Appendix VI

Manitowoc River Basin Watershed Narratives and Tables

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SEVENMILE-SILVER CREEK WATERSHED (MA01)

Existing Management and Monitoring Recommendations

1. Basin staff should consider upgrading the use classifications on Silver Creek, Calvin Creek, Point Creek, and Sevenmile Creek to WWSF; because of their use by native gamefish.

2. Basin staff should identify sensitive areas around Carstens Lake and English Lake as defined in NR 107.

3. Basin staff should work with central office staff to identify potential funding sources to establish a basin assessment fixed station monitoring site on Silver Creek to assess long-term water quality trends in the Manitowoc River Basin .

4. Basin staff should actively encourage self-help monitoring on the following lakes: Hartlaub Lake and Silver Lake to gather information for long range lake management planning and protection.

5. Basin fisheries and water resources staff and Bureau of Environmental Analysis staff should continue to work with the Department of Transportation (DOT) to purchase sensitive land areas around English Lake to improve water quality as identified in the Lake Planning Grant Process.

6. Basin staff should conduct water quality monitoring on Hartlaub Lake as a follow up to a winterkill that occurred in 1995.

7. Basin staff should conduct limnological monitoring on Silver Lake as part of the Silver Creek diversion project and develop a fisheries rehabilitation management plan.

8. WDNR Integrated Science Services (SS) staff should analyze the sediment core they collected from English Lake to provide a historical perspective of the lake's trophic status and summarize the results in a report.

Stream Descriptions

For more information about the following streams, please see the *Nonpoint Source Pollution Control Plan for the Sevenmile-Silver Creek Priority Watershed, 1987.*

Calvin Creek

Calvin Creek has limited flows for most of its length during drier summer and fall periods. Stream habitat assessment surveys indicate poor to fair habitat. Calvin Creek most likely supports at least some native gamefish during high water years and high water periods, and may merit a WWSF classification. Minimal migration of salmonid species from Lake Michigan during spring and fall spawning runs is most likely associated to low flows. Staff should conduct surveys to assess existing and potential uses during normal to slightly higher water summer periods.

Centerville Creek

Centerville Creek, a four mile creek that originates southwest of Cleveland, experiences extremely low flows for the majority of the year. It supports a forage fishery. Stream habitat ratings at three sites indicate fair to poor habitat, which reflects the low flow and significant sedimentation in pools.

Fischer Creek

Fischer Creek, a six-mile creek, supports some seasonal migration of brook trout, rainbow trout and coho salmon from Lake Michigan with some natural reproduction occuring, meriting a Cold I or II classification. Fischer Creek is one of the Lake Michigan tributaries being managed by the WDNR as a Class II steelhead stream. As such, it receives annual smolt stockings of the ganaraska strain of steelhead. Mortality among fall-spawning brook trout was documented during a summer fish kill investigation. The fishery is limited by low flow conditions during the summer and the fall. Siltation inhibits fish spawning. Nonpoint source pollution from an unnamed tributary (T17N R23E S15) is degrading the water quality of Fischer Creek and has caused several fish kills.

In 1996, 123 acres known as the Fischer Creek property was added to the Manitowoc County park system. The state's Stewardship Fund purchased the property. (Refer to the Surface Water Quality Report for additional information on the Stewardship Fund). The Fischer Creek property stretches along a mile of Lake Michigan shoreline between Manitowoc and Sheboygan. This is the only substantial public access to the lake in the area. The tract is a mixture of young forest, marsh and grassland crossed by the creek, with seasonal runs of fish from Lake Michigan. The greatest value of the property will be for non-consumptive recreation such as birding, walking and photography. Manitowoc County is developing a management plan for the area and will oversee its operation. Development will be limited to trails, picnic areas, parking areas near the highway and two access points. Some development work began in 1997 (Crehore 1996).

Unnamed Tributary to Fischer Creek T17N R23E S15

An unnamed tributary discharging to Fischer Creek is less than one mile in length. Nonpoint source pollution in this unnamed tributary has degraded the water in Fischer Creek, which serves as a spawning and nursery area for brook trout and rainbow trout. Several fish kills have been documented and the source was traced to a single pipe that is suspected to originate from an agricultural source (WDNR 1996).

Memee Creek

Memee Creek is an intermittent tributary entering Sevenmile Creek approximately half a mile upstream from its mouth at Lake Michigan. The creek is limited by low flows most of the year; but, is capable of supporting a Warm Water Forage Fishery.

Pine Creek

Agricultural nonpoint sources, two point source dischargers, and several road crossings impact the water quality of Pine Creek in Manitowoc County. The stream's biological potential to support a balanced biological community is affected by low flow. During spring runoff, Lake Michigan fish species such as smelt may use the mouth areas of Pine Creek for spawning. An investigation conducted by WDNR biologists suggests the classification of the stream should be upgraded from LAL and WWFF to WWSF

and LAL, respectively. A field survey was conducted in October 1996 and biologists believe the classification could be WWSF and LAL.

- ***Use the final report that integrated the State Lab of Hygiene water chemistry results and the recommendations to upgrade use classification to WWSF.***

Point Creek

This six mile creek supports several species of fish considered relatively intolerant of pollution. The potential of the stream to support a significant sport fishery is some what limited by flow; but, native gamefish species are suspected to use this stream during high water years and high water periods. A seasonal spawning run of Lake Michigan salmonid species occurs and provides opportunities for fishing. Staff should conduct surveys to assess existing and potential uses during normal to slightly higher water summer periods.

Sevenmile Creek

The fishery in Sevenmile Creek is dominated by pollution-tolerant forage fish; but, fisheries staff feel there is a high likelyhood of native gamefish using the stream or portions of the stream during periods when normal to higher than normal water levels exist. The ability of the creek to support a significant sport fishery is limited due to the extreme low flow. Stream habitat assessments indicate fair habitat although dissolved oxygen readings, obtained in conjunction with habitat survey, were depressed. These low dissolved oxygen readings are indicative of organic pollution. Staff should conduct surveys to assess existing and potential uses during normal to slightly higher water summer periods.

Silver Creek

Silver Creek Park at the mouth of Lower Silver Creek provides public access to the stream and Lake Michigan. The majority of the recreational activity on Lower Silver Creek occurs at the park. Biotic index samples taken in 1985 at one site on Lower Silver Creek indicate poor to very poor water quality (Nonpoint Source Pollution Control Plan 1987). Silver Creek below Silver Lake has a diverse population of fish including northern pike, bluegill, bullhead, sucker, as well as brook trout, rainbow trout, and brown trout. Salmonid (trout and salmon) species are reported to migrate up the creek during spring and fall spawning runs, at which time the stream receives significant fishing pressure. Surveys conducted in the upper reaches of Silver Creek indicate that flow is intermittent and the stream is often without flow during the summer and fall. The creek supports a population of rough and forage species of fish, with very few game fish present above the lake. In addition to poor water quality, the fishery in the stream is further limited by very low flow during the summer and fall. Streambank erosion in the sandy soil area near the mouth of the stream appears to be severe and may have a significant impact on the localized stream habitat and fishery. Silver Creek is one of the Lake Michigan tributaries being managed by the WDNR as a Class II steelhead stream and as such receives annual smolt stockings of the ganaraska strain of steelhead.

Future water quality impacts to Silver Creek and Silver Lake may result from a developing industrial park located north of the stream between State HWY 151 and Interstate 43. Stormwater discharge locations to Silver Creek and Silver Lake are unknown at this time. During storm events Silver Creek may receive increased flows along with elevated loadings of sediments, nutrients, toxins, and other pollutants from the impervious surfaces. Stormwater usually receives no treatment before discharge. Stormwater control ordinances that require that design controls be incorporated into new projects should be adopted by the city of Manitowoc and nearby communities. (Refer to the recommendations under “Ordinances.”)

Table 5. Sevenmile & Silver Creek Watershed (MA01) - Stream Information - Part 1 of 4

Counties: Manitowoc, Sheboygan

Square Miles: 113

NAME OF STREAM	WBIC	LENGTH (MILES)	EXISTING Biological Use USE/MILES	POTENTIAL Biological Use (MILES)	Supporting Assessment Category	Assessment Data	Codified CLASS
Calvin Creek	66900	6	WWFF (6.0)	WWFF	Partially	M	**WWFF**
Centerville Creek	65400	6	WWFF (6.0)	WWFF	Threatened	M	**WWFF**
Unnamed Tributaries							
T17N, R23E, S27	65700	2	Unknown				**Default**
Fischer Creek	65800	7	Cold I & II (7.0)	Cold I & II	Threatened	M	**Change WWFF to Cold I & II**
Unnamed Tributaries							
T17N, R23E, S15 NWSW	**Needs A WBIC**	2.5	LAL (2.5)	LAL		E	**Default**
T17N, R23E, S15 SESE	**Needs A WBIC**	2.5	LAL (2.5)	LAL		E	**Default**
Memee Creek (T16N, R23E, S15)	**Needs A WBIC**	2	WWFF (2.0)	WWFF	Partially		**Change LAL to WWFF**
Pine Creek	66300	0-4	WWSF (4.0)	WWSF	Threatened	M	LAL **(should be WWSF)**
		4-6	LAL (2.0)	LAL	Threatened		**Default**
Unnamed Tributaries							
T18N, R23E, S27	66400	1	Unknown (1.0)	Unknown			**Default**
T18N, R23E, S22	66500	1	LAL (1.0)	LAL			LAL
T18N, R23E, S25	**Needs A WBIC**	<1	Unknown (<1.0)	Unknown			**Default**
Point Creek	66000	**12**	WWFF (12)	WWFF	Partially		**WWFF**
Unnamed Tributaries							
T18N, R23E, S32	66100	1	Unknown				**Default**
Sevenmile Creek	65100	5	WWFF (5.0)	WWFF	Threatened	M	**Default**
Unnamed Tributaries							
T16N, R23E, S15	65200	1	Unknown				**Default**
Silver Creek	67300	15	WWSF (15)	WWSF	Partially	M	**change WWFF to Cold ?**
Unnamed Tributaries							
T19N, R23E, S28	67500	1	Unknown				**Default**
T19N, R23E, S28	67600	<1	Unknown				**Default**
T19N, R23E, S32	67800	<1	Unknown				**Default**
T18N, R23E, S07	68000	1	Unknown				**Default**

Table 5. Sevenmile & Silver Creek Watershed (MA01) - Stream Information - Part 2 of 4

Counties: Manitowoc, Sheboygan

Square Miles: 113

NAME OF STREAM	LENGTH (MILES)	HBI (Water Quality) "Integrity Indicator"	Joe Ball Habitat Form 3200-68, 1-85 sm= stream mile from mouth
Calvin Creek	6	X=6.68 (fair), spring 1996 (sm=0.2)	164 (fair) fall 1997 (sm=0.2) 165 (fair) summer 1996 (sm=0.2)
Centerville Creek	6	7.52 (poor), fall 1989 (sm=1.7) 6.30 (fair), spring 1989 (sm=1.7) 6.48 (fair), spring 1989 (sm= 2.5) 8.00 (poor), fall 1989 (sm= 4.0) 7.75 (poor) spring 1989 (sm=4.0)	
Unnamed Tributaries			
T17N, R23E, S27	2		
Fischer Creek	7	4.43 (very good), spring 1985 (sm=1.0)	
Unnamed Tributaries			
T17N, R23E, S15 NWSW	2.5		
T17N, R23E, S15 SESE	2.5		
Memee Creek (T16N, R23E, S15)	2		
Pine Creek	0-4	6.48 (fair), fall 1996 (sm=0.7) 7.25 (poor), fall 1996 (sm=2.3)	180 (fair), fall 1996 (sm=0.7) 169 (fair), fall 1996 (sm=2.3)
	4-6		
Unnamed Tributaries			
T18N, R23E, S27	1		
T18N, R23E, S22	1		
T18N, R23E, S25	<1		
Point Creek	**12**	9.2 (very poor) winter 1986 (sm=0.1) X=6.87 (fairly poor) winter 1986 (sm=2.7) X=5.77 (fair), spring 1985 (sm=2.7) X=5.92 (fair),winter 1986 (sm=5.3) 5.23 (good), winter 1986 (sm=6.9)	
Unnamed Tributaries			
T18N, R23E, S32	1		
Sevenmile Creek	5	X=9.44 (very poor), spring 1985 (sm=1.0)	
Unnamed Tributaries			
T16N, R23E, S15	1		
Silver Creek	15	6.39 (fair), fall 1996 (sm=0.6) 5.37 (good), spring 1996 (sm=0.6) X= 4.39 (very good), spring 1985 (sm=1.6)	121 (good), fall 1996 (sm=0.6)
Unnamed Tributaries			
T19N, R23E, S28	1		
T19N, R23E, S28	<1		
T19N, R23E, S32	<1		
T18N, R23E, S07	1		

Table 5. Sevenmile & Silver Creek Watershed (MA01) - Stream Information - Part 3 of 4

Counties: Manitowoc, Sheboygan

Square Miles: 113

		Environmental Problems				
NAME OF STREAM	LENGTH (MILES)	SOURCE	IMPACT	REFERENCES	TREND	Comments
Calvin Creek	6	NPS, Stream Bank Pasturing	Nut,Hab,DO	11, 14	Unknown	N
Centerville Creek	6	NPS	Sed, Nut	11, 14	Unknown	N
Unnamed Tributaries						
T17N, R23E, S27	2				Unknown	
Fischer Creek	7	NPS, Manure management	Sed, Nut, DO	11, 14, 33, 48	Unknown	N
Unnamed Tributaries						
T17N, R23E, S15 NWSW	2.5	NPS, Barnyard	Nut, DO, Hab	28, 33, 48	Unknown	N
T17N, R23E, S15 SESE	2.5	NPS, Cropland	Nut, Hab	28	Unknown	
Memee Creek (T16N, R23E, S15)	2	NPS	DO	11, 14	Unknown	
Pine Creek	0-4	NPS, Point Source Industrial		11, 14, 27, 76, 78	Unknown	N / R
	4-6	NPS, Streambank Erosion				
Unnamed Tributaries						
T18N, R23E, S27	1	Point Source Municipal			Unknown	
T18N, R23E, S22	1	Gravel Pit		27	Unknown	
T18N, R23E, S25	<1			77	Unknown	
Point Creek	**12**	NPS, Streambank Erosion	Sed, Nut	11, 14	Unknown	N
Unnamed Tributaries						
T18N, R23E, S32	1				Unknown	
Sevenmile Creek	5	NPS, Streambank Erosion	Nut	11, 14	Unknown	N
Unnamed Tributaries						
T16N, R23E, S15	1				Unknown	
Silver Creek	15	NPS, Streambank Erosion	Nut, Hab	11, 14, 28, 42	Unknown	N / R
Unnamed Tributaries						
T19N, R23E, S28	1				Unknown	
T19N, R23E, S28	<1				Unknown	
T19N, R23E, S32	<1				Unknown	
T18N, R23E, S07	1				Unknown	

Table 5. Sevenmile & Silver Creek Watershed (MA01) - Stream Information - Part 4 of 4

Counties: Manitowoc, Sheboygan

Square Miles: 113

NAME OF STREAM	LENGTH (MILES)	Data Reliability Level 1-least 4-most	NPS Rank	Additional Comments
Calvin Creek	6	2	High	Spring 1996 HBI is a mean (X=) of two reps (stream mile 0.2 = CTH LS)
Centerville Creek	6	2	High	(stream mile 1.7 = Dairyland Rd) (stream mile 2.5 = CTH XX) (stream mile 4.0 = Hwy 43)
Unnamed Tributaries				
T17N, R23E, S27	2	1	High	
Fischer Creek	7	1	High	(stream mile 1.0 =Centerville Rd) 2 manure spills resulted in Fish Kills in 1990s
Unnamed Tributaries				
T17N, R23E, S15 NWSW	2.5	1	High	
T17N, R23E, S15 SESE	2.5	1	High	
Memee Creek (T16N, R23E, S15)	2	1	High	
Pine Creek	0-4	2	High	(stream mile 0.7 = CTH U) (stream mile 2.3 = CTH R)
	4-6			
Unnamed Tributaries				
T18N, R23E, S27	1	1	High	
T18N, R23E, S22	1	1	High	
T18N, R23E, S25	<1	1		
Point Creek	**12**	2	High	(X= the average of three replicates) (stream mile 0.1 = near mouth) (stream mile 2.7 = Point Creek Rd)
Unnamed Tributaries				
T18N, R23E, S32	1	1	High	
Sevenmile Creek	5	1	High	(X= the average of three replicates) (stream mile 1.0 = CTH LS)
Unnamed Tributaries				
T16N, R23E, S15	1		High	
Silver Creek	15	3	High	(X= the average of three replicates) (stream mile 0.6 = CTH LS) (stream mile 1.6 =East crossing of Silver Creek
Unnamed Tributaries				
T19N, R23E, S28	1	1	High	
T19N, R23E, S28	<1	1	High	
T19N, R23E, S32	<1	1	High	
T18N, R23E, S07	1	1	High	

Lake Descriptions

Lakes with moderate development, a lake organization or those that are potentially subject to water quality degradation are likely candidates for the Self-Help Monitoring Program (i.e., Hartlaub, Silver). The overall goal of the program is to educate the lake property owners about lake ecology while building a long-term information base on a large number of lakes.

Carstens Lake Manitowoc County T18N, R23E, Sec. 17

Carstens Lake, the headwaters of Pine Creek, is one of four small lakes in the Sevenmile-Silver Creek Watershed. It is a hard water seepage lake in a ground moraine, with a surface area of 20 acres, a maximum depth of 30 feet, and a mean depth of 12 feet. The total shoreline length is 0.77 miles, with 0.3 miles in public ownership. Six acres of wetlands adjoin the lake, which drains a 1.0 square mile watershed. Northern pike are present, largemouth bass and panfish are abundant. Carstens Lake is a high priority for sensitive area designation. Sensitive areas are areas of aquatic vegetation offering critical or unique fish and wildlife habitat, water quality protection, or erosion control benefits to the lake. Refer to the Aquatic Plant Management Program in the Lakes Report for additional information on sensitive area designation.

In 1982, the lake was treated with a piscicide to eliminate excessive rough fish populations and a fish barrier was placed at the lake outlet. Since the rough fish were removed, water clarity has improved, no longer algae dominated, and macrophyte (rooted aquatic plant) populations have increased. Current activities include an aeration program run by the Manitowoc County Lakes Association.

In 1995 and 1996 algae dominated the lake. Rooted aquatic plants were scarce. In the past rooted aquatic plants were observed in large quantities and were said to inhibit recreational use of the lake (Ward 1996). The aeration of Carstens lake is conducted as needed. Currently, the Bureau of Fisheries Management and Habitat Protection cannot operate the aerator; unless sport club members volunteer to run the aerator, it will not be operated in the near future (Hogler 1996).

In 1994 a WDNR biologist identified and confirmed the presence of Eurasian water milfoil in Carstens Lake (Johnson 1994). For more information on Eurasian water milfoil please refer to the Lakes Element.

English Lake Manitowoc County T18N, R23E, Sec. 7

English Lake is a small, deep seepage lake in the outwash plain west of Newton. Silver Creek originates at English Lake. The lake covers 51 acres and has a maximum depth of 80 feet. The lake supports a viable warm/cool water fishery that includes largemouth bass and northern pike. Walleye stocking occurs in alternating years. Volunteers sample English Lake as part of the self-help monitoring program.

English Lake received a high ranking using the nonpoint source criteria developed for lakes and is therefore eligible as a Priority Lake Project under the nonpoint source program. Using the phosphorus classification scheme, English Lake falls into Class 1B. The lake's water quality is threatened by agricultural runoff that results in dense algal blooms during the open water season. A few fields are tiled to the lake edge, which would add to the runoff problem. Best management practices implemented in this lake's watershed would protect the lake's viable fishery and its aesthetic value.

English Lake is a high priority for sensitive area designation. Sensitive areas are areas of aquatic vegetation offering critical or unique fish and wildlife habitat, water quality protection, or erosion control benefits to the lake. Refer to the Aquatic Plant Management Program in the Lakes Report for additional information on sensitive area designation.

The Bureau of Research collected a sediment core from the lake in the summer of 1991. The information from this core provided an important historical perspective of the lake's changing trophic status when tied to known landuse changes.

Lake Planning Grants were awarded to English Lake in 1991 and 1992 to complete the following:

* Determine lake water quality.
* Identify cause(s) of water quality problems.
* Increase awareness of property owners regarding water quality problems.

* Map and identify aquatic plant communities.

WDNR staff working with Wisconsin DOT personnel helped purchase and implement a detention pond that has improved water quality by protecting the lake from agricultural runoff. Sensitive upland areas have been defined through the planning grant process and existing priority watershed programs.

Gass Lake Manitowoc County

Gass Lake is a small seepage lake covering 6 acres and having a maximum depth of 24 feet. A public boat ramp provides public access.

Hartlaub Lake Manitowoc County T18N, R23E, Sec. 10

Hartlaub Lake, a seepage lake forming the headwaters of Calvin Creek, has an area of 38.4 acres, a maximum depth of approximately 60 feet, and a mean depth of 20 feet. The total shoreline length is 1.2 miles, of which 0.01 miles are publicly owned. There are six acres of adjoining woody wetlands. The drainage basin covers 1 square mile. Northern pike are present, while largemouth bass and panfish are common.

Monitoring data show high phosphorus concentrations, which add to its eutrophic, or nutrient-rich, condition. An extensive fish kill occurred in the spring of 1995. Dozens of largemouth bass and hundreds of bluegills were observed dead in the lake. The cause of this spill could not be determined with certainty although nutrient levels, especially phosphorus were very high. Land use around the lake includes undeveloped land as well as tile lines that drain agricultural fields and empty into the lake. Additional monitoring would identify pollution sources and aid the lake management process.

The Hartlaub Lake Association, along with the Manitowoc County Soil and Water Conservation Department and WDNR staff are documenting extensive water quality problems associated with runoff from agricultural practices and their impacts on the lake. When all controllable phosphorus sources are addressed, the option of a lake rehabilitation plan may be feasible. The Hartlaub Lake Association would like to apply for a Lake Planning Grant to fund the rehabilitation plan process (Rasman 1996).

Silver Lake Manitowoc County T19N, R23E, Sec. 33, 34

Silver Lake has an area of 67 acres, a maximum depth of 40 feet, and a mean depth of 16 feet. Total shoreline length is 2.20 miles, of which a portion, including a boat ramp, is open to the public. The existing watershed for the lake covers 12,000 acres and includes English Lake, which intermittently drains into the lake via Silver Creek. Historically Silver Creek did not drain into Silver Lake as it currently does. A road construction project in the 1930s diverted Silver Creek into Silver Lake and resulted in the lake receiving drainage and nutrients from a much larger watershed. About 10 acres of wetlands adjoin the lake. Silver Creek enters at the northeast end of the lake and exits a short distance away. A feasibility study completed in 1985, indicated that approximately 95 percent of the annual phosphorus loading to the lake was delivered by Silver Creek. Holy Family Convent and minimal residential development surround the lake. Northern pike and panfish are common, and largemouth bass are present.

A current project proposes to rectify the artificially modified watershed for Silver Lake and restore it to more natural conditions by rerouting Silver Creek so that it doesn't drain into the lake. This project has a large group of partners and support and will most likely be implemented between 2001-2003. By rerouting Silver Creek, the drainage basin for Silver Lake can be reduced from 12,000 acres to 500 acres and reduce the nutrient loading to the lake by as much as 95%. After the diversion project is completed a rough fish control project will be implemented using Rotenone. Once the rough fish populations have been controlled a lake alum treatment will implemented to remove excess nutrients from the water column and form a cap to minimize future recirculation of lake bed sediments and nutrients. Fish

stocking will be the last step in the recovery process. Post project aquatic plant management activities will focus on establishing and maintaining a healthy aquatic plant community that provides high quality habitat.

In 1965 the lake was treated with toxaphene to eradicate rough fish. The lake was restocked, but carp returned and are present at nuisance levels.

Using the phosphorus classification scheme, Silver Lake falls into Class 1B category. A lake management district was created in 1979 and a lake feasibility study done in 1980 (WDNR 1985). Silver Lake is severely limited by excessive algae and both winter and summer fish kills. Small panfish, and bullheads are the main components of the fishery (Hogler, 1996). Northern pike, sucker and carp seasonally run to Silver Lake to spawn. The northern pike will travel even further than Silver Lake to Silver Creek marshy areas to headwaters to spawn (Hogler 1995). The results of the lake feasibility study indicate the lake is hyper-eutrophic with the phosphorus loading more than 20 times the acceptable level. Reductions in the phosphorus loading would allow the trophic status of the lake to improve. The lake has excellent fishery potential, but is limited by the extremely poor water quality and the large, persistent rough fish population. In the lake feasibility study the annual phosphorus loading to Silver Lake was estimated to be approximately 10,000 pounds per year, with 97 percent of the loading attributed to agricultural sources.

The lake's watershed contains 78 livestock operations estimated to produce the majority of the remaining phosphorus loading to Silver Lake. This estimate includes barnyard runoff and phosphorous loading from spread manure. Streambank erosion accounts for a negligible portion of the phosphorus loading to Silver Lake. The Holy Family Convent waste water treatment plant serves the Holy Family Convent, Silver Lake College, St. Joseph Church and School, and a convent retirement home. The treatment plant was originally constructed in 1950. In 1969, chlorination equipment was added. In 1972, the facilities were further upgraded with the addition of phosphorus removal equipment and buildings over the Imhoff tank and trickling filter (WDNR 1996). In 1996, a dechlorination system was added to the wastewater treatment plant (Free, 1996).

The Silver Lake Protection and Rehabilitation District has received two lake planning grants. Some of this funding was used to determine total phosphorus and water budgets for the lake. Funds were also used for planning a partial diversion of Silver Creek, which may eliminate some of the nutrient inputs to the lake. Once the diversion is completed carp and bullhead populations need to be controlled, and then an aluminate treatment, and possibly aeration, would be used to remove phosphorus from the water column. NR 120 will fund 70 percent of the cost of the aluminate treatment, but none of the diversion costs. The plan was developed under the lake planning grant and is in the implementation stage (Rasman 1995). A partial diversion was completed in fall 1995, utilizing Lake Protection Grant Program funds. Eventually it is hoped to completely divert Silver Creek around the lake, at which point fisheries management will address future management needs. A hydraulic evaluation of the partial diversion of Silver Creek was conducted between September, 1996, and May, 1997. Modeling and monitoring was also conducted to determine the present fraction of Silver Creek inflows that move directly to the outlet from Silver Lake without mixing the lake water and evaluate alternative schemes to maximize inflow bypassing. A project report was completed in July, 1997. This study was a cooperative effort among several agencies: UW-Madison, WDNR, Manitowoc County Soil & Water Conservation Department, and the Silver Lake Protection and Rehabilitation District.

A fish kill was reported on April 19, 1996, thousands of dead fish were observed floating in Silver Lake. Low dissolved oxygen levels was the suspected cause of the kill. Fisheries staff surveyed the lake by examining the entire shoreline, and multiple transects across open water to determine the species affected, and the mortality numbers for each species. A total of 5,791 dead fish were counted. This included 5,598 carp, 186 panfish (mostly black crappie), 1 black bullhead, 1 walleye, 2 largemouth bass, and 3 white sucker. The Silver Lake Protection and Rehabilitation District members and many other volunteers removed the dead fish from the lake, and reported that 18,000 pounds were taken the landfill. To determine the fish species remaining in the lake Fisheries Management set two fyke nets for three nights each. A total of 298 fish were caught; 92 golden shiner, 77 black crappie, 64 black bullhead, 27 yellow

perch, 16 northern pike, 14 white sucker, and 8 carp. Additional surveys may be conducted to further assess the remaining fish populations (Hogler 1996).

Weyers Lake Manitowoc County

Weyers Lake is a small seepage lake covering 6 acres and having a maximum depth of 32 feet. A public boat ramp provides public access.

Table 6. Sevenmile - Silver Creeks Watershed (MA01) - Lake Management & Trophic State Information

Part 1 of 3

Lake Name	County	WBIC	Twn-Rng-Sec	Surface Area (acres)	Maximum Depth (feet)	Lake Type	History of Winter Kill	Access
Carstens Lake	Manitowoc	66800	T18N, R23E, S17	21	28	Drained	Occassional	Boat Ramp
English Lake	Manitowoc	68100	T18N, R23E, S07	51	80	Drained	No	Barrier-free
Hartlaub Lake	Manitowoc	67200	T18N, R23E, S10	34	60	Drained	Occassional; extensive kill in 1995	Boat Ramp
Silver Lake	Manitowoc	67400	T19N, R23E, S34	69	43	Drainage	Occassional	Boat Ramp
Gass Lake	Manitowoc	67100	T18N, R23E, S03	6	24	Seepage	Occassional to Frequent	Boat Ramp
Glomski Lake	Manitowoc	45400	T18N, R23E, S04	9	43	Seepage	Unknown	No Access
Kasbaum Lake	Manitowoc	45800	T18N, R23E, S03	9	68	Seepage	Unknown	No Access
Teek Lake	Manitowoc	67700	T18N, R23E, S28	5	36	Drainage	Occassional	No Access
Vetting Lake	Manitowoc	67900	T19N, R23E, S32	4	34	Seepage	Unknown	No Access
Weyers Lake	Manitowoc	49400	T18N, R23E, S10	6	32	Seepage	Occassional	Boat Ramp

Table 6. Sevenmile - Silver Creeks Watershed (MA01) - Lake Management & Trophic State Information

Part 2 of 3

		Mercury	Eurasion	Lake	Planning or
		fish consumption	Water	Management	Protection
Lake Name	Self Help	advisory	Milfoil	Organization	Grants
Carstens Lake		None Listed	Present	ASSC	(LPL #441 Cartsens/Weyers Lakes LMP) Aerator
English Lake	Secchi	None Listed; multiple species tested in 1996	None Reported	DIST	(LPT #79, LPL #341, LPL # 437, LPL # 438, LPL #132)
Hartlaub Lake	Secchi	None Listed	None Reported	ASSC	
Silver Lake		None Listed; multiple species tested in 1994	None Reported	DIST	(LPT #36, LPT #151, LPL #227)
Gass Lake		None Listed	None Reported	ASSC	
Glomski Lake		None Listed	None Reported	Recommended; see comments	
Kasbaum Lake		None Listed	None Reported	Recommended; see comments	
Teek Lake		None Listed	None Reported	Recommended; see comments	
Vetting Lake		None Listed	None Reported	Recommended; see comments	
Weyers Lake		None Listed	None Reported	ASSC	(LPL #441 Cartsens/Weyers Lakes LMP)

Table 6. Sevenmile - Silver Creeks Watershed (MA01) - Lake Management & Trophic State Information

Part 3 of 3

	Lake Trophic State Information				Phosphorus	Additional
	TSI	TSI	TSI	TSI	Sensitivity	Comments
Lake Name	Class	Total Phos	Secchi Depth	Chl A	P Class	
Carstens Lake	Eutrophic	GSM=64.0	GSM=55.7	GSM=59.7	I-B	GSM = Growing Season Mean
English Lake	Meso to Eutrophic	TSI's mostly Eutrophic ranging from 50 to 80	Highly variable, mostly Mesotrophic; TSI's ranging from 35 to 55	TSI's Eutrophic ranging from 50 to 60	I-B	1996 Mercury sampling based on 29 fish including: Walleye, LMB, Northern Pike, Black Bullhead, Yellow Perch, Bluegill, Black Crappie
Hartlaub Lake	50-80, EU				I-B	
Silver Lake	52-71, EU				I-B	1994 Mercury sampling based on 13 fish including: LMB, Yellow & Black Bullhead, Yellow Perch, Bluegill, Black Crappie
Gass Lake					I-B	occasional to frequent fish kills
Glomski Lake					I-B	Individual Lake Management Organization may not be practical; Check to see if they are a member of the Manitowoc County Lakes Association
Kasbaum Lake					I-B	Individual Lake Management Organization may not be practical; Check to see if they are a member of the Manitowoc County Lakes Association
Teek Lake					I-B	Individual Lake Management Organization may not be practical; Check to see if they are a member of the Manitowoc County Lakes Association
Vetting Lake					I-B	Individual Lake Management Organization may not be practical; Check to see if they are a member of the Manitowoc County Lakes Association
Weyers Lake	Meso / Eutrophic	GSM=52.6	GSM=48.8	GSM=48.4	I-B	GSM = Growing Season Mean

LOWER MANITOWOC RIVER WATERSHED (MA02)

Existing Management and Monitoring Recommendations

1. FMHP staff should seek easement acquisition along the Manitowoc River to increase water quality protection, and to obtain angler access by using the Stewardship Program.

2. FMHP staff should update and approve the Draft Manitowoc/Branch River Fisheries Plan.

3. FMHP staff should, as per the Manitowoc/Branch River Fisheries Plan, maintain, improve and protect fish habitat in the Manitowoc River.

4. Basin staff have reviewed the classification for Mud Creek at Reedsville, and have determined that the stream should be reclassified from a LAL to a WWFF. The change should be reflected in the next revision of Chapter NR 104 Wisconsin Administrative Code.

5. Basin staff should work with central office staff to identify potential sources of funding to establish a basin assessment fixed station stream monitoring site on Mud Creek and the Manitowoc River to assess long-term water quality trends in the Manitowoc River Basin .

6. Basin staff should should work with central office staff to identify potential sources of funding to conduct fixed station (ambient) monitoring on the Manitowoc River at HWY JJ to assess long-term water quality data and to meet the statewide water quality monitoring network goals .

7. Basin staff should work cooperatively with Bureau of WT staff to secure funds to continue operating the U.S. Geological Survey flow gauging station on the Manitowoc River at HWY JJ .

Stream Descriptions

Manitowoc River

The main stem of the Manitowoc River, formed by the confluence of the North and South branches of the Manitowoc River, flows eastwardly approximately 36 miles before entering Lake Michigan at the city of Manitowoc. The river has two distinct portions: The upper half, above Clarks Mills, is wide, sluggish, and marshy with a soft bottom and a gradient of about one foot per mile; below Clark Mills, the gradient increases to about 12 feet per mile, the river becoming shallow and fast, with a bottom composed primarily of rock in sizes from gravel to boulder, with an occasional sand bar. The steep gradient continues 16.4 miles downstream to the Manitowoc Rapids where 4.8 miles upstream from Lake Michigan the river slows as it approaches lake level. This lower stretch of river has deep natural pools and dredged areas (Peeters 1990). The overall water quality, based on the Hilsenhoff Biotic Index, was good (1990) at the two stations monitored below the Clarks Mills Dam. The stream habitat evaluation at these same sites were fair to good (1990). One site was also monitored above the Clarks Mills Dam. The biotic index rated the stream as fair and the stream habitat as good (WDNR 1995). Additional monitoring will

be conducted on the Manitowoc River as part of the basin long-term water quality trend assessment. Refer to the recommendations report for more information.

Historic reductions in the percentage of forested and wetland vegetation have resulted in a watershed that lacks adequate opportunities for infiltration and retention of precipitation and snow melt resulting in flashy runoff which overwhelms existing stream channels and aquatic habitat. This excessive runoff also strips valuable sediments and nutrients from the terrestrial environment and delivers them to our streams and lakes where they result in degraded water quality and poorer habitat which can kill sensitive and intolerant fish and aquatic invertebrates. Flashy runoff also limits the amount of water available to sustain adequate flows during drought. Restoration efforts should focus on increasing the overall percentage of forested and wetland vegetation in this watershed to restore a more natural hydrologic regime and minimize the impacts of flashy runoff and an altered hydrologic regime.

Most of the land use along the river is agricultural. The upper reaches are extensive river bottoms that are difficult, if not impossible, to farm in some locations. These wet soils are conducive to erosion and runoff; the lower reach of the river flows through Manitowoc. There are nearly 150 acres of adjoining wetlands in the vicinity to the west of the Collins Marsh area. The wide-open, non-wooded stretch of river 10 miles upstream of Clarks Mills is a wildlife area of concern.

Beginning in the 1960s and continuing into the 1980s, the area of the Manitowoc River below the dam at Manitowoc Rapids was managed as part of the Lake Michigan trout and salmon program. When the trout and salmon program began in the 1960s, hatchery trucks simply delivered trout and salmon to Lake Michigan harbors. Trout and salmon stocking programs have changed throughout the years with modified fish management techniques. Tiger trout are no longer stocked; coho salmon stockings were moved to the south end of Lake Michigan, and lake trout stockings were moved to reefs in protected refuges.

In the 1970s and early 1980s, snagging of fish was allowed in rivers where salmon had been stocked and were returning as mature adults on a dead end spawning run. As part of this policy, chinook salmon were stocked and snagging was permitted in the Manitowoc River.

In the early 1980s, an internal WDNR steelhead trout committee worked to improve a faltering rainbow trout program, placing emphasis on stocking improved steelhead strains of rainbow trout in select rivers to improve the recreational fishery. Snagging was not compatible with this program, which established guidelines precluding steelhead stocking in rivers where snagging was allowed.

In 1983, the dam on the Manitowoc River at Manitowoc Rapids was removed. In preparation for developing a steelhead trout project on the Manitowoc River, chinook salmon stocking was moved away from the river in 1983 and in 1984 the snagging season was discontinued in the Manitowoc River. The Manitowoc River is one of the Lake Michigan tributaries being managed by the WDNR as a Class I steelhead stream and as such receives annual smolt stockings of the chambers creek, ganaraska, and skamania strains of steelhead. The river also receives stockings of brook trout, brown trout, chinook and coho salmon.

In 1944, the Oslo dam on the Manitowoc River upstream of North Union Road was abandoned. A section of the dam failed in the 1960s, and in 1985, the dam was breached and much of the material was removed from the stream to allow upstream migration of fish. Finally the dam was removed, in the early 1990s. The Manitowoc Fish and Game Club developed the site as a public angler access area (Surendonk 1996).

Fish management of the Manitowoc - Branch River system changed significantly in the spring of 1986 when, as part of the larger steelhead trout study, anadromous strain steelhead were stocked in the Branch

River. From 1986 through 1988, more than 430,000 steelhead smolt were stocked in the Branch River. These steelhead smolt were released in an upriver area to improve imprinting and subsequent homing by adults to the Manitowoc - Branch River system. Fall fingerling coho were also stocked into the Manitowoc River system in 1988. This represents the first plant of coho in the Manitowoc River in more than a decade. Ongoing steelhead surveys will facilitate evaluations of this coho plant. A WDNR Lake Michigan Steelhead Management Plan calls for continued steelhead stockings in the Manitowoc - Branch River system. Currently, Fisheries Management and Habitat Protection staff stock chinook and coho salmon, brown trout, brook trout, and two strains of steelhead in the Manitowoc River. Stockings may occur in downtown Manitowoc (across from the submarine), or at upstream locations (Manitou Park or HWY "S").

The Water Resources Division of the U.S. Geological Survey, in cooperation with local, State and Federal agencies, obtains a large amount of data pertaining to the water resources of Wisconsin each year (Holmstrom 1995). A gaging station is located on the Manitowoc River on the right bank 300 feet upstream from the County Trunk Highway JJ bridge, just west of the Manitowoc city limits and 6.6 miles upstream of the mouth. Discharge data has been collected since July 1972. Please refer to the U.S. Geological Survey *Water Resource Data Wisconsin Water Year 1995* for specific data. Funding should be secured to continue operating this U.S. Geological Survey gauging station to maintain adequate flow records in the Manitowoc Geological Management Unit (GMU).

Little Manitowoc River

The Little Manitowoc River is small tributary that enters Lake Michigan on the north side of city of Manitowoc. The lower 1.5 miles of the river are within the city limits of Manitowoc. The stream has a slight gradient and stream bottom consists of gravel and rubble. The overall water quality, based on the Hilsenhoff Biotic Index, was fair (1979), and fair (1990). Stream habitat evaluations rated the stream as fair (1990). Spring and fall runs of smelt and salmon occur when sufficient flow is available to permit entrance from Lake Michigan. The fishery is dominated by forage species.

Maple Grove Swamp

Maple Grove Swamp is located in the northwest portion of Manitowoc County, near the town of Maple Grove. This area is wet but has little or no permanent standing water. The swamp has a low elevation that keeps it too wet to farm. Historically it may have been dominated by coniferous stands, but presently are dominated by bottomland hardwoods. The swamp is privately owned, divided among many landowners, but at little risk to alteration. Primary interest in ownership is deer hunting land.

Mud Creek

Mud Creek originates in a marsh area in the southeast corner of the town of Holland in southern Brown County and flows southward for 15 miles through Manitowoc County before joining the main stem of the Manitowoc River. Mud Creek has a rather low gradient and sluggish flow with a $Q_{7, 10}$ of 0.12 cfs one mile south of Reedsville. (The $Q_{7, 10}$ is the seven-day mean flow below which the flow will fall an average of once in 10 years.) Above Reedsville the $Q_{7, 10}$ is .04 cfs. The stream flows through Reedsville and drains Maple Grove Swamp on the north and Collins Marsh on the south. The stream, especially where impounded, has a high supportive value for wildlife, with more than 2,000 acres of adjoining wetlands.

The overall water quality, based on the Hilsenhoff Biotic Index, was fair and poor (1990) at the two stations monitored. The stream habitat evaluation at these same sites were fair (1990). Additional

monitoring will be conducted on the Manitowoc River as part of the basin long-term water quality trend assessment. Refer to the recommendations report for more information.

The current stream classification for Mud Creek is Limited Aquatic Life (LAL). The district water quality biologist suggests that the classification for Mud Creek be changed to a warm water forage fishery (WWFF) in the next revision of NR 104. This proposed change may require more strict effluent limits for the **village of Reedsville WPDES permit**. The village of Reedsville is presently upgrading their WWTP to provide a higher level of treatment. An oxidation ditch with ultraviolet disinfection is being constructed, capable of providing treatment to 10mg/l BOD_5

Mud Creek (Hills, Left)

Mud Creek (also known as Hills or Left Creek) flows through predominantly agricultural lands with some wetlands areas before discharging into the main stem of the Manitowoc River. The overall water quality, based on the Hilsenhoff Biotic Index, was fair (1990). Stream habitat evaluations rated the stream as fair (1990).

Schisel Creek

Schisel Creek originates from Schisel Lake, flows south to Bergene Lake and eventually enters the Manitowoc River. Small panfish may inhabit certain areas, but minnows are the principal occupants of this stream. Sediment and nutrients entering the stream is causing adverse impacts on water quality including habitat impairment, and excessive aquatic plant growth. The overall water quality, based on the Hilsenhoff Biotic Index, was fair (1990) at the two stations monitored. The stream habitat evaluations at these same sites were fair (1990).

Vanderbloemen Bog State Natural Area

Vanderbloemen Bog State Natural Area is 24 acres is size and located 2.3 miles south east of St. Nazianz. The site contains an undisturbed open bog with successional patterns to hardwood swamp. The bog lies within the end moraine of the Valders stage of Wisconsin glaciation. The site features a quaking bog without open water. Typical bog species include pitcher plant, sundews, moccasin flower, and cranberries. Surrounding the open bog is a fringe of tamarack, black spruce, and white pine. The outer edge of the area is wooded with white birch, red maple, and black ash. Nesting birds include wood thrush, veery, crested flycatcher, ovenbird, northern oriole, and goldfinch. Compatible uses include research, group use, and hiking. Management and land control lies with the Biology Department at Silver Lake College in Manitowoc. Site inspections and monitoring are conducted periodically. The site is used by Silver Lake College for class trips and research. Any other educational or research use requires permission. The site was designated a state natural area in September 1966 (WDNR 1989). A plant list, research reports and breeding bird surveys are on file.

Table 8. Lower Manitowoc River Watershed (MA02) - Stream Information - Part 1 of 4

Counties: Manitowoc

Square Miles: 168

NAME OF STREAM	WBIC	LENGTH (MILES)	EXISTING Biological Use USE/MILES	POTENTIAL Biological Use (MILES)	Supporting Assessment Category	Assessment Data	Codified CLASS
Little Manitowoc River	82500	7	WWSF (7.0)	WWSF	Parrtially	M	**Default**
Unnamed Tributary							
T19N, R23E, S12	82600	**4**	LAL (4.0)	LAL	Unknown	M	**Default**
Manitowoc River	71000	36	WWSF (36)	WWSF	Partially	M	**Default**
Unnamed Tributaries							
T19N, R23E, S17	72400	1	Unknown				**Default**
T19N, R22E, S31	73500	3	LAL (3.0)	LAL	Fully		LAL
Mud Creek (T18N, R21E, S12)	73600	10	WWFF (10.0)	WWFF	Partially	M	**Default**
Unnamed Tributaries							
T18N, R21E, S13	73700	4	WWFF (4.0)	WWFF	Fully		LFF **(Should be WWFF)**
T18N, R21E, S13	73800	2	Unknown				**Default**
T18N, R21E, S24	73900	<1	Unknown				**Default**
T18N, R21E, S14	74400	1	Unknown				**Default**
T18N, R22E, S15	74500	1	Unknown				**Default**
T18N, R22E, S22	74600	<1	Unknown				**Default**
Mud Creek (T19N, R21E, S34)	75000	0-4.5	LFF (4.5)	LFF	Partially	M	LFF
		4.5 - 20	WWSF (15.5)	WWSF	Partially	M	Default **(Change to WWSF)**
Unnamed Tributaries							
T19N, R21E, S23	75300	6	Unknown				**Default**
T19N, R21E, S02	75500	3	Unknown				**Default**
T19N, R21E, S02	75600	2	Unknown				**Default**
T18N, R21E, S23 (St. Nazianz Trib ?)	**Determine WBIC !**	2	LAL (2.0)	LAL			LAL
Schisel Creek (T19N, R22E, S24)	72600	0-1.5	WWFF (1.5)	WWFF	Partially	M	WWFF
		1.5-2.0	Cold (0.5)	Cold	Fully		**Default (add to Trout Book; then,Change to Cold)**
Unnamed Tributaries							
T19N, R22E, S30	73200	2	Unknown				**Default**

Table 8. Lower Manitowoc River Watershed (MA02) - Stream Information - Part 2 of 4

Counties: Manitowoc
Square Miles: 168

NAME OF STREAM	LENGTH (MILES)	HBI Water Quality "Integrity Indicator"	Joe Ball Habitat Form 3200-68, 1-85 sm= stream mile from mouth
Little Manitowoc River	7	6.6 (fair), fall 1990 (sm=2.2) X=6.1 (fair), fall1987 (sm=2.2)	195 (fair), spring 1991 (sm=2.2) 139 (fair), fall 1990 (sm=2.2)
Unnamed Tributary			
T19N, R23E, S12	**4**		
Manitowoc River	36	4.9 (good), fall 1990 (sm=17) 9.1 (very poor), fall 1996 (sm=26) **art. sub.** 7.1 (fairly poor), summer 1996 (sm=26) **art. sub.** 5.03 (good), fall 1990 (sm=26) 6.1 (fair),	82 (good), spring 1991 (sm=17) 147 (fair), fall 1990 (sm=17) 186 (fair), fall **1996** (sm=26) 161 (fair) spring 1991 (sm=26) 125 (good) fall 1990 (sm= 26) 192 (fair) spring 1991 (sm=28.5) 139 (fair) fall 1990 (sm=28.5) 121 (good) sp
Unnamed Tributaries			
T19N, R23E, S17	1		
T19N, R22E, S31	3		
Mud Creek (T18N, R21E, S12)	10		122 (good), spring 1991 (sm=2) 159 (fair), fall 1990 (sm=2)
Unnamed Tributaries			
T18N, R21E, S13	4		
T18N, R21E, S13	2		
T18N, R21E, S24	<1		
T18N, R21E, S14	1		
T18N, R22E, S15	1		
T18N, R22E, S22	<1		
Mud Creek (T19N, R21E, S34)	0-4.5	8.3 (poor) fall 1996 (sm=0.8) **art. sub. (see comments)**	159 (fair) spring 1991 (sm=3.8) 152 (fair) fall 1990 (sm=3.8)
	4.5 - 20	8.0 (poor) fall 1990 (sm=9)	164 (fair), spring 1991 (sm=9) 167 (fair) fall 1990 (sm=9)
Unnamed Tributaries			
T19N, R21E, S23	6		
T19N, R21E, S02	3		
T19N, R21E, S02	2		
T18N, R21E, S23 (St. Nazianz Trib ?	2		
Schisel Creek (T19N, R22E, S24)	0-1.5	4.58 (good), fall 1990 (sm=0.2) 4.82 (good), fall 1987 (sm=0.2)	164 (fair), spring 1991 (sm=0.2) 131 (fair), fall 1990 (sm=0.2) 185 (fair), spring 1991 (sm=1.0) 158 (fair) fall 1990 (sm=1.0)
	1.5-2.0		
Unnamed Tributaries			
T19N, R22E, S30	2		

Table 8. Lower Manitowoc River Watershed (MA02) - Stream Information - Part 3 of 4

Counties: Manitowoc
Square Miles: 168

		PCB Fish	**Environmental Problems**			
	LENGTH	Consumption				
NAME OF STREAM	(MILES)	Advisory	SOURCE	IMPACT	REFERENCES	TREND
Little Manitowoc River	7		NPS, Stream Bank Erosion	Hab, Nut, Turb	1, 9, 10, 28	Unknown
Unnamed Tributary						
T19N, R23E, S12	**4**		NPS, Cropland, Barnyards	Habitat	28	Unknown
Manitowoc River	36	Channel Catfish >20" should not be eaten Channel Catfish <20" should not be eaten more than once every two months Smallmouth Bass should not be eaten more than once a month Northern Pike should not be eate	NPS, Stream Bank Erosion	PCB, Hab, Nut, Turb	1, 9, 10, 27, 28, 45, 51	Unknown
Unnamed Tributaries						
T19N, R23E, S17	1		Point Source Industrial, Point Source Municipal	Heavy Metals, Fish Consumption Advisory, PCB		Unknown
T19N, R22E, S31	3				27,78	Unknown
Mud Creek (T18N, R21E, S12)	10		NPS	Sed, Turb, Hab	1,9,10, 28	Unknown
Unnamed Tributaries						
T18N, R21E, S13	4				1,9,10, 78	Unknown
T18N, R21E, S13	2					Unknown
T18N, R21E, S24	<1					Unknown
T18N, R21E, S14	1					Unknown
T18N, R22E, S15	1					Unknown
T18N, R22E, S22	<1					Unknown
Mud Creek (T19N, R21E, S34)	0-4.5		NPS, Stream Bank Erosion	Turb, Sed, Hab	1,9,10,27,28,78	Unknown
	4.5 - 20					
Unnamed Tributaries						
T19N, R21E, S23	6					Unknown
T19N, R21E, S02	3					Unknown
T19N, R21E, S02	2					Unknown
T18N, R21E, S23 (St. Nazianz Trib ?)	2		Point Source Municipal		1,10	Unknown
Schisel Creek (T19N, R22E, S24)	0-1.5		NPS	Sed, Turb, Nut, Hab, and Aquatic Plants	1,9,10, 28	Unknown
	1.5-2.0					
Unnamed Tributaries						
T19N, R22E, S30	2					Unknown

Table 8. Lower Manitowoc River Watershed (MA02) - Stream Information - Part 4 of 4

Counties: Manitowoc
Square Miles: 168

NAME OF STREAM	LENGTH (MILES)	Comments	Data Reliability Level 1-least 4-most	NPS Rank	Additional Comments
Little Manitowoc River	7	N	1+	High	(stream mile 2.2 = CTH B) 1987 HBI is a mean of 3 replicates
Unnamed Tributary					
T19N, R23E, S12	**4**		1	High	MWBF lists as <1 mile long; Basin Report lists as 4 mile long
Manitowoc River	36	N / R	2	High	(stream mile 17 =CTH H) (stream mile 26 = CTH JJ) (stream mile 28.5 = Quarry Rd) Clarks Mills Dam and it's associated impoundment are negatively impacting the Lower Manitowoc River in several ways. It disrupts fish migration for Northern Pike, Salmon, and Trout. It also alters the natural transport of fine and course organic particulate matter, sediments, diurnal DO and temperature, and other important natural stream ecosystem functional values. Removal should be considered when future costly repairs or replacement are needed.
Unnamed Tributaries					
T19N, R23E, S17	1		1	High	
T19N, R22E, S31	3		1	High	
Mud Creek (T18N, R21E, S12)	10	N	1	High	(stream mile 2 = CTH A)
Unnamed Tributaries					
T18N, R21E, S13	4		1	High	
T18N, R21E, S13	2		1	High	
T18N, R21E, S24	<1		1	High	
T18N, R21E, S14	1		1	High	
T18N, R22E, S15	1		1	High	
T18N, R22E, S22	<1		1	High	
Mud Creek (T19N, R21E, S34)	0-4.5	N / R	2	High	HBI @ stream mile 0.8 is influenced by Lentic ecology of Collins Marsh (stream mile 0.8 = CTH JJ) (stream mile 3.8 = Hill
	4.5 - 20				(stream mile 9 = Taus Rd)
Unnamed Tributaries					
T19N, R21E, S23	6		1	High	
T19N, R21E, S02	3		1	High	
T19N, R21E, S02	2		1	High	
T18N, R21E, S23 (St. Nazianz Trib ?)	2		1	High	
Schisel Creek (T19N, R22E, S24)	0-1.5	N	2	High	(stream mile 0.2 = Petska property crossing near mouth) (stream mile 1.0 = Morgan Rd)
	1.5-2.0				
Unnamed Tributaries					
T19N, R22E, S30	2		1	High	

Lake Descriptions

Bullhead Lake Manitowoc County T19N, R20E, Sec. 17

Bullhead Lake is a 67-acre landlocked seepage lake lying in an outwash plain, with hard, alkaline water and a maximum depth of 40 feet. The mean depth is 13 feet. There are 1.07 miles of shoreline of which 0.01 miles are publicly owned. Twelve acres of wooded wetlands adjoin the lake. The watershed encompasses 2.0 square miles. Hybrid Muskellunge were stocked in 1980, but it is unlikely any remain. Walleye have been stocked throughout the 1980s. Largemouth and smallmouth bass are common, and panfish are abundant. This lake is listed under a consumption advisory because of mercury levels. Pregnant women should not eat more than one meal a month of walleyes <18". Walleyes >18" should not be eaten by pregant or breastfeeding women, women who plan to have children, and children under 15. Everyone else should not eat any more than 26 meals a year for walleyes >18".

DNR staff treated the lake with aluminate on August 23, 1978. As part of a research project, aluminum sulfite was applied through the process of hypolimnetic injection. (See WDNR Tech. Bulletin #153). The treatment worked for almost 10 years before phosphorus levels reached pretreatment levels.

In 1986, the Bullhead Lake Association requested guidance from the WDNR due to high levels of phosphorus causing increased algal productivity. WDNR provided technical assistance for a second aluminum sulfite treatment applied on October 8, 1988, at four to six feet below the water surface in an area of the lake with depths greater than 12 feet. The treatment proved successful, although phosphorous levels as of 1991 are increasing.

Bullhead Lake is monitored by volunteers as part of self-help monitoring program. Secchi disc readings have been taken since 1986. Since 1990, Bullhead Lake has been part of the expanded self-help monitoring program. Dissolved oxygen, pH, phosphorus, and secchi data are now available from this expanded volunteer data collection program.

Bullhead Lake received a "High" ranking using the NPS criteria developed for lakes and is therefore eligible as a Priority Lake Project under the NPS program. Using the phosphorus classification scheme, Bullhead Lake falls into Class 1A (phosphorus sensitive). The water quality of the lake is threatened as recent data shows phosphorus values increasing just three years after the aluminum sulfite treatment. Cropping practices in the drainage area are degrading the water quality. The implementation of best management practices in the lake's watershed would protect the investment the lake district made through the application of aluminum sulfite and protect this high use lake and its aesthetic value.

The Bureau of Integrated Science Services (SS), in conjunction with the Northeast Region Lake Biologist, collected a sediment core from Bullhead Lake during the summer of 1991. The core was to be used to better characterize the trophic history of Bullhead Lake. This information can then be used to establish achievable water quality goals and better realize the potential for a full recovery of the lake. This technique has proven useful for the management and understanding of other lake systems in Wisconsin. The status for this core data is unknown.

The lake association applied in August 1995 and received a lake planning grant to characterize land use practices that impact water quality in Bullhead Lake. The district limnologist is working with the lake association to determine impacts of sediment delivery to the lake following significant rain events. Please refer to the district Watershed Management files for specific data on the lake study.

Big Clarks Mills Pond Manitowoc County T19N, R22E, Sec. 21, 28

An impoundment of the Manitowoc River, this waterbody covers 43 surface acres and is 6 feet deep.
The shoreline totals 2.47 miles, of which .01 miles are publicly owned. A 411 square mile watershed drains into this impoundment. There are no adjoining wetlands. Partially wooded areas and lawns are steeply sloped towards the pond. Abundant algae blooms severely reduce water clarity. Northern pike and largemouth bass are present, while panfish are abundant.

Schisel Lake Manitowoc County T19N, R22E, Sec. 13 (6)

Schisel Lake is a seepage lake in a terminal moraine drained by a small stream at the south end. This lake covers 12.5 surface acres, has a maximum depth of 33 feet, and a mean depth of 18 feet. The total shoreline length is 0.6 miles and has no public access. A 1.0 square mile watershed drains into the lake. A few houses and several docks are located along the shoreline. The Schisel family operates a boat livery on the lake. The surrounding watershed is entirely agricultural and moderate to severe slopes lead to the lake. Northern pike are present, while largemouth bass and panfish are common.

Table 9. Lower Manitowoc River Watershed (MA02) - Lake Management & Trophic State Information

Part 1 of 3

				Surface	Maximum	**Lake Management Information**		
				Area	Deth		History of	
Lake Name	County	WBIC	Twn-Rng-Sec	(acres)	(feet)	Lake Type	Winter Kill	Access
Clarks Mills Pond (Impoundment)	Manitowoc	73100	T19N, R22E, S28	43	6	Drainage / Impoundment	Unlikely	Roadside
Schisel Lake	Manitowoc	72800	T19N, R22E, S13	14	32	Seepage	Unlikely	No Access
Bullhead Lake	Manitowoc	68300	T19N, R21E, S19	67	40	Seepage	Likely	Barrier-free

Table 9. Lower Manitowoc River Watershed (MA02) - Lake Management & Trophic State Information

Part 2 of 3

		Mercury	Eurasion	Lake	Planning or
		fish consumption	Water	Management	Protection
Lake Name	Self Help	Advisory	Milfoil	Organization	Grants
Clarks Mills Pond (Impoundment)		None Listed	None Reported		
Schisel Lake		None Listed	None Reported		
Bullhead Lake	Expanded	Walleye 18"-26"; category 2 Walleye <18" category 1	None Reported	Association	LPL #318

Table 9. Lower Manitowoc River Watershed (MA02) - Lake Management & Trophic State Information

Part 3 of 3

	Lake Trophic State Information				Phosphorus	Additional
	TSI	TSI	TSI	TSI	Sensitivity	Comments
Lake Name	Class	Total Phos	Secchi Depth	Chl A	Class	
Clarks Mills Pond (Impoundment)					II-C	Clark's Mills Dam and it's associated Impoundment negatively impact the normal stream ecosystem functional values for the Lower, North Branch, and South Branches of the Manitowoc Rivers. Negative impacts include: prohibiting normal fish migration patterns for Northern Pike, Trout, Salmon, and other fish species, normal course and fine particulate organic matter transport, sediment transport, flow regimes, thermal dynamics, diurnal dissolved oxygen, and normal stream trophic functions.
Schisel Lake					I-C	
Bullhead Lake	Mesotrophic / Eutrophic	GSM=51.75	GSM=47.75	GSM=50.5	I-B	GSM=Growning Season Mean; TSI data is from 1993

*The current stream classification for Mud Creek is Limited Aquatic Life (LAL). The district water quality biologist suggests the classification for Mud Creek should be Warm Water Forage Fishery (WWFF) and that it be changed in the next revision of NR 104. This proposed change may require more strict effluent limits for the village of Reedsville WPDES Permit. See the narrative for Mud Creek for additional information.

**The expiration date of the WPDES permit was September 30, 1988. There has, however, been no discharge from the Manitowoc Confined Disposal Facility since 1984.

BRANCH RIVER WATERSHED (MA03)

Existing Management and Monitoring Recommendations

1. Basin staff should conduct assessment monitoring on streams in the Branch River subwatershed to further define nonpoint source problems. Assessment monitoring should include stream habitat surveys (Simonson et al., 1993) to help identify stream segments that are degraded because of the lack of adequate buffers and vegetative filter strips. This information will help guide and acquire funding from the Conservation Reserve Enhancement Program (CREP), the Targeted Runoff Management (TRM) program, and other conservation funding programs for the areas of greatest need.

2. Basin staff should work with central office staff to identify potential sources of funding to conduct basin assessment fixed station stream monitoring on the Branch River to assess long-term water quality trends in the Manitowoc River Basin .

3. Basin staff should identify sensitive areas around Kellners Lake as defined in NR 107 .

4. Basin staff should seek easement acquisition along the Branch River to increase water quality protection, and to obtain angler access by using the Stewardship Program .

5. FMHP and Facilities and Lands staff should update and approve the Manitowoc/Branch River Fisheries Plan .

6. FMHP and Facilities and Lands staff should, as per the Manitowoc/Branch River Fisheries Plan, maintain, improve and protect fish habitat in the Branch River .

7. Basin staff should recruit a self help monitoring person to conduct trophic status index monitoring on Hemptons Lake .

Streams Descriptions

Branch River

The Branch River, like the Manitowoc River, exhibits a dual "personality." Upstream from Taus Road, the Branch River is slow and soft bottomed with a stream gradient of about one foot per mile. Downstream from Taus Road the Branch River drops about 11 feet per mile through a rocky channel for 11.2 miles before it joins the Manitowoc River 11.4 miles from Lake Michigan.

Historic reductions in the percentage of forested and wetland vegetation have resulted in a watershed that lacks adequate opportunities for infiltration and retention of precipitation and snow melt resulting in flashy runoff which overwhelms existing stream channels and aquatic habitat. This excessive runoff also strips valuable sediments and nutrients from the terrestrial environment and delivers them to our streams and lakes where they result in degraded water quality and poorer habitat which can kill sensitive and intolerant fish and aquatic invertebrates. Flashy runoff also limits the amount of water available to sustain adequate flows during drought. Restoration efforts should focus on increasing the overall

percentage of forested and wetland vegetation in this watershed to restore a more natural hydrologic regime and minimize the impacts of flashy runoff and an altered hydrologic regime.

The Branch River (Manitowoc County portion) has been classified as an exceptional resource water under NR 102. It is one of the few rivers in the state that provides steelhead trout (*Oncorhynchus mykiss*) fishing. The river also supports a unique fish resource, the Greater Redhorse (*Moxostoma valenciennesi*), which is worthy of special protection. The Greater Redhorse, which was listed as a special concern species in 1979 and upgraded to threatened in 1989, is sensitive to chemical pollutants, turbidity and siltation. Populations are threatened with domestic sewage and particulate runoff (Becker 1983). Siltation, turbidity and chemical pollutants may be even more of a limiting factor for the Redhorse's diet organisms. The river has also been proposed as a priority stream for the purchase of easements under the Stewardship Stream Bank Easement Program, NR 51.63.

The Bureau of Fisheries Management and Habitat Protection (FMHP) is working on developing a new fishery area on the Manitowoc and Branch rivers. FMHP staff propose to manage this area for angler access, habitat protection and fish habitat restoration. Specifics on the proposal are available in the 1990 Manitowoc/Branch River Fisheries Plan (Draft). The draft plan includes the area up to County Trunk Highway (CTH) J on the Branch River and up to Clark Mills on the Manitowoc River. A list of fish species found during a shocker survey in 1983 demonstrates the river supports good species diversity.

One particular stretch of the Branch River should be considered a key habitat area and acquired if possible. This particular stretch lies within property owned and managed by the Rahr Malting Company. About a mile of the Branch River runs through the approximately 365-acre Rahr property. In addition to the extensive Branch River frontage several large and stable springs that contribute significant flow to the Branch River are on this property. This spring flow is especially important to the stableness of the Branch River during seasons of lower river flow. This area has also served as important smolting habitat for stocked steelhead yearlings before they migrate to Lake Michigan. To date, all steelhead smolt stocked in the Manitowoc - Branch river system have been released within or just upstream from the Rahr property. This stretch of the Branch River also has several excellent adult steelhead holding areas. In 1996, a stretch of the Branch River became eligible for stewardship easement acquisition. Approximately 20 miles of the river between the Brown/Manitowoc County Line and downstream of North Union Road is eligible for easement acquisition for increased water quality protection. Since the Branch River is one of the better steelhead streams in the basin, easements should include angler access. The Branch River is managed by the WDNR as a Class I steelhead stream and as such receives annual smolt stockings of Chambers Creek and Skamania strains of steelhead. The river also receives stockings of coho salmon.

A proposed cold water discharge from the Lemberger Landfill Site (Superfund Site) could impact the fishery and other aquatic life in the Branch River near HWY J. Groundwater discharge typically is cold with low dissolved oxygen levels. Flow conditions may also affect the fishery. A consulting firm will be conducting pre and post surveys of the discharge area to determine what affect the discharge has on the fish community structure. The consultants will use John Lyons warmwater criteria, and calculate an Index of Biotic Integrity (IBI). The IBI is used to assess biotic integrity and environmental quality in streams. For additional information on the IBI method reference “Using The Index Of Biotic Integrity (IBI) To Measure Environmental Quality in Warmwater Streams Of Wisconsin” by John Lyons, printed by United State Department of Agriculture, General Technical Report NC-149. The pre-discharge survey is scheduled for June 1996 and discharge is to begin later this summer (1996). Additional water quality information was collected during the Branch River Priority Watershed Appraisal. Refer to the 1995 Branch River Priority Watershed Appraisal by Mary Gansberg Water Quality Biologist, WDNR Green Bay.

Table 11. Branch River Watershed (MA03) - Stream Information - Part 1of 4

Counties: Manitowoc, Brown

Square Miles: 108

NAME OF STREAM	WBIC	LENGTH (MILES)	EXISTING Biological Use USE/MILES	POTENTIAL Biological Use (MILES)	Supporting Assessment Category	Assessment Data	Codified CLASS
Branch River	71300	0-6.5	COLD III (6.5)	COLD III	Threatened	M	ERW
		6.5-38	WWSF (31.5)	WWSF	Threatened		WWSF
Unnamed Tributaries							
T19N, R22E, S03	71600	3	LFF 3.0)	LFF		E	LAL
T20N, R22E, S24	71400	4	COLD (4.0)	COLD		M	Default
T20N, R22E, S27	71500	3	WWSF (3.0)	WWSF		M	Default
T20N, R22E, S07	71800	2	Unknown (2.0)	Unknown		M	Default
T20N, R22E, S06	**Needs A WBIC !**	<1	WWFF (<1.0)	WWFF		M	Default
T20N, R22E, S06	71900	5	WWSF (5.0)	WWSF		M	Default
T21N, R21E, S09	**Needs A WBIC !**	1	LFF (1.0)	LFF		M	Default
T21N, R21E, S21	72300	1.5 or 3.0	WWSF (1.5 or 3.0)	WWSF		M	Default
T21N, R21E, S06	**Needs A WBIC !**	2.5	WWFF (2.5)	WWFF		M	LAL

Table 11. Branch River Watershed (MA03) - Stream Information - Part 2of 4

Counties: Manitowoc, Brown

Square Miles: 108

NAME OF STREAM	LENGTH (MILES)	HBI Water Quality "Integrity Indicator"	Joe Ball Habitat Form 3200-68, 1-85 sm=stream mile from mouth
Branch River	0-6.5	4.87 (good),fall 1996 (sm= 0.9) 5.15 (good), spring 1996 (sm=0.9) 5.1 (good), spring 1994 (sm=1.7) 4.0 (very good), fall 1993 (sm=1.7)	87 (good) fall 1996 (sm=0.9) 198 (fair), summer 1994 (sm=0.9) 85 (good), spring 1994 (sm=1.7) 125 (good), fall 1993 (sm=1.7) 69 (excellent), summer 1994 (sm=5)
	6.5-38	**(see 1999 BTI invert data)** 4.6 (good), spring 1994 (sm=12) 4.5 (good), fall 1993 (sm=12) 7.7 (poor), spring 1994 (sm=26) 8.2 (poor), fall 1993 (sm=26) 8.0 (poor), spring 1994 (sm=28) 8.0 (poor), fall 1993 (sm= 28)	114 (good), summer 1994 (sm=7) 113 (good), summer 1994 (sm =12) 78 (good), spring 1994 (sm=12) 105 (good), fall 1993 (sm=12) 127 (good), summer 1994 (sm=12) 121 (good), sumer 1994 (sm=14) 139 (fair), summer 1994 (sm=16) 161 (fair), summer 1994 (sm=19) 215 (poor), summer 1994 (sm=22) 158 (fair), fall 1993 (sm=24) 108 (good), spring 1994 (sm=25) 160 (fair), fall 1993 (sm=26) 162 (fair), fall 1993 (sm=26) 166 (fair), summer 1994 (sm=28) 117 (good), spring 1994 (sm=28) 170 (fair), summer 1994 (sm=28)
Unnamed Tributaries			
T19N, R22E, S03	3		
T20N, R22E, S24	4		
T20N, R22E, S27	3		
T20N, R22E, S07	2		
T20N, R22E, S06	<1		
T20N, R22E, S06	5		
T21N, R21E, S09	1		
T21N, R21E, S21	1.5 or 3.0		
T21N, R21E, S06	2.5		

Table 11. Branch River Watershed (MA03) - Stream Information - Part 3 of 4

Counties: Manitowoc, Brown

Square Miles: 108

		PCB Fish	**Environmental Problems**			
	LENGTH	Consumption				
NAME OF STREAM	(MILES)	Advisory	SOURCE	IMPACT	REFERENCES	TREND
Branch River	0-6.5	follow Lake Michigan PCB advisory for trout and salmon	NPS, Point Source Industrial, Stream bank pasturing, Cropland, Stream bank erosion, Barnyards	Sed, Hab, Nut	1, 6, 9, 13, 21, 27, 32, 33	Unknown
	6.5-38					
Unnamed Tributaries						
T19N, R22E, S03	3		NPS, Cropland, Barnyards, Streambanks, Point Source Municipal	Nut, Sed, Hab, Aquatic Plants, Turb,	1, 9, 13, 21, 27, 32, 78	Unknown
T20N, R22E, S24	4		NPS, Cropland, Barnyards	Nut, Sed, Temp, Hab	21, 32	Unknown
T20N, R22E, S27	3		NPS, Cropland	Nut, Sed, Streambanks, Hab, Aquatic plants, Turb	21, 32	Unknown
T20N, R22E, S07	2				32	Unknown
T20N, R22E, S06	<1		NPS, Cropland, Barnyards, Streambanks	Sed, Nut, Ditching, Hab, Turb	21, 32	Unknown
T20N, R22E, S06	5		NPS, Cropland, Barnyards, Streambanks	Sed, Nut, Ditching, Hab, Turb	21, 32	Unknown
T21N, R21E, S09	1		NPS	Flow, Sed, Aquatic plants, Ditching, DO, Hab, Turb,	21, 32	Unknown
T21N, R21E, S21	1.5 or 3.0		NPS	Flow, Sed, Aquatic plants, Ditching, DO, Hab, Turb,	32, 51	Unknown
T21N, R21E, S06	2.5		NPS, Point Source Municipal, Impoundment	Flow, Sed, Aquatic plants, Ditching, DO, Hab, Turb,	21, 27, 32	Unknown

Table 11. Branch River Watershed (MA03) - Stream Information - Part 4 of 4

Counties: Manitowoc, Brown

Square Miles: 108

		Data Reliability		
	LENGTH	Level 1-least	NPS	Additional Comments
NAME OF STREAM	(MILES)	4-most	Rank	
Branch River	0-6.5	3	High	Additional information provided in watershed **Narrative** and **Recommendations** sections (stream mile 0.9 = North Union Rd) (stream mile 1.7 = Branch River Rd)
	6.5-38	3	High	**Lemberger Superfund Site** (stream mile 7.0 = CTH T) (stream mile 12 = middle crossing of W Hillcrest Rd) (stream mile 14 = CTH J) (stream mile 16 = Taus Rd)
Unnamed Tributaries				
T19N, R22E, S03	3	1	High	
T20N, R22E, S24	4	1	High	
T20N, R22E, S27	3	1	High	
T20N, R22E, S07	2	1	High	
T20N, R22E, S06	<1	1	High	
T20N, R22E, S06	5	1	High	
T21N, R21E, S09	1	1	High	
T21N, R21E, S21	1.5 or 3.0	1	High	
T21N, R21E, S06	2.5	1	High	

Lakes Descriptions

Hemptons Lake Manitowoc County T19N, R22E, Sec. 3

Hemptons Lake is a 10.4-acre seepage lake located in a terminal moraine. A small creek drains the lake to the north and joins the Branch River. The maximum depth is 18 feet. Total shoreline length is 0.57 miles and is all privately owned. There are seventy acres of adjoining wetlands. WDNR lacks sufficient data to make further recommendations for Hemptons Lake. Monitoring would provide basic trophic state information so that management decisions can be made to enhance lake health. Whitelaw sewage treatment plant discharges into one of the tributaries of Hemptons Lake.

Kellners Lake Manitowoc County T20N, R22E, Sec. 3

Kellners Lake is a 14.7-acre seepage lake with a maximum depth of 6 feet. The lake is surrounded by 126 acres of wooded wetland and cattail marsh. The 0.70 miles of shoreline are completely undeveloped as of 1994 and there is no public access. A two square mile watershed drains into the lake. A combination of shallow water and extensive aquatic plant and algae growth create severe winterkill conditions that preclude a sport fishery. The lake provides critical habitat for reptiles, amphibians, birds and

invertebrates. Kellners Lake is a high priority for sensitive area designation. Sensitive areas are areas of aquatic vegetation offering critical or unique fish and wildlife habitat, water quality protection, or erosion control benefits to the lake. Refer to the Aquatic Plant Management Program in the Lakes Report for additional information on sensitive area designation.

Table 12. Branch River Watershed (MA03) - Lake Management & Trophic State Information - Part 1 of 3

				Surface	Maximum	**Lake Management Information**		
				Area	Depth		History of	
Lake Name	County	WBIC	Twn-Rng-Sec	(acres)	(feet)	Lake Type	Winter Kill	Access
Hemptons Lake	Manitowoc	71700	T19N, R22E, S03	10	18	Drainage	Unknown	None listed
Kellners Lake	Manitowoc	72100	T20N, R22E, S03	15	5	Seepage	yes	None listed

Table 12. Branch River Watershed (MA03) - Lake Management & Trophic State Information - Part 2 of 3

		Mercury	Eurasion	Lake	Planning or
		fish consumption	Water	Management	Protection
Lake Name	Self Help	advisory	Milfoil	Organization	Grants
Hemptons Lake	None	None listed	None Reported	None	None
Kellners Lake	None	None listed	None Reported	None	None

Table 12. Branch River Watershed (MA03) - Lake Management & Trophic State Information - Part 3 of 3

	Lake Trophic State Information				Phosphorus	Additional
	TSI	TSI	TSI	TSI	Sensitivity	Comments
Lake Name	Class	Total Phos	Secchi Depth	Chl A	Class	
Hemptons Lake	Eutrophic				I-C	Whitelaw WWTP discharges to an intermittent tributary
Kellners Lake	Meso / Eut	GSM=56.5	see comments	GSM = 44.8	II-D	GSM = Growing Season Mean Secchi depth exceeds maximum

NORTH BRANCH MANITOWOC RIVER WATERSHED (MA04)

Existing Management and Monitoring Recommendations

1. Basin staff should conduct basin assessment monitoring on streams in the North Branch of the Manitowoc River Watershed to further define nonpoint source problems. Assessment monitoring should include stream habitat surveys (Simonson et al., 1993) to help identify stream segments that are degraded because of the lack of adequate buffers and vegetative filter strips. This information will help guide and acquire funding from the Conservation Reserve Enhancement Program (CREP), the Targeted Runoff Management (TRM) program, and other conservation funding programs for the areas of greatest need.

2. Basin staff should work with central office staff to identify potential sources of funding to conduct basin assessment fixed station stream monitoring on the North Branch of the Manitowoc River to assess long-term water quality trends in the Manitowoc River Basin .

3. Basin staff should conduct basin lake assessment monitoring on the following lakes: Becker Lake, Boot Lake, and Round Lake to determine priority lake eligibility under the nonpoint source priority watershed program .

4. Basin staff should conduct contaminant sediment inventory monitoring on the North Branch of the Manitowoc River at the confluence with the main stem of the Manitowoc River to update the Manitowoc River Basin Sediment Database .

5. Basin staff should, in the next revision of NR 104 Wis. Adm. Codes, remove Spring Creek at Brillion from the list of variance waters .

6. Basin staff should recruit a self help monitoring person to conduct trophic status index monitoring on Grass Lake and Round Lake

7. Fisheries Management and Habitat Protection (FMHP), in cooperation with WT, should analyze walleye from Bullhead Lake to determine mercury concentrations .

8. FMHP, in cooperation with WT, should analyze northern pike, largemouth bass, and various panfish from Big Long Lake to determine if mercury is present. Largemouth bass should also be analyzed for PCB's .

9. Basin staff should conduct lake assessment monitoring on Big Long Lake to assess water quality as a part of the Long-Term Trend Monitoring (LTTM) Strategy .

10. Basin staff should conduct a stream assessment on Black Creek to determine if the golf course is affecting the stream and to update the water quality information on this stream .

Streams Descriptions

Black Creek

Black Creek is an intermittent stream that seasonally flows into Brillion Marsh. It offers little or no fishery potential and limited potential for other forms of aquatic recreation. Black Creek flows past a golf course that frequently uses large amounts of chemicals and fertilizers and has little to no buffer zones next to the stream (Nikolai 1996).

Brillion Marsh Wildlife Area

Brillion Marsh, a state-owned wildlife area, is the largest wetland within the watershed. The marsh is used extensively by the public for hunting, trapping, dog trials and training, snowmobiling, berry and mushroom picking, nature observation and photography. The area is managed for waterfowl. Numerous waterfowl species use the area during migrations. Mallards, blue-winged teal, wood ducks and Canada geese nest on the property. Great blue herons, great egrets (a Wisconsin threatened species) and sandhill cranes are commonly observed during the summer months. A great blue heron rookery consisting of 30-40 nests is located here. Other summer resident birds include American bitterns, sora and virginia rails, ospreys and green herons. Wetland furbearers, including muskrats, mink, are common. Thirty-five species of reptiles and amphibians are believed to inhabit the marsh, including Blanchard's Cricket Frog (1981-83 frog survey), a Wisconsin endangered species.

Common fish species in the main river of the marsh include carp, black bullhead, and mudminnows, while sunfish, bluegills, northern pike and other minnows are present in low numbers. Tributaries to the main river within the wildlife area boundary include Spring Creek and Black Creek as well as an unnamed drainage flowing from the west, another creek flowing from the south and several drainage ditches. The watershed of Brillion Marsh constitutes approximately 73 square miles. Runoff from the drainage basin is stored in the Brillion Marsh and elsewhere in the floodplain of the Manitowoc River, and is released slowly through the natural point of control at Cato Falls, some 20 miles downstream.

This eutrophic situation contributes to excessive cattail establishment and encroachment, limiting adequate water flow through the marsh and reducing the potential for flowage development and water level management. The lack of open water areas has reduced the value of the marsh for waterfowl and other wetland wildlife. Chemical control and cattail removal have been used since 1984 in an effort to increase open-water areas.

Hilbert Tributary

The Hilbert Tributary, a hard water stream, originates near Hilbert in Calumet County and flows northeasterly through this community before draining into the North Branch at the west end of the Brillion Marsh. The Hilbert WWTP outfall is on the Hilbert Tributary. The stream is classified as a limited forage fishery.

North Branch of Manitowoc River

The North Branch of the Manitowoc River flows for nearly 10 miles from its origin west of Brillion Marsh to its confluence with the South Branch to form the main stem of the Manitowoc River. It is a sluggish, hard water stream that drains most of northeastern Calumet County. During extensive dry periods there is no measurable flow in the river. Wetland complexes located along upper portions of this stream are attractive to ducks, pheasant, deer and small game mammals.
Historic reductions in the percentage of forested and wetland vegetation have resulted in a watershed that lacks adequate opportunities for infiltration and retention of precipitation and snow melt resulting in flashy runoff which overwhelms existing stream channels and aquatic habitat. This excessive runoff also strips valuable sediments and nutrients from the terrestrial environment and delivers them to our streams and lakes where they result in degraded water quality and poorer habitat which can kill sensitive and intolerant fish and aquatic invertebrates. Flashy runoff also limits the amount of water available to sustain adequate flows during drought. Restoration efforts should focus on increasing the overall percentage of forested and wetland vegetation in this watershed to restore a more natural hydrologic regime and minimize the impacts of flashy runoff and an altered hydrologic regime.

Spring Creek

Spring Creek, a very hard water stream, originates north of Brillion and flows more than five miles generally southwesterly before draining into the North Branch of the Manitowoc River. This stream flows through most of the Brillion Marsh, which provides an excellent breeding habitat for many wildlife species. The fishery consists of forage species only, due to the small size of this creek.

Common fish species in Spring Creek include fathead minnows, white suckers, sticklebacks, sunfish, bullheads and carp. The sport fishery is limited due to the sluggish flow of water through the Brillion Marsh, as well as the periodic low oxygen content.

Runoff from surrounding croplands and treated wastewater from two Brillion industries currently contribute a large amount of sediment and nutrient load to Spring Creek and the Brillion Marsh ecosystem. The Brillion WWTP has been in use since 1985. Before that time it was a primary treatment facility. Hilbert has also recently upgraded their system.

The eutrophic situation contributes to excessive cattail establishment and encroachment, limiting adequate water flow through the marsh and reducing the potential for flowage development and water level management. The lack of open water areas has reduced the value of the marsh for waterfowl and other wetland wildlife. Chemical control and cattail removal have been used since 1984 in an effort to increase open-water areas.

Wildlife Management staff have been managing the cattails on Spring Creek from 1984 to 1993. Spraying was used to open up the channel to allow for better water flow. Some ponds were also created to allow sediments to settle and improve water quality. Obstructions (fallen trees) were also removed to increase the water flow. The area that has been managed is located east of Sunset Drive to Bastian Road. Various

sites were chosen each year (in September) to spray and sites from the previous years were revisited to control missed vegetation (Nikolai 1996).

The current stream classification for Spring Creek is Warm Water Forage Fishery (WWFF). WT staff review determined that the classification for Spring Creek at Brillion be removed from the variance waters list in the next revision of NR 104 and reclassified as a warm water forage fishery. This proposed change might require more strict effluent limits for the **Brillion Iron Works Inc**. WPDES Permit.

Table 14. North Branch of the Manitowoc River Watershed (MA04) - Stream Information - Part 1 of 4

Counties: Manitowoc, Calumet

Square Miles: 77

			EXISTING	POTENTIAL	Supporting	Assessment	
		LENGTH	Biological Use	Biological Use	Assessment	Data	Codified
NAME OF STREAM	WBIC	(MILES)	USE/MILES	(MILES)	Category		CLASS
Black Creek	77000	2	LAL (2.0)	LAL			LAL
North Branch Manitowoc River	75900	0-5	WWSF (5.0)	WWSF	NOT	M	WWSF
		5-20	WWSF (15.0)	WWSF	Fully		WWSF
Unnamed Tributaries							
T19N, R20E, S25 (**Brillion WWTP effluant Channel**)	76000	1	LAL	LAL		E	LAL
T19N, R20E, S23	76200	1	Unknown				Default
T19N, R20E, S15	76300	1	Unknown				Default
T19N, R20E, S15 (**Potter WWTP Ditch to N Br**)	**Check Permit**	1	LAL	LAL		E	LAL
T19N, R20E, S04	76700	3					
Hilbert Trib	**Needs a WBIC !**	0-3	LFF (3.0)	LFF		E	LFF
		3-4	WWFF (1.0)	WWFF			WWFF
Spring Creek	76900	8	WWFF (8.0)	WWFF		E	WWFF
Unnamed Tributaries							
T20N, R20E, S34	77100	4	Unknown				Default

Table 14. North Branch of the Manitowoc River Watershed (MA04) - Stream Information - Part 2 of 4

Counties: Manitowoc, Calumet
Square Miles: 77

NAME OF STREAM	LENGTH (MILES)	HBI Water Quality "Integrity Indicator"	Joe Ball Habitat Form 3200-68, 1-85 sm= stream mile from mouth
Black Creek	2		
North Branch Manitowoc River	0-5	8.7 (very poor), fall 1996 (sm= 0.7) **art. sub** 9.0 (very poor), spring 1996 (sm=0.7) **art. sub**	140 (fair), summer 1996 (sm=0.7)
	5-20		
Unnamed Tributaries			
T19N, R20E, S25 (**Brillion WWTP effluant Channel**)	1		
T19N, R20E, S23	1		
T19N, R20E, S15	1		
T19N, R20E, S15 (**Potter WWTP Ditch to N Br**)	1		
T19N, R20E, S04	3		
Hilbert Trib	0-3		
	3-4		
Spring Creek	8	6.2 (good), spring 1996 (sm=3.2)	Conducted in 1996, No data sheets in files
Unnamed Tributaries			
T20N, R20E, S34	4		

Table 14. North Branch of the Manitowoc River Watershed (MA04) - Stream Information - Part 3 of 4

Counties: Manitowoc, Calumet
Square Miles: 77

		Environmental Problems			
NAME OF STREAM	LENGTH (MILES)	SOURCE	IMPACT	REFERENCES	TREND
Black Creek	2	Point Source Municipal		6, 27	Unknown
North Branch Manitowoc River	0-5	Point Source Municipal, NPS	Turb, Sed, Hab	1, 10, 13	Unknown
	5-20				
Unnamed Tributaries					
T19N, R20E, S25 (**Brillion WWTP effluant Channel**)	1			1, 13	Unknown
T19N, R20E, S23	1				Unknown
T19N, R20E, S15	1				Unknown
T19N, R20E, S15 (**Potter WWTP Ditch to N Br**)	1	Point Source Municipal		1, 13, 27, 78	Unknown
T19N, R20E, S04	3				Unknown
Hilbert Trib	0-3	Point Source Municipal, NPS		1, 10, 13, 27, 78	Unknown
	3-4				
Spring Creek	8	Point Source Industrial, NPS, Cropland	Sed, Nut, FLOW, DO	1, 10, 13, 27, 78, 80	Unknown
Unnamed Tributaries					
T20N, R20E, S34	4				Unknown

Table 14. North Branch of the Manitowoc River Watershed (MA04) - Stream Information - Part 4 of 4

Counties: Manitowoc, Calumet
Square Miles: 77

NAME OF STREAM	LENGTH (MILES)	TREND	Data Reliability Level 1-least 4-most	NPS Rank	Additional Comments
Black Creek	2	Unknown	1	High	Additional information provided in Narrative
North Branch Manitowoc River	0-5	Unknown	2	High	HBI's from Artificial Substrates (stream mile 0.7 =Riverview Rd) Additional information provided in **Narrative** with specific management **Recommendations**
	5-20				
Unnamed Tributaries					
T19N, R20E, S25 (**Brillion WWTP effluant Channel**)	1	Unknown	1	High	
T19N, R20E, S23	1	Unknown	1	High	
T19N, R20E, S15	1	Unknown	1	High	
T19N, R20E, S15 (**Potter WWTP Ditch to N Br**)	1	Unknown	1	High	
T19N, R20E, S04	3	Unknown	1	High	
Hilbert Trib	0-3	Unknown	1	High	Additional information provided in Narrative
	3-4				
Spring Creek	8	Unknown	1	High	(stream mile 3.2 =CTH PP) Additional information provided in **Narrative** with specific management **Recommendations**
Unnamed Tributaries					
T20N, R20E, S34	4	Unknown	1	High	

Lakes Description

Becker Lake Calumet County T19N, R20E, Sec. 12

Becker Lake is a 31.2-acre seepage lake with an intermittent outlet to Grass Lake and an intermittent inlet from Long Lake in Manitowoc County. The drainage basin covers 14.50 square miles. The maximum depth is 51 feet with a mean depth of 15 feet. There is 0.98 miles of shoreline, of which 0.05 miles are publicly owned. Northern pike, largemouth and smallmouth bass are present and panfish are common. Becker Lake fish community structure shows signs of occasional to frequent fish kills.

Boot Lake Calumet County T19N, R20E, Sec. 1 (4)

Boot Lake is a landlocked 9.7-acre seepage lake that drains a 0.24 square mile watershed. During high water periods it is connected to Long Lake in Manitowoc County. The maximum depth is 15 feet and the mean depth is 6 feet. There is 0.62 miles of shoreline of which 0.1 miles are publicly owned. Northern pike, largemouth bass, and panfish comprise the fishery. The lake winterkills every three to five years and

a knowledgeable lake resident stated that game fish have never been seen in the lake (Kamke 1995). It does support an abundant minnow population. Historically, yellow perch have survived to a large size (Meyers 1974).

Grass Lake Calumet County T19N, R20E, Sec. 1 (6)

The most notable lake from a wildlife standpoint is Grass Lake, which is essentially a northern bog lake in a southern setting, surrounded by farmland. Vegetation includes various orchid species, calla lilies, buck bean and a variety of other bog plants. It is the only bog of its type in Calumet County. Some of the birds seen on Grass Lake include sandhill crane, with at least one nesting pair per year, double crested cormorant, great blue heron, nesting green heron, woodcock and snipe. The area is a significant nesting area for many species of ducks and Canada geese. Black terns have been seen on both Round lake and Grass lake. WDNR lacks sufficient data to make further recommendations for Grass Lake. Monitoring would provide basic trophic state information so that management decisions can be made to enhance lake health.

Long Lake Manitowoc County T19N, R21E, Sec. 6,7

Big Long Lake is primarily a natural seepage lake with a 2 $mi.^2$ watershed lying in Manitowoc County. It is one of the 50 lakes in the Long-Term Trend Monitoring Program. The lake encompasses 119 acres and has a maximum depth of 38 feet. There are 2.18 miles of shoreline, of which 0.21 miles are publicly owned. An intermittent creek flows into Big Long Lake at the north end and out of the south end to Becker Lake. There are 13 acres of adjoining wetlands.

The lake is highly eutrophic, with a secchi disc transparency rarely exceeding one meter. A bloom of blue-green algae persists during the entire open water season, at times so thick it becomes toxic. Aquatic macrophyte surveys were conducted in 1988 and 1991. They indicated that macrophyte production is limited by the algae present. Coontail and curly-leaved pondweed were the predominant species although all macrophyte growth was limited below 1.5 feet. The aquatic plant survey conducted in July 1988 found Hydrodictyon, or water net, drifting in the littoral zone. Water net is considered a nuisance in surface waters (Rasman 1988). Northern pike, largemouth bass, and panfish are common in this lake. A major fish kill occurred in July of 1984. The lake association now aerates the lake when dissolved oxygen becomes critical to maintain viable fishery.

Round Lake Calumet county T19N, R20E, Sec. 1 (2)

Round Lake is a landlocked seepage lake with a 0.7 square mile drainage basin. It covers 10.0 surface acres. The maximum depth is 55 feet and the mean depth is 30 feet. The total shoreline length is 0.55 miles of which 0.2 miles are publicly owned. Largemouth bass, panfish, and trout are common in the lake. Toads, wood frogs and green frogs are also common. WDNR lacks sufficient data to make further recommendations for Round Lake. Monitoring would provide basic trophic state information so that management decisions can be made to enhance lake health.
Round Lake suffered it's last fish kill in 1999.

Table 15. North Branch Manitowoc River Watershed (MA04) - Lake Management & Trophic State Information

Part 1 of 3

Lake Name	County	WBIC	Twn-Rng-Sec	Surface Area (acres)	Maximum Depth (feet)	Lake Type	History of Winter Kill	Access
Becker Lake	Calumet	77300	T19N, R20E, S12	32	53	Seepage	Occasional	Boat Ramp
Boot Lake	Calumet & Manitowoc	77600	T19N, R21E, S06	11	16	Seepage	Frequent	Boat Ramp
Grass Lake	Calumet	77200	T19N, R20E, S01	15		Drained	Frequent	None
Long (Big) Lake	Manitowoc	77500	T19N, R21E, S07	120	38	Seepage	Infrequent; last reported kill July 1984	Boat Ramp
Round Lake	Calumet	68600	T19N, R20E, S01	11	50	Seepage	Last fish kill occurred in 1999	Boat Ramp

Table 15. North Branch Manitowoc River Watershed (MA04) - Lake Management & Trophic State Information

Part 2 of 3

Lake Name	Mercury fish consumption advisory	Eurasion Water Milfoil	Lake Management Organization	Planning or Protection Grants
Becker Lake	None Listed	None Reported	Recommended; see comments	
Boot Lake	None Listed	None Reported	Recommended; see comments	
Grass Lake	None Listed	None Reported	Recommended; see comments	
Long (Big) Lake	None Listed	None Reported	Association	
Round Lake	None Listed	None Reported	Recommended; see comments	

Table 15. North Branch Manitowoc River Watershed (MA04) - Lake Management & Trophic State Information

Part 3 of 3

	Lake Trophic State Information				Phosphorus	Additional
	TSI	TSI	TSI	TSI	Sensitivity	Comments
Lake Name	Class	Total Phos	Secchi Depth	Chl A	P Class	
Becker Lake	49-67 EU				II-C	Individual Lake Management Organization may not be practical; recommend cooperative efforts with other smaller lakes
Boot Lake	54-81 EU				I-C	Check to see if they are a member of the Manitowoc County Lakes Association
Grass Lake						Important Wetland Area habitat
Long (Big) Lake	62-67 EU		63		I-B	Long Lake Association monitors DO & operates aeration system. Long Term Trend Monitoring Lake. Last Major fish kill - 1984
Round Lake					I-C	Individual Lake Management Organization may not be practical; recommend cooperative efforts with other smaller lakes

SOUTH BRANCH MANITOWOC RIVER WATERSHED (MA05)

Existing Management and Monitoring Recommendations

1. Basin staff should conduct basin assessment monitoring on streams in the South Branch of the Manitowoc River Watershed to further define nonpoint source problems. Assessment monitoring should include stream habitat surveys (Simonson et al., 1993) to help identify stream segments that are degraded because of the lack of adequate buffers and vegetative filter strips. This information will help guide and acquire funding from the Conservation Reserve Enhancement Program (CREP), the Targeted Runoff Management (TRM) program, and other conservation funding programs for the areas of greatest need.

2. FMHP staff should conduct a fisheries survey on the South Branch of the Manitowoc River below the Chilton Millpond to determine if there is a smallmouth bass population .

3. A Basin stream biologist should monitor Cedar Creek to determine potential biological use .

4. The Northeast Region Nonpoint Source Selection Advisory Committee should consider the South Branch of the Manitowoc River Watershed as a potential nonpoint source project due to its “High” stream and groundwater ranking .

5. The Northeast Region NPS Selection Advisory Committee should consider Hayton Millpond as a potential priority lake project due to its “High” lakes ranking .

6. Basin staff should conduct basin assessment monitoring on Cedar Creek, the Killsnake River and the South Branch of the Manitowoc River to assess long-term water quality trends in the Manitowoc River Basin .

7. Basin staff should ensure that the unnamed tributary to the South Branch of the Manitowoc River (where Foremost Farms USA discharges) is listed in NR 102 as a cold water fishery stream .

8. Basin staff have reviewed the classification for Jordan Creek at New Holstein, and have determined that the stream should be reclassified from a LAL to a WWFF. The change should be reflected in the next revision of Chapter NR 104, Wisconsin Administrative Code .

9. Basin staff should recruit a self help monitoring person to conduct trophic status index monitoring on Mud Lake .

Stream Descriptions

Cedar Creek

Cedar Creek is a small, shallow stream originating from the outlet of Mud Lake and flowing northwesterly for 7.2 miles to eventually drain into the South Branch of the Manitowoc River. Cedar Creek is surrounded by Hayton Marsh during the last two miles of its course. Numerous springs near the headwaters contribute to this creek's volume and water quality. Cedar Creek was selected as a basin assessment trend monitoring station. Sampling will begin in January 1996 and run through December, 1996. For more information regarding this monitoring refer to the Surface Water Quality Report.

Hayton Marsh

Hayton Marsh is located in western Calumet County, six miles east of Chilton. This area is wet but has little or no permanent standing water. The marsh has a low elevation that keeps it too wet to farm. Historically it may have been dominated by coniferous stands, but presently are dominated by bottomland hardwoods. The marsh is privately owned, divided among many landowners, but at little risk to alteration. Primary interest in ownership is deer hunting land.

Jordan Creek

Jordan Creek originates southeast of New Holstein and flows northerly for 1.2 miles, partly through the east side of New Holstein, before draining into Pine Creek, which flows into the South Branch near Hayton. The New Holstein WWTP outfall is on Jordan Creek. Tecumseh Products, Inc. is also located on this channel and due to previous water quality standard violations it now discharges to the WWTP. The current stream classification for Jordan Creek is Limited Aquatic Life (LAL). The district water quality biologist suggests the classification for Jordan Creek should be a warm water forage fishery (WWFF) and that it be changed in the next revision of NR 104. This proposed change may require more strict effluent limits for the **City of New Holstein WPDES Permit**.

South Branch of the Manitowoc River

The South Branch of the Manitowoc originates in northeastern Fond du Lac County and flows through Chilton and Hayton before joining the North Branch to form the main stem of the Manitowoc River. Two impoundments, Hayton Pond and Chilton Millpond, are on this stream. Common fish species include smallmouth bass, northern pike, pumpkinseed, bullhead, and carp. Smallmouth bass were stocked below Chilton Millpond in the 1980s (Meyers 1996). It is unknown if a population was ever established in the river. Waterfowl make moderate use of the river and adjacent 1,325 acres of primarily wooded wetlands

during spring and fall migrations. The potential biological use of the stream is a warm water sport fishery. The South Branch of the Manitowoc River was selected as a basin assessment trend monitoring station. Sampling will begin in January 1996 and run through December, 1996. For more information regarding this monitoring refer to the Surface Water Quality Report.

Historic reductions in the percentage of forested and wetland vegetation have resulted in a watershed that lacks adequate opportunities for infiltration and retention of precipitation and snow melt resulting in flashy runoff which overwhelms existing stream channels and aquatic habitat. This excessive runoff also strips valuable sediments and nutrients from the terrestrial environment and delivers them to our streams and lakes where they result in degraded water quality and poorer habitat which can kill sensitive and intolerant fish and aquatic invertebrates. Flashy runoff also limits the amount of water available to sustain adequate flows during drought. Restoration efforts should focus on increasing the overall percentage of forested and wetland vegetation in this watershed to restore a more natural hydrologic regime and minimize the impacts of flashy runoff and an altered hydrologic regime.

The Water Resources Division of the U.S. Geological Survey, in cooperation with local, State and Federal agencies, obtains a large amount of data pertaining to the water resources of Wisconsin each year (Holmstrom 1995). A gauging station is located on the South Branch of the Manitowoc River on the left bank 100 feet downstream from Weeks Road bridge, at Hayton. The station has been in service since July 1993. The type of data being collected include: chemical, discharge, sediment, and water temperature. Please refer to the U.S. Geological Survey *Water Resource Data Wisconsin Water Year 1995* for specific data.

Killsnake River

The Killsnake River originates northwest of Brant and flows easterly 14 miles before joining the North Branch of the Manitowoc River. Prior to joining the South Branch of the Manitowoc River, the Killsnake flows through a large wetland area known as Aebisher's Marsh. Waterfowl make heavy use of this river and adjacent wetlands. A majority of the land draining to it is in agricultural use, with overgrazed streambanks and improper cropping practices. The hard bottom substrate is covered by silt and in some pools the silt deposits are excessive. This is indicative of soil erosion in the watershed. The Killsnake River likely only supports a forage fishery in its present condition. The Killsnake River has a history of fish kills in the lower reaches. A comprehensive fish survey was conducted in 1979 (Meyers 1996). Land use practices dominated by agriculture have left the fish habitat in poor shape due to excessive siltation.

The Killsnake River was selected as a basin assessment trend monitoring station. Sampling will begin in January 1996 and run through December, 1996. For more information regarding this monitoring refer to the Surface Water Quality Report.

Killsnake River Wildlife Area

The Killsnake Wildlife Area drains the south half of Calumet County and parts of adjacent Manitowoc, Sheboygan and Fond du Lac counties with a watershed area of approximately 193 square miles. The center of the area includes the confluence of the Killsnake River, the South Branch of the Manitowoc River and Cedar Creek. Waters draining into Killsnake Marsh are generally high in sediment and low in dissolved oxygen. Runoff from adjoining croplands contains a heavy load of plant nutrients, resulting in vigorous aquatic growth among coontail, water milfoil and pondweeds. This growth causes the river to be nearly closed to even canoe travel in the summer and reduces the value to wildlife.

Carp and black bullheads are the most common species, with northern pike, rock bass, white sucker, fathead minnow, creek chub and other unidentified forage minnows also present. Historically, crayfish were common along with many snails, mayflies and scuds (1977 stream survey). These same species were also common in the South Branch of the Manitowoc River and Cedar Creek. According to local sources, Cedar Creek once was a brook trout stream, while the Manitowoc River supported larger populations of northern pike than it does now.

During spring migrations, Killsnake Marsh supports waterfowl by the thousands. Common species include mallards, pintails, northern shovelers, redheads, wood ducks, blue-winged teal, black ducks, lesser scaup, widgeon, ring-necked ducks, coot, Canada geese and tundra swans. Mud flats are heavily used by greater and lesser yellow legs, pectoral sandpipers, semi-palmated sandpipers, dunlins, yellow rail, and other unique shore and songbirds. Other birds seen on the marsh include common snipe, sandhill crane, black tern, great blue heron, green heron and American bittern. Reptiles and amphibians known to occur include snapping turtle, western painted turtle, northern water snake, eastern garter snake, spotted salamander, toads, spring peepers, leopard frogs and green frogs.

Pine Creek

Pine Creek is a well-buffered healthy stream in Calumet County that receives no noticeable nonpoint source pollution and has no point source discharges along its length. Due to its cool temperature and adequate year 'round flow, Fisheries staff believe it could support trout. Biotic index work indicates “very good” water quality.

Jordan Creek is a tributary of Pine Creek. Information collected during the May 1990 triennial standards review for Pine and Jordan Creek indicates a higher quality resource in Pine Creek and a higher potential in Jordan Creek than existing classifications suggest.

The Water Resources Division of the U.S. Geological Survey, in cooperation with local, State and Federal agencies, obtains a large amount of data pertaining to the water resources of Wisconsin each year (Holmstrom 1995). Two surface water quality stations are located on Pine Creek; Meggers Road near New Holstein (monitored April to September 1995) and at Quarry Road near Hayton (monitored February 1994 to September 1995). The water samples have been collected at the two stations and analyzed for PCB's, chlorophyll A, chloride, particle size and suspended sediments. Please refer to the U.S. Geological Survey *Water Resource Data Wisconsin Water Year 1995* for specific data.

Stony Brook

Stony Brook is a clear, hard water tributary of the South Branch of the Manitowoc River. During the 1970s Fisheries Management implemented a brown trout stocking program to provide a trout fishery in the area. The stream does not support the natural reproduction. A stream survey in the late 1970s indicated some carryover of trout. A wild trout strain could be stocked with the goal of establishing a self sustaining population if the stream is still capable of supporting a cold water fishery (Meyers 1996). If the stream is not capable of supporting a cold water fishery, the WDNR publication, *Wisconsin Trout Streams*, should be updated to reflect the correct classification. Intensive agricultural practices has greatly reduced any recreational potential Stony Brook may have once offered.

Table 17. South Branch Manitowoc River Watershed (MA05) - Stream Information

Counties: Calumet, Manitowoc

Square Miles: 189

NAME OF STREAM	WBIC	LENGTH (MILES)	EXISTING Biological Use USE/MILES	POTENTIAL Biological Use (MILES)	Supporting Assessment Category	Assessment Data	Codified CLASS
Cedar Creek	78700	9	Cold	Cold III	Partially	E	Default (**Change to Cold**)
Hayton Creek	78900	6	Unknown			M	Default
Jordan or Jordon Creek	80200	4	WWFF	WWFF	Partially	M	LAL (**Change to WWFF, Doelger 1990**)
Unnamed Tributaries							
T17N, R20E, S11	80300	1	Unknown				Default
T18N, R19E, S13	81300	1	Unknown				Default
T18N, R19E, S26	81400	3	Unknown				Default
Killsnake river	78200	0-5	WWFF (5.0)	WWFF	Partially	M	Default (**Change to WWFF**)
		5-20	WWFF (15.0)	WWFF	Partially	M	
Unnamed Tributaries							
T18N, R19E, S01	78300	2	Unknown				Default
T19N, R19E, S27	78400	3	Unknown				Default
T19N, R19E, S28	78500	1	Unknown				Default
T19N, R19E, S21	78600	2 or 1	Unknown				Default
South Branch Manitowoc River	77900	37	WWSF (37.0)	WWSF	Partially	M	Cold (this **should be changed to WWSF**)
Unnamed Tributaries							
T18N, R19E, S24	**Needs a WBIC !**	0-1.8	LFF (1.8)	WWSF	Not	M	Cold (**should this be changed ?**)
		1.8-3.3	LFF (1.5)	Cold	Not		Cold
Pine Creek	79900	0-4.0	WWFF (4.0)	WWFF	Partially	M	WWSF
		4.0-9.0	WWSF (5.0)	Cold	Threatened		Cold (**previuosly unlisted**)
Unnamed Tributaries							
T18N, R20E, S21	80000	2	Unknown				Default
T18N, R20E, S27	80100	5	Unknown				Default
T17N, R20E, S08	**Needs a WBIC !**	3	Unknown			M	Default
Stony Brook	81500	6	Cold	Cold II	Partially	E	Default
Unnamed Tributaries							
T17N, R18E, S16	**Needs a WBIC !**	4	Unknown				Default
T17N, R19E, S16	81700	3.0	Unknown				Default
T17N, R19E, S34	**Needs a WBIC !**	1	Unknown				Default
T16N, R19E, S33	**Needs a WBIC !**	2	Unknown				Default
T16N, R18E, S12	**Needs a WBIC !**	3	Unknown				Default

Table 17. South Branch Manitowoc River Watershed (MA05) - Stream Information

Counties: Calumet, Manitowoc

Square Miles: 189

Part 2 of 4

NAME OF STREAM	LENGTH (MILES)	HBI Water Quality "Integrity Indicator"	Joe Ball Habitat Form 3200-68, 1-85 sm= stream mile from mouth	PCB Fish Consumption Advisory
Cedar Creek	9	6.73 (fairly poor), fall 1996 (sm=1.8) **art. sub** 6.92 (fairly poor), summer 1996 (sm=1.8) **art. sub**	130 (fair), fall 1996 (sm=1.8)	Extensive Advisory for the South Branch and its Tributaries see PUB No FH824 00Rev
Hayton Creek	6			Extensive Advisory for the South Branch and its Tributaries see PUB No FH824 00Rev
Jordan or Jordon Creek	4	5.57 (fair), fall 1989 (sm=0.3) 7.70 (poor), fall 1989 (sm=1.5)	169 (fair), fall 1989 (sm=0.3) 160 (fair), fall 1989 (sm=1.5)	Extensive Advisory for the South Branch and its Tributaries see PUB No FH824 00Rev
Unnamed Tributaries				
T17N, R20E, S11	1			
T18N, R19E, S13	1			
T18N, R19E, S26	3			
Killsnake river	0-5	6.88 (fairly poor), fall 1996 (sm=0.3) **art. sub** 7.17 (fairly poor), summer 1996 (sm=0.3) **art. sub**	188 (fair), fall 1996 (sm=0.3)	Extensive Advisory for the South Branch and its Tributaries see PUB No FH824 00Rev
	5-20			
Unnamed Tributaries				
T18N, R19E, S01	2			
T19N, R19E, S27	3			
T19N, R19E, S28	1			
T19N, R19E, S21	2 or 1			
South Branch Manitowoc River	37	6.41 (fair), fall 1996 (sm=4.5) **art. sub** 5.07 (good), summer 1996 (sm=4.5) **art. sub** X=5.40 (good), fall 1989 (sm=10.8) 7.3 (fairly poor), spring 1999 (sm=32)	180 (fair), spring 1999 (sm=32)	Extensive Advisory for the South Branch and its Tributaries see PUB No FH824 00Rev
Unnamed Tributaries				
T18N, R19E, S24	0-1.8	collected in 1996 - no data sheets in files !	184 (fair) summer 1996 (sm=0.6) 214 (poor), summer 1996 (sm=1.0) 209 (poor), summer 1996 (sm=1.5)	
	1.8-3.3		193 (fair), summer 1996 (sm= 2.0)	
Pine Creek	0-4.0			Extensive Advisory for the South Branch and its Tributaries see PUB No FH824 00Rev
	4.0-9.0	4.34 (very good), fall 1989 (sm=6.0)	134 (fair), fall 1989 (sm=5.3) 144 (fair), fall 1989 (sm=6.0) 149 (fair), fall 1989 (sm=7.0)	
Unnamed Tributaries				
T18N, R20E, S21	2			
T18N, R20E, S27	5			
T17N, R20E, S08	3			
Stony Brook	6	4.13 (very good), fall 1996 (sm=0.6) 4.6 (good), fall 1996 (sm=2.9)	73 (good), summer 1996 (sm=0.6) 68 (excellent), summer 1996 (sm=2.1) 60 (excellent), summer 1996 (sm=2.9) 96 (good), summer 1996 (sm=3.5)	Extensive Advisory for the South Branch and its Tributaries see PUB No FH824 00Rev
Unnamed Tributaries				
T17N, R18E, S16	4			
T17N, R19E, S16	3.0			
T17N, R19E, S34	1			
T16N, R19E, S33	2			
T16N, R18E, S12	3			

Table 17. South Branch Manitowoc River Watershed (MA05) - Stream Information

Counties: Calumet, Manitowoc

Square Miles: 189 Part 3 of 4

		Environmental Problems			
NAME OF STREAM	LENGTH (MILES)	SOURCE	IMPACT	REFERENCES	TREND
Cedar Creek	9			45	Unknown
Hayton Creek	6	NPS	Sed	46, 47	Unknown
Jordan or Jordon Creek	4	NPS, Point Source Municipal	Sed, Sediment Contamination	1, 4, 13, 27, 52, 78	Unknown
Unnamed Tributaries					
T17N, R20E, S11	1				
T18N, R19E, S13	1				
T18N, R19E, S26	3				
Killsnake river	0-5	NPS, Cropland	PCB, Fish Consumption Advisory, Sediment Contamination	6, 45, 51, 52	Unknown
	5-20				
Unnamed Tributaries					
T18N, R19E, S01	2				Unknown
T19N, R19E, S27	3				Unknown
T19N, R19E, S28	1				Unknown
T19N, R19E, S21	2 or 1				Unknown
South Branch Manitowoc River	37	NPS, Point Source Industrial, Point Source Municipal,	PCB, Fish Consumption Advisory, Sediment Contamination,	7, 27, 28, 45, 51, 52	Unknown
Unnamed Tributaries					
T18N, R19E, S24	0-1.8	Point Source Industrial, Hydrologic modification	Habitat	27, 73	Unknown
	1.8-3.3				
Pine Creek	0-4.0	NPS	PCB, Fish Consumption Advisory, Sediment Contamination	1, 3, 13, 45, 51, 52	Unknown
	4.0-9.0				
Unnamed Tributaries					
T18N, R20E, S21	2				Unknown
T18N, R20E, S27	5				Unknown
T17N, R20E, S08	3	NPS	PCB, Fish Consumption Advisory, Sediment Contamination	46, 52	Unknown
Stony Brook	6	NPS		1, 13, 17	Unknown
Unnamed Tributaries					
T17N, R18E, S16	4				Unknown
T17N, R19E, S16	3.0				Unknown
T17N, R19E, S34	1				Unknown
T16N, R19E, S33	2				Unknown
T16N, R18E, S12	3				Unknown

Table 17. South Branch Manitowoc River Watershed (MA05) - Stream Information

Counties: Calumet, Manitowoc

Square Miles: 189

Part 4 of 4

NAME OF STREAM	LENGTH (MILES)	Data Reliability Level 1-least 4-most	NPS Rank	Additional Comments
Cedar Creek	9	1	High	(stream mile 1.8 = Hwy 151) Additional information provided in Narrative and Recommendations Sections
Hayton Creek	6	1	High	PCB's at New Holstein Additional information provided in Narrative Sections
Jordan or Jordon Creek	4	2	High	(stream mile 0.3 =Charlesburg Rd) (stream mile 1.5 =CTH X / WI Ave, above STP) Additional information provided in Narrative and Recommendations Sections
Unnamed Tributaries				
T17N, R20E, S11	1	1	High	
T18N, R19E, S13	1	1	High	
T18N, R19E, S26	3	1	High	
Killsnake river	0-5	2	High	(stream mile 0.3 = Lemke Road) Additional information provided in Narrative and Recommendations Sections
	5-20			
Unnamed Tributaries				
T18N, R19E, S01	2	1	High	
T19N, R19E, S27	3	1	High	
T19N, R19E, S28	1	1	High	
T19N, R19E, S21	2 or 1	1	High	
South Branch Manitowoc River	37	2	High	(X= the average of 3 HBI samples) (stream mile 4.5 = Lemke Rd) (stream mile 10.8 = Irish Rd)
Unnamed Tributaries				
T18N, R19E, S24	0-1.8	2	High	(stream mile 0.6 = Hwy 151) (stream mile1.0 =Quinney Rd) (stream mile 1.5 =Court Rd)
	1.8-3.3			(stream mile 2.0 =CTH F)
Pine Creek	0-4.0		High	Additional information provided in Narrative and Recommendations Sections
	4.0-9.0	2		(stream mile 5.3 = Charlesburg Rd) (stream mile 6.0 =Tecumseh Rd) (stream mile 7.0 =CTH T)
Unnamed Tributaries				
T18N, R20E, S21	2	1	High	
T18N, R20E, S27	5	1	High	
T17N, R20E, S08	3	1	High	
Stony Brook	6		High	(stream mile 0.6 =Stony Brook Rd) (stream mile 2.1 =Quinney Rd) (stream mile 2.9 =Court Rd)
Unnamed Tributaries				

Lakes Description

Chilton Millpond Calumet County T18N, R19E, Sec. 13

Chilton Millpond is a highly eutrophic impoundment of the South Branch of the Manitowoc River, located in the City of Chilton. The millpond, which covers 8.9 surface acres, has maximum depth of 6 feet, and a mean depth of 3 feet. Total shoreline length is 0.81 miles, of which 0.06 miles is publicly owned. The millpond drains a 67.0 square mile basin. PCB contamination has resulted in a fish consumption advisory with all species and all sizes listed as unsafe for human consumption. Past records have indicated a fishery dominated by carp along with limited number of northern pike, rock bass, and sunfish (WDNR 1996). Since the completion of the Inland Lake Renewal Project, largemouth bass, northern pike, bluegill and perch were stocked in the past in order to establish a fishery. Panfish are present, but the bulk of the biomass is tied up in carp, bullhead, and assorted sucker and minnow species (Kamke 1995). Fish kills are a reoccurring problem within and above the Chilton Millpond; because, of nonpoint source pollution and agricultural runoff.

In 1977 28,000 yd^3 of sediment were removed and an additional 35,000 yd^3 of sediment were removed in 1980 to reduce plant growth by: removing the rooting medium, lessening light penetration to the bottom through increased depth, and by removing nutrients. Between 1979 and 1988, northern pike, largemouth bass, yellow perch, bluegill, and general panfish were stocked in the pond. The results of D.O. vs Temp. profiles and other sampling indicate that conditions in the millpond preclude a viable sport fishery from June through August (Atkinson 1993).

In 1993 Lake Management Planning Grant dollars were used to fund a study of the millpond, which characterized physical, chemical, biological, and watershed aspects of the millpond. The goal is to provide information on which to base decisions to continue efforts to establish a warm water fishery (Atkinson 1993)

Hayton Millpond Calumet County T18N, R20E, Sec. 16

Hayton Pond is an impoundment of the South Branch of the Manitowoc River and covers 26.6 surface acres. The maximum depth is 6 feet and the mean depth is 2.0 feet. The shoreline totals 2.05 miles, of which 0.01 miles are publicly owned. The pond lies in a 104.0 square mile watershed. A few northern pike and panfish are present, but carp, bullheads, and sucker and minnow species predominate (Kamke 1995).

In 1990, routine fish monitoring identified high levels of PCB in fish from a portion of the South Branch Manitowoc River. Fish sampled showed PCB concentrations that exceeded state water quality standards and U.S. Food and Drug Administration (USFDA) human health fish consumption guidelines. A fish consumption advisory (Do Not Eat Any Fish) currently exists for the study area (See Health Advisory Map in protective sheets). An investigation of the water, sediment and fish tissues conducted between 1992 and 1994 identified contamination in eight miles of river stretching from Hayton Millpond, and impoundment on the South Branch Manitowoc River, through Pine Creek, a Hayton Millpond tributary, and Jordan Creek, a tributary to Pine Creek adjacent to the city of New Holstein.

This area was selected by the WDNR as a priority sediment remediation demonstration project site. The study area is referred to as the Hayton Area Remediation Project (HARP).

A cleanup investigation began in January, 1995. Foth and Van Dyke, in association with Asci Corporation, were selected by the WDNR and Wisconsin Department of Administration (WDOA) to

conduct a remedial investigation and feasibility study on select soils and sediments in Calumet County. Field sampling completed in August 1995 characterized the extent and magnitude of PCB contamination. The study suggests soil and sediments in drainage ditches in the northeast section of New Holstein are the source of the contamination. Field sampling will be conducted in 1996 to complete the characterization efforts. The WDNR is working in partnership with key stakeholders in the Hayton/New Holstein areas to complete characterization, conduct a feasibility study and develop a risk management strategy for PCB's in the project area (Foth and Van Dyke 1996). For more information on the HARP site refer to the Remedial Investigation Report Hayton Area Remediation Project, February 1996, Volume I and II Text, and Volume I and II Appendices.

Mud Lake Manitowoc County T17N, R21E, Sec. 9

Mud lake is a 62.3-acre landlocked seepage lake, with a maximum depth of 3 feet. The 1.7 miles of shoreline has no public access. This lake drains a 1 square mile basin. There are 47 acres of non-woody wetlands surrounding the lake. Consistent winterkill precludes a sport fishery. WDNR lacks sufficient data to make further recommendations for Mud Lake. Monitoring would provide basic trophic state information so that management decisions can be made to enhance lake health.

Table 18. South Branch Manitowoc River Watershed (MA05) - Lake Management & Trophic State Information

Part 1 of 3

				Surface	Maximum			
				Area	Depth		History of	
Lake Name	County	WBIC	Twn-Rng-Sec	(acres)	(feet)	Lake Type	Winter Kill	Access
Chilton Millpond	Calumet	81200	T18N, R19E, S13	10	7	Drainage	None	Boat Ramp
Hayton Millpond	Calumet	79800	T18N, R20E, S16	36	5	Drainage	None	Roadside
Mud Lake	Manitowoc	79600	T17N, R21E, S09	62 (Error ?); more likely 6.2	3	Seepage	Unknown	None

Table 18. South Branch Manitowoc River Watershed (MA05) - Lake Management & Trophic State Information

Part 2 of 3

		PCB	Eurasion	Lake	Planning or
		fish consumption	Water	Management	Protection
Lake Name	Self Help	Advisory	Milfoil	Organization	Grants
Chilton Millpond		**All species & sizes are unsafe for consumption**	None reported	LMD	LPL #683 (Active)
Hayton Millpond		**All species & sizes are unsafe for consumption**	None reported		
Mud Lake		None Listed	None reported		

Table 18. South Branch Manitowoc River Watershed (MA05) - Lake Management & Trophic State Information

Part 3 of 3

	Lake Trophic State Information				Phosphorus	NPS	Additional
	TSI	TSI	TSI	TSI	Sensitivity	Rank	Comments
Lake Name	Class	Total Phos	Secchi Depth	Chl A	P Class		
Chilton Millpond	72, EU				II-B	Not ranked	LPL #683 Active 4/1/2000 to 12/31/2002
Hayton Millpond					II-C	High	Harp Project
Mud Lake					II-C	Not ranked	

REFERENCES

1. Doelger, Tim. Lake Michigan District, Biologist. 1991. Personal Communication. WDNR, Green Bay.

2. Doelger, Tim. 1982. Stream Classification for Mud Creek. WDNR, Green Bay.

3. Doelger, Tim. 1989. Triennial Standards Review for Pine Creek and Jordon Creek. WDNR, Green Bay.

4. Doelger, Tim. 1990. Triennial Standards Review for Pine Creek. WDNR, Green Bay.

5. Martin, Ron. 1983. Wisconsin Lakes - A Trophic Assessment Using Landsat Digital Data Wis. WDNR, Madison.

6. Fassbender, Ronald. 1971. Surface Water Resources of Calumet County. WDNR, Madison.

7. Weber, John, Michael Desparte, and C.W. Theiren. 1968. Surface Water Resources of Manitowoc County. WDNR, Madison.

8. Nelson, Linden, and Ronald Fassbender. 1972. Surface Water Resources of Brown County. WDNR, Madison.

9. Peeters, Paul. Lake Michigan District Fisheries Manager. 1991. Personal Communication. WDNR, Two Rivers.

10. Rasman, Tim. Lake Michigan District, Limnologist. 1991. Personal Communication. WDNR, Green Bay.

11. Rumery, Carolyn. Self-Help Coordinator. 1991. Personal communication. WDNR, Madison.

12. Peeters, Paul. 1990. Manitowoc/Branch River Fisheries Plan Wis. WDNR, Manitowoc.

13. WDNR. 1979. Manitowoc River Water Quality Evaluation. WDNR, LMD Green Bay.

14. WDNR. 1987. Nonpoint Source Pollution Control Plan for Sevenmile-Silver Creek Priority Watershed. WDNR, Madison.

15. WDNR. 1979. The Lower Manitowoc River Priority Watershed Plan. WDNR, Madison.

16. WDNR. 1979. WQM Plan for Manitowoc River Basin. WDNR, Madison.

17. WDNR. 1980. WQM Plan for Sheboygan River Basin. WDNR, Madison.

18. WDNR. 1990. Wisconsin Self-Help Lake Monitoring Program With Specific Data from 1986-1988. WDNR, Madison.

19. WDNR. 1969. Report on an Investigation of the Pollution in the Manitowoc River Drainage Basin. WDNR, Madison.

20. WDNR. 1991. Oshkosh Area Office: Fish Management Files.

21. WDNR. 1996. Nonpoint Source Control Plan for the Branch River Priority Watershed. Wisconsin DNR, Madison.

22. Rasman, Tim. WDNR Lake Michigan District, Limnologist. 1995. Personal Communication. WDNR, Green Bay.

23. McLennan, Rob. WDNR Lake Michigan District, Nonpoint Source Coordinator. 1995. Personal Communication. WDNR, Green Bay.

24. Szymanski, Scott. WDNR Lake Michigan District, Lake Biologist. 1995. Personal Communication. WDNR, Green Bay.

25. Gansberg, Mary. WDNR Lake Michigan District, Biologist. 1995. Personal Communication. WDNR, Green Bay.

26. Johnson, Bradley. Lake Michigan District Biologist. 1995. Personal Communication. WDNR, Green Bay.

27. WDNR. 1996. Lake Michigan Region: Wastewater Management Files.

28. WDNR. 1996. Lake Michigan Region: Water Quality Management Files.

29. WDNR. 1993. Wisconsin Administrative Code NR 102. Water Quality Standards for Wisconsin Surface Waters.

30. WDNR. 1980. Wisconsin Trout Streams. PUB1.6-3600(80).

31. WDNR and Wisconsin Geological Natural History Survey (WGNHS). 1987. Wisconsin Groundwater Susceptibility Map. Madison.

32. Gansberg, Mary. 1995. Branch River Priority Watershed Appraisal. WDNR, Green Bay.

33. Hogler, Steve. Lake Michigan District Fisheries Manager. 1995. Personal Communication. WDNR, Manitowoc.

34. Raber, James. 1995. Personal Communication. Wis. DNR, Green Bay.

35. Johnson, Bradley. 1994. LMD Eurasian Water Milfoil Survey. WDNR, Green Bay.

36. WDNR. 1995. Lake Planning Grant Tracking Sheet. LMD, Green Bay.

37. WDNR. 1995. Self-Help Monitoring Program Files. LMD, Green Bay.

38. WDNR. 1996. LMD WT 1996 Monitoring Plans. Green Bay.

39. WDNR. Bureau of Endangered Resources. 1989. Vanderbloemen Bog State Natural Area No. 46. Monona, WI.

40. Kamke, Kendall. Lake Michigan District Fisheries Manager. 1995. Personal Communication. WDNR, Oshkosh.

41. Pritzl, Jeff. Lake Michigan District Wildlife Manager. 1996. Personal Communication. WDNR, Manitowoc.

42. Rasman, Tim. Lake Michigan District Limnologist. 1996. Personal Communication. WDNR, Green Bay.

43. Tewes, Tom. Lake Michigan District Wastewater Specialist. 1996. Personal Communication. WDNR, Green Bay.

44. Haack, Jeff. Lake Michigan District Wastewater Engineer. 1996. Personal Communication. WDNR, Green Bay.

45. Amrhein, Jim. Bureau of Fisheries Management and Habitat Protection. 1996. Personal Communication. WDNR, Madison.

46. Doelger, Tim. Lake Michigan District Biologist. 1996. Personal Communication. WDNR, Green Bay.

47. Northern Environmental. 1993. Silver Lake Water Quality Restoration Study. Mequon.

48. WDNR. 1996. WT Fish Kill Files. LMD, Green Bay.

50. WDNR. 1994. Health Guide For People Who Eat Sport Fish From Wisconsin Waters-Fish Advisory. PUBL-IE-019 4/94REV. WDNR, Madison.

51. Foth and Van Dyke. Remedial Investigation Report Hayton Area Remediation Project (HARP). 1996. Volume I and II Text, and Volume I and II Appendices. Green Bay.

54. Hogler, Steve. WDNR Lake Michigan District, Fisheries Manager. 1996. Silver Lake Fish Kill Memo. WDNR, Manitowoc.

55. WDNR. 1985. Impact of Phosphorus Reduction via Metalimnetic Alum Injection in Bullhead Lake. Technical Bulletin No. 153. WDNR, Madison.

56. WDNR. 1985. Silver Lake Feasibility Study Results and Management Alternatives. WDNR, Madison.

57. Surendonk, Steve. WDNR Lake Michigan District, Fisheries Technician. 1996. Personal Communication. WDNR, Manitowoc.

58. WDNR. 1986. Collins Marsh Wildlife Area Master Plan. WDNR, Madison.

59. WDNR. December, 1991. A Nonpoint Source Control Plan for the Milwaukee River South Priority Watershed Project. Publ-WR-245-91.

60. WDNR. Jan-Feb 1986. Sediment from construction sites is a major - yet avoidable - pollutant. WDNR Special Report - Nonpoint Source Pollution: Where to go with the flow. Bergquist, Susan (ed.).

61. Baumann, J. April 1989. Construction Site Erosion Control Handbook. Wisconsin DNR Publication WR-222 92 Rev.

62. Hronek, Mike. 1996. GIS Wetland Acreage. WDNR, Green Bay.

63. Meyers, Lee. 1974. Fisheries Report on Boot Lake. Fish Management Files-Oshkosh.

64. Meyers, Lee. WDNR Lake Michigan District, Fisheries Biologist. 1996. Personal Communication. WDNR, Lake Michigan District Headquarters.

65. Wisconsin Administrative Code NR 51.61. Stewardship Streambank Easement Program.

66. WDNR. 1996. LMD Headquarters Office: Fish Management Files.

67. Becker, George C. 1983. Fishes of Wisconsin. The University of Wisconsin Press.

68. MacKay, H. H. 1963. Fishes of Ontario. Ont. Dep. Lands for., Toronto.

69. Black, J. D. 1944. Carp Problem in 1901. Wisconsin Conservation Bulletin. 9(7):6.

70. Sigler, W. F. 1958. The Ecology and use of Carp in Utah. Utah Department of Fish and Game, Salt Lake City.

71. Mraz, D., and E. L. Cooper. 1957. Reproduction of Carp, Largemouth Bass, Bluegills, and Black Crappies in Small Rearing Ponds. J. Wildlife Management.

72. Hacker, V. A. 1975. Wisconsin Waters with Quillback, Buffalo, Sheepshead, Carp, Dogfish, Garfish, and Eelpout Removal 1947-1974. WDNR, Oshkosh.

73. Gansberg, Mary. 1996. Stream Classification Unnamed Tributary to the South Branch of the Manitowoc River. WDNR, Green Bay.

74. Nikolai, Dick. WDNR Wildlife Manager. 1996. Personal Communication. WDNR, Appleton.

75. Holmstrom, B.K., D.L. Olson, and B.R. Ellefson. 1995. Water Resource Data Wisconsin Water Year 1995. U.S. Geological Survey.

76. Bougie, Cheryl and Tim Rasman. Water Quality Planner, and District Limnologist. 1996. Stream Classification on Pine Creek - Draft. WDNR, Green Bay.

77. U.S. Geological Survey Topography Maps-Cleveland East, and Manitowoc. 1994. Washington D.C.

78. WDNR. 1989. Wisconsin Administrative Code NR 104. Intrastate Waters - Uses and Designated Standards.

79. Crehore, Dave. Northeast Region Public Information Officer. 1996. A Magnificent Mile. Wisconsin Natural Resource Magazine. Vol. 20, No. 6.

80. Gansberg, Mary. 1996. Stream Classification Spring Creek. WDNR. Green Bay.

81. UWEX. Keeping Current-An Update on Wisconsin's Water Resources Programs and Issues. December/January 1997. University of Wisconsin-Extension, Madison.

82. Free, Eugene. Holy Family WWTP Operator. 1996. Personal Communication. Manitowoc.

83. Ward, Thomas. Manitowoc County Soil and Water Conservation Department. Department Director. 1996. Personal Communication. Manitowoc.