Yahara Kegonsa
Focus Watershed Report
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Subject: Yahara Kegonsa Focus Watershed Report

Dear Reader:

This Yahara Kegonsa Focus Watershed Report is an appendix to the Rock River State of the Basin report, an "umbrella" report that will provide a broad perspective the resources of the entire Rock River Basin. The Yahara-Kegonsa Watershed Report provides detailed information about water and land resource conditions and emerging threats to these resources and a strategic direction for managing those issues.

This focus watershed report is a starting point in our work to find out more about the rich land and water resources and to articulate a management approach that effectively merges citizen perception of issues with scientific understanding of resource condition. This report is part of a larger framework of data and information outlined in the Rock River State of the Basin Report, the Fish & Wildlife Habitat Plan 2001-2006, priority watershed plans, sewer service area plans, and County Land and Water Plans.

We hope this document furthers efforts to support diverse land uses and effective land and water strategies that maintain and enhance the biological and cultural strengths of the watershed. Read of the treasures this rapidly changing watershed has to offer -- enjoy its unique features -- and get informed and involved in activities that promote stewardship of its rich landscape and improved water quality.

Sincerely,

_____
Ken Johnson,
Water Basin Leader

_____
Tim Galvin
Land Basin Leader

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The Yahara River/Lake Kegonsa Watershed: LR06

The 126 square mile Yahara River/Lake Kegonsa Watershed lies within the Lower Rock River Basin. The boundaries of this watershed stretches from just east of Madison southward to the Yahara River's confluence with the Rock River below Indianford in Rock County. The majority of the watershed is in Dane County and major municipalities within the boundaries of the watershed are the cities of Stoughton, the Village and Town of Cottage Grove, and the towns of Pleasant Springs, Dunn, Dunkirk, Fulton and Porter. In 1999, the approximate population of the watershed was 30,000. The central feature of the watershed is the Yahara River, including Lower Mud Lake and Lake Kegonsa. Other waterbodies of importance are Door Creek and the wetlands of Door Creek, and Gibbs Lake (Figure 1, Yahara River-Lake Kegonsa Watershed Map).

The geology of the area consists of Pre-Cambrian, Cambrian, Ordovician and Quaternary age rocks. The watershed obtains its water supply from sandstones, dolomites, and shales of Cambrian and Ordovician ages and sand and gravel deposits of the Quaternary. The rocks in Dane and Rock Counties dip gently to the south, southeast, and southwest, forming the central part of the southward-plunging arch, called the Wisconsin Arch. All major streams flow in a southerly direction due to this pitch in the underlying geology.

Glaciation formed the topography of the Yahara-Kegonsa watershed, which is east of the Milton Moraine, a terminal moraine of the Green Bay Lobe of the last glacier. In the Yahara River Valley, the ice eroded the hilltops and valley bottoms. This erosion widened the river valley and deepened the lake basins. The deposition of the eroded material dammed up large valleys, and converted a graded, pre-glacial stream into a chain of large lakes and wetlands. The Yahara River valley physiographic area is primarily glacial ground moraine, with extensive areas of peat and marsh deposits. The current drainage system conforms to the pre-glacial drainage pattern, although present topography has much less relief than the pre-glaciated topography. Streams in this physiographic area are generally flatter and more sluggish than those in the Driftless Area, and fewer are spring fed.

The Yahara-Kegonsa watershed is in the Eastern Glacial Plains Ecological Landscape where soil fertility is good to very good. A variety of soils have developed over the glacial material and range from shallow to very deep glacial till often with a thin layer of wind blown loess over them. Darker prairie soils that include loams and silt loams can be found in the river valley in Rock County and up the Yahara River through central Dane County. Stream bottoms and major wetlands consist of mineral soils and organic soils (mucks). The dominant soil types in this watershed are the Dodge-St. Charles McHenry association which are well and moderately well drained, deep silt loams; the Plano-Ringwood-Griswold association, which are also well and moderately well drained, deep silt loams and loams; and the Batavia-Houghton-Dresden association which ranges between well drained and poorly drained, deep silt loams and mucks that are underlain by silt, sand, and gravel. The majority of the soils in this region can be used for agricultural production.

At the time of European settlement, oak savannas, oak openings and prairies dominated the land in Dane County with wetland complexes stretching along the Yahara River and its tributaries. Rock County at this time consisted of gentle rolling and arable prairies and oak openings and heavily timbered tracts (Figure 2, Original Vegetation Map). The presettlement landscape was likely influenced by fire, both natural and Native American set, which maintained the early succession vegetation (prairie grasses and oak forest types). After European settlement, much of the oak openings and savannas were either placed under plow or allowed to develop into fully stocked oak woodlands. Between 1830 and 1950, the

Figure 1. Yahara River-Lake Kegonsa Watershed Map

Figure 2. Original Vegetation Map

Figure 3. Current Land Use Map

Figure 4. Wetland Loss Map

landscape changed from an open prairie-forest mosaic to an agricultural dominated land use. Today, the watershed is primarily agricultural, but is also urbanizing rapidly, especially in and around the Township of Cottage Grove (Figure 3, Current Land Use Map).

Huge tracts of wetlands have been ditched and drained for agricultural and development purposes, destroying habitat and decreasing water quality. Hydric soils, also known as wetland soils, demonstrate characteristics of long term hydrology and waterlogged conditions. In Figure 4 (Wetland Loss Map), the hydric soils show the previous extent of wetlands in the watershed. Although large tracts of wetlands remain, they comprise only 5.4 percent of the land use in the watershed, while agriculture accounts for 81 percent and urban land uses account for 6.9 percent. The loss of these important wetlands is one of the major issues facing the Yahara River/Lake Kegonsa watershed today. Wetlands are invaluable as wildlife and fishery habitat, and help to protect the water quality of lakes and streams.

Other threats to the Yahara River/Lake Kegonsa watershed include: 1) increased eutrification and pollution of lakes and rivers due to uncontrolled erosion and stormwater runoff; 2) the effect of dams on the water quality and habitat; 3) the declining baseflow of the Yahara River as a result of wastewater diversion to the Badfish Creek; 4) the declining groundwater level caused by overpumping and loss of groundwater recharge; 5) increased urbanization and the conversion of rural lands for urban uses; 6) the fragmentation and loss of wildlife habitat; and 7) wetland loss and degradation.

IMPORTANT ISSUES

Below is a list of significant issues in the Yahara-Kegonsa watershed. These issues are *not* ranked in order of importance and are not necessarily all encompassing. They are meant to be a starting point for discussions.

Wetlands

- Protect remaining wetlands consistent with administrative code and DNR guidelines.
- Restore degraded wetland functional values with an emphasis on "high quality" restoration sites.
- Identify and prioritize wetlands for restoration.

Streams and Rivers

- Asses status of 303(d) listed streams in the watershed.
- Evaluate existing stream classifications prioritizing waters for reassessment.
- Change stream classifications where necessary.

Non-Point Source Pollution

- Evaluate and prioritize municipal and industrial sludge and septage land spreading programs for potential impacts to receiving waters (this includes nutrients such as phosphorus and nitrogen).
- Develop procedures and priorities for implementing Urban Stormwater programs.
- Identify, assess and prioritize the Best Management Practices (BMPs) to reduce nutrient and sediment loads.

Point Source Pollution

- Identify, prioritize and implement procedures to mitigate the impact of phosphorus from point source discharges.

- Asses/evaluate Madison Metropolitan Sewerage District's (MMSD) discharge location to determine if other locations are viable.

Dams
- Individual assessments of dams are needed in order to determine if their location, design, operation or condition is having adverse impacts. Develop a priority process for looking at dams.

Drinking Water and Groundwater
- Assess the impact of groundwater withdrawal on hydrologic systems.
- Evaluate alternatives for addressing contamination of groundwater due to point and non-point discharges.
- Assess the extent of contamination in private wells.

Wildlife and Fisheries
- Identify important or critical aquatic and terrestrial resources for protection (Endangered and Threatened species, important spawning or nesting habitats, etc.)
- Identify important or critical aquatic and terrestrial resources for restoration.

Grants Program
- Develop a process for integrating local, state and federal grants programs in a manner compatible with other programs or objectives.

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 Stoughton on Nov. 29, 2000 (Appendix D). The recommendations are grouped according to 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 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.

SURFACE WATER RESOURCES

The Yahara River/Lake Kegonsa Watershed has 6 named and 9 unnamed streams that equal a total of 74 miles. In addition to the large number of streams and rivers in this watershed, there are 8 lakes (2 unnamed), whose combined surface area equals 3,595 acres. There are also extensive wetland systems near Door Creek and Lower Mud Lake. There are no Exceptional Water Resources or Outstanding Water Resources in this watershed. The Streams Table identifies the source and impacts of environmental problems in the streams found in this watershed (Appendix A1, B). The Lakes Table (Appendix A2, C) gives general characteristics of each lake in the watershed, including the trophic state index.

Yahara River

The Yahara River is a large tributary to the Rock River, draining over 1/3 of Dane County. The river is nearly 40 miles in length with 23 miles in the Yahara-Kegonsa watershed. The stretch of the Yahara River in this watershed flows from the dam at Lake Waubesa and ends at the river's confluence with the Rock River. The river is slow-moving in most areas with an average gradient of 3.6 feet/mile and a baseflow of 68.8 cfs as it passes through the largely agricultural landscape.

The section of the Yahara that flows south from Lake Kegonsa was added to the 303(d) list in 1996. The 303(d) listed waters are those waters, which have impairment that prohibit them from meeting their potential use. Environmental problems have impacted the level of flow, habitat, fish migration, turbidity, dissolved oxygen, and sedimentation on the Yahara River. Efforts have been made over the past 20 years to reduce non-point and point source pollution. Despite these efforts, however, the Yahara River

continues to be on the 303 (d) list of impaired waters. Fishkills, usually due to low dissolved oxygen, also continue to be a problem in the Yahara River below Lake Monona.

Although there is some point source pollution to the river, the greatest water quality problem in this stretch of the Yahara is from urban and rural non-point source pollution. Urban stormwater run-off carries sediment and pollutants to area surface waters. In addition, high development pressures in the region pose the threat of increasing construction site erosion. Since the majority of Dane County's population resides within the Yahara River Valley, development pressure on the Yahara system has been and continues to be intense. As the demand for waterfront property grows in the watershed, the lower Yahara River in particular will face increasing development pressure.

Rural sources of non-point pollution come from cropland erosion, pesticides, and runoff from barnyards and cattle exercise lots. Runoff from agricultural lands carries nutrients and sediment, which harm the aquatic habitat and water quality in the watershed. Sedimentation of the river and lake beds also increases turbidity of the water and decreases the amount of dissolved oxygen in the water.

Stoughton has the only wastewater treatment plant that discharges directly to the Yahara River. Other point sources discharges include runoff from the railroad yards which is contaminated with oil, sulfur, and chloride; noncontact industrial cooling waters; and city swimming pool outflow.

Hydrologic modification to surface waters also negatively impacts water quality. The Yahara River has undergone only limited channelization projects, but its flow has been interrupted at many points by dams and locks built for navigation. Four dams occur on this reach of the river: at Lake Kegonsa's outlet, Stoughton, Dunkirk and Stebbinsville. A fifth dam at Fulton has been removed. Hydrologic modifications, such as dams, can impair water quality by slowing flow, acting as sediment and nutrient collection basins, impeding fish movement, warming waters in the impoundment and, consequently, warming waters downstream.

Groundwater inputs are reduced and flows decline during dry periods due to the heavy pumping demands placed on the aquifer by the City of Madison and the diversion of sewage effluent around the Yahara lakes into Badfish Creek. The Madison Metropolitan Sewerage District (MMSD) began diverting flow around the Yahara Lakes in 1958. MMSD now provides advanced treatment and the current statutes would allow the DNR to evaluate a proposal to return the discharge to the upper lakes. See Surface Water Quality Issues for a more detailed discussion. Due to its proximity to ½ million people, the Yahara is heavily used for recreational purposes. The many parks along the Yahara River and the Stoughton lakeshores provide easy public access for hunting, fishing, canoeing and other recreation. In addition to its use for human activities, significant tracts of wetlands are particularly productive for waterfowl, especially the wetlands that lie between Lake Kegonsa and Stoughton.

The river also supports a diverse warm water sport fishery of approximately forty-eight species, containing most of the species common to the Madison lakes. Some areas of the river provide a rocky gravel substrate and good flow, making it an important spawning area for white bass and walleye. Crappie, sucker and northern pike also spawn in the river to some extent. Commonly found species include: northern pike, central stoneroller, common carp, golden, emerald, common and spottail shiner, bluntnose and fathead minnow, creek chub, buffalo (unsp.) white sucker, black, yellow, and brown bullheads, brook silverside, brook stickleback, white bass, pumpkinseed, bluegill, largemouth bass, white and black crappie, johnny darter, yellow perch, walleye, and mottled sculpin.

Lower Mud Lake

The Yahara River flows from Lake Waubesa into Lower Mud Lake. The lake has a surface area of 195 acres and a maximum depth of 15 feet. In addition to river flow, water sources include groundwater discharge by small springs and seepages from the surrounding marsh. Water quality

problems exist as a result of heavy nutrient loads carried into the lake by the Yahara River, from direct runoff from adjacent agricultural fields, and from surrounding urban development. Increasing urbanization and development pressure in the Village of McFarland near the lake is responsible for much of the sediments and nutrients deposited into Lower Mud Lake. Occasional low flow conditions in the lake, likely from the diversion of effluent around the Yahara Lakes, exacerbates water quality problems (Fix 2000, personal communication).

The shallow Lower Mud Lake experiences excessive aquatic plant growth and is used extensively by migrating waterfowl. The open water area of Lower Mud Lake, is an extremely important resting area for migrating waterfowl during the spring. Ducks, geese, herons and swans will stop to rest and feed here. Since the water opens early on the river, the area is especially good for early migrating waterfowl. Fast boat traffic, however, degrades established wetland plants and stir bottom sediment, clouding the water, releasing stored nutrients in sediment, and reducing overall lake and wetland functional values.

Evaluations by South Central Region Lake Management and Nonpoint Source staff characterize this lake and its wetlands as threatened and in need of management and protection. In 1996, Dane County and the Village of McFarland received DNR grants to acquire land to protect the lake. *This lake would benefit from protection of existing wetlands and enhancement of buffers.*

Commonly found fish species include the longnose gar, bowfin, northern pike, common carp, golden shiner, bluntnose and fathead minnow, white sucker, black, brown, and yellow bullhead, channel catfish, brook silverside, white and rock bass, green sunfish, pumpkinseed, bluegill, largemouth bass, white and black crappie, yellow perch, walleye, and freshwater drum. The lake is predominantly a panfish and bass lake and walleye fishing is negligible. Lack of adequate public access to the lake is a problem.

Lower Mud Lake Wetlands

The Lower Mud Lake Wetlands that surround Lower Mud Lake act to buffer the wetland from surrounding agricultural lands as well as provide a much needed groundwater recharge area and critical fishery and waterfowl habitat. These wetlands are a part of the many large peat deposits along the Yahara River. The Dane County Regional Planning Commission has ranked this wetland as a "Priority I," one of the most important in the county for management and protection.

The wetland on the east side of Lower Mud Lake is a sedge meadow on a deep layer of peat and encompasses about 200 acres. The Department of Natural Resources owns 137 of the 200 acres on the east side. The east wetlands provide breeding and feeding habitat areas for the woodcock and snipe. This wetland extends into the Village of McFarland where it is designated as a park and conservancy area. In two places, arms of this wetland extend eastward to connect with the Door Creek wetlands along Lake Kegonsa. Shrubs, trees and reed canary grass are currently invading this area.

A second wetland area is on the west side of Lower Mud Lake. It is about 400 acres in size and fed directly by springs and partially from overland runoff. This area is a deep peat deposit and has more standing water than the east side wetland. Keenan's Creek flows into the wetland, and there are many springs and seepages discharging groundwater. USH 51 bisects the west wetland. DNR owns approximately 180 acres of land on the west side of Mud Lake. Together the east and west wetlands serve as buffers around Lower Mud Lake and contribute to its value as an isolated wildlife area.

The Tower Road wetland, the third wetland component of the area, is about 100 acres in size and borders Lake Waubesa. This area is similar in character and size to the west side wetland along Mud Lake. It is primarily an emergent wet meadow with some areas of scrub vegetation on wet soils.

The only significant development along Lower Mud Lake is the development of five residential sites on Rivercrest Road, outside of McFarland. Fast boat traffic in Lower Mud Lake impairs wetland plant growth and releases nutrients from the lake sediments reducing the wetland's functions.

As a major wetland area along the Yahara River, Lower Mud Lake is a significant environmental feature in this watershed. In 1994, Dane County Board of Supervisors adopted the Lower Mud Lake Resource Protection Project Plan prepared by the Dane County Parks Commission and the Dane County Regional Planning Commission. The objectives of the plan are to 1) create a 1,700 acre preserve to protect and restore natural resources such as wetland, floodplain, springs and other related features, 2) provide for and protect natural habitat for fish, waterfowl and wildlife, and 3) preserve archeological and historic resource sites.

These wetlands provide critical fish habitat and spawning grounds for fish in Lower Mud Lake and the Yahara River. Northern Pike move upstream from Lake Kegonsa to spawn in these wetlands. Walleyes are also present in this area during spawning season. Largemouth bass and northern pike are the dominant predator species, while bluegills and black bullheads are the most numerous panfish.

Keenan Creek

Keenan Creek enters Lower Mud Lake on its southwestern shore. The creek drains approximately 3.6 square miles, which is largely agricultural in the northern portions and is adjoined by 400 acres of wetland in the southern reaches of the watershed. The creek is nearly 4.5 miles long and has a surface area of 2.1 acres. It has a gradient of 25 feet/mile and a baseflow of 1.3 cfs. The creek's wetland area contains small springs and is valuable as waterfowl habitat. There are also wet meadows and shallow marshes further upstream. Small warm water forage fish are present, but the potential for the development of a more valuable fishery is low. The brook stickleback is the most commonly found fish species. *A stream survey is needed to improve the level of data for Keenan Creek.*

Lake Kegonsa

The Yahara River flows into Lake Kegonsa, a large, highly eutrophic, moderately shallow drainage lake. Lake Kegonsa was formed as glacial deposits dammed the Yahara River. It is the furthest downstream of all of the Yahara River lakes and has a surface area of 3,209 acres and a maximum depth of 31 feet. The Kegonsa dam maintains water levels between 843.0 and 843.5 based upon the 1929 datum. Lake Kegonsa is located outside of the central urban area and it is surrounded primarily by agricultural land. Except for about 1.5 miles of shoreline in public ownership, much of the shoreline is developed with seasonal cottages and year-round homes.

Water quality has improved over the last 40 years since the Madison Metropolitan Sewerage District diverted wastewater from the area's lakes. Yet, excess sediment, nutrient and chloride loads from upstream lakes, from the Yahara River, Door Creek and surrounding agricultural land continue to affect the lake's water quality. Since the 1970s, phosphorus concentrations have declined in the lake, attributable to lower levels from upstream lakes. Despite overall reductions in nutrient loads, severe blue-green algae blooms still occur during summer, restricting beneficial aquatic plant growth. Such blooms result from temporary summer stratification and frequent mixing combined with excess nutrient and sediment loads. Lake Kegonsa is susceptible to mixing due to the shape of the lake and lack of significant macrophyte growth. The mixing action stirs up bottom sediment and effectively recycles the nutrients into the water column. These recycled nutrients contribute to the growth of blue-green algae.

The lake is highly turbid, but modest improvements in water clarity would allow limited growth of aquatic plants, benefiting the lake's fishery. Fish kills have occurred in the past, some attributable to natural causes while the cause of others remains undetermined. Fish sampling in Lake Kegonsa has detected toxic contaminants, but at levels below health concern standards. High fecal coliform levels found in the lake in 1987 were probably caused by numerous poor or failing septic systems around the lake. More recently, local governments have provided sewer service to development around the lake

shoreline to eliminate possible pollutant discharges from septic tanks. The creation of sanitary districts around the lake and the construction of wastewater collection and treatment systems are expected to eliminate this source of pollution.

The health of the lake is also affected by the growth of undesirable, non-native, macrophyte plant growth. Eurasian watermilfoil (*Myriophyllum spicatum*) had been the dominant aquatic plant species and the lake is currently experiencing expanding beds of sago pondweed (*Potamogeton pectinatus*), wild celery (*Vallisneria americana*), and curlyleaf pondweed (*Potamogeton crispus*).

The lake supports waterfowl migration and waterfowl hunting is good. It also has an excellent, diverse warm water sport fishery. Walleye and northern pike are stocked in this lake. Some of the largest bass in the area are found in Lake Kegonsa. Bluegill and yellow perch are the most numerous non-game species captured. Commonly found species include: the longnose gar, northern pike, emerald shiner, golden shiner, common carp, bluntnose minnow, channel catfish, fathead minnow, brook silverside, bigmouth buffalo, black, yellow and brown bullhead, white bass, rock bass, green sunfish, pumpkinseed, bluegill, smallmouth and largemouth bass, white and black crappie, Iowa darter, yellow perch, logperch, walleye, freshwater drum, bowfin, and white sucker. The lake is intensively used by boaters, skiers, and swimmers. Access is also available though the Yahara River and numerous boat landings. Boat rentals are also available on the lake.

Little Door Creek

This small ditched stream joins Door Creek south of U.S. Hwy 12/18. It begins in the south central portion of the Town of Cottage Grove. The creek has a surface acreage of 2.3 acres, gradient of 11.8 feet/mile and a baseflow of 1.8cfs. Agricultural lands dominate the watershed and several small areas of wet meadow adjoin the stream along its length. Water quality is below average due to intensive agricultural influences including hydrologic modification and non-point source pollution. Low flow, turbidity and ditching limit the fishery to forage species. Commonly found fish species include the brassy minnow, creek chub, white sucker, brook stickleback, and johnny darter. *Improved soil conservation practices in the watershed are needed to improve the fishery and water quality.*

Door Creek

Door Creek, a tributary to the Yahara River entering at Lake Kegonsa, begins as a small stream in the southeast corner of the Town of Burke, and flows south 12.7 miles to Lake Kegonsa. Door Creek and its tributaries drain 29.5 square miles of rolling agricultural land in the drumlin-marsh area of eastern Dane County. It has a gradient of 2.4 feet/mile and surface area of 12.3 acres.

Door Creek is a relatively sluggish stream subject to high temperatures and low flow. Formerly, wastewater from the sewage lagoon in Cottage Grove entered through a small tributary. In 1982 the sewage was re-directed to MMSD. Compared to predevelopment conditions, groundwater discharge to Door Creek has been reduced an estimated 28% due to area wide pumping and wastewater diversion.

Door Creek enters on the north shore of Lake Kegonsa and has been channelized and ditched along its entire length. Soil loss in the watershed from cropland erosion is high and the stream bottom is covered with silt. This sedimentation decreases the amount of adequate aquatic habitat, increases the turbidity of the water and affects the creek's temperature. In addition, large portions of the adjacent wetlands have been drained. Much of Door Creek has been straightened and ditched to facilitate drainage and provide more agricultural land. Drainage projects date back to 1919 when the Door Creek Drainage District was organized. At that time about 5,000 acres of wetland were reportedly too wet for agricultural use. By the late 1950s, only 1,280 acres of wetland remained in the Door Creek watershed. Due to continued draining, only about 800 acres remain. A large, shallow marsh near the mouth of the stream, however,

provides excellent northern pike spawning grounds. Waterfowl and upland game birds also use the area. Water quality in the stream is poor and some stretches have 4-6 feet of silt under 2 feet of water. Drainage of wetlands and poor soil conservation practices within the watershed contributes to high phosphorous and inorganic nitrogen loading from Door Creek to Lake Kegonsa.

Door Creek's physical characteristics and low flow limit the fishery to forage species. The most common fish species include common and spotfin shiner, mud minnow, bluntnose minnow, creek chub, white sucker, black bullhead, brook stickleback, bluegill, and johnny darter. *Water quality improvements have been documented and the stream should be upgraded to a warm water forage fishery or warm water sport fishery.*

Door Creek Wetlands

The Door Creek Wetlands are a shallow marsh with stands of cattail, which sits on a major peat deposit of the Yahara River Valley. The north end of the peat deposit is drier than the southern area, with sedge meadow and shrubs. Peat disturbance caused primarily by changes to Door Creek's course for agricultural purposes has a major nutrient impact on the Yahara River. This high quality wetland complex at the mouth of Door Creek provides excellent habitat for northern pike spawning and sandhill crane nesting; the cranes are expanding their range into the area.

The largest threats to the wetland complex are the rapid growth of the Cottage Grove area, development and changes to areas along Door Creek, and the impacts of the drainage district upstream of the wetland complex. The upper reaches of Door Creek have been ditched and farmed extensively. Tile drains and channelization of the creek through the wetland has impaired the wetlands' functional values. Door Creek's ditched water course is lined with dense and disturbance vegetation, reducing its filtering ability. Therefore, nutrient and sediment input into Lake Kegonsa is very high from this source.

In its channeled condition, Door Creek provides access to important spawning areas in the wetlands, especially in the extreme southern part where the ditch has collapsed. In other areas of the wetland the reproductive potential is significantly limited by the ditch, especially in the spring when the floodwaters subside and the small fry become trapped behind the berms lining the ditch. *The natural reproduction of northern pike in Door Creek and Lake Kegonsa could be substantially improved by providing more access into the interior marsh areas through lateral connections with the ditch.*

In 1992 the Friends of Lake Kegonsa (FOLKS) received a Lake Planning Grant from DNR. The resulting report examined the existing condition of the Door Creek wetlands at the mouth of the stream and looked at sediment loading rates, peak flow hydrographs, and channel morphology of the stream through the wetlands. The report concluded the wetland had several "outstanding" features:

- An extensive, relatively diverse vegetation base that supports a wide array of associated wildlife
- A streamside location with marsh edges and openings that provide important spawning habitat for game and forage fishes
- A lakeside location that offers aesthetic and recreational resources for residents and visitors to enjoy
- Buffering and storage of agricultural and urban stormwater runoff
- Environmental greenspace which offers refuge for wildlife and preserves a large segment of the Lake Kegonsa shoreline from development

The report also recommended against using the wetland as a sediment trap due to the detrimental effect on the existing wetland ecosystem. The report identified a number of best management practices (BMPs) to control sediment in the Door Creek sub-watershed (Mead & Hunt).

A second Lake Planning Grant was awarded to FOLKS and the Dane County Regional Planning Commission (DCRPC) in 1998 to do a follow-up study looking at what could be done in the sub-watershed to improve the conditions of the marsh. The plan developed a comprehensive wetland resource

protection plan tailored to the Door Creek wetland with special emphasis placed on restoring and enhancing the functional role of the wetlands as well as their associated benefits. The County Board approved the plan on April 18, 2000.

Leuten Creek

Leuten Creek is a 3 mile long, spring-fed tributary to the Yahara River, entering below Lake Kegonsa. The creek has a surface area of 2 acres, a gradient of 9.7 feet/mile and a baseflow of 3 cfs. The creek is surrounded by agricultural land with scattered residual wetlands. Although extensive ditching has destroyed most of the original wetlands and has disturbed the remainder, some migrating waterfowl frequent the area. Water quality is below average for the Dane County due to hydrologic modification, and non-point source pollution from cropland erosion. High turbidity and sedimentation have negatively impacted aquatic habitat in the creek. Leuten Creek was managed for trout in the 1950s but supports only a few species of forage fishes.

Virgin Lake

Virgin Lake, formerly known as Hull Pond, is a 10 acre lake surrounded by a shallow marsh. The lake does not have a direct surface water connection to the Yahara River. The lake is located just northwest of Stoughton in T5N, R11E, Section 6. The DNR determined it to be a natural, navigable lake. A development around the lake is currently under construction and may raise the pond's water level 2 feet. Plans also include a bike path around the perimeter of the lake where a walking path currently exists.

Stoughton Millpond

The Stoughton Millpond is a shallow impoundment of the Yahara River. It has a surface area of 82 acres and a maximum depth of 5 feet. The majority of the millpond lies within the Stoughton city limits. The surrounding land is dominated by agriculture to the north and municipal and residential areas to the south. Non-point source pollution and urban stormwater runoff negatively impair the millpond. No major wetlands border the lake, but several small sedge and grass meadows provide limited habitat for waterfowl and muskrats. The lake bottom is mostly clay with sand, silt, and some detritus present as well. With the exception of cattail stands on the lake's east side, macrophytes are scarce as a result of the large carp population. The water is turbid, alkaline, and shows signs of eutrophication. Nuisance algae growths are common.

The Stoughton Millpond supports a diverse warm water fishery, and fish species include northern pike, common carp, bluntnose minnow, buffalo (unsp.), white sucker, black, yellow and brown bullhead, brook silverside, green sunfish, pumpkinseed, bluegill, largemouth bass, white and black crappie, johnny darter, yellow perch, walleye, and freshwater drum. Access is available at Stoughton and from the Yahara River by way of Viking County Park just north of the lake.

Gibbs Creek

Gibbs Creek, a small seepage fed stream approximately 4 miles long, flows north from its headwaters in Little Gibbs Lake, through Gibbs Lake, to the Yahara River. The creek has a surface area of approximately 2 acres and a gradient of 21.4 feet/mile. Adjoining the creek is a fresh meadow wetland of 155 acres where sandhill crane and other waterfowl have been observed. Primary threats to water quality are high soil erosion rates from agricultural runoff, streambank erosion and barnyard runoff from the 26 barnyards in the Gibbs Creek sub-watershed. The average soil erosion rate for this area is about 6 tons/acre/year, with 44 percent of the cropland eroding above the Soil Conservation Service acceptable

rate (tolerable) for soil loss. Streambank erosion is prevalent and could be addressed by improved management practices. The drainage of nearby wetlands also poses a threat. Many unnamed springs in the watershed have been ponded, which, when natural, help maintain the creek's flow.

The fishery is dominated by forage species, which often migrate between Gibbs and Little Gibbs Lakes. Commonly found fish species in the creek include central mudminnow, common carp, fathead minnow, creek chub, white sucker, black bullhead, brook stickleback, and bluegill.

Gibbs Lake

Gibbs Lake is a small, hard water, drainage lake in Rock County, which drains through Gibbs Creek to the Yahara River. It has a surface area of 72 acres and a maximum depth of 20 feet. A popular county park surrounds two-thirds of the lake. A small dam was constructed in the 1960's to control water levels and prevent the downstream movement of northern pike. The pike traveled downstream (instead of upstream) to spawn on a wetland area. The wetland often dried up and farmers would illegally harvest the fish with pitchforks. In the past, the lake was used by migrating and nesting waterfowl. The dam continues to hold the lake at a higher than normal level (about two feet) and prevents the unintentional downstream migration of northern pike.

Today, it has extensive vegetation with a large population of panfish. Extensive nutrient loads from non-point source pollution have caused occasional winterkill, nuisance aquatic growth and algae problems. Eurasian watermilfoil dominates the lake and water clarity is poor. The lake was the site of littoral zone research focusing on Eurasian watermilfoil. Secchi disk readings during 1986 indicated poor to very poor water clarity. Secchi disk readings from 1988 indicated good water clarity. One possible explanation for the differences between the readings is the lower rainfall, particularly in the spring of 1988, which may have reduced sediment and nutrients entering the lake. Agricultural runoff from the two-square-mile drainage area also affects the lake's water quality. Local interest in lake management and control of polluted runoff is high. *Efforts to control soil erosion in this watershed should be made a priority. This lake would benefit from the identification of sources of polluted runoff and excess stormwater and the implementation of best management practices.*

Controls have been imposed in an attempt to increase the fishery health of the lake. A weed-cutting project conducted by the University of Wisconsin served to cut predator lanes through the weedy patches. This increased panfish predation has helped to raise the overall size of bluegill by decreasing population pressure. This was effective only in the short term and was discontinued due to the high expense. A size limit for bass was also imposed, thereby increasing predators. In addition, walleye, northern pike and northern catfish have been stocked in this lake.

Agricultural runoff in this portion of the watershed affects the Gibbs Lake fishery. Siltation has caused loss of habitat and rough fish populations are a problem. Gibbs Lake is a panfish fishery and commonly found species include northern pike, common carp, golden shiner, white sucker, black bullhead, yellow bullhead, brown bullhead, green sunfish, pumpkinseed, bluegill, largemouth bass, yellow perch, walleye, black crappie. Access to the lake can be gained via Gibbs Lake Park.

Little Gibbs Lake

Little Gibbs Lake is a hard water, seepage lake with a surface area of 11.2 acres and a maximum depth of 8 feet. The lake is surrounded by agricultural land uses and drains through an undefined channel to Gibbs Lake. Water quality and aquatic habitat in Little Gibbs Lake is adversely affected by non-point source pollution and nutrient enrichment. Little Gibbs Lake experiences periodic winterkill. The shoreline of the lake is comprised of mostly shrubby wetlands and is used by migratory and nesting waterfowl. Fish species commonly found in this lake include bullhead (unspecified), pumpkinseed,

bluegill, northern pike (stocked), flathead catfish (stocked in 1991), and orange spotted sunfish (unusual). The lack of public access to the lake is a problem.

Gibbs Lake Wetlands

The wetland area between Little Gibbs Lake and Gibbs Lake primarily shrub carr with some areas of wet meadows. The primary vegetation is cattails, reed canary grass and red-osier dogwood. The presence of reed canary grass is an indicator of disturbed wetland areas. Little detailed information is available on these wetlands. Gibbs Lake Park encompasses the wetlands between the lakes and around Gibbs Lake and improved information may interest the park's visitors.

Unnamed Lakes and Streams

Several unnamed lakes in the watershed that do not have a direct hydrologic connection with the Yahara River are included in Table 1. Many of the unnamed streams in Table 2 may be intermittent.

Table 1. Unnamed Lakes

Township, Range, Section	Surface Area (acres)	Comments
T5N, R11E, Sections 35, 36	5	
T5N, R11E, Section 36	5	Completely on private property; T of Dunkirk

Table 2. Unnamed Streams

Name/Number	Township, Range, Section	Tributary of	Municipality
Creek 17-10W	T7N, R11E, Sections 7, 18	Door Creek	Cottage Grove
Creek 17-10E	T7N, R11E, Section 17	Door Creek	Cottage Grove
Creek 26-8	T6N, R10E, Section 26	E shore of Lake Kegonsa	Town of Dunn
	T6N, R12E, Section 20	NW shore of Lake Kegonsa	Town of Pleasant Springs
Creek 28-12	T6N, R12E, Section 27	Leuten Creek and Yahara River	Stoughton and Town of Pleasant Springs
Creek 21-9	T5N, R11E, Section 21	Yahara River	Town of Dunkirk
Creek 35-6	T5N, R11E, Sections 15, 23, 26	Yahara River	Town of Dunkirk
Creek 10-3	T4N, R11E, Section 15	Yahara River	Town of Porter
	T4N, R11E, Sections 24, 25	Yahara River	Town of Porter

SURFACE WATER QUALITY ISSUES IN THE WATERSHED

Non-point Source Pollution

The Yahara River brings needed flow but also pollutants from north of the Yahara-Kegonsa watershed including the Madison metropolitan area into Lake Kegonsa and the lower portion of the Yahara River. The watershed is also vulnerable to pollution from non-point source pollution originating within the watershed. Nonpoint source pollution includes animal waste, construction and agricultural

fields, and urban runoff such as pesticides and car oil carried by rain and snowmelt. Nonpoint source pollution can reduce the levels of dissolved oxygen that fish and other aquatic life need to live, cause algae growth, decrease light penetration for plant growth, cover important fish spawning habitat with sediment, and in some cases, kill scores of fish at once.

The dominant land use in a watershed often helps to identify the potential threats to surface waters. Though downstream from an urbanized area, the Yahara-Kegonsa watershed is primarily agricultural. Soil particles, or sediment, running off of agricultural fields are important source of non-point source pollution in this watershed. The soil particles carry phosphorus, which occurs naturally in most soils. Phosphorus is also a common component of fertilizer, which adsorbs to soil particles. When phosphorus is applied in greater amounts then is needed by the planned crop, the soil becomes "enriched" with phosphorus. During rain events, the soil particles with the phosphorus adsorbed may be carried off fields with high erosion potential and into surface waters. Phosphorus, the limiting nutrient in aquatic systems, is then released into the water. Although there may be no immediate effect of high phosphorus levels, eventually elevated nutrients can cause increased algal blooms and an altered aquatic environment.

Another potential source of non-point pollution is from the hundreds of acres approved for land-spreading, which is considered a point source discharge for regulatory purposes. There are three different types of land-spreading activities as regulated by the Department of Natural Resources: municipal sludge, industrial sludge, and septage. Sludge is the biosolids from a wastewater treatment plant or an industrial factory. Septage is a mixture of sludge, fatty materials and wastewater pumped from septic tanks and holding tanks. Industrial sludge is generally waste products from food industries and has potential to be used as fertilizer.

The Madison Metropolitan Sewerage District, the Stoughton Wastewater Treatment Facility, Superior Special Services, and Honey Wagon Septic Services are granted permits or licenses by the DNR to spread these waste products on approved agricultural sites in this watershed.

The sludge and septage are sources of phosphorus and nitrogen and can be used as low cost fertilizers on agricultural fields. The goal of land-spreading is to return or recycle organic wastes to the land and regulations are in place to minimize the impacts of land-spreading. Careful management is necessary to avoid environmental problems and impacts on water quality, though, and currently the DNR staff resources are too limited to provide needed oversight of septage application and siting.

Under current regulations, soil tests are required for all sites that receive municipal sludge. They are not required for septage sites and may be required for industrial sites. In addition, although current regulations examine nitrogen levels in soil and sludge, they do not restrict land-application based upon phosphorus levels. Sludge and septage can be spread on soils that already have high phosphorus levels.

Currently, municipal and industrial sludge and septage can be land-applied to any site at least 200 feet away from a wetland or surface waterbody. There is no requirement for buffer strips for an application at this distance. However, if a buffer strip is present, industrial sludge can be spread at 100 feet from a stream.

There is much discussion both nationally and within the state concerning the need to restrict the amount of phosphorus that is land applied by fertilizers be it manure, commercial or recycled waste products. The largest of the regulated land applications is probably Madison Met which spreads on about 300 acres per year, a minor portion of the watershed. Although by itself Madison Met's contribution of phosphorous is probably insignificant, the much larger issue is the cumulative affect of excess phosphorus from all sources.

It is increasingly important to reduce phosphorus loads in surface waters by reducing non-point source pollution. Education and the increased use of best management practices are necessary to achieve this goal. Through a change in administrative code, expanded regulation of land-spreading sites would

also be possible. *Soil tests should be required of all potential sites. Land spreading permits should be conditioned on not only plant nitrogen needs but phosphorus as well. Sites with a high level of phosphorus should be allowed to spread only sludge or septage with a limited phosphorus content. In addition, it should be required that land-spreading sites install the appropriate best management practices to ensure that phosphorus is prevented from running off into nearby lakes, streams, rivers and wetlands.*

Point Source Discharge

Controlling phosphorus discharged from municipal and industrial wastewater treatment plants is a key factor in preventing eutrophication of surface waters. Nabisco Brands, Inc. discharges only cooling water to the Yahara River and the City of Stoughton has a wastewater treatment plant (Table 3). The City of Stoughton treats its wastewater and discharges it to the Yahara River below Lake Kegonsa where baseflow is high enough to assimilate the treated wastewater. The facility has an average design flow of 1.65 mgd and is permitted to discharge a monthly average of 1.5 mg/L of phosphorus.

Table 3. Point Source Dischargers

Discharger	Location	Discharge	Waterbody
Nabisco Brands, Inc., Ortega Products	Stoughton	Non-contact cooling water	Yahara River
Stoughton Wastewater Treatment Plant	Stoughton	Treated wastewater	Yahara River

Madison Metropolitan Sewage District

Wastewater treatment plants generally discharge treated effluent to the surrounding surface water. However, Madison Municipal Sewage District (MMSD) diverts its effluent to Badfish Creek rather than discharge to the upper Yahara River. Badfish Creek joins the Yahara River in Rock County, downstream of the Madison area lakes. MMSD serves the entire Madison metropolitan region, including Cottage Grove and Verona, with its direct discharge and pretreatment programs. Until 1958, MMSD discharged wastewater into the Yahara Lakes when severe eutrophication and nuisance algae problems lead to increased surface water quality standards and a state law requiring tertiary treatment of wastewater discharged to the Yahara River system. To comply with the new standards, MMSD built a pipeline to carry effluent to Badfish Creek, also in Dane County. Currently, this pipeline handles the majority of MMSD's effluent. Although it has a capacity of 50 million gallons per day (mgd), the average discharge is 37 mgd to Badfish Creek. The total phosphorus in the discharge is roughly 0.43mg/L, well below the plant's permit limit of 1.5 mg/L.

Since the diversion of effluent to Badfish Creek, conditions in the Yahara chain of lakes have improved. While this diversion has reduced nutrient inputs and improved water quality in the Yahara Lakes, it has also reduced baseflow conditions throughout the system. The Yahara River total flow at McFarland has been reduced by about 35 percent. The river's low flow ($Q_{7,10}$)--the time when base flow is most important--has been estimated as reduced by 70 percent. Further reductions in base flow due to groundwater pumping and reduced infiltration due to increased urbanization could prove problematic in the future.

The water quality conditions in Badfish Creek, which also suffers from the impacts of severe soil erosion, appear to have remained stable since the discharge diversion. Fish and insect surveys are

completed every year in order to monitor long term trends in water quality. Fish managers, however, are concerned that the effluent may interfere with natural reproduction of fish, particularly since brown trout have occasionally been found in the stream and commonly found in tributaries to the stream.

In addition to Badfish Creek, MMSD discharges to Badger Mill Creek, a tributary of the Sugar River and, in emergency overflow situations, can discharge to Nine Springs Creek and Upper Mud Lake. The discharge to Badger Mill Creek is approximately 2.2 mgd. Survey work has shown that the last two miles of Badger Mill Creek are a cold water fishery. The Sugar River is also classified as a cold water fishery and an Exceptional Resource Water. Fish managers have raised concerns regarding the impacts of MMSD discharge into this system.

The future of MMSD's discharge needs to be examined. Within the next 15-20 years, the plant is expected to reach its capacity as a result of the rapid development in the Madison area. MMSD's plant also has a new ultraviolet disinfection and biological phosphorus removal system, which might enable the diverted discharge to be returned to the Yahara Lakes. Some of the options include returning the discharge to the Yahara system, increasing the discharge to Badfish Creek or to Badger Mill Creek, or discharge effluent to Koshkonong Creek, northeast of Madison.

Returning treated discharge to the upper Yahara Lakes would increase baseflow, which would have some ecological and recreational benefits. On the other hand, it would also increase nutrient inputs to lakes, which already have algae blooms in the summer and are heavily used for recreation. If the discharge were returned to Upper Mud Lake and Lake Waubesa, the additional phosphorus could also increase the number and severity of algae blooms. The discharge could also be returned below Lake Kegonsa to avoid exacerbating the eutrophication of the lakes. The discharge to Badfish Creek could be increased, however, this would continue to deprive the upper Yahara River of baseflow and also impact Badfish Creek's water quality. *A comprehensive analysis of these and other options should be completed to determine which is the most cost-efficient and has the least environmental impact.*

The U.S. Geological Survey is refining the Yahara Lakes reservoir routing model with the support of a DNR Lake Management Planning Grant. As part of the Dane County Regional Hydrologic Study, the model will be a valuable tool in evaluating management options to address fluctuating lake levels and flow, establishing realistic and achievable regulatory limits, and determining potential management measures for future problems.

Hydrologic Modification and its Effect on Surface Water Quality

Hydrologic modification such as ditching, draining, channelizing and damming has taken place in this watershed. Ditching and straightening of streams and drainage of wetlands to improve cropland productivity is a long-standing practice in Wisconsin; unfortunately, this practice facilitates the delivery of sediments and nutrients to surface water. This practice not only temporarily affects chemical water quality, long-term changes in the stream's shape and the quality and quantity of biological habitat are almost guaranteed. Draining of wetlands often results in an increase in sediment and nutrient loads entering nearby streams, an increase in downstream peak flood elevations, and the loss of fish cover and spawning areas. Ditching and straightening of streams in the Door Creek area has been especially prevalent and the area has the only active drainage district in the watershed.

There are four dams in place on the Yahara River in this watershed: the Kegonsa dam at Lake Kegonsa's outlet, the Stoughton dam, Dunkirk dam and Stebbinsville dam. The Stebbinsville dam was drawn down in 1998 and a dam at Fulton was removed in 1993. The impoundments on the Yahara River significantly impact the water quality conditions and exacerbate the problems in the lower part of the Yahara River.

DAMS ON THE YAHARA RIVER

The Yahara River originates in Columbia County and forms the backbone of three watersheds in Columbia and Dane Counties: the Yahara River/Lake Mendota, Yahara River/Lake Monona, and Yahara River/Lake Kegonsa watersheds. The Yahara River system drains approximately 517 sq. miles before its confluence with the Rock River in Rock County (Figure 5, Dams on the Yahara River Map). The Yahara River has many tributaries and passes through numerous large wetlands and several large lakes providing many recreational and aesthetic opportunities, such as: canoeing, kayaking, wildlife viewing and fishing.

The river's gradient is not dramatic between Lakes Mendota and Kegonsa but becomes steeper below Lake Kegonsa where the gradient is 4 feet/mile until its confluence with the Rock River. According to a USGS gage near Fulton, the Yahara's mean annual flow is 371 cfs. The baseflow, however, is only 68.8 cfs, which indicates that inputs to the Yahara are dominated by surface water. Flows decline during dry periods due to 1) reduced groundwater inputs as a result of the City of Madison's heavy demands placed on the groundwater aquifers 2) diversion of sewage effluent of the metropolitan area around the Madison lakes and into Badfish Creek. Despite the reduction in pollution sources in the past 20 years, the Yahara River below Lake Monona is on the 303(d) list of impaired waters and low dissolved oxygen levels continue to be a problem.

Much of the land in the basin north of Lake Mendota is devoted to agriculture, with a fairly high percentage of cropland. A large volume of wastewater is diverted through the Madison Metropolitan Sewage District's treatment plant and discharged to Badfish Creek. This wastewater then enters the Yahara River south of the major lakes. See the Surface Water section for a discussion on the MMSD diversion. Wastewater discharges do not have significant impacts on surface water in this part of the basin. The streams in the northern part of the watershed (upstream from Lake Mendota) generally have good baseflow and water quality conditions. Token Creek, a tributary in the headwaters of the Yahara River, has substantial groundwater inflow and supports a Class III trout fishery above USH 51. Other tributaries generally support warm water fisheries dominated by forage fish, with influxes of northern pike and panfish from Lake Mendota during spawning season. This section of the river is capable of supporting a diverse year-round warm water fishery that includes game species.

The central part of the basin-the area surrounding Lakes Mendota, Monona and Waubesa- is primarily urban, with limited agricultural uses on the fringe of the central urban area. Urban nonpoint sources of pollution especially erosion from construction and development activities, delivers sediment, nutrients and toxic substances directly to the lakes and urban streams such as Starkweather Creek, Pheasant Branch Creek, Nine Springs Creek and Murphy (Wingra) Creek. These urban streams also suffer from alteration, channelization and urban runoff. For example, Starkweather and Nine Springs Creeks are both highly-altered urban streams with low gradients, and generally poor water quality conditions resulting from previous point source discharges and urban runoff. Pheasant Branch Creek has experienced serious stream erosion problems from increased stormwater runoff. The central part of the basin also suffers from the effects of groundwater pumping and diversion, which have substantially reduced groundwater discharge and baseflow sustaining these resources.

The southern portion of the Yahara River Basin, including the area directly adjacent to Lake Kegonsa, is predominantly agricultural, with only the communities of Stoughton and Oregon contributing any significant urban influence. The main sources of pollution in this part of the basin include agricultural nonpoint source pollution from both cropland erosion and livestock operations, and point sources of pollution – wastewater discharges from the City of Stoughton to the Yahara, and from the Village of Oregon MMSD to Badfish Creek. As a tributary of the Yahara, Badfish Creek receives nearly 40 million gallons per day of treated wastewater effluent from MMSD and from the Village of Oregon.

Impoundments and instream biological activity supported by substantial nutrient inputs from the Yahara River lakes cause most of the water quality problems and conditions in this lower part of the basin.

Impacts of Dams

Dams were constructed for a whole variety of reasons beginning in the mid 1800's and extending into the present date. Similarly dams may have a variety of impacts, of both a positive and negative nature, on both the waters they impound and the ones they discharge into. Over the years, assessment of dam related impacts have benefited from research and evaluation. It is important to assess the impacts of dams on an individual basis. *Individual assessment is needed in order to determine if their location, design, operation or condition is having adverse impacts*. Concerns about the seven dams on the Yahara River include: water level management, fish migration, water quality and the movement of sediments, which degrade water quality and alter temperatures and oxygen levels, and navigability.

Water Level Management

The dams on the Yahara aid in managing the water levels of the river and the lakes to protect property as well as encourage fishery habitat and recreation. Although water level minimums have been set for each water body on the Yahara River, water level management has been a problem as precipitation in the watershed fluctuates. During a dry year, the upper lakes such as Mendota and Monona are maintained to meet their minimum levels and, as a result, Lake Kegonsa and Waubesa suffer from reduced flow. Although both Lake Kegonsa and Waubesa have excellent northern pike spawning habitat, low water levels reduce or eliminate reproduction because the pike cannot gain access to the flooded marsh vegetation where they lay their eggs. *Increased coordination between dam operators could improve water level management.*

Failure to operate the dams according to the operating procedures can also cause serious problems. In March of 2000, the Dunkirk dam allegedly violated its established water levels when the dam was left open causing the impoundment to drain. The impoundment bed was an exposed mudflat with a channel meandering through it. This alleged violation to operate the dam occurred during a critical time of year for northern pike spawning and likely exposed their eggs when the impoundment was drained. According to Don Bush, a DNR fishery biologist, the consequences of the drawdown could include any one of the following problems: stranding eggs and disrupting spawning cycles of northern pike and other early spring spawning fish; stranding fish on the mudflats; passing large numbers of fish downstream to areas with inadequate habitat; and stranding fish downstream with inadequate flows once the Dunkirk dam was closed. If large numbers of fish were passed downstream; there may be a void in the fishery of Dunkirk that will allow carp to overpopulate.

The dams have also altered natural flow patterns, or hydroregime, of the Yahara River. Portions of the Yahara River has been transformed from free-flowing rivers, supporting community assemblages associated with moving water, to a patchwork of river reaches and impoundments that support life suited to slow moving, lake-like waters. This change in hydroregime has slowly altered the composition and distribution of plants, insects, birds and animal communities. Confounding the shift from a river environment to a lake-like environment is the lack of natural diurnal water-level fluctuations on lakes and wetlands. Gradual daily fluctuation in water level is necessary to support species accustomed to natural cyclical variation in water regime.

Figure 5. Dams on the Yahara River Map

Fish Migration

None of the dams on the Yahara River currently have fish passage facilities and therefore, block upstream (and occasionally downstream) movement of fish when the gates are closed. Fish migration and the ability to move throughout the length of a river is extremely important. Studies show trout have been documented to travel as much as 90 miles in the span of a few days. A study of smallmouth bass showed that the fish would regularly travel as much as 50 miles between summer and winter habitats and catfish and walleye may travel up to 90 miles. Although fish passage can enable some fish to pass around dams, multiple dams along a river make safe passage unlikely.

It has been shown that the removal of the Stebbinsville and Dunkirk dams would allow a free flow of the river to the Rock River and improve fish migration and possibly spawning too.

Sediment

Dams also alter the sediment balance of a stream. By slowing flows, dams allow silt to collect on river bottoms and the impoundments become less attractive for swimming and wading. Fine sediment accumulation eventually buries the underlying substrate that previously served as habitat for aquatic life. Downstream areas are starved of sediments that play important roles in river health. As sediments are trapped behind the dam, the pond fills in. Predictably, one of the most vexing technical issues in removing a dam is what to do about the sediment build-up behind that dam. Silt trapped above dams can accumulate heavy metals and other pollutants. Gravel, logs, and other debris are also trapped by dams, eliminating their use downstream as valuable food and habitat. Warm, murky reservoirs often favor predators of naturally occurring species.

In cases where a contaminant source occurs on the river, an impoundment may retain the contaminants--such as metals and organic compounds--which attach to fine grain-sized organic sediment. In addition, certain flow and water chemistry conditions resuspend sediments and increase contaminant bioavailability, enhancing their uptake through the food chain and eventually affecting the suitability of fish for human consumption.

In cases where dams have been placed to artificially form reservoirs, such as the Stoughton Mill pond and the impoundments above Dunkirk and Stebbensville, the structure restricts flushing flows that would otherwise partially clear accumulated sediment from the impounded system. In addition, ironically, some water level control structures may allow the formation of wetlands in the backwaters of the reservoirs, while at the same time drown diverse wetlands which may require diurnal fluctuations in water level and minute gradations in the littoral zone.

In-stream Habitat

As a free-flowing river enters an impoundment behind a dam, the in-stream habitat becomes more lake-like with reduced flows and silt creating ideal conditions for carp. One reason the Yahara River is on the 303 (d) Impaired Waters list is turbidity which carp increase in a system. Dam removal has been shown to decrease the number of carp and improve fish habitat on rivers in Wisconsin such as the Baraboo River where the number of fish species more than doubled 18 months after the Baraboo Waterworks Dam removal.

Impoundments also lower the dissolved oxygen content of the water and increase water temperatures. When dissolved oxygen drops below a certain concentration, the result can be fish kills, both in the pond and downstream. When oxygen deprived water is released from behind a dam, it can kill fish and vegetation downstream. Sediment and water quality are inextricably linked; the discharge of toxins or conventional pollutants affect sediment quality directly and/or indirectly. Flow regimes also affect sediment quality by either flushing excess sediment downstream or trapping and accumulating sediment

behind structures. Grain size also influences the extent to which this occurs. Numerous additional factors affect and are affected by sediment quality, including eutrophication, trophic dynamics, and sediment organic carbon content.

Impoundments also influence thermal and chemical characteristics of the water, which in turn affects the suitability of the aquatic habitat. These changes are problematic for the many species with a narrow range of thermal and chemical requirements. By slowing water flow, most dams increase water temperatures. Others decrease temperatures by releasing cooled water from the bottoms of reservoirs. Fish and other species are sensitive to these temperature irregularities, which often destroy native, and often rare, populations. DNR presently lacks quantitative information concerning the loss of suitable aquatic habitat due to increases in water temperature and changes in water chemistry associated with impoundments on the Rock River system.

Navigation

In addition to preventing fish migration, the dams on the Yahara River also block human movement as well. Only the Mendota Locks and Lake Waubesa Dam have locks allowing boats to pass through when the dam is shut. Dams generally reduce downstream water levels and hamper certain recreational uses of this valuable recreational resource. Low water makes navigation of the river difficult and may substantially detract from the aesthetics of the river basin by exposing "mudflats" in the areas vacated by the water.

Analysis of Dams on the Yahara River

The Yahara River has undergone only limited channelization projects, but its flow has been interrupted at many points by locks and dams built for navigation and recreation (Figure 5, Dams on the Yahara River). However, their main purpose now is to control water levels as none of the dams currently produce power or provide fish passage when they are shut.

The dams on the Yahara River are all defined as large dams and the DNR is required to inspect them every 10 years. Although dam repair typically costs three to five times more than removal, 9 out of 10 decisions statewide end in dam repair at great cost to the dam owner and/or local community. Currently, the Dunkirk Dam is in need of repair and the Stebbinsville Dam has been drawn down.

Mendota Locks

The Mendota Locks, also known as the Tenney Park Locks, is located at the outlet of Lake Mendota. The Yahara's drainage area at this point is 233 square miles. The original Mendota Locks and Dam were constructed around 1847 for a flour mill. The City of Madison purchased the dam in 1896 and replaced the wooden dam with a concrete dam and constructed the lock. The existing lock and dam was constructed in 1959. Ownership of the lock and dam was transferred from the City of Madison to Dane County in 1980.

The lock and dam consists of a spillway with two 12-foot wide tainter gates, a 20-foot wide by 110-foot long lock, and has a 16 foot structural height but holds only a 5 foot head (difference of headwater and tailwater). It has a storage capacity of approximately 160,000 acre-feet between the bottom of the lock and the tip of the dam. Although the lake storage volume is approximately 440,000 acre-feet, only 160,000 acre-feet is actually impounded by the dam. Based on USGS data, the dam can pass a 100-year flood without overtopping. The probability of failure of the dam is low and according to a 1980 report, there is no evidence of structural problems. In the event of a dam failure, the flood wave would be greatly attenuated due to the storage capacities of Lakes Monona, Waubesa, and Kegonsa and is not expected to cause a failure of any downstream dams.

The Mendota Lock and Dam functions to aid recreation, maintenance of navigation between Lakes Mendota and Monona and stabilization of Lake Mendota water levels.

Personnel operate the lock from May through October and the dam has a normal hydraulic head of 4-5 feet. The dam maintains the water level of Lake Mendota between a maximum of 850.1 feet, MSL datum, and a minimum of 849.6 feet during the summer. The winter minimum is 848.2 feet. Record levels occurred in 2000.

Lake Waubesa Dam

The Yahara River flows unimpeded from the Mendota Locks through Lake Monona and Lake Waubesa. The Lake Waubesa Dam, popularly known as the Babcock Park Lock and Dam, is located at the outlet of Lake Waubesa in the Town of Dunn. Dane County constructed the 10 foot dam in 1938 to control lake levels and aid navigation. The dam holds a very small hydraulic head, often less than a foot and dam is often open during the year because the water level is held up by the channel constriction downstream of the dam. The dam controls the water levels for Lake Monona and Waubesa and continues to be owned and operated by Dane County.

The County endeavors to maintain the water levels of Lake Monona and Waubesa at a lower level during the winter to prevent ice damage to the shoreline and to provide flood storage capacity during the spring runoff. During the spring, the levels are raised to aid the spawning of northern pike and allow recreational use adjacent to the shoreline. The raised water level allows the pike access to the marsh grass where they spawn in the early spring. The County also passes 50 cubic feet per second between April 1 and May 15 to aid the spawning of walleye and other fish downstream of the dam. Walleye prefer to spawn in flowing water over gravel substrate. At all other times, a minimum discharge of at least 10 cfs is maintained. Due to heavy rains, the lakes reached record levels in 2000.

Kegonsa Dam

Dane County constructed the 10 foot dam at Lake Kegonsa's outlet in 1938 to control the water level of Lake Kegonsa and improve navigation. Like the Waubesa Dam, the dam holds a small head and is often open during the year. Dane County owns and operates the Kegonsa Dam, which maintains the water level of Lake Kegonsa between 843.0 and 843.5, MSL Datum. The Door Creek Drainage District has expressed interest in lowering the lake level to improve drainage. Such a change would require a consensus building effort to include a variety of users, many of whom prefer the current water levels. Water level records show that Lake Kegonsa's water level has often been higher than the maximum even when the dam is entirely open. Recently, Dane County dredged the railroad bridge opening downstream of the dam to improve the outflow from the dam. This may help lower the lake levels back into the range more quickly after heavy rains.

Stoughton Dam

The Stoughton Dam is located in the City of Stoughton, which owns and operates it. Built in 1843, the spillway was washed out following a large storm in 1915 that also caused the Dunkirk and Stebbinsville dams to fail and was re-built the following year. The Stoughton dam generated power until the summer of 1999. The City of Stoughton would need to apply for a federal license if they elect to generate electricity again.

The dam is 520 feet long and 14.3 feet high with a normal hydraulic height (difference between headwater and tailwater) of 9 feet and dam creates a long, narrow impoundment lined with many landowners. The maximum storage capacity is 108 acre-feet, which can handle a flood of 2-1/2 times the magnitude of the 100-year flood. The dam must pass 15 cubic feet of water per second, which is the

seven-day low flow with a ten-year recurrence interval on the Yahara River. The maximum water level is 842 feet and the minimum is 841 feet. The dam appears to need of only minor repairs but has not been inspected recently.

Dunkirk Dam

The Dunkirk Dam is located 2.9 miles downstream of the Stoughton Dam in Dunkirk. The first structure was authorized in 1843. In 1915, the Dunkirk Dam was destroyed by a washout caused by a large storm and was rebuilt the following year. In 1926, the City of Stoughton installed the necessary equipment to generate electrical power and generated power from 1926 to 1973. The dam was transferred from the City of Stoughton Electric Utility to the Wisconsin Edison Company in 1974. The Wisconsin Edison transferred the dam to the Dunkirk Dam Lake District in 1997, which currently owns the dam. The 20 foot dam holds a 13 foot hydraulic head and no longer produces power.

The DNR established the maximum level of the Dunkirk Pond at 832.30 feet and the minimum at 831.70 feet, MSL datum, in April 1985 with the idea of reducing the range of water level fluctuations in the pond and minimizing adverse impacts to wildlife, wetlands, and riparian landowners. The minimum flow passed through the dam is 25 cubic feet per second at all times.

Dunkirk Dam is in need of major repair or removal. The DNR would like to remove the Dunkirk dam to improve fish and water quality on the Yahara. The effects of the removal are expected to be similar to improvements seen after the 1993 removal of Fulton Dam further downstream. Property owners around the impoundment formed the Dunkirk Dam Lake District to maintain the dam. The Dunkirk Dam Lake District recently turned down an offer by the DNR to buy their dam because the purchase would lead to the removal of the dam. Instead, the group of property owners voted 38-2 to go forward with reconstruction or replacement of the former hydropower dam. Repair costs are estimated at more than $300,000, half of which could come from a DNR grant if a fish passage was included in the construction. Removal costs would be considerably less often a third to a fifth of the repair costs.

The Lake District has partnered with Thomas Reiss of Dunkirk Water Power to begin generating power at the dam. An exemption has been approved by the Federal Energy Regulatory Commission. FERC is now the lead regulatory authority and is not requiring a fish passage to be constructed. The Lake District can cooperate with the department on the fish passage and receive the grant or can comply with FERC, not construct the passage but not receive the department cost sharing grant. The District has decided to not construct a fish passage.

An incident of an alleged failure to operate the dam occurred in March of 2000. The alleged violation caused the impoundment to fall below the established water levels on March 18 and 19, 2000. In addition, the alleged water level violation occurred at a very critical time in the fish spawning season likely harming reproduction. See Water Level Management for other possible impacts to the fishery. The Dunkirk Dam was opened to allow for repairs to be made in 2000. However, high water limited the amount of work that could be accomplished.

Stebbinsville Dam

The Stebbinsville Dam is located approximately 4 miles downstream of Dunkirk in Rock County. The 19 foot high dam, with a 12 foot hydraulic head, is the most downstream dam on the Yahara River since the Fulton Dam was removed in 1993. The drainage area at the dam is about 430 sq. miles. Built in 1917, the Stebbinsville Dam stopped generating power in 1996 and due to cracks in the left abutment wall and other structural problems, it has been drawn down since 1998. The dam owner, Wisconsin Edison Company, would need to repair the dam and apply for a FERC license or exemption before recommencing hydrogeneration.

The exposed lands behind the deteriorated dam have revegetated and some local residents are increasingly interested in having the dam removed. The Stebbinsville impoundment is highly silted and supports high densities of carp, which exacerbates turbidity and sedimentation problems in the river. Removal of the dam would open up an additional 4 miles of warm water fish habitat and could benefit over 50 species of fish found in the Yahara and Rock rivers. Repair or removal estimates have not been determined. However, according to a 1996 UW Extension report, dam repairs typically cost 3 to 5 times more than the one-time cost of dam removal. If it is repaired, provision must be made for an adequate fish passage around the dam.

Fulton Dam (Removed 1993)

Built in 1841, the Fulton dam was drawn down in 1986 and removed in 1993 due to its poor physical condition. The dam created a shallow, heavily silted, 49-acre pond and has functioned as a saw mill, grist mill, and has generated hydroelectric power. The drainage area of the former dam is 530 sq. miles.

Carp dominated the pond's fishery prior to the drawdown and sport fish included black crappies, white bass, northern pike, bullheads and channel catfish. With the removal of the dam, walleye have begun moving upstream.

Prior to drawdown about 40 acres of cattail-dominated wetland adjoined the impoundment. This wetland area is being replaced by fresh (wet) meadows dominated by grasses, such as red-top grass and reed canary grass, and by forbs such as goldenrod and aster. The former pond bed is covered by a colony of stinging nettle up to 8 feet high, which supports little wildlife. Down cutting of the old lakebed also occurred as the Yahara returned to its channel and reaches equilibrium.

DRINKING WATER AND GROUNDWATER RESOURCES

Groundwater provides for nearly all water supply sources in the Yahara River/Lake Kegonsa watershed. In addition, groundwater is essential for providing water to lakes and baseflow to many streams and rivers in the watershed. Dane County wells typically draw water from dolomite or sandstone aquifers. Rock County's wells are screened, sand and gravel wells, drawing from the sand and gravel aquifers. There are no public supply wells in the Rock County portion of this watershed. Public water systems including residential, industrial, and commercial account for 75% of the use in Dane County. The remaining 25% are made up of sources such as irrigation, rural domestic and self supplied industry. Average groundwater use in Dane County is approximately 61 million gallons per day with residential consumption averaging 75 gallons per capita per day.

The principal aquifers in the majority of the watershed are the dolomite and sandstones of Late Cambrian age, namely Mt. Simon, Eau Claire, Galesville, Franconia, and Trempealeau. These aquifers underlie all of Dane County. Wells tapping the sandstones of Late Cambrian age generally yield 1,000 to 2,000 gallons per minute. The St. Peter Sandstone and other rock units of Ordovician age, which overlie the sandstones of Late Cambrian age, may yield small to moderate amounts of water to wells. The Mt. Simon aquifer is deep sandstone and a source of water for nearly all of the deep municipal wells in Dane County. Where the Cambrian rocks are nearer the surface, many domestic wells also draw water from these formations. Water resources in Rock County are often extracted from the high permeable sand and gravel found in the glacial outwash plains and alluvial filled valleys in Rock County.

The groundwater in the watershed mostly originates as precipitation such as rainfall and snowmelt. As a result, the most groundwater recharge occurs in the spring after the temperature rises above freezing. Most lakes and streams in Dane and Rock Counties are discharge points for the groundwater where the

water table intersects the land. The groundwater in this watershed flows horizontally toward the Yahara River. However, due to heavy groundwater pumping, this direction of flow has been reversed in some areas and instead flows towards the municipal wells. Heavy municipal pumping can accelerate downward leakage of "shallow" groundwater and surface water, which may increase the flow of associated contaminants to municipal wells.

With both public and private water supplies relying on groundwater resources, groundwater conservation and protection is critical in this watershed. Proper land use management, increased recharge, and a decrease in water diversion from this watershed are the keys to protecting these resources.

Adequacy of Groundwater and Drinking Water Supplies

Although there is no immediate shortage of groundwater available for future needs, pumping has already lowered groundwater levels, significantly reducing baseflow from groundwater to urban streams and wetlands. A large cone of depression on the southwest side of Madison, the result of pumping in the Madison metropolitan area, has deprived some springs and streams of base flow.

Increasing urbanization has caused a decrease in groundwater recharge. A decrease in recharge is the result of the construction of impervious surfaces like buildings, roads, and parking lots over previously undeveloped land. Water then runs off the land surface instead of infiltrating and replenishing groundwater supplies, resulting in additional water table declines. Consequently, declining groundwater levels decreases baseflow to streams and lakes and de-waters wetlands, and the expanding cone of depression increases the vulnerability of municipal wells to contamination.

This pumping, combined with wastewater diversion, has been responsible for reducing the mean annual baseflow through the Yahara River system at McFarland by approximately 40 percent (61 cfs) and reducing the dry weather baseflow by 52 percent. Door Creek and its surrounding wetlands have also experienced a decrease in flow due to pumping and diversion. Pre-development flow of Door Creek was around 7.25 cfs, while its present day level is approximately 5.20 cfs. These levels are only expected to continue to decrease as a result of continued diversion and increased groundwater pumping.

The Dane County Regional Planning Commission, Madison Metropolitan Sewerage District and the City of Middleton recently funded a study by the U.S. Geological Survey and Wisconsin Geographic and Natural History Survey. The Dane County Regional Groundwater Flow Model was developed as a planning tool for assessing various management alternatives. The model has been used to help determine how new well placement may affect groundwater and surface water and what affects land use changes will have on groundwater conditions. The model is also used to evaluate alternative zones of contribution as the basis for delineating Wellhead Protection Areas (WHPA) for municipal wells. Preliminary results of the modeling effort show that most of the groundwater in the county originates within the county boundaries. This highlights the need for water conservation and proper land use planning to maintain groundwater supplies and base flow to the county's streams.

Municipal Groundwater Supply Systems

Cottage Grove, located in the northeastern corner of the watershed has three wells that pull groundwater mainly from the northeast. The wells pump approximately 292,000 gallons/day from a deep sandstone aquifer. The total elevated storage is 590,000 gallons. There are two locations in town where groundwater is being remediated because of contamination. However, both locations are down gradient from the municipal wells and are not a threat to municipal wells. The Village also has developed, adopted and enforces a well head protection plan for all of its municipal wells.

McFarland, located in the western corner of the watershed, pumps approximately 575,000 gallons each day from the deep sandstone aquifer. The projected per capita use of groundwater per day is roughly 130

gallons per day (1995). The total elevated storage is 500,000 gallons and a new 750,000 gallon elevated tank is under construction. McFarland has 3 active municipal wells and 1 inactive municipal well. The inactive well was shut down in 1987 when trichloroethylene (TCE) was detected. Although the extent of drinking small amounts of trichloroethylene for long periods is not yet clear, it may cause liver and kidney damage, nervous system effects, impaired immune system function, and impaired fetal development in pregnant women. A groundwater remediation system is addressing the groundwater contamination caused by a business located up gradient from the well. The Village does not have a well head protection plan.

Stoughton is a municipality located approximately in the center of the watershed, near Lake Kegonsa. Stoughton pumps approximately 1,283,000 gallons each day from 5 active wells and currently serves approximately 4,000 water and wastewater customers within the city. The facility has 550,000 gallons of elevated storage and 400,000 gallons of ground storage. The City of Stoughton has adopted a well head protection plan for their newest well #7. Recently, Stoughton installed dechlorination facilities at its waste treatment facility and has implemented an extended seasonal disinfection program. The plant's permit was renewed in 1993. The city also maintains its own pre-treatment program.

GROUNDWATER QUALITY ISSUES IN THE WATERSHED

The Yahara River/Lake Kegonsa watershed has a medium susceptibility for groundwater contamination based on the Wisconsin DNR groundwater susceptibility mapping. Groundwater susceptibility is determined by a variety of factors including depth to groundwater, depth to bedrock, type of bedrock, and soil characteristics. These factors help to determine the potential that certain contaminants will infiltrate into groundwater resources. Contamination may originate from both surface and subsurface sources and may be physically impossible or prohibitively expensive to clean up. Therefore, prevention of groundwater contamination is essential.

It is imperative to know what the potential sources of pollution are in order to prevent groundwater contamination. While the greatest threat to municipal wells are bacteria and some nitrates, residential wells are put at risk by agricultural fertilizers, pesticides and animal manure. Contamination sites such as landfills, and Superfund sites can also potentially leak pollutants to both municipal and residential wells. Through the use of the permitting system for point sources of pollution, groundwater contamination is regulated and somewhat controlled.

Potential Sources of Pollution

There are numerous sources for potential groundwater pollution in this watershed. The known water quality problems have largely resulted from nitrates and bacteria, pesticides such as atrazine, and volatile organic compounds (VOCs). Leaking underground storage tanks, bulk fertilizer and pesticide storage and loading sites, chemical companies, septage application or land spreading and manure storage facilities all have the potential to leak these contaminants to the groundwater.

Nitrates are highly soluble in water and can seep easily through the soil and into the groundwater. Nitrate pollution occurs primarily in private wells and in this watershed, it is probable that 10-20% of wells have a nitrate problem. Residential wells should be tested every 3-5 years depending on the nitrate level. Potential sources of nitrate pollution include lawn and agricultural fertilizers, animal feedlots, land application of manure, on-site wastewater systems, silage juice and decaying plant debris.

The most common sources of nitrate in the Yahara River/Lake Kegonsa watershed comes from fertilizers used on cornfields, from animal manure and from septic systems. Corn is grown throughout

the watershed, and the town of Dunkirk has one of the highest concentrations of land acreage in corn in eastern Dane County. Corn requires fertilizers with a high concentration of nitrogen. As a result, this contaminant is the most common and widespread contaminant in Dane County's groundwater.

The health effects of exposure to nitrates are not well understood, however, many experts believe that long-term exposure may increase the risk of cancer. Nitrate exposure has been linked to a serious, but easily treated, blood disorder in infants called methemoglobinemia (commonly known as "blue baby" syndrome).

Bacterial pollution is a problem found predominantly in residential wells. This type of pollution is often associated with poorly constructed or located wells. Bacteria can cause acute illness and result in life-threatening conditions for some population groups. Chlorination and other methods might help treat bacterial pollution, but does not always solve the problem. Ear wigs are also a common problem.

Pesticide contamination of groundwater results from field application, pesticide spills, misuse, or improper storage and disposal. Atrazine, the most commonly used corn herbicide in Wisconsin for the past 30 years, is often found in the groundwater in primarily agricultural areas of Wisconsin. As a result of this threat to groundwater supplies, DATCP has enacted rules to limit and, in many areas, prohibit the use of this herbicide. This watershed is almost entirely within the area prohibited from atrazine use.

Volatile Organic Compounds (VOC's) mainly come from point sources and can include gasoline, industrial solvents, paints, paint thinners, etc. Trichloroethylene is the VOC most commonly found in Wisconsin's groundwater. Sources of VOCs include landfills, underground storage tanks, and hazardous substance spills. In the short term, high concentrations of VOCs can cause nausea, dizziness, tremors, or other health problems.

Contamination Sites within the Watershed

Within the Yahara River/Lake Kegonsa Watershed, six sites are being investigated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or "Superfund" program. Of these six sites, two are on the National Priorities List (NPL). One NPL Superfund site is located at the Hydrite Chemical's hazardous waste storage facility. Contamination was first detected in a drainage pond near a subdivision. The Hydrite Chemical facility is not currently a threat to the municipal wells because the groundwater in that area flows southeast and the municipal wells draw their water from the north. This facility, however, does pose the threat of contamination to residential wells and developable land in the area (Adam Hogan 2000, personal communication). As of 1998, there were also six licensed active landfills, 19 waste disposal sites and two hazard ranking sites within the boundaries of this watershed. One of the hazardous waste disposal sites is located in Stoughton and the other is in Dunkirk.

Soil and groundwater contamination is also common at agri-chemical facilities. Wells in close proximity to the sites are potentially at risk. There are a few bulk fertilizer and pesticide storage facilities in the Yahara River/Lake Kegonsa watershed. One active and one inactive Danco Prairie FS Cooperative site, and the Eugsters Farm Market Inc. are located in Stoughton. Cottage Grove has two active Cottage Grove Cooperative sites, and one active Hydrite Chemical Co. site.

In addition to landfills, waste disposal sites, and agri-chemical facilities, groundwater resources are also threatened by high priority leaking underground storage tanks, (LUSTs). These high priority tanks are generally 20 years old or greater, which may now be leaking because they have corroded and do not have leak detection devices. These tanks are often used for storing various substances such as petroleum, fertilizers, pesticides, and industrial chemicals. There are many of these sites scattered throughout the watershed, of which 11 in the Stoughton area are in wellhead protection zones.

Another potential for contamination stems from sites in the Environmental Repair Program (ERP), such as: sites with aboveground storage tanks, a spill site, or other sites with the potential to pollute groundwater. Pollutants can contaminate groundwater through percolation or through wells that have not been abandoned properly. The Yahara-Kegonsa watershed contains several ERP sites.

State issued permits and construction standards must be followed during the construction and operation of above and underground storage sites in order to reduce the threat of contamination from leaking tanks.

Point Source Permitted Discharges

Although point source pollution from contaminated tanks and leaking waste disposal sites is difficult to predict and control, some point sources of pollution are allowed through a strict permitting system. A permit can be granted to pump, treat and discharge contaminated groundwater. This discharge is highly regulated and controlled and must meet state-specified standards. In this watershed, 12 sites hold WPDES permits to pump, and treat groundwater and discharge it to area surface water. Permit-holders and the type of permit are listed in Table 4. The Nabisco Brands Inc., Ortega Products plant in Stoughton also has a permit to discharge to groundwater through land-spreading. A University of Wisconsin Physical Science Lab has a permit that allows the discharge of cooling water, containing additives, to be discharged to a seepage pond in the watershed. The water in this pond may potentially seep into the groundwater of Lake Kegonsa.

Table 4. **Point Source Discharges to Groundwater**

Petroleum Contact Water	**Non-contact cooling**	**LUST**
T Pleasant Springs	Nabisco Foods Co.	Bjoin Property
	Nelson Division	McFarland Motors
	Old Halverson Restaurant	Open Pantry
		Former Woods Garage
		Gunnelson Property
		Arnold Larson Park
		Adem's Restaurant

Non-point Source Permitted Discharges

Non-point source pollution also poses a great threat to the groundwater in this watershed. Some sources of non-point contamination that threaten groundwater originate from waste disposal activities, agricultural land uses, and well construction and improper abandonment. Many activities require permits before they can be carried out. Permits can be required by a variety of governing bodies from the federal government to the state and local levels of government. Waste disposal activities require permits. This includes solid waste disposal sites, junkyards, land disposal of wastewater, sanitary sewers, and on-site wastewater systems. All of these activities, except junkyards and some on-site wastewater systems are regulated by the state government. The proper well construction and abandonment is regulated at the state and local level.

Effect of Wastewater Diversion on Groundwater Levels

In addition to decreasing the baseflow of surface water within this watershed, the diversion of treated wastewater to Badfish Creek by the Madison Metropolitan Sewage District Nine Springs Treatment Plant also had an effect on the groundwater level. As a result of this discharge out of the watershed, groundwater levels are declining. Eventually the diversion of groundwater outside the Upper Yahara River Basin will cause a decline in surface water levels. This diversion could have a significant impact on the watershed's lakes, streams, and wetlands. Returning treated water to the Upper Yahara River Basin or recharging the aquifer with treated water may help reduce problems with groundwater depletion. For more information on the effects of the MMSD diversion, see the Surface Water section.

AGRICULTURAL LAND USE IN THE WATERSHED

Approximately 81 percent of the land use in the Yahara River/Lake Kegonsa watershed is agricultural. See Figure 3, Current Land Use Map. Outside of the City of Stoughton, there are approximately 425 landowners in the watershed. Corn and soybeans are the dominant crops. Most of the dairy or livestock operations are small-scale farms and commonly grown crops include hay, corn, and soybeans with average yields around 3.8 tons/acre hay, 160 bushels/acre corn, and 55 bushels/acre of soybeans. Although canning crops such as peas, sweet corn, cabbage and beets are grown on the silt loams of the watershed, the most commonly grown crops are corn, oats, and alfalfa. Silt loams and mucks that are underlain by silt, sand and gravel are used primarily for corn cultivation and some specialty crops.

Current Conditions

Today, one trend occurring on agricultural land in the watershed includes an increasing rate of development of agricultural lands. These transitional areas are high sediment producers. When agriculture is no longer profitable, development becomes a viable option. In addition to increasing development, many farmers are changing the size and type of their farm operations. Increasing economic pressure has hurt small agricultural operations, in favor of larger scale operations. Without proper planning, these large scale and expanding farm operations can be major threats to water quality .

The main problem in the watershed, however, due to the high percentage of land in agricultural production is erosion. The majority of problems with non-point pollution sources stem from cropland erosion. This non-point pollution is capable of carrying high levels of sediment, phosphorus, nitrogen, and bacteria to area surface water. The tolerable soil loss for most agricultural land is 5 tons per acre per year. In the Stoughton area, however, approximately 80 percent of farmers are enrolled in the Conservation Reserve Program and of these 80 percent, 90 to 95 percent average less than 5 tons of soil loss per acre per year (Aicardo Roa 2000, personal communication).

Soil conservation practices are vital to protecting long term productivity of the land as well as water quality. In 1999, 1,983 acres of farmland in the watershed were enrolled in the Conservation Reserve Program. In addition, moldboard plowing trends have been decreasing as more farmers are using no till methods. In addition, soil erosion rates have also declined as more farmers use mulch tilling. Despite these declines, conventional tilling is still common on farms in this watershed.

Nutrient problems in surface and groundwater can also stem from barnyard runoff or improperly designed or managed waste storage facilities. Fortunately, there are relatively few problematic manure storage facilities in the Yahara River/Lake Kegonsa watershed.

Agricultural Permits

In addition to encouraging best management practices, many federal and state sponsored permitting programs are working to protect and preserve land and water resources in the watershed. The Animal Waste Management program was developed through Wisconsin Administrative Code NR 243 to address pollution problems caused by the handling, storage and disposal of animal waste on Wisconsin farms. This regulatory program requires Wisconsin Pollutant Discharge Elimination System (WPDES) permits be issued to the largest animal operations in the state, those with more than 1,000 animal units. (An "animal unit" is a codified measurement with a 1,000 pound steer as the standard for one animal unit.) An equivalence table appears in the code stating the numbers of other livestock, such as poultry and swine, it takes to achieve one animal unit. Although 100 livestock operations of this size have been identified and issued discharge permits, none of these are located within the watershed.

Most of the regulatory activity has involved farms with fewer than 1,000 animal units. For these, the Department has historically responded to complaints submitted by the public. Department staff works with the state Department of Agriculture, Trade and Consumer Protection (DATCP) and the counties in completing the investigation and determining whether a significant water quality impact exists. If such a problem exists, the Department issues a "notice of discharge" to the owner, requiring action to alleviate the animal waste discharge. Notices of discharge typically allow the livestock operation to request technical and cost sharing assistance. The program has been particularly important because of the regulatory ability to issue permits to those refusing to respond to the notice of discharge. Although complaints have been submitted within the watershed, none of them have resulted in a significant water quality impact, and therefore, no farms have an active notice of discharge. Due to workload issues, complaint follow up in smaller farms has been given a lower priority.

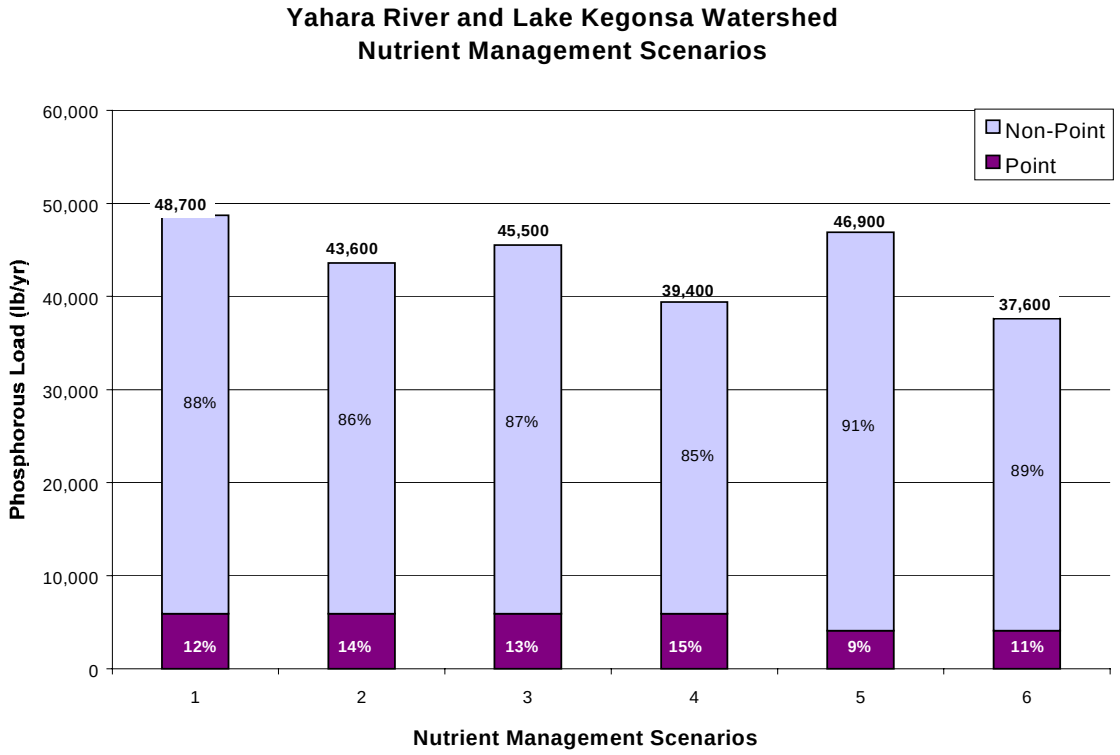
Permits issued by the state Department of Natural Resources are also required to spray irrigate industrial wastewater. Industries that hold these permits use agricultural fields to spray nutrient laden wastewater. The crops on the fields uptake these nutrients and reduce the amount that reaches surface and groundwater.

Landspreading permit holders typically use approved agricultural fields to dispose of wastewater and treated sludge and septage. For more information on landspreading permits, refer to the Surface Water and the Groundwater and Drinking water sections. The continued control of agricultural activities through permitting could effectively reduce the effect of agricultural non-point source pollution on water quality and wildlife habitat.

Nutrient Management and Nutrient Trading

Nutrient management is also exceedingly important to protecting the health of the watershed's streams, rivers and wetlands. Nutrient management involves applying the correct amount and form of plant nutrients for optimum yield and minimum impact on water quality. Applying nutrients in excess of the crop's need is a major source of non-point source pollution. Excess nitrogen leaches through the soil into the groundwater and phosphorus can be carried off cropland following heavy rains and cause weed growth and algae blooms in surface waters. The impacts of possible scenarios for nutrient management are shown in below (Figure 7).

Figure 7.



1. Current agricultural practices with current point source discharges. This includes relative comparison by watershed of point and non-point sources.
2. Conventional tillage converted to conservation tillage and existing conservation tillage converted to no-till with current point source discharge levels.
3. Current tillage practices with nutrient management practices employed and current point source discharge levels.
4. Conventional tillage converted to conservation tillage and existing conservation tillage converted to no-till and nutrient management practices with current point source discharge levels.
5. Current agricultural practices with point source discharge phosphorus concentrations reduced to 1mg/l (the level designated in NR217).
6. Conventional tillage converted to conservation tillage and existing conservation tillage converted to no-till and nutrient management practices employed with point source discharge levels at 1 mg/l.

Conservation Programs

A variety of federally sponsored programs exist in order to help remediate the effects of non-point source pollution caused by agricultural land uses on water quality and wildlife habitat. The Conservation Reserve Program (CRP) is a voluntary program that provides farmers with incentives to plant long-term resource-conserving covers to improve soil, water and wildlife resources. The Conservation Reserve

Enhancement Program (CREP) is a recent refinement of the Conservation Reserve Program developed to address specific state and nationally significant water quality, soil erosion and wildlife habitat issues related to agricultural use. The Environmental Quality Incentives Program (EQIP) offers financial, educational, and technical help to install or implement structural, vegetative, and management practices in designated priority areas. The Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private lands. The Wetlands Reserve Program (WRP) is a voluntary program to restore and protect wetlands on private property. For more information on any of the eligibility requirements of these programs, go to the Farm Bill webpage at http://www.nhq.nrcs.usda.gov/OPA/FB96OPA/MiscFB.html.

URBANIZATION IN THE WATERSHED

Although the watershed is predominantly agricultural, its proximity to the Madison Metropolitan area has increased development pressure in the surrounding communities. Near Madison, the Village of Cottage Grove has shown the highest level of growth in the watershed and population has increased by over 250% in the last 10 years. Other communities have also shown tremendous growth (See Table 5). The largest municipality within the watershed is Stoughton, located along the Yahara River, east of Badfish Creek and south of Lake Kegonsa. The city has grown to more than 12,000 people at a rate of 40% over a ten-year period.

This growth leads to severe land use development pressure. The impact of this development leaves lasting effects on the wildlife, hydrology and water quality of an area. Generally, urbanization decreases wildlife habitat acreage and decreases the diversity of terrestrial and aquatic species. Urbanization also creates impervious areas, thereby decreasing groundwater infiltration and increasing the volume of stormwater runoff. In addition, development increases the sediment load in surface waters as a result of soil erosion from construction sites.

Table 5. Population Growth

Municipality	1990 Census	2000 Census	Percent Change
V. Cottage Grove	1,131	4,059	258.89%
T. Bristol	1,835	2,698	47.03%
C. Stoughton	8,786	12,354	40.61%
T. Pleasant Springs	2,867	3,158	10.15%
T. Fulton	3,525	3,839	8.91%
T. Cottage Grove	2,660	3,053	14.77%
T. Dunkirk	2,121	2,053	-3.21%

Data from the Department of Administration; Demographic Services Center 1999; and the US Census Bureau at http://www.census.gov 2001.

Stormwater

High levels of development are increasing the threat from stormwater runoff. Development increases the amount of impervious surfaces, changing the hydrology of an area. As a result, larger volumes of water to reach the streams at a faster rate, increasing the threat of flash floods. This altered hydrology results in higher peak flows, and reduced base flow in streams during the dry weather periods. In addition, these flashy high flows in streams contribute to streambank erosion.

As stormwater runs over these impervious areas, it carries with it fertilizers, pesticides, herbicides, nutrients, heavy metals and other pollutants. These non-point pollution sources cause an increase in phosphorus and nitrogen loads and eventually lead to eutrofication and algal blooms. In addition, increased plant growth and the input of nutrients can reduce oxygen levels in lakes, rivers and streams, causing fish kills and changing aquatic habitat. The eroded material carried by stormwater causes the siltation of fish habitat, increases the turbidity and temperature of the water. Ultimately, stormwater runoff from urban areas combined with agricultural lands will change aquatic habitat.

These impervious areas are often served by an efficient stormwater drainage system, which is highly effective at transmitting pollutants to receiving waters. This pollution consists of vegetation such as leaves, grass clippings, yard and garden debris; atmospheric deposition of dustfall and debris; traffic-related debris including sand and salt; eroded soil and sediment; animal wastes; lawn and garden fertilizers; pesticides and general litter. Effective control of this stormwater runoff can help improve water quality. Many communities have stormwater ordinances in place and Dane County is currently working to enact countywide stormwater control (Table 6).

Currently, Dane County is in the process of developing a county wide stormwater ordinance. Under the ordinance, stormwater plans will be required for:

- residential, commercial, industrial, or agricultural construction or expansion that results in 20,000 square feet of impervious surface area
- any alteration of existing development or any redevelopment that results in changes the stormwater rate, type, location or quantify any development which would involve the construction of any new public or private roads, or access drives any development which requires a subdivision plat, any certified survey map for commercial or industrial area, and other land development activities.

The county wide ordinance sets minimum standards, which will supersede less restrictive city and village stands in Dane County. Under the new ordinance, all communities must show progress or significant intent toward adoption/amendment/program implementation within 6 months after date of county board adoption. (Dane County Stormwater Standards, Draft 2)

Under the federal Clean Water Act, the U.S. EPA has instituted Phase I regulations to control polluted stormwater runoff. Phase I requires municipalities with populations of 100,000 or more to obtain coverage under a municipal stormwater discharge permit to control the discharge of pollutants as well as construction sites of 5 acres or more and 10 categories of industrial activities. Phase II federal stormwater regulations, which were promulgated in October 1999, will require municipal stormwater discharge permits for certain municipalities with populations of less than 100,000 and all land-disturbing construction sites of 1 acre or more. Phase II will also have more rapid implementation for "common sense" stormwater management concepts and more stringent regulation of total maximum daily loads (TMDL). Both Dane and Rock counties are designated for coverage under the stormwater discharge permit program. In Wisconsin, EPA has delegated the authority to administer comparable stormwater regulations to Wisconsin Department on Natural Resources.

Regulation of stormwater at the local level is generally confined to developing plans that "detain" water at some predetermined level—before development occurs—during the plat review and permit

approval process. This local regulatory action takes place through ordinance development. This comprehensive planning is an effective water management strategy for improving water quality.

Construction Site Erosion

Increasing growth in these rapidly developing regions leads to an increasing number of construction sites. These sites create large areas of open soil that are vulnerable to erosion during rainfall events. Construction site erosion is a major problem in rapidly growing areas. Construction site erosion can average as much as 40 times greater than the sediment delivered from agricultural lands. Although the tolerable soil loss rate for construction site erosion is 7.5 tons per acre per year, the average soil loss from construction sites in Dane Co. is roughly 15 tons per acre per year. (Aicardo Roa 2000, personal communication) Through the enactment and enforcement of construction site erosion ordinances, many of the communities in the watershed have already taken steps to control the effects of this erosion on water quality (Table 6).

Table 6. Stormwater and Erosion Plans and Ordinances (as of 1998)

Municipality	Stormwater Plans and/or Ordinances	Erosion Control Ordinances
C. Stoughton	Plan, ordinance recommended	Ordinance in place
V. McFarland	Subdivision ordinance in place	Subdivision ordinance in place
C. Edgerton	Plan, ordinance recommended	County ordinance in place (Ch. 14)
T. Cottage Grove	Plan, ordinance recommended	County ordinance in place (Ch. 14)
T. Fulton	Plan, ordinance recommended	County ordinance recommended
T. Dunkirk	Subdivision ordinance in place	Ordinance in place
V. Cottage Grove	Plan, ordinance recommended	Ordinance in place

Impacts on Wildlife Resources and Fisheries

Increased residential development has important impacts on wildlife especially when it is scattered throughout agricultural lands. The primary impact is the loss of acreage and fragmentation of habitat including woodlots, grasslands and wetlands. In general, wildlife species that are generalists or adapt well to humans, such as deer, coyotes, red-winged blackbirds, and robins can do well in urbanizing landscapes. Species that are specialists; however, or need larger areas to roam such as upland sandpipers, dickcissels, harriers, and western meadowlarks, will not do as well in fragmented landscapes that are being created by scattered development. As bedroom communities grow in the Madison metropolitan area, the increased traffic also may become increasingly detrimental to wildlife. Habitat loss and fragmentation also impacts local hunting.

Urbanization can diminish the quality of local fisheries. Surface waters and fish spawning habitat are particularly susceptible to increased volumes of stormwater runoff caused by the increase in impervious area. Stormwater runoff and construction site erosion carry increased volumes of sediment to streams. Increased sediment loads alters the in-stream habitat by depositing sediment on the stream bed and increasing turbidity and nutrients.

Growth Management Measures

One way to control the high rate of development is through the use of growth control measures. Currently used growth control measures include zoning restrictions and lot size limits. Zoning

restrictions work to preserve land cover by preventing residential or commercial development in a particular area. Lot size limits can restrict the amount of land converted to impervious areas and restrict the amount of land that is built up. Conservation easements and purchase of development rights are other management tools to prevent the development of vulnerable land. An easement is a permanent restriction on the use or development of land. Landowners may voluntarily pursue a conservation easement to preserve land. The easement is generally made to protect wildlife habitat or open space, or to preserve agricultural lands. A Purchase of Development (PDR) program is a voluntary program that serves to preserve farmland and support viable farm operations and to protect open space and environmentally sensitive areas. Other functions of PDR's, as shown in the Town of Dunn, are to maintain the town's rural character and quality of life and to protect the town from the urban encroachment. This program works by purchasing a landowner's right to develop their land for any use other than agriculture.

State Comprehensive Planning Legislation

Other methods that will be used to control development and decrease non-point source pollution that stems from stormwater runoff and construction site erosion are to use comprehensive planning as defined by the tenets of the Smart Growth Initiative. The Smart Growth Initiative, as incorporated into the 1999 to 2001 state budget, stresses the importance and relevance of planning and works to create guidelines for development with respect to both financial and environmental concerns. Highlights of the legislation includes guidelines for traditional neighborhoods and conservation subdivisions ordinances, encouragement for identifying "smart growth areas," and goals for comprehensive planning.

Comprehensive planning is required of all local governments by January 1, 2010. The plans will include nine prescribed elements: issues and opportunities; housing; transportation; utilities and community facilities; agriculture, natural, and cultural resources; economic development; land use; intergovernmental; and implementation and all programs and/or actions must be consistent with that plan. The Smart Growth Initiative legislation offers grants for comprehensive planning, smart growth dividend aids, and transportation planning grants related to the development of a comprehensive plan. For more information on this new legislation, go to http://www.doa.state.wi.us/olis/index.asp.

WILDLIFE, FORESTRY AND HABITAT MANAGEMENT

> *Twenty or thirty years [ago] the cheerful, chattering song of the active bird, the short-billed marsh wren (Cistothorus stellaris) (sic) was heard in every low prairie covered with fine Carex (sedges)… I have seen or heard scarcely a bird of this kind for fifteen or twenty years. Their song has been silenced by the click of the mower. The hay harvest comes before the young are fledged, hence the mower is fatal to this wren's best interests. They have gone, I hope, somewhere where Carex abounds and mowers do not*. – Philo R. Hoy, *Man's Influence on the Avifauna of Southeastern Wisconsin* (Hoy 1885).

Habitat and Natural Community Trends

> *The southeast and north and northwest part of this township is rolling prairie. From the northeast to the southwest there is a line or chain of marshes that lies so low and flat that it cannot be drained so as to be of any use, the ridges of dry land between the marshes are thinly timbered with white oak, black oak, and burr oak.* – Description of Cottage Grove township by land surveyor Orson Lyon, May, 1834

Much of what we know of the presettlement flora comes from the original land surveyors in the 1930's as they marked and recorded witness trees to identify section and quarter-section corners. Oak savanna was by far the most widespread and abundant plant association in the Yahara River/Lake Kegonsa watershed. Prairie and open marsh communities are also frequently mapped in this watershed.

The surveyors' records make no mention of specific plants found on these upland prairies except to say that they contained "prairie grasses" or sometimes "grasses and weeds." However, the treeless condition of these prairie areas is supported by the fact that, instead of marking witness trees to indicate section and quarter-section corners, the surveyors were forced to build mounds of earth and sod to locate these points (Cheney and True 1893; Ellarson 1949).

Oak Savanna

Oak savanna was by far the most widespread and abundant plant association in the Yahara River/Lake Kegonsa watershed at the time of the original land surveys (Ellarson 1949). The term savanna refers to a plant association that is structurally transitional between prairies (with very few trees) and woodlands (with tree canopies mostly touching). Oak savanna canopies are dominated by burr, white and often black oak trees, although hazel and oak underbrush are frequently mentioned by the original land surveyors in the 1830's (Ellarson 1949). It would be misleading to think of a savanna simply as a prairie with interspersed trees. Our common perception focuses on the canopy trees, often overlooking a rich and unique flora in the understory, which include hundreds of forb, sedge, grass and shrub species. The groundcover of forbs and grasses will vary, depending on soil richness and degree of light reaching the soil. Leach and Givnish (1999) found that many forbs reached their peak coverage in the partial shade of savanna trees, while grasses reached their peak coverage in the most brightly lit areas or on the poorest soils. Since savannas provide partial shade, the authors suggested that most Wisconsin savannas were not "grasslands" but instead "forblands."

Oak savannas represent a link to southern Wisconsin's history and are important in maintaining species diversity region-wide. Savannas, historically found in southern and western Wisconsin, were the gradation between the great prairies and the eastern deciduous forests. In the early to mid-19th century, the oak savanna as an ecosystem was thoroughly fragmented and nearly totally destroyed throughout its range. Most of its acreage suffered one of the following fates: 1) clearing and plowing; 2) overgrazing, or 3) invasion by dense shrub and tree growth due to lack of fire, lack of grazing, or both. Oak savanna now shares equal billing with tallgrass prairie as the most threatened plant community in the Midwest and among the most threatened in the world (DNR 1995). Intact examples of oak savanna vegetation are now so rare that less than 500 acres are listed in the Wisconsin's Natural Heritage Inventory as having a plant assemblage similar to the original oak savanna. This is less than 0.01% of the original 5.5 million acres in the state.

The increasing abandonment of lightly to moderately grazed wooded pastures and the accelerating succession of oak woodlots toward heavy-shade-producing trees and shrubs will lead to the decline and possible loss of much of what remains of the savanna flora and fauna, including the eventual decline of the oaks themselves. There are an untold number of acres of private land in the watershed, both overgrazed and overgrown, with retrievable oak savanna. Much of the savanna tree canopy can be restored with a combination of tree thinning, brushing and burning techniques. However, restoration of a complete savanna ecosystem, including the groundlayer plants and animals, may be more difficult.

Although light grazing have been recommended as a means of maintaining the open habitat required by many savanna species, cattle can be of more harm than good. John Curtis explains that cattle seek out forbs, such as *Silphium*, "like hidden candy at a child's birthday party" (Curtis 1971). By selectively removing forb species, grazing would shift the plant community composition towards grasses.
The success of savanna restoration efforts depends on many factors, such as soil conditions, the state of the local flora and site history. Despite these complications, Leach and Givnish (1998) have suggested two elements that are characteristic of restorable oak savannas: the presence of historic open-grown oaks and a species rich groundlayer of native plants in both sunny and shadier conditions.

Grassland/prairie

Original land survey records of the 1830's indicate there were 3.1 million acres of treeless grassland in Wisconsin or 9% of the total land cover. Tallgrass prairie and related oak savanna are now the most decimated and threatened plant communities in the Midwest and in the world. Wisconsin has only .5% (13,000 acres) of its original grassland ecosystem remaining in a relatively intact condition and much of this remnant acreage has been degraded to some degree by livestock grazing or woody invasion. Over 80% (11,000 acres) of this remaining acreage is sedge meadow and the rest (2,000 acres) is native prairie.

Most grassland acreage has suffered one of the following fates: 1) conversion to crop production; 2) over-grazing; or 3) invasion by shrubs and trees due to lack of fire, lack of grazing, or both. But as Leopold said in Game Management (1933), *"…game [wildlife] can be restored by the creative use of the same tools which have heretofore destroyed it – axe, plow, cow, fire, and gun"*. Managed use of fire, removal of trees and shrubs, light grazing, control of exotics, and prairie grass/forb plantings will aid prairie restoration. Establishing surrogate grassland habitat on both private and public lands can also restore populations of grassland mammals and birds.

Recovering and maintaining native grassland biodiversity in Wisconsin is very feasible for many, but not for all components (e.g., birds, plants and invertebrates). Most remnants are too small to support most vertebrate species but are capable of supporting viable populations of plant species and prairie-dependent invertebrates. The greatest opportunities for recovery of degraded sites in the Yahara River/Lake Kegonsa Watershed are at the dry and wet ends of the soil moisture spectrum. Often these sites were not converted to farming because they were too wet or too dry and some may still have grassland remnants.

Given the fragmented nature and small size of native remnants and even potential restorations, the main hope for grassland vertebrates lies with surrogate grassland habitat that does not necessarily have native vegetation. The opportunities for establishing this habitat are extensive on private lands. In many cases establishment would only require removal and control of woody growth. In others it would require the establishment of permanent grass/forb cover. And in still others, intensive rotational grazing systems using refuge paddocks or warm-season grass paddocks may serve as valuable surrogate grasslands, particularly for grassland nesting birds.

Wetlands

Wetlands are complex and diverse ecosystems, supporting a number of plants, wildlife, and human uses. Wetlands represent a dynamic transition between land and water, with unique set of physical and biological characteristics. Before European settlement wetlands occupied an estimated ten million of the state's 35 million acres. Ever since, wetlands have been subjected to intense draining and ditching, and as a result Wisconsin has lost 47% of its original wetland area. One explorer in the early 1800's summed up the prevailing attitude, "To change a marsh from its foetid, cold and vaporous atmosphere, into a fruitful, smiling plain …is the object of draining land…" More recently people have recognized the benefits that wetlands provide after having experienced innumerable losses when wetlands have been degraded and destroyed.

Wetlands perform a variety of functions in our landscape that benefit wildlife and people. Wetlands support an abundance of plants and wildlife such as fish, waterfowl, and other wild game. Ducks and other migratory waterfowl are dependent on wetlands for food, escape cover and breeding grounds. Currently 32% of the state's threatened and endangered plants and animals are wetlands dependent. Wetlands dampen flood peaks by storing and slowing down floodwaters. Water flowing out of wetlands can be cleaner than incoming waters because sediment and nutrients are often filtered out. Wetlands are prized by ecologists for their complexity, chemical transformations, and carbon storage.

The wetlands in the Yahara River/Lake Kegonsa watershed provide critical wildlife habitat. Lower Mud Lake Wetlands provided breeding and feeding habitat areas for the woodcock and snipe (Bedford et al. 1974). These wetlands are also important spawning grounds for Northern Pike and Walleye. In the Door Creek wetlands sandhill cranes might be found nesting.

The Friends of Lake Kegonsa (FOLK) reported a list of wetland functions that they valued; including, a diverse plant community that supports a variety of wildlife, spawning habitat for game and forage fishes, aesthetic and recreational resources, greenspace, wildlife habitat, and preservation of the Lake Kegonsa shoreline from development. FOLK concluded and recommended against using the Door Creek wetlands as a sediment trap due to the detrimental effect on the existing wetland ecosystem.

Despite increasing public awareness of wetland values, wetlands are still threatened by development, urbanization, and fragmentation. In coming years, wetland-filling continues to threaten wetlands as development pressures become more intense. Land use practices continue to degrade wetlands through barnyard and feedlot runoff, pesticide, salts and fertilizer runoff, and sedimentation from nonpoint sources. Increased runoff can facilitate the invasion of exotic, weedy plants.

Invasive plants often replace natives and grow too dense to support the variety of wildlife found in native plant communities. Reed canary grass, purple loosestrife, and the hybrid cattail are common wetland invaders in this watershed (scientific names: *Phalaris arundinaceae*, *Lythrum salicaria*, and *Typha* X *glauca*, respectively). These invasive plants share similar characteristics in that they typically grow in very high densities, have high reproductive rates, decrease species richness, and have high rates of spread. Their dense growth crowds out native species and it becomes difficult to control invasives once they have become established. Prevention, early detection and eradication are the most cost-effective methods of controlling these invasive plants.

Wetlands are complex, biologically diverse ecosystems. Scientists have learned that intact, completely functional wetlands cannot be simply replaced if destroyed elsewhere. Protecting wetlands from destruction and degradation is crucial to maintaining their functions, values, and benefits to wildlife and society.

Wildlife Management and Forestry Trends

The Lands Program at the Department of Natural Resources is a hands-on management program that works to protect and restore habitat for all types of wildlife. In the Yahara River/Lake Kegonsa watershed, wildlife management focuses primarily on grassland and wetland habitat preservation and restoration for a variety of species. Forest management is primarily private forestry, and most private forest owners emphasize management for wildlife habitat and outdoor recreation.

Very little of the oak savanna and prairie that once dominated the landscape of the watershed remain. See Figure 2, Original Vegetation Map. The DNR, however, often assists private agricultural landowners in the Yahara-Kegonsa watershed to manage their property for timber, wildlife, aesthetics, and water quality. Oak reproduction is encouraged to provide habitat and forage for wildlife and deer control is also important in protecting seedlings. Many farmers, with technical assistance from the DNR, are taking advantage of the Conservation Reserve Program (CRP) and the Managed Forest Law (MFL*)* program to plant trees on former agricultural lands and ease the burden of property taxes. The DNR has also assisted the City of Stoughton with urban forestry projects and tree plantings. See Appendix E for more information on forestry programs.

Habitat loss and fragmentation are the main concerns for wildlife in the Yahara-Kegonsa watershed. Habitat continues to be degraded, simplified, fragmented or destroyed by some land and water use practices, policies and development decisions. The watershed's fish and wildlife, the continued

enjoyment of hunting and fishing, the tourism industry and the quality of life depend on high quality natural habitat. Much of the fish and wildlife habitat in the watershed is privately owned or affected by local regulations. Federal, state and local units of government need to work effectively with private landowners to protect and manage natural resources.

Participation in fishing and hunting has not kept pace with the state's population growth. Hunters and anglers are the primary supporters of the DNR's fish and wildlife conservation programs. Declining participation threatens the ongoing protection of these resources and perhaps even the long-term viability of these recreational activities. Reasons for declining participation include inadequate public access, lack of readily available "how-to-get started" information, poor exposure and marketing of these activities, and competition by other activities for people's time.

Generalist species are dominant in highly altered landscapes and species with more specific habitat requirements are less likely to thrive. Some of the commonly managed animals include deer, turkey, pheasant, waterfowl and non-game grassland birds. Often managing for these species will also benefit other less known species.

Deer

The number of deer in the Yahara-Kegonsa watershed varies between 22-33 deer/square mile. The watershed crosses into parts of three Deer Management Units, (Unit 76, 76M, and 77A). While many hunters might think that there aren't enough deer, others believe that there are too many. As a result, deer management is a tricky situation. The Department of Natural Resources has tried to respond to management needs by issuing more deer hunting permits which is the primary method of deer population control. Deer Management in urban areas, where hunting might not be an option and citizens' viewpoints are diverse, has become one of the more controversial wildlife management problems. Information on hunting areas can be found in the Public Lands section.

Turkey

The watershed is located within turkey management zone 26. Wild turkeys are one of the "success" stories of southeastern Wisconsin wildlife. They have made a tremendous comeback and are now present in good numbers. Turkeys need a relatively small range and are very adaptable. They were originally found in association with oak savannas but have adapted to use mature hardwood forests, specifically oak, which is interspersed with openings, both agricultural and non-agricultural. In addition to providing acorns for food, oak trees provide roosting and nesting ground for the birds.

Turkey habitat management has become more and more difficult as a result of changing land use practices. The biggest threat to turkey habitat is the development of oak forests for residential and commercial purposes. In addition, active fire suppression halts oak regeneration and enables invasive shrubs such as the buckthorn to invade the oak's habitat. Silviculture can provide some management of oak tree and turkey habitat, but it is labor intensive.

Many landowners, including the DNR, will leave unharvested grain on a ½ to 1-acre plot as a winter "food plot" for the birds. Some individuals will receive payments from the Turkey Federation for this practice. Other money for turkey habitat restoration and preservation is available through the DNR's Turkey Stamp fund.

Pheasant

The pheasant was introduced into Waukesha County in 1916 and pheasant hunting began in 1927. Today, the Yahara River/Lake Kegonsa watershed lies in the heart of the pheasant range in Wisconsin. Although not native to the area, pheasants have filled the void left by the absence of other upland bird

species such as the sharp-tailed grouse, prairie chicken, and the ruffed grouse. They nest in grasslands and often winter in shrub carr wetlands and cattail stands. The pheasant is better able to adapt to a fragmented landscape than many of the native birds and often use agricultural land as a surrogate for grassland.

Despite this ability to adapt, however, pheasant numbers have been declining and continue to decline. A possible explanation for this decline is the change in agricultural crops, the methods of harvesting and also predation by raccoons, skunk and cats. Alfalfa is harvested earlier and more often than previous crops and therefore does not provide good nesting ground. There are also fewer acres in Conservation Reserve Program in Wisconsin as compared to the early to mid-1990s resulting in less secure grassland nesting cover.

The DNR maintains a state game farm in Poynette that raises birds strictly for hunting purposes. Pheasants also use "food plots" in winter months as supplemental food sources. In addition, various local groups such as Wings Over Wisconsin and Pheasants Forever are also active in pheasant habitat restoration and preservation.

The Pheasant Stamp program is another way that protection of pheasant habitat is conducted. Hunters must purchase a pheasant stamp to hunt pheasants in pheasant management counties such as Dane County. The money from the sale of the stamps is then used for pheasant habitat management within the pheasant management counties.

Waterfowl

A variety of waterfowl use wetlands and surface water in the Yahara River/Lake Kegonsa watershed. Many of the most abundant breeding waterfowl in Wisconsin are found in the watershed including wood ducks, mallards, blue-winged teal and giant Canada geese. Spring and fall migrants include black ducks, pintail, shovelers, green-winged teal, American wigeon, redheads, ruddy ducks, and ring-necked ducks. The Lower Mud Lake wetlands are a popular spot for viewing waterfowl.

The watershed itself is located in the Southeast Focus Area of the Upper Mississippi River and Great Lakes Region which is part of the North American Waterfowl Management Plan (NAWMP) signed by the United States and Canada. The goal of this program is to restore wildlife habitat (including wetlands and prairies), the preservation of current habitat and the purchase of lands (DNR 1992).

Within the Southeast Focus Area, townships with critical habitat are identified into which implementation of this plan will be directed. Dunkirk, Fulton, Rutland, and Porter are designated as townships with critical habitat. Habitat work will be directed at increasing dabbling duck production. State, federal, and private agencies will be concentrating their wetland and waterfowl programs in these focus areas to achieve the goals and objectives outlined in the Joint Venture. The primary strategies include increasing upland nest cover, doing wetland restoration and enhancement, and managing "complexes" around existing Waterfowl Protection Areas and state lands.

Grassland Birds

Although much attention has been given to the plight of forest-interior songbirds, grassland-dependent birds have actually experienced more precipitous population declines than their more celebrated cousins in the forest. Between 1966 and 1994 the populations of ten grassland bird species declined significantly in Wisconsin according to the Federal Breeding Bird Survey (BBS). These declines were not only evident in Wisconsin, but were widespread throughout the Midwest and the continent as a whole (Sample and Mossman 1997).

Native grasslands have been almost completely lost since European settlement, and agricultural land has undergone many changes, from the era of wheat farming in the late 1800s, to the dominance of dairy

farming in the mid-1900s, to the growth of row cropping in recent decades (Sample 1989). Some bird species adapted well to agricultural land use in the early to mid-1900s, but since the late 1950s large acreages of pasture and small grain crops have been converted to row crops, which decreased useable agricultural habitat for grassland bird species (Graber and Graber 1963). Also, much late-harvested grass hay has been converted to alfalfa, which is harvested early and frequently, causing significant mortality of nesting birds (Frawley 1989). The loss of hay and pasture acreage is strongly correlated with declines in grassland bird populations in the Midwest (Herkert et al. 1996).

Each grassland bird species has a particular range of habitat conditions to which it is well suited (Sample 1989). Because grassland bird habitat requirements are diverse, management designed to benefit one or a few species will not adequately accommodate the needs of all other species (Sample and Mossman 1997). The general rule of thumb for grassland management units – at all scales – is the larger the better, even for small blocks of land. Idle grassland cover near hayfields may provide re-nesting habitat for birds displaced from a mowed field after cutting. Many agricultural habitats are subject to farming-related disturbances during the breeding season that may lower grassland bird nesting success. The conservation of undisturbed or idle habitats is therefore important. The most valuable agricultural habitats for grassland birds are old fields, lightly to moderately grazed pastures, fallow fields, wet meadows, and late-cut hay.

Federal Breeding Bird Survey

The Federal Breeding Bird Survey (BBS), started in 1966, is a survey organized by the Fish and Wildlife Service and conducted by volunteers who survey specific routes throughout the state. There are three routes in Dane County, all three of which touch a small portion of the watershed. Routes 320 and 167 are still being run. Route 67 was discontinued in 1990. A composite list of breeding birds identified on route 320 is probably the best reflection of birds found in this watershed (Table 7). However route 320 has only been run since 1998 and may not reflect a complete list of breeding birds in the area. Of the 54 species observed thus far on this route, 4 are species of Special Concern. Special Concern species are those species about which some problem of abundance or distribution is suspected but not yet proved. The main purpose of this category is to focus attention on certain species before they become threatened or endangered.

Table 7. Wisconsin Federal Breeding Bird Survey Route 320

American Crow	Eastern Meadowlark	Northern Bobwhite
American Goldfinch	Eastern Phoebe	Northern Cardinal
American Robin	Eastern Wood-Pewee	Northern Rough-winged Swallow
Baltimore Oriole	European Starling	Red-eyed Vireo
Barn Swallow	Field Sparrow	Red-tailed Hawk
Black-billed Cuckoo	Grasshopper Sparrow*	Red-winged Blackbird
Black-capped Chickadee	Gray Catbird	Ring-necked Pheasant
Blue Jay	Great Blue Heron*	Rock Dove
Bobolink	Great Crested Flycatcher	Rose-breasted Grosbeak
Brown Thrasher	Hairy Woodpecker	Savannah Sparrow
Brown-headed Cowbird	Horned Lark	Song Sparrow
Cedar Waxwing	House Finch	Tree Swallow
Chipping Sparrow	House Sparrow	Vesper Sparrow
Common Grackle	House Wren	Warbling Vireo
Common Yellowthroat	Indigo Bunting	Western Meadowlark*
Dickcissel*	Killdeer	Wild Turkey
Downy Woodpecker	Least Flycatcher	Willow Flycatcher
Eastern Kingbird	Mourning Dove	Yellow-shafted Flicker

* = *Species of Special Concern.* For more information, see www.mbr.nbs.gov/bbs/bbs.html

Frogs and Toads

Frogs and toads rely on a variety of habitats during their life cycles that range from upland forests to wetlands. The Wisconsin Frog and Toad survey was initiated in 1981 by the DNR to help determine the status and population trends of Wisconsin's 12 species of frogs and toads. Survey data are collected annually by cooperators who note the distinctive calls of each species along permanent roadside routes. It serves as an index to the relative abundance of frogs and toads throughout the state. Amphibians are particularly susceptible to environmental changes. As a result, these surveys can be very valuable for showing the impacts of land use changes.

Survey route #132 overlaps with part of the watershed and shows that 8 of the state's 12 species of frogs and toads are found are present (Table 8). Of those species, 5 show declining trends with a statistically significant decline for the Cope's gray tree frog and Eastern Gray Treefrog.

Table 8. Wisconsin Frog and Toad Survey Results for Route #132

Species	Population Trend
Chorus Frog	Stable
Spring Peeper	Declining
Leopard Frog	Declining
American Toad	Stable
Eastern Gray Treefrog	Declining*
Cope's Gray Treefrog	Declining*
Green Frog	Declining
Pickerel Frog	Unknown

Stable – Three population indices show both positive and negative trend.
Declining – All three population indices show negative trend.
Unknown – Individuals present on route but not enough data to develop population indices.
***** - One or more of the population indices were statistically significant when P=0.05.

For more information, see http://www.mbr-pwrc.usgs.gov/geotech/wisconsin/wieco.html

Fisheries Management

A variety of fish, as detailed in the Surface Water Section, are found in the waters of the Yahara River/Lake Kegonsa watershed. Through stocking, the Department of Natural Resources is able to maintain sport fisheries in areas where natural reproduction is not very strong. In the Yahara River/Lake Kegonsa Watershed, the Department has historically stocked walleye, musky, and northern pike. Due to the poor survival rate of musky, stocking was discontinued. Currently, walleye and northern pike are stocked as fingerlings typically every other year in Lake Kegonsa. Once the Pike reach 26 inches, they can be legally harvested from the Lake.

Northern Pike spawning takes place in flooded areas with emergent vegetation during late March to early April when the temperature is between 34 and 40ºF. Eggs are deposited on vegetation to which they adhere. Spawning habitat in Lake Kegonsa is limited by the heavily developed shoreline and natural reproduction is minimal. Much of the remaining shoreline is either sand, gravel, or a mixture of both. During spawning season, the pike travel north through the Yahara River to the Lower Mud Lake wetlands. The Door Creek wetlands can also provide excellent habitat for northern pike spawning if the wetlands can be protected and water levels can be maintained at an appropriate level for spawning activity. The DNR has hopes of acquiring land in this area to be set aside for the protection and promotion of the sport fishery of Lake Kegonsa.

Walleye spawn generally between mid-April and early May at water temperatures of 38-44ºF and reaches a peak when water temperatures are 42-50ºF. They prefer to broadcast their eggs over gravel substrate in an area of flowing water. Walleye, like northern pike, are known to spawn on the Yahara between Lakes Waubesa and Kegonsa particularly just below the Babcock Dam. This stretch along the Yahara River between Lakes Waubesa and Kegonsa is very sensitive and important for spawning.

In an effort to promote the fishery of Lake Kegonsa, fish cribs have been installed in Lake Kegonsa. Fish cribs are wooden structures located at various locations on the 11 foot to 15 foot contours of the lake, off of the weeds. These structures act to concentrate a variety of fish species (Conversation with Scot Stewart 2000m, personal communication).

In addition, fish managers have been looking at the impoundments on the Yahara River and the effect these impoundments have on fish movement and reproduction. DNR has recommended that fish passage be installed in the Dunkirk Dam. This passage would benefit the fish species in the stretch of the river from Dunkirk to Stoughton.

The vegetation in Lake Kegonsa is thick in some spots. Dense beds of Eurasian watermilfoil (*Myriophyllum spicatum*) grows in most of the shallow areas like Barber's Bay and the large littoral zone between Lund's Point and Nichol's Point. During recent electrofishing surveys Eurasian watermilfoil had been the dominant aquatic plant species; however, in scattered areas around the lake's perimeter expanding beds of sago pondweed *(Potamogeton pectinatus)*, wild celery (*Vallisneria americana)*, and curlyleaf pondweed (*Potamogeton crispus)* were observed.

One or two substantial fishkills a year are typical in the Yahara lakes. Fishkills usually result from the rapid heating of the water during the first hot spell of summer (Mike Vogelsang 2000, personal communication). An extreme temperature change stresses the fish, making them more susceptible to naturally occurring viruses and bacteria in the lake.

Endangered and Threatened Resources

The Wisconsin Natural Heritage Inventory documents endangered, threatened species and species of concern. See Table 9. It is illegal to take, transport, possess, process or sell any wild animal on the list without a permit. A valid permit is also necessary for processing, selling, cutting, destroying, or removing any plant on the list. Endangered species are in jeopardy of becoming extinct based on

scientific evidence and threatened species are likely to become endangered in the foreseeable future. Species of Concern could become threatened in time.

The loss and fragmentation of habitat are major threats to these species. The endangered species, Wild Hyacinth, the Prairie White-Fringed Orchid and the Barn Owl are native to rapidly disappearing habitats. Wild Hyacinth can be found growing in damp prairie soils but also along roadsides and railroad right-of-ways. The Prairie White Fringed Orchid is found in mesic prairies, especially on calcareous, rich, sandy or deep black soils, and sedge meadows. The Barn Owl is typically a grassland species but also hunts along wet meadows, lightly grazed pastures, hayfields and abandoned agriculture fields where their prey is most available. For more information regarding Endangered and Threatened species visit: http://www.dnr.state.wi.us/org/land/er/rare.htm

Table 9. Endangered Species in the Yahara/Kegonsa Watershed

Endangered	Threatened	Species of Concern	
Wild Hyacinth	Yellow Giant Hyssop	Richardson Sedge	Lake Sturgeon
Prairie White-Fringed Orchid	Pale-Purple Coneflower	Purple Meadow-Parsnip	Black-Crowned Night-Heron
Barn Owl	Small White Lady's Slipper	Innocence	Prairie Vole
	Prairie Indian Plantain	Prairie False-Dandelion	Lesser Fringed Gentian
	Wooly Milkweed	Sycamore	American Eel
	Snowy Campion	Earleaf Foxglove	
	Blandings Turtle		
	Prairie Milkweed		
	Sticky False-Asphodel		

Goals and Objectives for Wildlife and Endangered Resources
(from the Department's Fisheries, Wildlife and Habitat Management Plan for Wisconsin-2000)

Making People our Strength

- Develop data sharing agreements with local units of government involved in land use planning and help them apply the data to local decisions.
- Work with private landowners to develop cooperative agreements for stewardship of rare plants and animals on private lands.

Sustaining Ecosystems

- Screen proposed management actions for impact on state and federally listed species; develop improved tools for screening and managing rare species and natural communities.
- Identify and implement strategies to buffer the effects of rural residential development adjacent to critical habitat.
- Restore degraded wetland complexes on public and private lands to recapture ecosystem function and value and in certain areas enhance migratory waterfowl habitat.
- Manage, enhance and restore native prairie remnants as refugia for flora, fauna and ecological processes.
- Work with partners to restore degraded oak savanna on private land.
- Prevent, control where feasible, or contain priority non-native invasive plant species.

Outdoor Recreation

- Expand and optimize spring and fall turkey hunting opportunities while maintaining high hunt quality and hunter satisfaction and a strong safety record. Implement habitat management practices to meet objectives outlined in the wild turkey management plan. Management practices to benefit turkeys include: prairie ecosystem establishment and management, oak savanna establishment and management, and hunter education.
- Expand pheasant hunting opportunities while improving hunt quality and hunter satisfaction. Implement habitat management practices to meet objectives outline in the pheasant management plan. Management practices for pheasants include: prairie ecosystem establishment and management, grassland CRP expansion and implementation and wetland preservation and restoration.
- Continue to implement the objectives of the Upper Mississippi River and Great Lakes Joint Venture including cooperation with the "all bird objectives". This will be done by restoring and enhancing wetlands and upland cover important for ducks and other bird species. The key to our success will be working through partners to achieve the Joint Venture goals.
- Continue to improve our Canada goose harvest management procedures to ensure we offer our hunters a simple system that meets scientific and management needs. We will continue to work with local governments and individuals to address the problems they are having with injurious Canada geese.
- We will continue aggressive harvest management strategies to lower the size of the deer population in deer management units 76, 76M, and 77A.
- All public schools in the watershed will receive at least one copy of a fish and wildlife education package and field trip guide to promote outdoor skills, ethics and habitat-related messages each year. The goal of this project is to increase 3rd through 5th grade student and teacher understanding and appreciation of Wisconsin fish, wildlife and other natural resources.

PUBLIC LANDS AND RECREATION IN THE WATERSHED

In addition to agricultural and developed land, this watershed also contains many publicly owned lands that are open to the public for a variety of recreational uses such as fishing, hunting, camping, hiking, boating, birdwatching picnicking and biking. Figure 6, Public Land and Recreation in the Watershed shows where the major public lands are located.

State Owned Land

Lower Mud Lake State Fishery Area

The Lower Mud Lake State Fishery Area is located on the east and southwest side of Lower Mud Lake. Over 400 acres provide opportunities for the preservation and restoration of natural resources and water quality, of which, approximately 300 acres are owned by the state. The Lower Mud Lake Resource Protection Project Plan was approved in November 1993. The objectives of the plan are to preserve wetlands, floodplain, springs and related features to protect water quality along the Yahara chain of lakes, provide and protect natural habitat for fish, waterfowl and wildlife and to preserve archeological and historic resource sites. Public hunting is allowed on state owned lands. Access is available at Babcock Park, Fish Camp Launch, McFarland Parks and off of Hidden Farm Rd.

Figure 6. Public Land and Recreation in the Watershed Map

Lake Kegonsa Rough Fish Station

This 19.8 acre area on the northwest side of Lake Kegonsa was formerly used as a carp collection station. Today, the land is used by the county as Fish Camp Launch Park. Access is gained from Fish Camp Rd. Hunting is not allowed.

Lake Kegonsa State Park

Lake Kegonsa State Park, established in 1962, is one of 48 parks and recreation areas in the Wisconsin State Park systems. Lake Kegonsa State Park consists of 343 acres on the east edge of Lake Kegonsa. Recreational activities at Lake Kegonsa State Park include camping, swimming, skiing, boating, hiking and fishing. There are 80 wooded campsites at the park. These sites do not have electrical hook-ups but can accommodate both campers and tents. There are shower and toilet facilities at the campground. The park has 7 picnic areas with nearly 150 picnic tables, 28 grills, and two shelters. The park has a boat landing and over 400 parking stalls. Roughly 50 stalls are available for boat trailers. There are close to 7 miles of hiking trails, 4 miles of these trails are groomed ski trails in the winter. The park accommodates year round fishing. Food service is available at the park. The park has a master plan that is available to the public. Access is gained at 2405 Door Creek Road in Stoughton, Wisconsin. For more information, call (608) 873-9695 or check out their website http://www.dnr.state.wi.us/org/land/parks/.

Extensive Wildlife Habitat Program (EWHP)

The goal of the Extensive Wildlife Habitat Program was to sustain populations of important wildlife species by protecting or enhancing critical habitat types primarily for pheasants and ducks. The department has control of less than 10% of the total land within the managed area. There are three EWHP parcels in the Town of Pleasant Springs portion of the watershed. Their combined acreage equals 155.61 acres. The largest parcel is 75 acres and is located east of Lake Kegonsa and the Yahara River, west of Highway N, south of Pleasant Street and north of Highway B. The next largest parcel, approximately 63 acres in size, is located east of Highway N, west of Highway BN, south of Interstate 90 and north of Koshkonong Rd. The smallest wildlife area is adjacent to Door Creek on the west, north of Highway MN, south of Siggelkow Rd and west of Vilas Rd. In the Town of Dunn, a 118.7 acre EWHP is adjacent to Lake Kegonsa Rd. The parcel is south and west of Highway 51. Two small federally owned parcels are also adjacent to this state-owned land. One small 9 acre EWHP is located in the Town of Dunkirk to the east of and adjacent to Spring Rd. and north of Highway 138. In the Town of Fulton, a 21 acre EWHP is located on the north east corner of the community of Fulton. The parcel is north of and adjacent to Highway M and the Yahara River, west of Staff Rd., and south of Pomeroy Rd. The program has been superseded by the Habitat Restoration Area concept due to the determination that larger areas with a mix of habitats are superior to small, scattered habitat acquisition efforts.

Scattered Wildlife Areas

The Scattered Wildlife program was initially known as the Scattered Wetlands program and was created to enable the DNR to purchase wetlands with high wildlife values. Within the Town of Dunn, there are two scattered wildlife areas within the boundaries of the watershed. A small, 7.32 scattered wildlife area is located south of Schneider Rd., north of Halverson Rd., west of Highway 51 and east of Greene Rd. Another scattered wildlife area is located near the Mud Lake Resource Protection Area. It is 10 acres in size and is adjacent and north of Keenan's Creek, west and south of Highway 51, and east of Keenan Rd. This program was first supplanted by the EWHP program, and more recently by the Habitat Areas program.

Statewide Small Lake Creation

In the Town of Dunkirk, the state owns a 60.09 acre parcel designated for statewide small lake creation. The parcel is located near the Dunkirk Dam, adjacent to and west of Oak Lawn Rd., west of Highway 138 and north of Hauge Rd. This program was established in the 1960's so that the Department could acquire sites where small lakes would be created, primarily by impounding streams. This program has not been active for many years.

County Owned Land

Babcock Prairie Park

The Babcock County Park, named for Stephen Babcock, internationally known Wisconsin dairy scientist, is located on the east side of Lake Waubesa where the Yahara River flows from the lake toward Lower Mud Lake. This 40 acre park is accessible to people with disabilities and offers picnic shelters, a campground, a boat launch and a boat lagoon for smooth launching on windy days. The boat launch offers a fish cleaning facility, and accessible fishing pier. The park also offers a canoe launch location and a play area. Babcock Prairie Park has a 25 unit campground with electricity, shower and bathroom facilities, and a dumping station. The park is located near the Village of McFarland on USH 151. For more information, call (608) 242-4576, or visit their website at http://www.co.dane.wi.us/parks/parkhome.htm.

Fish Camp Launch

This 19-acre site is located in Dane County on the northwest end of Lake Kegonsa at the inlet of the Yahara River. The park provides a picnic area, hiking trail, fishing, boating and canoeing, and facilities for people with disabilities. It offers one of the best boat launch sites at the mouth of the Yahara River on Lake Kegonsa with its protected launching area and large car-trailer parking lot. The launch area was renovated in 1995-96 by installing new launch piers, bathrooms and fish cleaning facility and parking area. A picnic area along the lakeshore provides a pleasant area for family outings and shoreline fishing with fully accessible fishing piers. A new canoe launch has also been installed on the Yahara River. This area is located at the end of Fish Camp Road off CTH AB, approximately one-mile northeast of the intersection of USH 51 and CTH AB. For more information, call (608) 242-4576, or visit their website at http://www.co.dane.wi.us/parks/parkhome.htm.

LaFollette Park

Located on the east shore of Lake Kegonsa at the outlet of the Yahara River, LaFollette Park is best known for its wayside picnic areas, shelter, play area and shore fishing at the locks and dam. Canoes can be launched at the north end of the park below the locks and dam. This 34.75 acre park is located just southeast of Lake Kegonsa State Park. It can be reached from USH 51 by traveling east on CTH B for one and one-half miles and turning north on Williams Drive. For more information, call (608) 242-4576, or visit their website at http://www.co.dane.wi.us/parks/parkhome.htm.

Viking Park

The Yahara River winds through Viking Park, separating the park from the surrounding countryside. The 100 acres of Viking Park offers a small picnic shelter, a nature trail, dog exercise area, a canoe launch and is ideal for family outings. The park lagoons offer shoreline fishing, The park can be reached by driving south on USH 51, then on CTH B to CTH N. For more information, call (608) 242-4576, or visit their website at http://www.co.dane.wi.us/parks/parkhome.htm.

Gibbs Lake Park

Gibbs Lake Park is the largest county park in Rock County. The park surrounds two-thirds of the Lake's east and south shores and is approximately 285 acres. The park offers a picnic area, hiking, fishing, canoeing and has a boat landing for boating access. The largest section of the park is located south of Gibbs Lake Rd., west of Eagle Rd., and north of Wheeler Rd.

Town and City Parks

Town of Dunn

Dunn has both a park and a natural area in the watershed. Rock Elm Park is located on Mallard Drive off of Barber Drive on the southwestern shore of Lake Kegonsa. The park is a 0.8 acre neighborhood park. On May 20, 2000, the park hosted its third annual all species "Fish for Fund" fishing tournament with the Madison B.A.S.S. club to raise money for parks in the Town of Dunn. The Colladay Point Stormwater Lot is on Colladay Point on the western shore of Lake Kegonsa between Colladay Point Drive, Zor Court and Hwy 51. The 7.3 acre area is used for water drainage but is also a candidate for park development.

Stoughton City Parks

Stoughton is home to 14 city parks. Five of these fourteen lie in close proximity to the Yahara River as it winds its way through Stoughton. Although not large in size, these parks offer a variety of recreational uses from baseball and basketball, to playground equipment and fishing. Fishing can be done at the following parks:

- Division Street Park, Division Street
- Dunkirk Avenue Park, Dunkirk Avenue
- Mandt Park, South Fourth Street and Mandt Park Drive
- Riverside Drive Park, Riverside Drive
- Veterans' Memorial Park, South Page Street and Riverside Drive

Mandt Park, the largest of the city parks, is approximately 30 acres in size and offers a variety of recreational activities including baseball, basketball, hand swing, horseshoes, ice skating, fishing and swimming. The park also offers grills and a concession stand. For more information on this and any of the Stoughton city parks, visit their website at www.danenet.wicip.org/stoughton

Camping in the Watershed

Lake Kegonsa State Park

There are 80 wooded campsites at the park. These sites do not have electrical hook-ups but can accommodate both campers and tents. There are shower and toilet facilities at the campground. The park is located at 2405 Door Creek Road in Stoughton. For more information call 608/873-9695

Babcock County Park

Babcock County Park has a 25 unit campground with electricity, shower and bathroom facilities, and a dumping station. The park is located on the east side of Lake Waubesa near McFarland on USH 151 where the Yahara River flows from the lake toward Lower Mud Lake. For more information, call (608) 242-4576

Kamp Kegonsa (Private)

Kamp Kegonsa is a privately owned campground with 90 large grassy sites, 66 with electricity. The campground has a dump station, pay showers, a public phone, wood and groceries. The grounds have a swimming beach, playground, horseshoes, fishing and paddleboat. Kamp Kegonsa is located at 2671 Circle Dr., in Stoughton. For more information, call (608) 873-5800.

Viking Village Campground & Resort, Inc. (Private)

This campground has 77 sites, 6 without electrical hookups. The campground offers offsite storage, laundry, dump station, showers, public phones, wood, and restaurant. The grounds offer a swimming pool, playground, ball diamond, mini golf, horseshoes, volleyball, basketball, game room and pavilion. Fishing, golfing and boating opportunities are nearby. The camp is located at 1648 County Trunk N in Stoughton. For more information, call (608) 873-6601.

Recreation

The Yahara/Kegonsa watershed has opportunities for many types of recreation ranging from biking, horseback riding, hiking to canoeing, boating, hunting and fishing. Hunting is allowed on DNR land in the Lower Mud Lake Resource Area and the Door Creek Resource Area. Walk-in access is available to both areas but without official parking areas. Door Creek Resource Area can be reached from Hidden Farm Road off of Elvehjem Road.

Land Trails

Several land trails are available for hiking, biking, skiing, snowmobiling, walking, and horseback riding (Table 10). For a scenic drive, Rustic Road 20 is also located between Lower Mud Lake and Lake Kegonsa. Dane County Parks and Open Space Plan 2000 also recommends land trails between Fish Camp Park and Lake Kegonsa State Park to link trails along the north shoreline of Lake Kegonsa and through the Door Creek Resource Area. This plan also recommends developing a trail from LaFollette County Park to Stoughton and Viking County Park.

Table 10. **Land Trails**

Name of Trail	Recreation	Location	Contact	Notes
Ice Age Trail	H	Cottage Grove	1-800-227-0046	Federal and state
Glacial-Drumlin Trail	B, H, S, SN	Cottage Grove	(920) 648-8774 / (414) 646-3025	Cottage Grove to Waukesha
7 trails	H, S	Lake Kegonsa State Park	(608) 873-9695	(see Park Description,)
River Trail	B, H, S	Stoughton Industrial Park	(608) 873-6746	Connects to Viking Park
Virgin Lake Trail	N	Virgin Lake Park	(608) 873-6746	
Lowell Trail	B	Lowell Park	(608) 873-6746	
Schefelker Trail	B	Schefelker Park	(608) 873-6746	
2 trails	H, BR	Gibbs Lake Park	(608) 757-5450	7.4 miles total

*H – Hiking trail; B – Biking trail; S – Skiing trail; SN – Snowmobiling trail; N – Nature trail; BR – Bridal trail (horse)

Water Trails

The Yahara River is relatively pristine and undeveloped on the stretch below Lake Kegonsa to its confluence with the Rock River and provides excellent canoeing and kayaking with a moderate current. Most of the waterbodies in the watershed have established access points such as boat launches or parks. They may also be accessed by foot at road crossings although parking is generally not available and also by connected waterbodies. Waterbodies without boat or canoe launches but may be accessed by water or at road crossings include: Keenan Creek, Door Creek, Leuten Creek and Door Creek. Dane County Parks and Open Space Plan 2000 recommends water trail development from Babcock Park to Fish Camp Park along the Yahara and for LaFollette County Park to Viking County Park also along the Yahara River.

Table 11. Summary of Boat Launches and Water Access Points in the Watershed

Access to Waterbody	Location of Access	Type of Access	Ownership
Yahara River	Babcock County Park	Boat Launch/Canoe	County
Yahara River	McFarland parks	Canoe	Village
Yahara River	Viking County Park	Canoe	County
Lower Mud Lake	Town of Dunn	Boat Launch (walk-in)	Town
Lower Mud Lake	McFarland Parks	Boat Launch (motorless)	Village
Lower Mud Lake	Fishery Area	Walk-in	State
Lake Kegonsa	Fish Camp Launch	Boat Launch/Canoe	County
Lake Kegonsa	Lake Kegonsa State Park	Boat Launch	State
Lake Kegonsa	Sunnyside	Boat Launch	Private
Lake Kegonsa	LaFollette County Park	Canoe	County
Lake Kegonsa	Town of Pleasant Springs	Boat Launch	Town
Lake Kegonsa	Kegonsa Cove	Boat Launch	Private
Lake Kegonsa	Quams Marina	Boat Launch	Private
Lake Kegonsa	Town of Dunn	Boat Launch	State
Lake Kegonsa	Town of Dunn	Canoe (dead-end road)	Town
Gibbs Lake	Gibbs Lake County Park	Boat Launch	County
Little Gibbs Lake	County land	Walk-in	County

PARTNERS, OUTREACH AND SPECIAL LOCAL INITIATIVES

Federal, State, and Local Partners

- *Natural Resources Conservation Service*

The Natural Resources Conservation Service, a part of the USDA, is the federal agency that works with landowners on private lands to conserve natural resources. Nearly three-fourths of the technical assistance provided by the agency goes to helping farmers and ranchers develop conservation systems uniquely suited to their land and individual ways of doing business. The agency also provides assistance to other private landowners and rural and urban communities to reduce erosion, conserve and protect water, and solve other resource problems.

J.B. Martin, Dane County Conservationist
Madison Service Center
Telephone (608) 224-3750

Roger Allan, Rock County Conservationist
Janesville Service Center
Telephone (608) 754-6617

- *Wisconsin Department of Natural Resources*

The Wisconsin Department of Natural Resources is the state agency charged with protecting Wisconsin's air, land, water, wildlife, fish and forests. The DNR promotes open and collaborative relationships with local groups and individuals interested in the state's natural resources.

Ken Johnson, Lower Rock River Water Leader
3911 Fish Hatchery Road
Fitchburg, WI 53711
Telephone (608) 275-3243
Fax (608) 275-3338

Tim Galvin, Rock River Land Leader
N7725 Highway 28
Horicon, WI 53032
Phone: (920) 387-7875
Fax: (920) 387-7888

- *The Dane County Regional Planning Commission*

Created in 1968 by an executive order of the Governor, as provided by state enabling legislation (66.945), the 13-member Commission represents 61 local units of government in Dane County. The Vision 2020 *Dane County Land Use and Transportation Plan*, prepared and adopted by the Commission, provides a broad, general framework plan for development of Dane County. It establishes policies that guide public and private actions. It delineates where urban development should take place, where farmlands should be preserved, and where environmental resources should be protected. In 1975, the Governor designated the RPC as the water quality planning agency for Dane County. The Dane County *Water Quality Plan* is a comprehensive, areawide plan that assesses water pollution problems, sources and solutions. It is the foundation for all activities relating to water quality protection and improvement.

William N. Lane, Acting Executive Director
217 S. Hamilton St. Suite 403
Madison, WI 53703-3266
Telephone (608) 266-4137
Fax (608) 266-9117

- *Dane County Land Conservation Department*

Their goal is to provide conservation planning assistance and technical service in the area of soil and water conservation to landowners, land users, and decision-makers of Dane County, Wisconsin.

Kevin F. Connors, County Conservationist
1 Fen Oak Court, Room 208
Madison, Wisconsin 53718
Telephone (608) 224-3730
FAX (608) 224-3745

Rock County Land Conservation Department
Tom Sweeney, County Conservationist
440 Hwy 14 E.
Janesville, WI
Telephone (608) 757-2187

Private Partners and Non-Profits

- *Rock River Coalition*

The Rock River Coalition is a non profit volunteer organization, established in 1994 to encourage cooperation among communities, organizations and individuals for the purpose of improving environmental, recreational, cultural and economic conditions in the Rock River Basin.

Warren Topel, President
Rock River Coalition, Inc.
P.O. Box 141
Watertown, WI 53094
Telephone (262) 593-8099

- *Dane County Natural Heritage Foundation*

The Dane County Natural Heritage Foundation was established in 1983. The board, staff and volunteers work with private landowners and public agencies to preserve lakeshores, wetlands, springs, woodlands and prairies in the Dane County area. These protected areas benefit all of us by providing plant and wildlife habitat, clean water and open space that adds beauty to our landscape. http://www.dcnhf.org/index.html.

John Hutchinson, President
Dane County Natural Heritage Foundation
303 S. Paterson Street, Ste. 6
Madison, WI 53703
Telephone (608) 258-9797

- *River Alliance of Wisconsin*

The River Alliance of Wisconsin is a statewide non-profit, non-partisan citizen advocacy organization for river protection and restoration. Current program priorities are: to help local citizens restore free-flowing rivers through community education and small dam removal; minimize the environmental impacts of hydropower facilities and increase recreational opportunities; strengthen local grassroots river and watershed protection efforts, and advocate for rivers at state regulatory agencies and in the Wisconsin Legislature. http://www.wisconsinrivers.org.

Todd Ambs, Executive Director
122 State St., Suite 202
Madison, WI 53703-2500
Telephone (608) 257-2424
FAX (608) 260-9799
Email: wisrivers@wisconsinrivers.org

- *Friends of Lake Kegonsa Society*

The Friends of Lake Kegonsa is a local citizen based organization, which promotes improved water quality in Lake Kegonsa. They received two Lake Planning Grants from the DNR to study the Door Creek Wetlands and methods to improve water quality in Door Creek.

Ray Potempa
3411 Stony Crest Dr.
McFarland, WI 53558
Telephone: 608-838-9329

- *Wisconsin Association of Lakes*

Jim Burgess
P.O. Box 55060
Madison, WI 53719

- *Yahara Fishing Club*

The Yahara Fishing Club has been promoting and protecting fishing rights and responsibilities since 1946. It is dedicated to fishing activities, conservation, social activities, and education. http://danenet.wicip.org/yafish/yfcindex.htm.

Jerry Paffenroth
President
P.O. Box 3271
Madison, WI 53704

Watershed Education and Outreach

- *Basin Educator*

The basin educator program is funded by the University of Wisconsin-Extension; the Wisconsin Department of Natural Resources and the National Resources Conservation Service (NRCS). The role of the educators will be to work with local advisory committees to develop a basin-wide education strategy; coordinate educational efforts of UW-Extension and other state agencies; and facilitate team building with NRCS and Land Conservation committee work groups and DNR basin partner teams.

Suzanne Wade
Basin Educator, Rock River Basin
864 Collins Road
Jefferson, WI 53549
Phone: (920) 674-7295
FAX: (920) 674-7200
Email: suzanne.wade@ces.uwex.edu

APPENDIX A1: STREAMS TABLE

Stream Name	WBIC	County	Length (Miles)	Existing Use (Miles)	Potential Use (Miles)	Supporting Potential Use (Miles)	Current Codified Use	303(d) Status	Use Impairment		Data Assess-ment	Data Level	Trend	References
									Source	Impact				
Door Creek	0802800	Dane	13	WWFF/13	WWSF/13	Not/13	LFF	N	HM, CL, NPS, URB, DEV	HAB, TURB, FLOW, TEMP, SED, MIG	M	B3 H2 C1	D	10, 12, 17, 23, 78
Gibbs Creek	0798800	Rock	4	WWFF/4	Same	Part	WWSF*	N	CL, SB, BY, HM	HAB, TURB, DO, TEMP, NUT, SED	M	B3 H2 C1	S	4, 78
Keenen Creek	0803500	Dane	2	WWFF/2	WWSF (seasonal)	Part	WWSF*	N	HM, BY, PSB, CL, NPS	SED, MIG, HAB, DO, TEMP, NUT	M	B2 H1	S	10, 12, 17, 23, 78
Leuten Creek	0802300	Dane	3	LFF/3	Same	Part	WWSF*	N	HM, CL, NPS	HAB, TURB, SED, TEMP, DO	M	B2 H1	S	10, 12, 23, 78
Little Door Creek	0802900	Dane	5	LFF/5	Same	Part	WWSF*	N	HM, NPS	HAB, TURB, TEMP, DO	M	B3 H2 C1	S	10, 17, 23
Yahara River	0798300	Dane Rock	23	WWSF/23	Same	Part - Thr	WWSF*	Y	HM, NPS, CE, URB, PSM, DEV, CL, BY	FLOW, HAB, MIG, TURB, DO, SED	M	B4 H4 C4	I	1, 4, 6, 10, 11, 12, 17, 78
9 Unnamed Streams		--	24	--	--	--	--	--	--	--	--	--	--	--

APPENDIX A2: LAKES TABLE

Lake Name	County	Township, Range, Section	WBIC	Water shed	Surface Area (Acres)	Max Depth (ft)	Mean Depth (ft)	Lake Type	Winter kill	Acc-ess	SH	Hg	Mac	LMO	TSI	TSI Class	Lake Plan Prot	P Sens	Comments	
																			Source	Impact
Dunkirk Millpond	Dane	T05NR11ES21	0801800	LR06	--	--	--	--	--	--	--	GA	EM	Y	--	EU	--	--	--	--
Gibbs Lake (Big Springs)	Rock	T04NR11ES27	0799200	LR06	71	23	--	DG	Y	BR	R	GA	EM	--	50*	EU	--	I Ins	HM, NPS, CL,	SED, NUT, ALG, MAC, HAB
Lake Kegonsa	Dane	T06NR11ES20	0802600	LR06	3,209	31	17	DG	N	♿ BR	X	GA	EM	Y	58***	EU	PLAN	II B	NPS	NUT, SED, ALG, HAB, TURB
Little Gibbs Lake	Rock	T04NR11ES27	0799300	LR06	18	18	--	SE	N	--	--	GA	EM	--	--	--	--	--	NPS	NUT, ACC
Lower Mud Lake	Dane	T06NR10ES11	0803400	LR06	195	15	--	DG	N	W	--	GA	EM	--	--	EU	PLAN PROT	II B	NPS, URB	NUT, SED
Stoughten Millpond	Dane	T05NR11ES08	0802000	LR06	82	5	--	DG	Y	BR	--	GA	EM	--	--	EU	--	II Ins	NPS, URB	HAB, NUT, TURB, ALG
Virgin Lake	Dane	T05NR11ES06	776850	LR06	10	--	--	SE	--	T	--	GA	--	--	--	--	--	--	--	--
2 Unnamed Lakes	Dane	T05NR11ES25 T05NR11ES36	--	LR06	5	--	--	SE	Y	--	--	GA	--	--	--	--	--	--	--	--

APPENDIX B: STREAMS TABLE GUIDANCE

The following information is included in the stream tables. Unknowns in the tables indicate that we have insufficient data to assess the given stream(s). In the future we hope to provide data on these unassessed waterbodies.

Name of Stream: All named streams and some unnamed streams are listed. Stream names are those found on U.S. Geological Survey (USGS) quadrangle maps unless the Wisconsin Geographic Names Council has established a different name. Streams in parentheses indicate a local name for the stream. Unnamed streams are identified by location of the stream mouth as indicated by township, range, and section.

Waterbody Identification Code (WBIC): All waterbodies have been assigned a waterbody identification code by the state to help in identifying streams and stream locations.

Length: The stream length is either the total length of the stream, or the starting and ending mile of the portion of the stream with a specific classification or biological use. The stream mile at the stream mouth is zero ("0") and increases as one moves upstream.

Existing Use: This column indicates the biological use that the stream or stream segment currently supports. This is not a designation or classification; it is based on the current condition of the surface water and the biological community living in that surface water. Information in this column is not designed for, and should not be used for, regulatory purposes. A "U" indicates that the existing use is unknown.

The existing uses are taken from the biological use categories listed below. These categories are defined in NR102(04)(3) under fish and aquatic life uses, and are the same categories used to describe the stream's codified use. A cold water community that supports trout may be indicated by a trout class (I, II, or III) based on the document, *Wisconsin Trout Streams* (DNR Publ. 6-3600[80]). This publication is currently being revised. As a result, some of the stream segments have a different use than that listed in this document.

Existing use is determined through recent surveys and/or through the professional judgement of DNR Personnel. The approximate length or portion of the stream meeting each of the use classes is indicated in the "Length" column.

- **COLD** Cold Water Community; includes surface waters that are capable of supporting a community of cold water fish and other aquatic life or that serve as a spawning area for cold water fish species.

- **COLD I** high-quality stream where populations are sustained by natural reproduction.

- **COLD II** stream has some natural reproduction but may need stocking to maintain a desirable fishery;

- **COLD III** stream has no natural reproduction and requires annual stocking of legal-size fish to provide sport fishing.

- **WWSF** Warm Water Sport Fish Communities; includes waters capable of supporting a community of warm water sport fish or serving as a spawning area for warm water sport fish.

- **WWFF** Warm Water Forage Fish Communities; includes surface waters capable of supporting an abundant, diverse community of forage fish and other aquatic life.

- **LFF** Limited Forage Fishery (intermediate surface waters); includes surface waters of limited capacity due to low flow, naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of tolerant forage fish and aquatic life.

- **LAL** Limited Aquatic Life (marginal surface waters); includes surface waters severely limited because of low flow and naturally poor water quality or poor habitat. These surface waters are capable of supporting only a limited community of aquatic life.

Potential (Attainable) Use: This column indicates the biological use that the investigator believes the stream or stream segment could achieve through proper management of "controllable" pollution sources. Beaver dams, hydroelectric dams, low gradient streams, and naturally occurring low flows are generally not problems that can be controlled.

The potential use may be the same as the existing use or it may be higher. Abbreviations for "potential use" are the same as those used in the "existing use" column. Unless otherwise noted, the source for trout streams was *Wisconsin Trout Streams* (DNR Publ. 6-3600[80]), Wis. Adm. Code NR102.10 and NR102.11, and the professional judgment of DNR personnel. In this column, the letter "U" indicates that the potential biological use is unassessed.

Supporting Potential Use: This column indicates whether a stream is threatened, or is fully, partially, or not meeting its potential biological use. An entry in this column shows the relationship between the stream's current and potential biological use. In this column, the letter "U" indicates that the potential biological use is unassessed.

- **Fully Supporting "Full"**
  A stream or stream segment's existing biological use is the same as its potential biological use (E = P). This includes stream or stream segments that are *not affected* and stream or stream segments that have *culturally irreversible* impacts. An example of culturally irreversible impacts are those effects in a river system with an "optimally operating" dam--a dam that operates with minimal to no effect on the fish and aquatic life community assemblage, productivity, and diversity. Note that fairly to poorly operating dams are not considered "culturally irreversible" and their effect on biological resources is factored into the use support designation (see partially supporting).

- **Fully Supporting/Threatened "Full-Thr"**
  A stream or stream segment's existing biological use is the same as its potential biological use (E = P), but there is a *clear and imminent* "threat" to the existing use remaining at its current level of biological productivity and ecological health. This threat could be due to actions likely to occur on or to the stream and/or in the watershed, such as:
  1. Rapid commercial, residential, and/or industrial development in the watershed,
  2. The advent of large-scale industrial operations in the watershed,

3. Planned or active channel modifications that have been, or will be permitted, or cannot be regulated under existing state or federal rules (i.e., drainage districts).

- **Partially Supporting "Part"**
  A stream or stream segment's existing biological use is the same as its potential biological use, except that implementation of management practices could enhance the overall ecological health of the biological community. Management practices in this category include modification of hydro-regimes to reduce the impact of dam operations on the biological community.
  Thus, E = P, but the potential use assessment is below the stream or stream segment's maximum biological potential and this "less than optimal" condition is reversible.

- **Not Supporting "Not"**
  When a stream or stream segment's existing biological use is less than its potential biological use by a factor of 1 or more of the following codified use classifications: WWSF, WWFF, LFF, LAL, and Cold (includes Cold I, II, and III in one group). Thus, E < P, with problems considered reversible by implementation of management actions.

Codified Use: This is the waterbody's classification that is formally and legally recognized by NR102 and 104, Wis. Adm. Code. This column shows the classification that will be used to determine water quality criteria and effluent limits. A stream can obtain a codified use by applying formal stream classification procedures, which are undergoing revision in 1996. This column's abbreviations will follow the same used under Existing Use. Classifications in this column are derived from:

1. Streams classified and listed in NR102 and NR104.
2. Streams formally classified during the WPDES permitting process. These streams are surveyed and classified to provide the basis for the permit's effluent discharge limitations.
3. Trout streams as defined by *Wisconsin Trout Streams* (1980) and listed in NR 104.
4. 4. ORW and ERW streams officially approved as such by the DNR board and listed in NR102.10 and NR102.11. Officially, ORW/ERW waterbodies are not fish and aquatic life use designations but are a separate category for the DNR antidegradation program. These waterbodies also receive a fish and aquatic life use classification for the purpose of determining water quality criteria and/or effluent discharge limitations. See description of ORW and ERW below.

- **Outstanding Resource Waters**, have excellent water quality and high-quality fisheries. They do not receive wastewater discharges; these point source discharges will not be allowed in the future unless the quality of such discharges meets or exceeds the quality of the receiving water. This classification includes national and state wild and scenic rivers and the highest quality Class I trout streams.

- **Exceptional Resource Waters** have excellent water quality and valued fisheries but may already receive wastewater discharges or may receive future discharges necessary to correct environmental or public health problems. All COLD I streams are ERW's, but not all ERW's are COLD I streams.

- **WWSF*** Streams that have not been formerly classified are identified here as Warm Water Sport Fishery by default. These streams are assumed to meet the Federal Clean Water Act goals of supporting recreation and aquatic life.

303(d) Status: This column states whether a stream or stream segment is currently on the 303(d) list of impaired waterbodies or should be added to the list. Streams or segments on this list have failed to meet one or more water quality standards are considered "impaired."

Use Impairments – Sources and Impacts: This column indicates probable sources of pollution in the stream and types of water quality problems present (impact). Often more detail is provided in the narrative. The following is a key to abbreviations in the stream tables:

Source (cause of problem). This is the source of threat or impairment

BDAM - Beaver dam

BY - Barnyard or exercise lot runoff

CE - Construction site erosion

CL - Cropland erosion

DEV - Intense development pressure

DRDG - Dredging

EX - Introduced species

HM - Hydrological modification (dam, ditching, wetland drainage)

LF – Landfill leaching

NPS - Unspecified nonpoint sources

PSB - Streambank pasturing

PSI - Point source, industrial discharge

PSM - municipal treatment plant discharge point

PWL - Woodlot pasturing

RS - Roadside erosion

SB - Streambank erosion

URB - Urban storm water runoff

DD – Drainage district

Impact (effect or impact of source on a stream) Variously known as the cause, impact or stressor, this column lists the effect on the stream as a result of the source.

BAC - Bacteriological contamination

COM - Competition (i.e, encroachment by introduced species)

DO - Dissolved oxygen

FKILL – Fish Kill

FLOW - Stream flow fluctuations caused by unnatural conditions

HAB - Habitat (in-stream sedimentation, scouring, etc.)

MAC - Undesirable rooted aquatic plant (macrophyte) or algal growth

MIG - Fish migration interference

NUT - Nutrient enrichment

PCB - PCB bioaccumulation

SED - Sediment

TEMP - Temperature (fluctuations or extreme high or low)

TOX - General toxicity problems

TURB – Turbidity

Data Assessment: This column states generally whether a stream has been assessed. It does not specify which stream segments have been monitored or evaluated. The terms *monitored, evaluated or unassessed* are defined as the following:

- **Monitored:** A stream has been "monitored" for the purposes of Wisconsin water quality management plans and/or Wisconsin's Water Quality Assessment Report to Congress (305[b]). This data is site-specific data collected in the past five years and is used to determine the quality or integrity of the resource.

- **Evaluated:** A stream has been "evaluated" if information other than site-specific data has been collected. Sources of "evaluated" information may include:
    1. Site-specific data that is more than five years old,
    2. Information on file provided by the public or others,
    3. Best professional judgment of a DNR biologist or a DNR fish manager.

- **Unassessed:** A stream has been not been assessed.

Data Level: In this column, indicate what level of data was used to make your decisions on this stream/segment. Ideally, the number is a composite of physical, chemical, biological and habitat data. Generalized for entire stream

Bioassessments:

- **BI**: Visual observations of biota, limited monitoring and extrapolations from other sites – unknown or low precision and sensitivity – professional biologist not required.
- **B2**: One assemblage required with reference conditions of available, biotic index or narrative evaluation of historical records; limited to single sampling and site specific studies; low to moderate precision and sensitivity, professional biologist may provide oversight.
- **B3**: Single assemblage, reference condition preferred; biotic index used or supplemented by historical records. Monitoring targeted sites during a single season; may be site specific study but may include spatial coverage for watershed level assessments. Moderate precision and sensitivity; professional biologist performs survey or training for sampling and assessment.
- **B4**: generally two assemblages, may be one if data quality high. Regional reference conditions use; biotic index used. Monitoring over 1 –2 sampling seasons; broad coverage of sites for site specific or watershed specific assessments; use of probabilistic design. High precision and sensitivity; professional biologist surveys and assesses.

Habitat:

- **H1**: Visual observation of habitat characteristics; no true assessment; documentation or readily discernible land use characteristics that might alter habitat quality, no reference conditions.
- **H2**: Visual observation of habitat characteristics and simple assessment; use of land use maps for characterizing watershed condition; reference condition preestablished by professional scientist.
- **H3**: Visual-based habitat assessment using SOPs; may be supplemented with quantitative measurements of selected parameters; conducted with bioassessment; data on land use compiled and used to supplement assessment; reference condition used as a basis for assessment.
- **H4**: Assessment of habitat based on quantitative measurements of instream parameters, channel morphology, and floodplain characteristrics; conducted with bioassessment; data on land use compiled and used to supplement assessment; reference condition used as a basis for assessment.

Toxicological Approaches:

- **T1**: Any one of the following: Acute or chronic WET, Acute ambient, or acute sediment
- **T2**: Any of the following: Acute or chronic ambient, acute sediment, acute and chronic WET for effluent dominated stream
- **T3**: Chronic ambient or acute or chronic sediment, acute and chronic WET for effluent dominated stream
- **T4**: Both of the following: acute and chronic ambient and acute or chronic sediment

Physical/Chemical

- **C1**: any one of the following: water quality with grab sample or water data extrapolated from upstream or downstream, monitoring data more than five years old, BPJ based on land use data, etc.
- **C2**: Any one of the following: water quality with grab sample or rotating basin surveys with multiple visits or automatic sampling synthesis of existing or historical info on fish contaminant levels, screening models based on loading data (not calibrated or verified)
- **C3**: Any one of the following, composite or a series of grab water samples (diurnal coverage as appropriate), calibrated models
- **C4**: All of the following: water quality monitoring used composite or series of grabs, limited sediment quality samples and fish tissue analyses at sites with high probability of contamination

Trend: This column can be based upon best professional judgment, or by comparing data from past plans to find that a waterbody has improved over previous assessments, or declined. This decline/improvement should not be the result of gaining data, but a relative assessment of changes occurring on the waterbody. The stream may be improving (I), stable (S), declining (D) or unknown (U).

References: The reference material used to complete the table for each stream is indicated by a number. A numeric list of references that is used for each watershed is provided below. Streams for which there are recommendations, or identified water quality impairments should have at least one reference listed in this column.

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APPENDIX C: LAKES TABLE GUIDANCE

The following explains the information used in the following lakes table. *Note: Cells that contain no data in the Lakes table means that data is unassessed or unavailable.*

***Lake Name*:** All named and unnamed lakes are listed. Lake names are those found on U.S. Geological Survey quadrangle maps unless the Wisconsin Geographic Names Council has established a different name. Some lakes are known locally by other names; where available, local names have been listed with the official name.

County: Indicates the county in which the lake is located.

Township, Range, Section: Lake locations are identified by township, range, and section.

Watershed Number: (ie., "LR01") The watersheds are identified for each lake listed using the WDNR Master Waterbody File in conjunction with U.S. Geological Survey seven minute topographic maps.

Surface Area: The surface area is the size of the lake, in acres, as listed on the WDNR Master Waterbody File, *Wisconsin Lakes* PUB-FM-900 (1995), Surface Water Resources of Dane County (WDNR, 1985), and *A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report* (SEWRPC, 1995).

***Max Depth*:** Maximum depths are reported in feet and are listed in *Wisconsin Lakes*, WDNR PUBL-FM-800-95REV and *A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report* (SEWRPC, 1995).

***Mean Depth*:** Mean depths, in feet, are those listed in *Wisconsin Lakes*, WDNR PUBL-FM-800-95REV and *A Regional Water Quality Management Plan for Southeastern Wisconsin: An Update and Status Report* (SEWRPC, 1995).

Lake Type: Each lake type displays unique limnological characteristics based on physical and chemical properties. Production of plant and animal life generally varies in accordance with lake type. Basic classifications and qualifying criteria are:

- **Drainage lake (DG):** Impoundments and natural lakes with the main water source from stream drainage. Has at least one inlet and one outlet.
- **Drained lake (DR):** Natural lake with the main water source dependent on the groundwater table and seepage from adjoining wetlands. Seldom has an inlet but will have an outlet of very little flow similar to the seepage lake except for the outlet.
- **Seepage lake (SE):** Landlocked. Water level maintained by groundwater table and basin seal. Intermittent outlet may be present.
- **Spring lake (SP):** Seldom has an inlet, but always has an outlet of substantial flow. Water supply dependent upon groundwater rather than surface drainage.

Winterkill: Winterkill (winter oxygen depletion) is a common problem in many shallow Wisconsin lakes. A kill can occur when at least four inches of snow cover the lake, which prevents sunlight from reaching the water. All photosynthesis stops and plants begin to die and decompose. The extent of oxygen

loss depends on the total amount of plant, algae and animal matter that decays. Drought increases the chance of winterkill by reducing the volume of water in the lake. A "Y" indicates the lake has experienced winterkill at least once. If not noted, winterkill is not known to have occurred. Data for this column is based on the best professional judgement of the Lakes Coordinator.

Access: This column identifies the type of access to a particular lake as follows:

BR = Boat Ramp

♿BR = Barrier-free boat ramp (boating dock and/or wheelchair accessible)

T = Trail

W = Wilderness

SH (Self Help Monitoring): This column identifies existing or recommended Self-Help monitoring. Data for this column is based on the Self Help Lake Monitoring Database and the best professional judgement of the Lakes Coordinator.
The following letters in each column signify that Self-Help monitoring is:

- **R** = recommended
- **X** = no longer being monitored
- **C** = currently being done

Hg (Mercury): Numerous lakes in Wisconsin contain fish with elevated levels of mercury. Fish consumption advisories are issued semi-annually for lakes with fish mercury levels of 0.5 parts per million (ppm) or greater. Generally, predator fish from soft water, poorly buffered, low pH lakes have the highest concentrations of mercury. The most updated listing of waterbodies with fish consumption advisories can be obtained by writing to: Fish Advisory, Wisconsin Department of Natural Resources, P.O. Box 7921, Madison, WI 53707.

- **R** = Fish mercury monitoring is recommended.
- **X** = Multiple fish populations have been tested for mercury content and a fish consumption advisory DOES NOT exist
- **SA (Special Advisory)** = Monitoring has been conducted and a special advisory exists for this waterbody
- **GA (General Advisory)** = This waterbody falls under a general statewide fish consumption advisory for mercury.

Mac (Macrophytes): This column identifies the status of macrophytes or aquatic plants in the lake. Specifically, it indicates if the lake experiences Eurasian watermilfoil and/or purple loosestrife, two invasive non-native plants that can impair the lake's aesthetic, ecological, and recreational values.

- **EM** = indicates that Eurasian watermilfoil is present in the lake and may be a problem
- **EM-W** = lake part of research project to study the effectiveness of Eurasian watermilfoil weevil in reducing and/or eradicating this plant from the lake.
- **PL** = indicates that purple loosestrife is present in the lake and may be a problem

LMO (Lake Management Organization): Indicates whether or not a lake management organization (LMO) exists for the lake. An LMO can range from a small, loosely organized group of lake property owners to an association to a district, complete with by-laws and taxing authority. In the lakes table, the following letters are used to indicate whether the LMO is an association or district. If the type of organization is not known, but one does exist, a "Y" is used. Data is drawn from: Pardee, M. and S. Harris. 2001. The Lake List: a Directory of Wisconsin Lake Management Organizations 2001-2001. Wisconsin Lakes Partnership. UW Extension publication FH-407.

- **Y** Indicates that a LMO does exist
- **ASSC** Indicates that a lake management association exists
- **DIST** Indicates that a lake management district exists
- **R** Recommends that a LMO be developed; this recommendation is usually accompanied by a narrative recommendation in the watershed analysis section.

Trophic State Index (TSI): The trophic state index indicates the productivity of the waterbody. Data are growing season averages of three parameters: Secchi depth (m), Chlorophyll-*a* content (ug/L), and Total Phosphorus (ug/L). The higher the TSI, the more eutrophic the waters (See TSI Class below). Data were gathered from the following sources (from 1996 to 2001): The Self Help Lake Monitoring Database, 2001 Baseline Monitoring Program data, and the UW Center for Limnology's North Temperate Lakes Long-Term Ecological Research Database.

- **TSI*** following the TSI number indicates that a TSI was calculated using only the Secchi depth parameter
- **TSI***** following the TSI number indicates that a TSI was calculated using all three parameters of Secchi depth, Chlorophyll-*a* content, and Total Phosphorus.

Trophic State Index (TSI) Class: Lakes can be divided into three categories (oligotrophic, mesotrophic and eutrophic) based on the trophic state index number. These categories are general indicators of lake productivity.

All lakes naturally age, or progress from being oligotrophic to eutrophic. In many places, people have accelerated this process by allowing nutrients from agriculture, lawn fertilizers, streets, septic systems, and urban storm drainage to enter lakes.

- **Oligotrophic** lakes are generally clear, cold and free of many rooted aquatic plants or large blooms of algae. Because they are low in nutrients, oligotrophic lakes generally do not support large fish populations. However, they often have an efficient food chain with a very desirable fishery of large predator fish. TSI values of 39 or less
- **Mesotrophic** lakes are in an intermediate stage between oligotrophic and eutrophic. The bottoms of these lakes often lack oxygen in late summer months, limiting cold water fish and resulting in phosphorus cycling from sediments. TSI values of 40 - 49
- **Eutrophic** lakes are high in nutrients. They are likely to have excessive aquatic vegetation or experience algae blooms, sometimes both. They often support large fish populations, but are also susceptible to oxygen depletion. Small, shallow lakes are especially vulnerable to a winterkill, which can reduce the number and types of fish. TSI values of 50 or greater

Lake Plan or Prot (Lake Planning or Protection Grant): This column refers to whether the lake has been the recipient of a lakes planning or protection grant in the past. Data were compiled from South Central Region Office Files, 2001.

- **PLAN** = Lake has received a Lakes Management Program Planning Grant in the past.
- **PROT** = Lake has received a Lakes Management Program Protection Grant in the past.

Phosphorus Sensitivity (P Sens)*:* This analysis classifies lakes according to their relative sensitivity to phosphorus loading and existing trophic condition. The screening identifies high quality lakes that should receive highest priority for nutrient control management.

This analysis applies only to lakes greater than 10 acres. The first step separates lakes that are sensitive to increased phosphorus loading (Class I) and lakes less responsive to changes in phosphorus loading (Class II). This classification is based on the following parameters: *flushing rate* (the watershed runoff rate divided by lake volume) and a *stratification factor* (an estimation of the physical barrier to nutrient movement from the hypolimnion to the trophogenic zone). Lakes with a low flushing rate tend to be more sensitive to P loading. Lakes that do not stratify have continual movement of nutrients from sediments to the trophogenic zone and are considered less sensitive to phosphorus loading.

Lakes are further subdivided based on existing water quality conditions (TSI score). Subcategory A represents lakes with fair to excellent water quality or a relatively low TSI score; while subcategory B represents lakes with poor to very poor water quality or a relatively high TSI score. Note: *As a water quality indicator, the TSI is a subjective description of perceived water quality. Therefore, it is used as a general guide to how most people perceive water quality, not as definitive ratings of water quality*.

- **Class I: lakes that are sensitive to increased phosphorus (P) loading**
  A = existing water quality fair to excellent; potentially most sensitive to increased P.
  B = existing water quality poor to very poor; less sensitive to increased P than Group A.
  Ins = data is insufficient to assess trophic condition; classification monitoring recommended.

- **Class II: lakes less responsive to changes in phosphorus loading**
  A = existing water quality fair to excellent; may not be as sensitive to P as Class I lakes.
  B = existing water quality poor to very poor; low sensitivity to increased P.
  Ins = data inadequate or insufficient to assess trophic condition.

For the purpose of this analysis, the TSI was calculated using an average of at least 3 values for Secchi depth, total phosphorus and/or chlorophyll-*a*, otherwise it was determined to have insufficient data. This model was adapted from Lathrop and Lillie 1980; Lillie and Mason 1983; Schreiber 1988. Data were taken from WDNR Surface Water Inventory and the Self Help Monitoring Database.

Lillie, R.A., and J.W. Mason. 1983. Limnological characteristics of Wisconsin lakes. Wisconsin Department of Natural Resources. Technical Bulletin 138. 116 pp

Lathrop, R.C., and R.A. Lillie. 1980. Thermal stratification of Wisconsin lakes. *Transactions of the Wisconsin Academy of Science, Arts, and Letters* 68:90-96.

Schreiber, J. D. 1988. Estimating soluble phosphorus (PO_4^-P) in agricultural runoff. Jour. Miss. Acad. Sci. 33:1-15.

Comments: Additional information that was available for the lakes has been included in the comments column. Abbreviations were used to conserve space as follows:

Source – the source of threat or impairment of designated uses in a waterbody.

AGSPR - Agricultural land spreading site

BY - Barnyard or exercise lot runoff (animal operations)

CE - Building construction site erosion

CL - Cropland erosion

DEV - Intense development pressure

HM - Hydrological modification (dam, ditching, wetland drainage)

NPS - Unspecified nonpoint sources

PSB - Streambank pasturing

PWL - Woodlot pasturing

RS - Roadside construction erosion

SB - Streambank erosion

SEP - Septic systems are or may be causing water quality problems

URB - Urban storm water runoff

WLF - Water level fluctuations

Impacts (effect or impact of source on a waterbody) – Variously known as the cause, impact or stressor, this column lists the effect on the waterbody as a result of the source.

HAB - Habitat

MAC - Undesirable macrophyte

ALG - Undesirable algae growth

ACC - Access problems relate to the general public's inability to access the lake.

SED - Sedimentation

TURB - Turbidity

NUT - Nutrient enrichment

APPENDIX D: STOUGHTON MEETING

Recommendations from Yahara River Lake Kegonsa Watershed Meeting
Stoughton Public Meeting. November 29, 2000

Topic	Text	Action
Dams	Concern about removing dams and the increased water moving downstream and diminishing of waters upstream.	Yes
Dams	Concern about dam removal impacts on lake property owners and lake to wetland frontage property.	Yes
Dams	Work with Dunkirk Dam Lake Management District.	Yes
Dams	Stebbinsville dam has been open since 1998, the Association doesn't have funds to repair it. What does the DNR plan to do with it? How are they moving forward? People would like to have some course of action decided.	Yes
Dams	Maintaining water levels (Stoughton dam, Yahara River flow).	Yes
Dams	Mill pond restoration.	Yes
Dams	Study the effect of dams in the watershed.	Yes
Dams	Study the effects of dams in the watershed.	Yes
Dams	Put fish passage in Dunkirk Dam.	Yes
Dams	Either remove Stebbinsville dam or make repairs providing adequate fish passage.	Yes
Dams	Study dams.	Yes
Dams	Without removing Stebbinsville Dam, we can't do anything with the land. It has been in limbo for 3 years and the dam owner isn't committing.	Yes
Dams	Concerns over ownership of dams and DNR's regulation of private dams. Should all dams be publicly owned and maintained. USGS is doing a study of dams.	Not included, not within scope of report
Dams and Water Level	Lake Kegonsa water level and "where it should be" so creeks flow into the lake.	Yes
Dams and Water Level	Water levels have varied tremendously/dramatically throughout the year especially downstream on the Yahara River.	Yes
Dams and Water Level	Concern over flow rate, water depth and the effect on fish habitat in the Yahara River.	Yes
Dams and Water Level	Control water level of Lake Kegonsa to allow proper use of agricultural lands.	Yes
Dams and Water Level	Stabilize water levels in the Dunkirk and Stebbinsville mill ponds if dams are not removed.	Yes
Dams and Water Level	Better communication between the dams so water levels can be better controlled.	Yes

Dams and Water Level	Maintain water levels in Lake Kegonsa for fish habitat and recreation.	Yes
Door Creek	Heavy siltation at the mouth of Door Creek. Dredge so the water can flow through and knock the berms down.	Yes
Door Creek Wetlands	Implement Door Creek Wetland Protection Plan and recommendations.	Yes
Door Creek Wetlands	The Door Creek Wetlands Protection Plan has been passed by the County and includes criteria for improving habitat, decreasing silt and runoff. DNR should assist in implementing the Plan.	Yes
Door Creek Wetlands	Ten properties adjoin Door Creek from the mouth to the railroad tracks. The DNR and County need to be more proactive in implementing the Door Creek Wetlands Protection Plan. The County should contact these landowners rather than wait for them to contact the County.	Yes
Door Creek Wetlands	Find alternatives to protect Door Creek Wetlands.	Not included, incomplete thought.
Education	More public education about the use of herbicides and fertilizers on park lands and lawns and the effects on the River.	Yes
Education	Increase public education about non point source pollution from ordinary citizens.	Yes
Education	Public education on ways public can reduce their impacts on water quality.	Yes
Education	The DNR advises farmers of programs, like the Wetland Reserve Program, and other ways landowners can be compensated for protecting the land, but the DNR should be more proactive in informing them.	Yes
Education	Improve education of home owners and fertilizing their lands.	Yes
Endangered/Threatened Species.	Survey the flora/fauna in Yahara River to identify endangered and threatened species.	Yes
Enforcement	Concerned about people not following rules regarding urban run-off (ie. at construction sites). Good rules but appear not to be enforced and brown water can be seen running off sites.	Yes
Enforcement	Raw sewage ran into the Yahara River (Stoughton incident from last summer, I believe) from construction company working on the line. DNR enforced but the fine was not significant enough to deter such activities.	Not included, not within scope of report
Fisheries	Monitor toxicants of fish in Lake Kegonsa.	Yes
Fisheries	Fish migration.	Yes
Fisheries	Create stone and gravel beds to aid fish spawning.	Yes
Fisheries	Fish habitat. (Dams, streams, wetlands).	Yes
Fisheries	Promote commercial harvesting of rough fish on Lake Kegonsa.	Yes
Forests	Increase forests and grasslands to decrease volume of runoff to streams.	Yes
Forests	Increase forests and grasslands to decrease volume of runoff to streams.	Yes
Gibbs Lake	Protect wetlands and enhance buffers around Gibbs and Little Gibbs Lake.	Yes

Gibbs Lake	Buffer around Gibbs Lake	Not included, incomplete thought.
Government Coordination	Better coordination among government agencies.	Yes
Government Coordination	Work closely with Dane County to maintain water levels in Lake Kegonsa to benefit fish spawning.	Yes
Government Coordination	Work closely with Dane County to maintain water levels in Lake Kegonsa to benefit fish spawning	Yes
Government Coordination	Work with stakeholders early in the process.	Not included, incomplete thought.
Groundwater	Promote conservation of groundwater and proper land use planning to protect it	Yes
Groundwater	Regulation of municipal well location so they don't adversely impact adjacent wells.	Not included, not within scope of report
Lake Kegonsa	Promote Self-Help monitoring on Lake Kegonsa.	Yes
Lake Kegonsa	DNR placed a culvert near Barber's Bay to alleviate water level problems but the water quality has decreased. Create a detention pond west of Hwy 51 to prevent silt from going through the culvert and into the Bay.	Not included, not within scope of report
Lake Kegonsa	There's a spit of land on the south side of the Yahara River across from Fish Camp Park, which used to act a s a good buffer but was flooded over 2 years ago and damaged from boat wakes. It should be recreated and a wingdam should be installed to protect this area and the boat launch from southerly winds.	Not included, not within scope of report
Lake Kegonsa & Door Creek.	Improve water quality in Lake Kegonsa and Door Creek.	Yes
Land Use	McFarland and Stoughton should aggressively enforce construction site erosion control ordinances.	Yes
Land Use	Concern over construction site runoff (best management practices).	Yes
Land Use	Create a hotline for runoff events, accidents, problems.	Yes
Land Use	City of Stoughton should develop storm water management plans and embrace construction site erosion control.	Yes
Land Use	Sedimentation from agricultural fields and construction sites	Yes
Land Use	Revisit zoning ordinances in light of current mindset.	Yes
Land Use	Cities should develop better construction erosion control ordinances.	Yes
Land Use	Use Transfer of Development Rights and improve consistency of local governments and their zoning ordinances.	Yes
Land Use	Regional storm water impact retention plan.	Yes
Land Use	McFarland, Stoughton and Cottage Grove should develop comprehensive stormwater management plans.	Yes
Land Use	Create protective upland buffer areas.	Yes
Land Use	Improve the locating of new housing and development on individual parcels and areawide.	Yes
Land Use	Stormwater management	Yes

Land Use	Non point source urban and rural.	Yes
Land Use	Engineering skills to take care of runoff from parking lots, roads, etc. ie. rain gardens, retention ponds.	Yes
Land Use	Non point source pollution	Yes
Land Use	Putting leaves into roads stops up storm drains and flushes nutrients into the river. This needs to change.	Yes
Land Use	Moratorium on building on lands adjacent to wetlands will be a better use of money than resorting.	Not included, not within scope of report
Land Use	The larger the farms, the less concern and efforts taken to protect the environment.	Not included, not a correct statement
MMSD	Evaluate proposals to return Madison Metropolitan Sewage Districts effluent to the upper Yahara	Yes
MMSD	Study the return of Madison's treated sewage water into the watershed with caution because of urbanization and water quality.	Yes
MMSD	Where to go with the water.	Yes
Navigation	- Navigation.	Not included, incomplete thought.
Recreation	Concern about losing access to some recreational lands especially around the lakes. (No parking signs, etc. put up).	Yes
Recreation	Have a no-wake opportunities on the lakes and rivers (ie. one day per week.)	Yes
Recreation	When governments acquire lands, they should include non-invasive public access such as bike paths near/around Lake Kegonsa and along the railroad, canoe access points on the rivers and lakes.	Yes
Recreation	Increase open space for recreational needs by creatively purchasing some limited recreational rights from private landowners.	Yes
Recreation	Purchase of additional lands to complete the Yahara River Tail and protect habitat.	Yes
Recreation	Concern with Tuesday night Bass Competitions (on Lake Kegonsa?) and too much boat traffic and wakes at one time.	Not included, not within scope of report
Recreation	Control motor boating on Lower Mud Lake.	Not included, not within scope of report
Recreation	Do not restrict power boats on Lower Mud Lake.	Not included, not within scope of report
Recreation	How much do motorboats contribute to the pollution of the lakes?	N/A
Recreation	Appreciate rustic waterways, particularly for canoeing and kayaking and other quiet activites.	N/A
Recreation	Concern about maintenance of property acquisitions by governments.	N/A
Rocks in Yahara River.	Leave the rocks in the Yahara River in place.	Not included, conflicting recommendations

Rocks in Yahara River.	Remove the large rocks from the creek (which one?) between Dryeson Bridge and the bend upstream (NW) to clear navigation and improve waterflow.	Not included, conflicting recommendations
Runoff.	Runoff.	Not included, incomplete thought.
Studies	Monitor and assess sources of runoff and pollution from City of Stoughton.	Not included, covered by new EPA regulations
Studies	Are there studies showing that wetlands improve by restoring meanders in streams versus ditching?	N/A
Water Quality	Stream Bed and Bank Restoration	Yes
Water Quality	Improve water quality in the Yahara-Kegonsa Watershed. Improve habitat for fish and other aquatic species.	Yes
Water Quality	Do a riparian survey and improve water quality.	Yes
Water Quality	Way too many Canada Geese and they are a source of pollution to the waters.	Not included, not within scope of report
Water Quality	Water Quality.	Not included, incomplete thought.
Water Quality	Can smell non point source pollution after a storm.	N/A
Water Quality	When the water level is low, great opportunities for clean-up.	N/A
Water Quality	Improve water clarity.	N/A
Water Quality	Just want clean and healthy water for wildlife and people.	N/A
Wetlands	Development is occurring too close to the wetlands. It is important to protect them and upland habitat too.	Yes
Wetlands	Additions to existing waterfowl production and wetland protection.	Yes
Wetlands	Restore functional wetlands.	Yes
Wetlands	More funding should be directed at restoring wetlands and working with private owners.	Yes
Wetlands	Support programs that restore and protect wetlands in low areas vulnerable to flooding.	Yes
Wildlife Habitat	Wildlife Habitat.	Not included, incomplete thought.

APPENDIX E: FORESTRY PROGRAMS

Tree seedlings are available through the state nurseries and numerous private nurseries that serve Wisconsin. Annually, the landowners in the Rock Basin plant in excess of 800,000 tree annually. In recent years, increased interest in direct seeding of hardwoods into open fields has shown potential. A number of demonstration projects were established to assist land resource managers in determining the merit and economic viability of direct seeding hardwoods into old fields.

Foresters: The Wisconsin Department of Natural Resources has Forestry staff located in Horicon, Janesville, Fitchburg, Hartford, Eagle and Sternevant. The forestry staff is available to assist forest owners on a variety of forest related issues. The assistance provided by the WI DNR forestry staff is limited to a maximum of 24 hours per year per ownership, following priorities established in Wisconsin Statutes and Administrative Codes. The assistance the WI DNR foresters may provide include the following: brief forest management plans, forest stewardship plans, tree planting plans, tree planting assistance, timber sale assistance, cost-sharing development and review, and other forest management activities.

Managed Forest Law (MFL) Program: The Managed Forest Law (MFL) program was developed in 1985 by the Wisconsin Legislature. The MFL program is the combining of the Forest Crop Law (FCL) (1927) and the Woodland Tax Law (WTL)(1954) programs into a single forest stewardship program. The purpose of the MFL program is to encourage the growth of future forest through sound forestry practices while recognizing the individual property owners' objectives and society's needs for compatible forest recreation, aesthetics, wildlife, erosion control, and protection of endangered resources. The definition of Forestry under the law means "managing the forest lands and their related resources, including trees and other plants, animals, soil, water, and air."

The MFL program has in excess of 30,000 landowners statewide, with over 3.0 million acres of forest in the program. Forest lands in the MFL program must have a written forest stewardship plan approved by local WDNR forester, 10 or more acres of woodlands, and a 25 or 50 year contract. The landowners can "close" up to 80 acres of MFL acres to public access. Forest acreage in the MFL program that exceeds 80 acres of woodlands in MFL per township must be left open to public access. "Open" MFL acres have a tax rate of $.74 per acre per year. "Closed" MFL acres are taxed at a rate of $1.74 per acre per year. Besides the annual acreage fee, a 5% yield tax is assessed on all commercial forest products harvested from the MFL acreage.

Managed Forest Law (MFL) Program in the Rock Basin as of January 1, 2001.

County	Acres in MFL
Columbia	1,121
Dane	2,689
Dodge	2,423
Green Lake	-0-
Jefferson	4,665
Fond du Lac	-0-
Rock	3,010
Washington	1,131
Waukesha	1,008
Basin Totals	16,047

Application deadline is January 31st. MFL applications submitted prior to January 31st will be admitted into the MFL program as of January 1st the following year. As part of the application process, a MFL forest stewardship plan must be developed by the WDNR forester or a co-op consulting forest, approved and signed by both the landowner(s) and the local WDNR forester. MFL contracts are for 25 or 50 years. Landowner must select the length of MFL contract at the time of application.

Best Management Practices (BMP's) for Forest: Wisconsin's forestry community practices voluntary Best Management Practices (BMP's) for water quality. Through this program, the forestry staff provides training, brochures, and on the ground assist to landowners, consultant foresters, forest product companies, and other resources professionals to limit the potential adverse effect of erosion from timber sales and other forest management actions. Annually, the staff in the Rock Basin shares in excess of 400 informational pamphlets to landowners through management plans and other informational materials. Our partners, such as consulting foresters and the federal agencies, also have a role in educating the public on the need to maintain water quality. These groups have been especially helpful in addressing the BMP needs of landowners not traditionally served by WDNR foresters.

Federal cost sharing programs: Since the 1950's, there has been a variety of federal programs designed to promote long term conservation on private lands. These programs have included such acronyms as FIP, ACP, TIP, SIP and many others. Today, the EQIP and the CRP are the two federal programs that have the greatest impact on forestry. Both are designed to address the needs of the lands and to reduce the long-term erosion from agricultural activities. Tree planting is the single largest forestry component of these two cost-sharing programs. The use of the state nursery stock, state and county tree planters, plus the customer tree planters and custom planters all have an impact on the local landscape and economy.

State cost-sharing programs: In 1998, the state legislature developed and approved authorization for the funding and development of a state forestry cost-sharing program. The state cost-sharing program was named the Wisconsin Forest Landowner Grant Program (WFLGP). WFLGP will cost-share a variety of forestry related conservation efforts that are included as part of the required forest stewardship plan. The stewardship plan is a forest management plan developed to meet the objectives of the landowner(s), plus the address the wide range management needs on the property. An approved forest stewardship plan must be on file with the local forest at the time of applying of cost sharing. WFLGP will cost-share the following forest management conservation practices:

- Forest stewardship plan development
- Reforestation
- Forest improvement (t.s.i.)
- Soil and water protection and improvement
- Wetland restoration and/or creation
- Fish and wildlife habitat enhancement
- Recreational, historical, and aesthetic forest enhancement
- Endangered or threatened resources protection

Partnerships: Forestry in Wisconsin has traditionally relied on a close relationship with its partnerships within the federal, state, and counties. This partnership began in the early 1950's with private forestry. The NRCS (former SCS), the FSA (former ASCS) in the USDA and the Department of Land Conservation (DLC) and UofW-Extension in the counties all are long term partners in the promotion of sound forest stewardship in the Rock Basin.

In recent years, the number of partners active with the forestry program has expanded as landowners and the general public has become more aware of land conservation. These include Co-op consulting foresters, Wisconsin woodlands owners Association (WWOA), Walnut Council, Turkey Federation, American forest Institute (Tree Farm Family), and other organizations interested in promoting forest stewardship. The reliance in partnership will expand in the years to come as awareness of sound forest stewardship expands and as Wisconsin continues its trend from a rural agricultural based society to one dominated by urban areas and absentee ownership's.

*****Co-op Consulting Foresters have a signed memorandum of understanding with the Wisconsin Department of Natural Resources that requires the consulting forester to maintain a minimum level of standards on forest management work to be a Wisconsin Co-op Consulting Forester. Agreements are reviewed and re-affirmed annually.

Urban forestry: At this time, the Rock Basin has maintained its rural agricultural land use. Over the past 10 years or more, the influence on the urban areas to the east (Milwaukee), west (Madison), and south (Janesville) have increased their influence on the basin. The role of urban forestry will increase, as the Rock Basin becomes more urban. The WI Department of Natural Resources has urban forestry staff located in the Fitchburg office to assist the local communities in urban forestry issues as they develop. Besides planning assistance, the urban forestry program has grants and other financial assistance available to address urban forestry issues in the state.

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