentage of mitigation fees to the enhancement of important wetland resources in Wisconsin	

		• Incorporate wetland restorations into new development • Create wetland-protection districts	
UW-MADISON STORMWATER RUNOFF MANAGEMENT PROJECT http://www.nelson.wisc.edu/wrm/workshops/2003/	WRM Workshop, 2003	Key recommendations for preservation of green space • During the planning stages of projects like the Murray Mall redevelopment, green space design BMPs and minimization of impervious surfaces should be incorporated. • The UW–Madison should adopt a "no-net-loss-of-green-space" policy. Key recommendations for current pedestrian facilities • The UW–Madison needs to explore creating a plan to ensure that all areas budget sufficient funds to replace deteriorating sidewalks. • Campus planners should look at reducing the size of excessive patios, sidewalks, and stairways by replacing excess concrete with turf or landscaping. If this is not possible, planters with trees and bushes should be placed on the excessive patios at existing buildings. • The minimum sidewalk and handicap ramp width on campus should be 8 feet. • After all sidewalks with safety concerns are replaced, the FPM should inventory narrow sidewalks and complete a plan for their augmentation or replacement with wider facilities. • The FPM should inventory all convenience paths and create a plan for each site to construct a sidewalk, build a deterrence, or allow it to remain if no problems are caused. • The campus needs to prepare a scooter plan to retrofit old buildings with designated and marked scooter parking, access points from the street to the scooter parking to avoid accidents with bicycles and pedestrians, and a possible parking permit program. • The FPM should inventory planting strips and create a plan for their replacement with a solid surface if necessary. • The University should experiment with alternatives to concrete for pedestrian design, including pervious pavement, pavers, and gravel. Key recommendations for controlling erosion on construction projects • Stormwater issues need to become a higher priority for construction activities on campus. • The scope of a particular project, the physical characteristics of a site, and other site-specific issues need to be clearly addressed in the planning and design process to properly implement effective best management practices. • Commonly used sediment control methods, such as silt fence and inlet protection, need to be properly installed and maintained, and should be used in combination with erosion-control methods that help stabilize the sediment within a site. • Although silt fencing is the most popular management strategy for dealing with construction stormwater issues, it is not a universal solution. Other management practices need to be considered when looking at the site-specific character of a site. • Efforts should be made to ensure that the latest best management practices are specified in construction contracts to help contractors address site-specific stormwater issues on their site.	Erosion, infiltration, rain garden, sediment, stormwater, street sweeping, water quality

		• Project planners should incorporate existing stormwater standards and be provided with the latest technical information to help them design to those standards. • Efforts should be made to monitor construction projects after major rain events to ensure that they are complying with existing standards. • The Landscape Architect's job should be expanded to include assisting in developing of and monitoring implementation of CSEC plans. • The Landscape Architect needs to be given access to WiscBuild, the DSF database of projects that has contact information and project details. This would improve communication among all parties involved in erosion- and sediment-control enforcement. Key recommendations for building design on campus • Buildings should utilize vertical, rather than horizontal space. • Neighboring buildings should utilize shared driveways whenever possible, and can increase infiltration by using pervious pavement for these driveways. • Main entrances to buildings should be located on their south sides to limit salt application in winter months. • Building designs should utilize pre-existing vegetation for infiltration purposes whenever possible. • Natural buffers between buildings and natural water bodies should be maintained. • Best management practices, such as chisel plowing and deep tilling, can be used to improve the natural permeability of compacted soils. • Other BMPs, such as rain gardens and grass swales, can be utilized to improve infiltration around building sites. Key recommendations for parking-lot design on campus • Parking requirements for buildings should be re-evaluated to ensure that parking-lot area does not exceed parking demand. • Stall dimensions can be reduced by devoting 30 percent of the stalls to compact vehicle parking and providing overflow parking on pervious surface. • Parking-space design should be done in the most space-efficient manner possible. • Neighboring buildings that have different peak parking times should utilize shared parking lots. • Best management practices, such as porous pavement, can be effectively utilized to decrease the extent of impervious area used for parking lots. Key recommendations for utilizing vegetated infiltration areas for parking-lot runoff • The use of vegetative infiltration areas can significantly improve infiltration of stormwater runoff from parking lots as well as provide increased aesthetics. • A combination of deep-rooted perennial plantings and various native trees will provide the best infiltration potential. • Weeding of vegetated areas should be done monthly for the first three years. After native plants are established, weeding should only be necessary once or twice a growing season.	

		• Because the availability of staff to water plants on campus is limited, drought-resistant species should be utilized for parking-lot infiltration areas. • The use of heavy machinery in creating vegetated infiltration areas should be avoided to reduce the effects of compaction. Key recommendations for managing stormwater on parking ramps • The UW–Madison should design future parking structures in accordance with the City of Madison requirement for all runoff from parking ramps to be conveyed to the sanitary sewer system, with the exception of the uppermost level. • Oil and grease filters, oil and grease separators, sand filters, or in-line treatment devices are required to deal with the water-quality concerns associated with parking ramps. • Runoff from the uppermost level of parking ramps is conveyed to stormsewers; vegetated infiltration areas can be an effective BMP for dealing with this runoff. Key recommendations for preventing soil compaction • During construction, divide large areas into sections to be consciously compacted for roads and foundations, and sections for lawns and landscaping. • Disturb only areas needed for construction. • Avoid wheel traffic and tillage of wet soils; use wider tires, dual tires, or tracks; minimize tractor weight. • Soil that will support lawns can be protected by sub-soiling and by stockpiling topsoil that will be returned to the site after construction. • Control vehicle and pedestrian traffic over campus green areas through proper landscape design of pedestrian walkways or trails and vehicle access routes. • During special events, lay down metal or wood mats for better distribution of weight for vehicular traffic or involving high volume of people in concentrated areas. • Do not use compacted fill material in areas intended for lawns. Key recommendations for alleviating soil compaction • Aerate compacted turf grasses annually. • The University should upgrade its aeration equipment to a GA 60 type aerator. • Where compaction is severe and turf is dead or dying due to compaction, areas should be reseeded or completely re-sodded when success is indicated. • Irrigation management should be adjusted to promote healthy green space vegetation. • Partial or total soil replacement may be needed. Replace dense soil with loose soil, or haul in topsoil. • Increasing or applying organic matter can help improve root penetration and increase water absorption. • Sub-soiling is another practical alternative to help alleviate compacted soils. Caution should be used here to be sure that sub-soiling will have the desired results.	

		Key recommendations for nutrient management • Continue efforts to optimize fertilizer use to meet, but not exceed the needs of turf grasses. • Continue the use of practices to reduce phosphorus loading to the lakes, including avoidance of sidewalks and roads, establishment of a fertilizer-free area around the Lake Mendota shoreline, and the use of soil testing to determine application schedules. • The FPM should work together with UW Athletics and the Department of Sports and Recreation to ensure consistency in nutrient management across campus. Key recommendations for salt best management practices • Excessive sidewalks, stairways, and plazas should be avoided to minimize snow removal labor costs. • If possible, main building entrances should be located on the south side of the building to utilize the sun's ability to melt ice so less salt is needed • If possible, buildings should be located and sized to minimize shadows on sidewalks and streets on the north side of the building. Tall buildings located just to the south of roads create a shadow for the entire winter and require additional salting (i.e., Rennebohm Hall of Pharmacy shades Highland Avenue). Key recommendations for snow removal • The UW–Madison Salt Best Management Practice must continue to be followed. The University Administration can show its support for the BMP by increasing budget for snow removal, deicing, and post-snowmelt street sweeping. • The berm separating the snow-storage pile for the parking lots on west campus from the 1918 Marsh should be redesigned and/or relocated. • New buildings and major renovations should be designed with snow removal in mind. • Minimize excessive plazas, sidewalks, and stairways. • If possible, main building entrances should be located on the south side of the building to use the sun's ability to melt ice. • If possible, buildings should be located and sized to minimize shadows on sidewalks and streets to the north. • Minimum sidewalk and handicap ramp width for mechanical snow removal should be 8 feet. • Snow storage should be provided adjacent to sidewalks, parking lots, and streets. • A sufficient amount of sand for the winter must be kept in a dry storage facility starting in the fall. Periodically, the University should evaluate the adequacy of existing sand and salt storage facilities for providing dry storage. • An increased budget for street sweeping, hand sweeping, and snow removal must be provided to keep all streets, bicycle paths, and sidewalks free of sand after the spring snowmelt and to reduce the need for salting and sanding. How much the budget should be increased would be determined with input from the Physical Plant and FPM staff.	

		Key recommendations for meeting agricultural standards • Any new gardens or other agricultural uses on the UW–Madison main campus should be designed so that no new erosion results. • The University should be sure that its agricultural facilities on and off the central campus meet the new state agricultural performances standards for preventing polluted runoff through a full assessment of current agricultural practice compliance and water quality and quantity impacts of University properties away from the UW–Madison main campus.	
LAKE WINGRA WATERSHED: A NEW MANAGEMENT APPROACH http://www.nelson.wisc.edu/research/wrm99/	WRM Workshop, 1999	Proposed a set of tools for the protection and enhanced management of the Lake Wingra watershed. In addition to proposing a set of tools, this work included synthesizing existing technical research, evaluating current management practices, analyzing stakeholder coordination, and designing an outreach strategy. Some of the major issues facing the Lake Wingra watershed: • Eutrophication and sedimentation from stormwater runoff • Reduced spring flows and groundwater levels • Degraded habitats • Introduction of exotic plant and animal species • Lack of stakeholder coordination and watershed-level management • Lack of funding to effectively implement management strategies The workshop recommended creation of a stormwater utility (SWU). SWUs provide a means for financing the capital and operating expenses needed for stormwater management. . . While many SWUs across the country are focusing simply on stormwater conveyance and flood protection, there are several that incorporate innovative management practices, educational programs, and public involvement activities. . . Madison could maximize the effectiveness of a SWU by incorporating an advisory board with citizen representation, watershed coordinators, fee-reduction incentives for both residential and non-residential properties, and a small grants program for watershed education and restoration projects.	Eutrophication, groundwater, sediment, stormwater
WATER RESOURCES ATLAS FOR TOKEN CREEK: A Water Resources Management Study http://www.nelson.wisc.edu/grad/wrm/workshops.htm	WRM Workshop, 1997	Summarized the current conditions of the Token Creek Watershed, how humans affect the water resources, possible future conditions, and watershed management options. This document is to be used to promote collaborative efforts between different stakeholders to protect and enhance the watershed. Focused on the impacts of urbanization on springs and a coldwater trout stream	
NINE SPRINGS WATERSHED AND ENVIRONMENTAL CORRIDOR http://www.nelson.wisc.edu/grad/wrm/workshops.htm	WRM Workshop, 1996	Conducted a hydrological assessment, a water resource management assessment, and an exploration of wetland and stream channel restoration possibilities in the Nine Springs Creek Watershed.	
THE UPPER SUGAR RIVER BASIN IN TRANSITION: A WATERSHED EVALUATION WITH MANAGEMENT OPTIONS	WRM Workshop, 1993	Identified trends which might signal significant long-term degradation of the resources and to identify the actions and activities which could be causing such trends. The workshop looked at the river basin as an integrated resource, looking at both the quantity and quality of surface and groundwaters as well as	Groundwater

http://www.nelson.wisc.edu/grad/wrm/workshops.htm		the management of these resources by individuals and the government.	
URBAN WETLANDS IN THE YAHARA-MONONA WATERSHED: Functional Classification & Management Alternatives http://www.nelson.wisc.edu/grad/wrm/workshops.htm	WRM Workshop, 1990	Developed a functional classification scheme to aid in the design of management alternatives for wetlands in urban areas, with a specific focus on the Yahara-Monona Watershed.	
LAKE WATCH: A GUIDE TO THE CARE OF THE YAHARA LAKES http://www.nelson.wisc.edu/grad/wrm/workshops.htm	WRM Workshop, 1987	Provided an history and the basics of limnology, aquatic biology and ecology along with ideas for ways to preserve and improve the lakes. The purpose was to educate the public about and promote citizen involvement in the protection and management of the water resources of the Yahara River watershed.	
REPORT OF THE DANE COUNTY ADVISORY COUNCIL FOR LAKE QUALITY IMPROVEMENT: A FRAMEWORK FOR LAKE MANAGEMENT LAKES MENDOTA AND MONONA, DANE COUNTY, WI http://www.nelson.wisc.edu/grad/wrm/workshops.htm	WRM Workshop, 1975	Consulted with the Dane County Advisory Council for Lakes Mendota and Monona which was formed to develop an action program for water quality improvement.	Water quality
WORKSHOP REPORTS ON THE UNIVERSITY OF WISCONSIN ARBORETUM AND LAKE WINGRA, MADISON WI http://www.nelson.wisc.edu/grad/wrm/workshops.htm	WRM Workshop, 1973	A broad analysis of the historical and present management and use of the UW Arboretum and to make recommendations for future policy, an aquatic education program, and an "environmentally sound" nature center.	
ALTERNATIVE SOLUTIONS FOR WATER QUALITY MANAGEMENT IN DANE COUNTY, WI http://www.nelson.wisc.edu/grad/wrm/workshops.htm	WRM Workshop, 1970 (First one done)	Identified and evaluated several alternative institutional frameworks for improving water quality management in Dane County.	Water quality

The following USGS reports may provide some historical perspective, but most are not available online and are on included other than as a footnote to this report:

Waschbusch, R.J., 1996, Stormwater-runoff data, Madison, Wisconsin, 1993–94: U.S. Geological Survey Open-File Report 95–733, 33 p. **DJVU**

McLeod, R.S., 1978, Water-level declines in the Madison area, Dane County, Wisconsin: U.S. Geological Survey Open-File Report 78–936, 15 p. **DJVU**

Lawrence, C.L., 1976, Regional flood limits of lower Yahara River, Lake Waubesa and south, in Dane County, Wisconsin: U.S. Geological Survey Open-File Report 76–805, 20 p. **DJVU**

Lawrence, C.L., 1976, Regional flood limits of upper Yahara River in Dane County, Wisconsin: U.S. Geological Survey Open-File Report 76–448, 15 p. **DJVU**

Krug, W.R., 1976, Flood-plain delineation for regional flood in Dane County, Wisconsin: U.S. Geological Survey Open-File Report 76–164, 168 p. not available online

Lawrence, C.L., and Holmstrom, B.K., 1972, Flood in Starkweather Creek basin, Madison, Wisconsin: U.S. Geological Survey Open-File Report 72–0221, 15 p. not available online

Lawrence, C.L., and Holmstrom, B.K., 1972, Floods on Yahara River tributaries, Dane County, Wisconsin: U.S. Geological Survey Open-File Report, 19 p. not available online

Lawrence, C.L., and Holmstrom, B.K., 1971, Floods on Yahara River, Lake Kegonsa dam to countyline, Dane County, Wisconsin: U.S. Geological Survey Open-File Report 72–0222, 10 p. not available online

Holmstrom, B.K., and Lawrence, C.L., 1971, Floods on Yahara River, Lake Mendota to Lake Kegonsa, Dane County, Wisconsin: U.S. Geological Survey Open-File Report 72–0168, 12 p. not available online

Shearman, J.O., and Lawrence, C.L., 1971, Floods on Yahara River upstream from Lake Mendota, Dane County, Wisconsin: U.S. Geological Survey Open-File Report, 7 p. not available online

Young, K.B., 1965, Effect of treated effluent diversion on Yahara River flow: U.S. Geological Survey Open-File Report 66–0157, 81 p. not available online