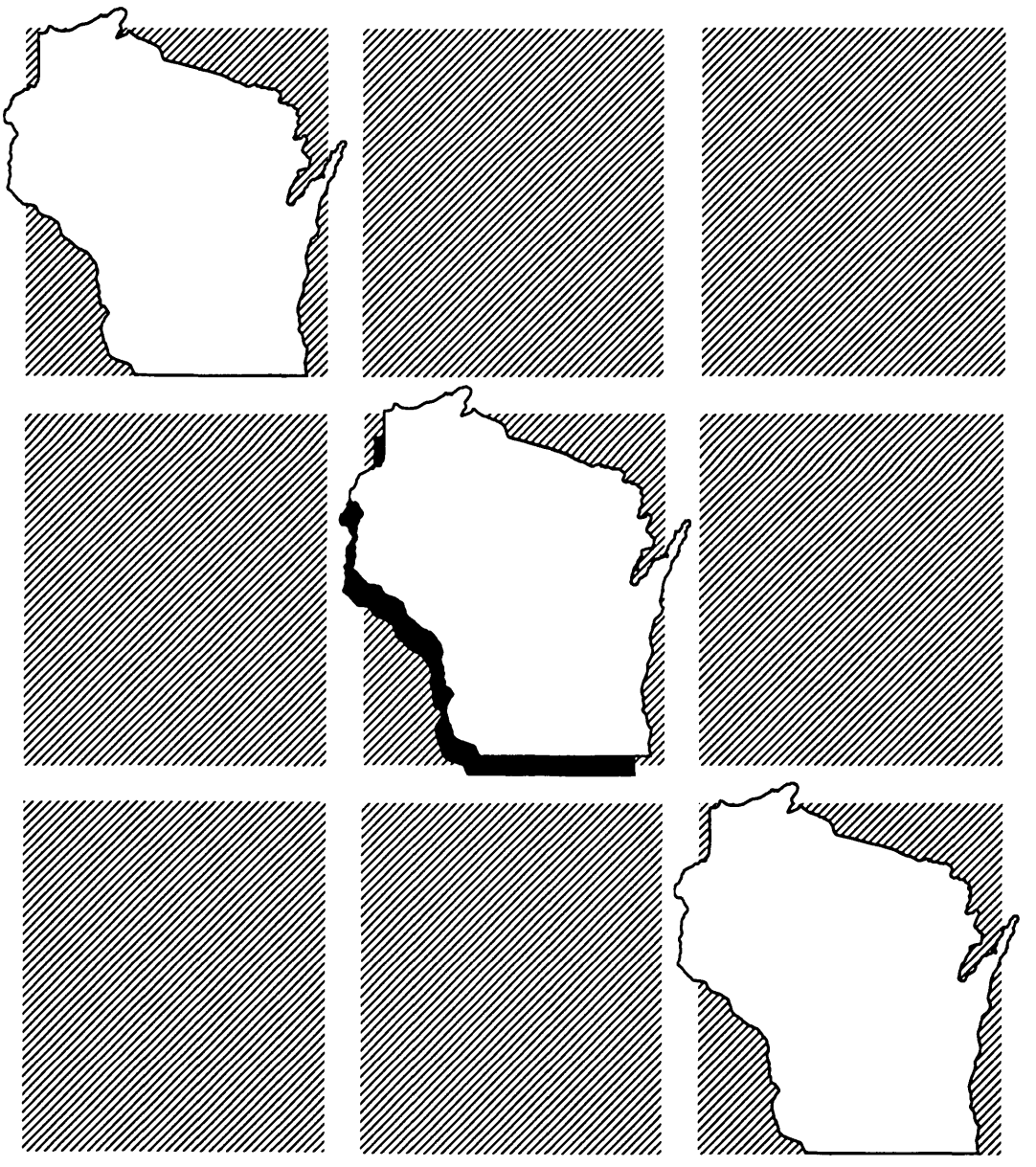
# WISCONSIN

A Summary of Cooperative Water Resources Investigations

U.S. Geological Survey and
Wisconsin Department of Natural Resources



2000

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# A SUMMARY OF COOPERATIVE WATER-RESOURCES INVESTIGATIONS

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U.S. GEOLOGICAL SURVEY
Water Resources Division
8505 Research Way
Middleton, Wisconsin 53562

and

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
P.O. Box 7921
Madison, Wisconsin 53707

2000

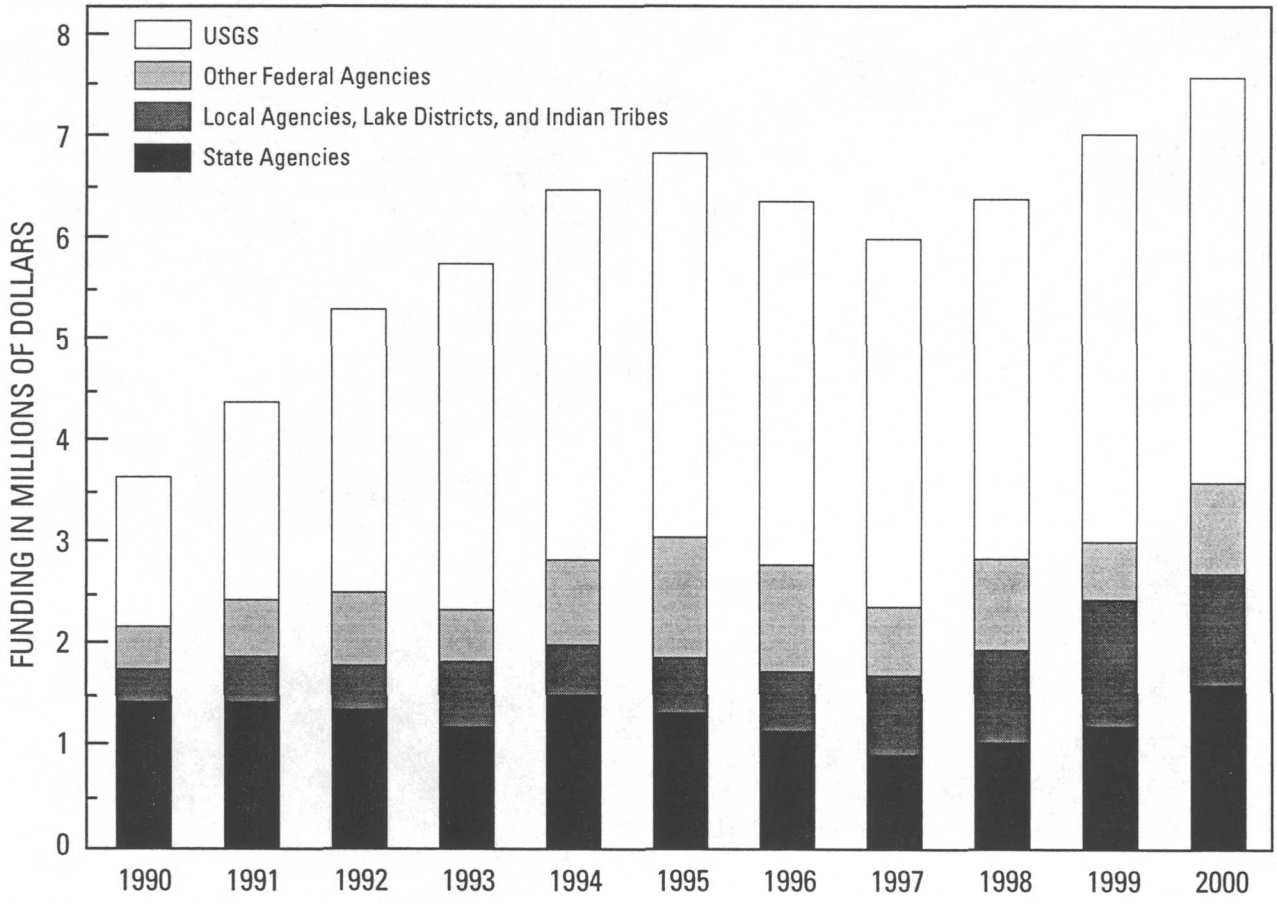
# A Summary of Cooperative Water-Resources Investigations U.S. Geological Survey and Wisconsin Department of Natural Resources

2000

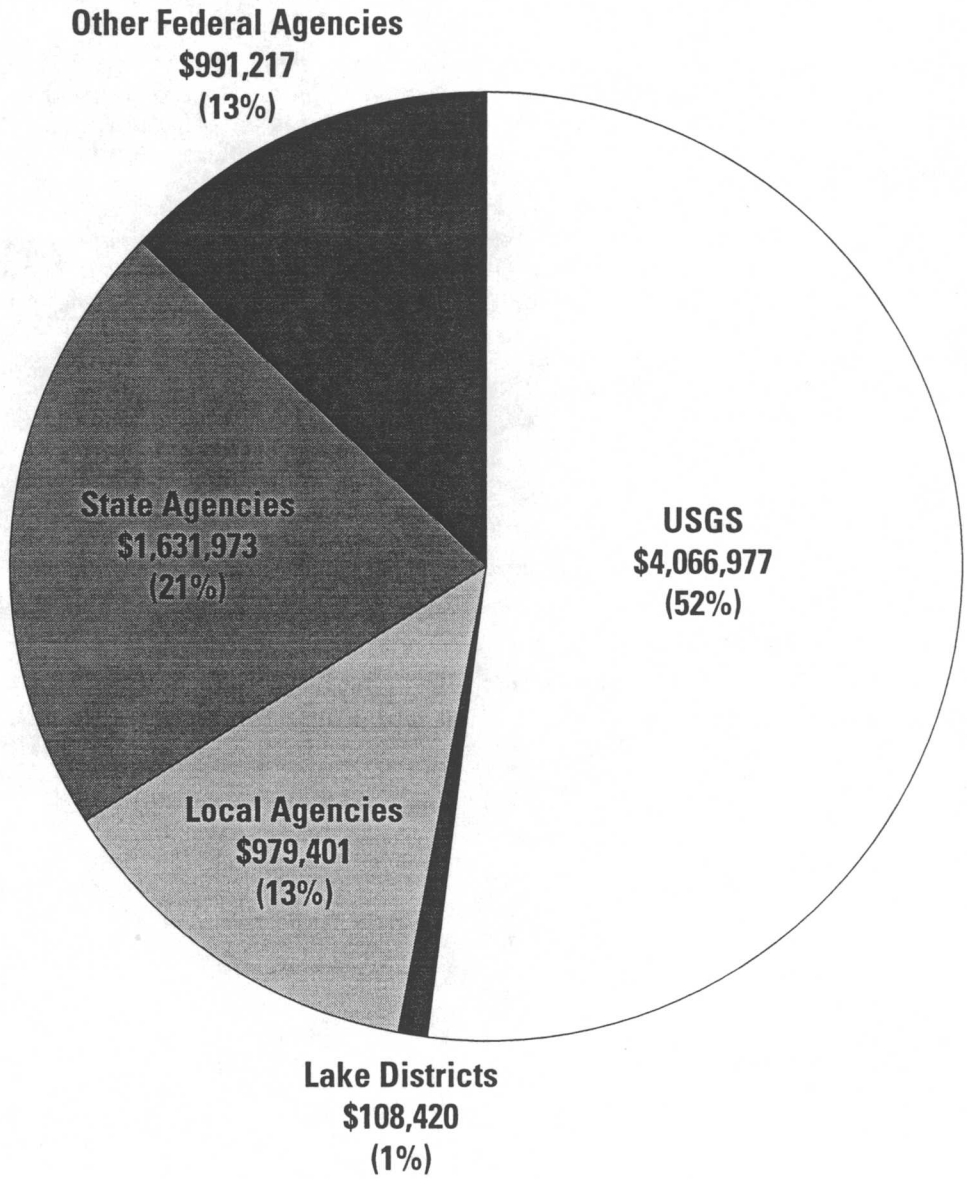
The cooperative program of water-resources investigations between the U.S. Geological Survey and the Wisconsin Department of Natural Resources began as a continuation of cooperative programs with the various State agencies which were merged to form the Wisconsin Department of Natural Resources. These investigations involve various aspects of research, resource evaluations, and water-quantity- and water-quality-monitoring activities.

This is a brief summary report of the activities and plans for the cooperative projects during the July 1999 through June 2000 fiscal year. Each project summary includes a brief description of the objectives, approach, and progress during the 2000 fiscal year, and plans for the 2001 fiscal year.

The appendixes include a detailed listing of proposed stream-monitoring stations for 2001. Also included is the proposed funding summary for the 2000-2001 fiscal year.

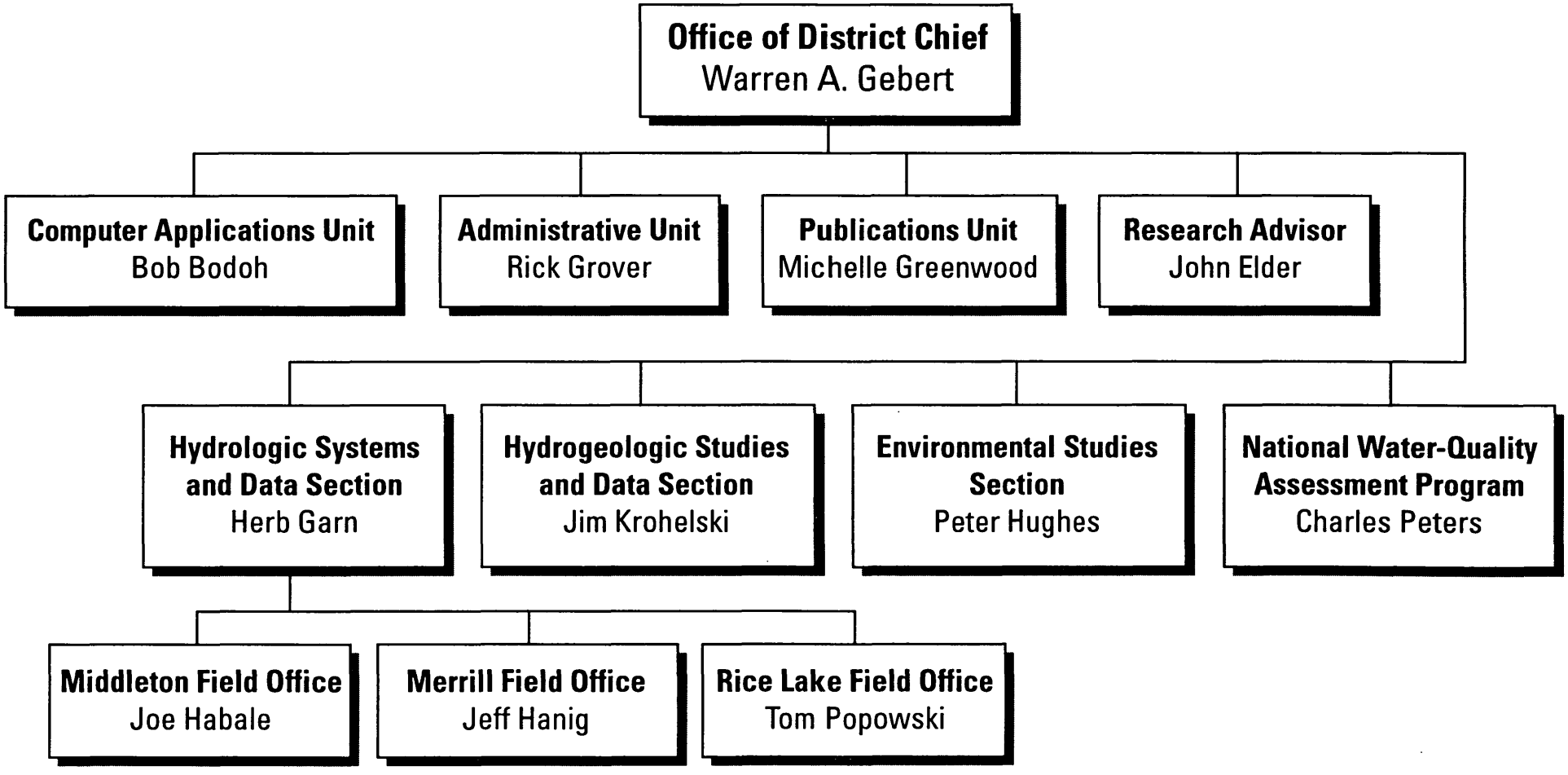


Funding sources for the Wisconsin District program for FY 2000 are shown on the following chart:




**Total Funding = $7,777,988**

## Water Resources Division, Wisconsin District



# CONTENTS

# COLLECTION OF BASIC RECORDS–SURFACE WATER, WI 00100

## COOPERATORS:

Bad River Band of Lake Superior Chippewa Indians
City of Barron
City of Beaver Dam
City of Black River Falls
City of Brookfield
City of Fort Atkinson
City of Hillsboro
City of Peshtigo
City of Sparta
City of Thorp
City of Waupun
Dane County Department of Planning and Development
Dane County Regional Planning Commission
Federal (Regular)
Federal Energy Regulatory Commission Licensees
- Consolidated Paper Corporation, Niagara Division
- Dairyland Power Cooperative
- Northern States Power Company
- Northwoods Hydropower
- Wisconsin Electric Power Company
- Wisconsin Public Service Corporation
- Wisconsin Valley Improvement Company

Fontana/Walworth Water Pollution Control Commission
Green Bay Metropolitan Sewerage District
Illinois Department of Transportation
Jefferson County
Kickapoo Reserve
Lac du Flambeau Band of Lake Superior Chippewa
Madison Metropolitan Sewerage District
Menominee Indian Tribe of Wisconsin
Oneida Tribe of Indians of Wisconsin
Rock County Public Works Department
Southeastern Wisconsin Regional Planning Commission
Stockbridge-Munsee Band of Mohican Indians
U.S. Army Corps of Engineers
Village of Wittenberg
Walworth County Metropolitan Sewerage District
Wisconsin Department of Natural Resources

**PROBLEM:** Surface-water information is needed for surveillance, planning, design, hazard warning, operation, and management in water-related fields such as water supply, hydroelectric power, flood control, irrigation, bridge and culvert design, wildlife

## LOCATION:

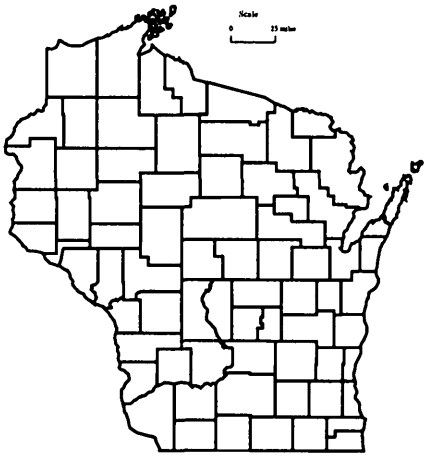
Statewide

## PROJECT CHIEF:

Barry K. Holmstrom

## PERIOD OF PROJECT:

July 1913-Continuing



management, pollution abatement, flood-plain management, and water-resources development. An appropriate database is necessary to provide this information.

**OBJECTIVE:** The objectives of this study are to provide continuous discharge records for selected rivers at specific sites to supply the needs for regulation, analytical studies, definition of statistical properties, trends analysis, determination of the occurrence, and distribution of water in streams for planning. The project is also designed to determine lake levels and to provide discharge for floods, low-flow conditions, and for water-quality investigations. Requests for streamflow data and information relating to streamflow in Wisconsin are answered. Basic data are published annually in the report "Water Resources Data–Wisconsin".

**APPROACH:** A network of streamflow stations and lake-level stations will be maintained throughout Wisconsin. This includes operating the equipment at the gaging station to record river or lake stage, making periodic discharge measurements at each streamflow station to establish or verify a stage-discharge rating curve, reducing the stage records to instantaneous and daily discharges, compilation of monthly and annual discharges, and preparing data for publication in the annual report "Water Resources Data–Wisconsin".

Requests for streamflow data from other government agencies, consultants, and private parties will be processed.

**PROGRESS** (July 1999 to June 2000): During the current fiscal year, streamflow data were collected at a total of 110 sites: 18 sites for the Corps of Engineers, 14 sites for the Southeastern Wisconsin Regional Planning Commission, 10 sites for the Wisconsin Department of Natural Resources (WDNR), 8 sites for the Federal program, 4 sites for Federal Energy Commission licensees, 3 sites for the Madison Metropolitan Sewerage District, 3 sites for the Lac du Flambeau Band of Lake Superior Chippewa, and 1 site each for the Bad River Band of Lake Superior Chippewa Indians, Menominee Indian Tribe of Wisconsin, Oneida Tribe of Indians of Wisconsin, Stockbridge-Munsee Band of Mohican Indians, Illinois Department of Transportation, Rock County Public Works Department, Fontana/Walworth Water Pollution Control Commission, Dane County Department of Planning and Development, Walworth County Metropolitan Sewerage District, Dane County Regional Planning Commission, Green Bay Metropolitan Sewerage District, Kickapoo Reserve, and cities of Barron, Beaver Dam, Brookfield, Fort Atkinson, Hillsboro, Peshtigo, Sparta, Thorp, Waupun, and village of Wittenberg. Streamflow data were also collected at 28 sites for agencies working jointly with the USGS. Lake-level data were collected at two sites for the Dane County Department of Planning and Development, two sites for the Corps of Engineers, one site for the Rock County Public Works Department, and one site for the WDNR.

A map showing the location of all continuous-record streamflow-gaging stations in Wisconsin is shown on page 5.

Computation of streamflow and lake-level records for all the network stations for the 1999 water year was completed, stored in our WATSTORE computer database, and published in the annual report "Water Resources Data–Wisconsin, water year 1999". More than 300 requests for streamflow information were answered.

**PLANS** (July 2000 to June 2001): Data will be collected at 114 continuous-streamflow stations (see the following list) and lake levels at 6 stations. Streamflow records will be computed and data published for the 2000 water year. Requests for streamflow information will be answered.

## Real-time data can be accessed on the World Wide Web at http://wi.water.usgs.gov

Discharge data computation and publication is planned to be discontinued for 05369500 Chippewa River at Durand, 05379500 Trempealeau River at Dodge, 05381000 Black River at Neillsville, and 05382000 Black River near Galesville for the 2001 water year. Stage data only will be collected at these four stations.

## SURFACE-WATER GAGING STATIONS EXPECTED TO BE OPERATED IN 2001 FY

| Station number | Name and location | Drainage Area | Period of record (water year) | Cooperator |
|---|---|---|---|---|
| 464646092052900 | Superior Bay, Duluth Ship Canal at Duluth, MN | 4200 | 1994- | C of E, Detroit |
| 04024430 | Nemadji River - South Superior | 420 | 1974- | WDNR |
| 04025500 | Bois Brule River - Brule | 118 | 1943-81, 1984- | USGS Federal Program |
| 04027000 | Bad River - Odanah | 597 | 1914-22, 1948- | Bad River Band of Lake Superior Chippewa Indians |
| 04027500 | White River - Ashland | 301 | 1948- | NSP/WDNR |
| 04029990 | Montreal River - Saxon Falls | 262 | 1987 | NSP/WDNR |
| 04063700 | Popple River - Fence | 139 | 1964- | USGS Federal Program |
| 04064500 | Pine River - Pine River Powerplant - Florence | 533 | 1924-76, 1996- | WEPCO/WDNR |
| 04065106 | Menominee River - Niagara | 2470 | 1993- | FERC |
| 04066003 | Menominee River - Pembine | 3140 | 1950- | WEPCO/WDNR |
| 04066030 | Menominee River - White Rapids Dam - Banat, MI | 3190 | 1999- | FERC |
| 04066500 | Pike River - Amberg | 255 | 1914-70, 2000- | USGS Federal Program |
| 04066800 | Menominee River - Koss, MI | 3700 | 1907-09, 1913-81, 1998- | FERC |
| 04067500 | Menominee River - McAllister | 3930 | 1945-61, 1979-86 1988-90, 1993-95, 1998- | WDNR |
| 04067958 | Peshtigo River - Wabeno | 447 | 1998- | WPS/WDNR |
| 04069416 | Peshtigo River - Porterfield | 1020 | 1998- | FERC |
| 04069500 | Peshtigo River - Peshtigo | 1080 | 1953- | City of Peshtigo |
| 04071000 | Oconto River - Gillett | 705 | 1906-09, 1914- | USGS Federal Program |
| 04071765 | Oconto River - Oconto | 966 | 1989-90, 1998- | WDNR |
| 04072150 | Duck Creek - Howard | 108 | 1988- | Oneida Tribe of Indians of WI |
| 040073365 | Fox River - Princeton | | 2001- | USGS Federal Program |
| 04073500 | Fox River - Berlin | 1340 | 1898- | C of E, Detroit |
| 04074950 | Wolf River - Langlade | 463 | 1966-79, 1981- | Menominee Indian Tribe of WI |
| 04077400 | Wolf River - Shawano | 816 | 1907-09, 1911- | Alliant Utilities/WDNR |
| 04077630 | Red River - Morgan | 114 | 1993 | Stockbridge-Munsee Band of Mohican Indians |
| 0407809265 | Middle Branch Embarrass River - Wittenberg | 76.3 | 1990- | Village of Wittenberg |
| 04078500 | Embarrass River - Embarrass | 384 | 1919-85, 1994- | USGS Federal Program |
| 04079000 | Wolf River - New London | 2260 | 1896- | C of E, Detroit |
| 04082400 | Fox River - Oshkosh | 5310 | 1991 | C of E, Detroit |
| 04084445 | Fox River - Appleton | 5950 | 1986- | C of E, Detroit |
| 04084500 | Fox River - Rapide Croche Dam - Wrightstown | 6010 | 1896- | LFRDA/WDNR |
| 040851385 | Fox River - Oil Tank Depot - Green Bay | 6330 | 1989- | Green Bay MSD |
| 04085200 | Kewaunee River - Kewaunee | 127 | 1964-96, 1998- | WDNR |
| 04085395 | S.Br. Manitowoc River - Hayton | 109 | 1993- | WDNR |
| 04085427 | Manitowoc River - Manitowoc | 526 | 1972-96, 1998- | WDNR |
| 04086000 | Sheboygan River - Sheboygan | 418 | 1916-24, 1951- | WDNR |
| 04086500 | Cedar Creek - Cedarburg | 120 | 1930-70, 73-81, 1983-87, 1991- | WDNR |
| 04086600 | Milwaukee River - Pioneer Road - Cedarburg | 607 | 1982- | SEWRPC |
| 04087000 | Milwaukee River - Milwaukee | 696 | 1914- | SEWRPC |
| 04087030 | Menomonee River - Menomonee Falls | 34.7 | 1975-77, 1979- | SEWRPC |
| 04087088 | Underwood Creek - Wauwatosa | 18.2 | 1975- | SEWRPC |
| 04087120 | Menomonee River - Wauwatosa | 123 | 1962- | SEWRPC |
| 04087160 | Kinnickinnic River - Milwaukee | 20.4 | 1976- | SEWRPC |
| 04087204 | Oak Creek - South Milwaukee | 25 | 1964- | SEWRPC |
| 04087220 | Root River - Franklin | 49.2 | 1964- | SEWRPC |
| 04087233 | Root River Canal - Franklin | 57 | 1964- | SEWRPC |
| 04087240 | Root River - Racine | 190 | 1963- | SEWRPC |
| 04087257 | Pike River - Racine | 38.5 | 1972- | SEWRPC |
| 05332500 | Namekagon River - Trego | 488 | 1928-70, 1988 | NSP/WDNR |
| 05340500 | St. Croix River - St. Croix Falls | 6240 | 1902- | NSP/WDNR |
| 05341500 | Apple River - Somerset | 579 | 1901-70, 1987 | NSP/WDNR |
| 05356000 | Chippewa River - Winter | 790 | 1912- | NSP/WDNR |
| 05356500 | Chippewa River - Bruce | 1650 | 1914- | NSP/WDNR |
| 05357254 | Trout River - CTH H - Boulder Junction | 58.9 | 1999- | Lac du Flambeau Band of Lake Superior Chippewa (LDF) |
| 05357335 | Bear River - Manitowish Waters | 81.3 | 1991 | LDF |
| 05360500 | Flambeau River - Bruce | 1860 | 1951- | NSP/WDNR, FERC |
| 05362000 | Jump River - Sheldon | 576 | 1915- | USGS Federal Program |
| 05365500 | Chippewa River - Chippewa Falls | 5650 | 1888-1983, 1987 | NSP/WDNR |
| 05365707 | North Fork Eau Claire River - Thorp | 51 | 1986 | City of Thorp |
| 053674464 | Yellow River - Barron | 153 | 1991 | City of Barron |
| 05368000 | Hay River - Wheeler | 418 | 1951- | USGS Federal Program |
| 05369000 | Red Cedar River - Menomonie | 1770 | 1907-08, 1913- | NSP/WDNR |
| 05369500 | Chippewa River - Durand | 9010 | 1928- | C of E, St. Paul |
| 05370000 | Eau Galle River - Spring Valley | 64.1 | 1944- | C of E, St. Paul |
| 05379400 | Trempealeau River - Arcadia | 606 | 1960-77, 2001- | USGS Federal Program |
| 05379500 | Trempealeau River - Dodge | 643 | 1914-19, 1934 | C of E, St. Paul |
| 05381000 | Black River - Neillsville | 749 | 1905-09, 1914- | C of E, St. Paul |

## SURFACE-WATER GAGING STATIONS EXPECTED TO BE OPERATED IN 2001 FY

| Station number | Name and location | Drainage Area | Period of record (water year) | Cooperator |
|---|---|---|---|---|
| 053813595 | Black River - Black River Falls | 1590 | 1985- | C of E, St. Paul, City of Black River Falls |
| 05382000 | Black River - Galesville | 2080 | 1932- | C of E, St. Paul |
| 05382325 | La Crosse River - Sparta | 167 | 1992- | City of Sparta |
| 05383075 | LaCrosse River - LaCrosse | | | WDNR |
| 05391000 | Wisconsin River - Lake Tomahawk | 757 | 1936- | WVIC/WDNR |
| 05393500 | Spirit River - Spirit Falls | 81.6 | 1942- | WVIC/WDNR |
| 05394500 | Prairie River - Merrill | 184 | 1914-31, 1939 | WVIC/WDNR |
| 05395000 | Wisconsin River - Merrill | 2760 | 1903- | WVIC/WDNR |
| 05397500 | Eau Claire River - Kelly | 375 | 1914-27, 1939- | WVIC/WDNR |
| 05398000 | Wisconsin River - Rothschild | 4020 | 1945- | WVIC/WDNR |
| 05399500 | Big Eau Pleine River - Stratford | 224 | 1914-26, 1937- | WVIC/WDNR |
| 05400760 | Wisconsin River - Wisconsin Rapids | 5420 | 1914-50, 1958- | WVIC/WDNR |
| 05401050 | Tenmile Creek - Nekoosa | 73.3 | 1963-79, 1988-94 1998- | WDNR |
| 05402000 | Yellow River - Babcock | 215 | 1944- | WVIC/WDNR |
| 05404000 | Wisconsin River - Wisconsin Dells | 8090 | 1935- | WVIC/WDNR |
| 05404116 | S. Br. Baraboo River - Hillsboro | 39.1 | 1988- | City of Hillsboro |
| 05405000 | Baraboo River - Baraboo | 609 | 1914-22, 1943- | USGS Federal Program |
| 05406500 | Black Earth Creek - Black Earth | 45.6 | 1954- | DCRPC |
| 05407000 | Wisconsin River - Muscoda | 10400 | 1903-04, 1914- | C of E, St. Paul |
| 05407500 | Kickapoo River - Ontario | 151 | 2001- | USGS Federal Program |
| 05408000 | Kickapoo River - LaFarge | 266 | 1939- | Kickapoo Reserve |
| 05410490 | Kickapoo River - Steuben | 687 | 1933- | C of E, St. Paul |
| 05413500 | Grant River - Burton | 269 | 1935- | C of E, R. Island |
| 05414000 | Platte River - Rockville | 142 | 1935- | C of E, R. Island |
| 05423500 | S. Br. Rock River - Waupun | 63.6 | 1948-69, 1987 | City of Waupun |
| 05425500 | Rock River - Watertown | 969 | 1931-70, 1977- | C of E, R. Island, Rock County PWD |
| 05425912 | Beaverdam River - Beaver Dam | 157 | 1984- | City of Beaver Dam |
| 05426000 | Crawfish River - Milford | 762 | 1931- | Rock County PWD, Jefferson County |
| 05426250 | Bark River - Rome | 122 | 1980- | SEWRPC |
| 05427085 | Rock River - Ft. Atkinson | 2240 | 1999- | City of Ft. Atkinson |
| 05427570 | Rock River - Indianford | 2630 | 1975- | Rock County PWD |
| 05429500 | Yahara River - McFarland | 327 | 1930- | DCDP&D |
| 05430150 | Badfish Creek - Cooksville | 82.6 | 1977- | MMSD |
| 05430175 | Yahara River - Fulton | 517 | 1977 | MMSD |
| 05430500 | Rock River - Afton | 3340 | 1914- | C of E, R. Island |
| 05431032 | Turtle Creek - Delavan | 83.3 | 1996- | WALCOMET |
| 05431486 | Turtle Creek - Clinton | 199 | 1939- | C of E, Rock Island, WALCOMET |
| 05432500 | Pecatonica River - Darlington | 273 | 1939- | C of E, R. Island |
| 05433000 | E. Br. Pecatonica River - Blanchardville | 221 | 1939-1986, 1988 | C of E, R. Island |
| 05434500 | Pecatonica River - Martintown | 1034 | 1940- | C of E, R. Island |
| 05435943 | Badger Mill Creek - Verona | 20.3 | 1997- | MMSD |
| 05436500 | Sugar River - Brodhead | 523 | 1914- | C of E, Rock Island |
| 05438283 | Piscasaw Creek - Walworth | 9.58 | 1992- | Fontana/Walworth WPCC |
| 05543800 | Fox River - Watertown Road - Waukesha | 77.4 | 1993- | City of Brookfield |
| 05543830 | Fox River - Waukesha | 126 | 1963- | SEWRPC |
| 05544200 | Mukwonago River - Mukwonago | 74.1 | 1973- | SEWRPC |
| 05545750 | Fox River - New Munster | 811 | 1940- | IL. DOT |
| | | LAKES | | |
| 04082500 | Lake Winnebago - Oshkosh | 5880 | 1882- | C of E, Detroit |
| 04084255 | Lake Winnebago - Stockbridge | 5880 | 1983- | C of E, Detroit |
| 05404500 | Devil's Lake - Baraboo | 4.79 | 1922-30, 1932, 1934-81, 1985- | WDNR |
| 05427235 | Lake Koshkonong - Newville | 2560 | 1987 | Rock County PWD |
| 05428000 | Lake Mendota - Madison | 233 | 1903, 1916- | DCDPW |
| 05429000 | Lake Monona - Madison | 279 | 1915- | DCDPW |

C of E, Detroit – Corps of Engineers, Detroit, MichiganL
C of E, R. Island – Corps of Engineers, Rock Island, Illinois
C of E, St. Paul – Corps of Engineers, St. Paul, Minnesota
DCDP&D – Dane County Department of Planning and Development
DCRPC - Dane County Regional Planning Commission
FERC – Federal Energy Regulatory Commission Licensees
Fontana/Walworth WPCC – Fontana/Walworth Water Pollution Control Commission
Green Bay MSD - Green Bay Metropolitan Sewerage District
IL. DOT – Illinois Department of Transportation
LFRDA - Lower Fox River Dischargers' Association
MMSD – Madison Metropolitan Sewerage District
NSP - Northern States Power Company
Rock County PWD - Rock County Public Works Department
SEWRPC – Southeastern Wisconsin Regional Planning Commission
WALCOMET – Walworth County Metropolitan Sewerage District
WDNR – Wisconsin Department of Natural Resources
WEPCO - Wisconsin Electric Power Company
WPS - Wisconsin Public Service
WVIC - Wisconsin Valley Improvement Company

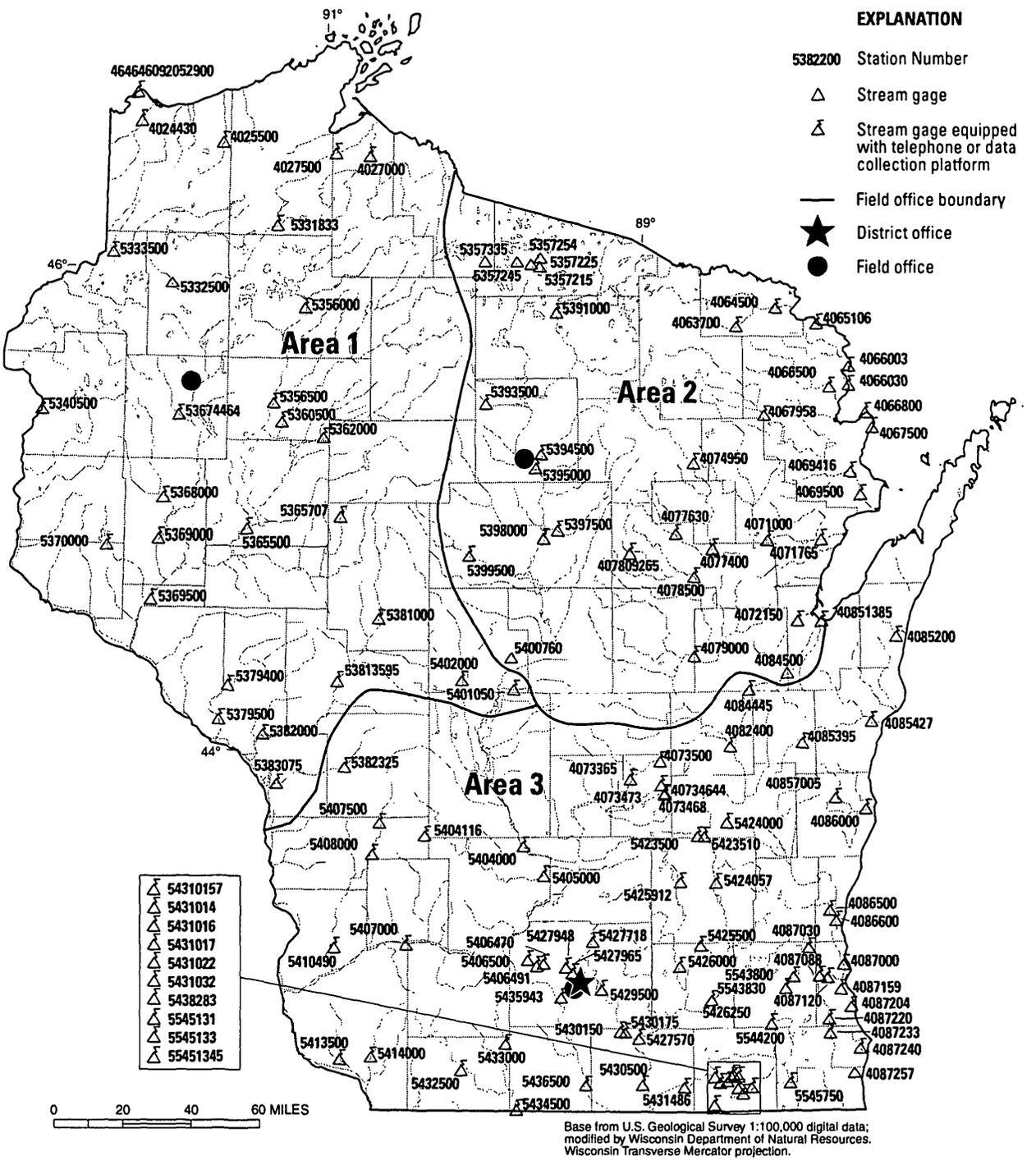



**Figure 8.** Location of continuous-record data-collection stations.

# DISCONTINUED SURFACE-WATER DISCHARGE STATIONS

The following continuous-record surface-water discharge stations in Wisconsin have been discontinued. Daily streamflow records were collected and published for the period of record, expressed in water years, shown for each station. Those stations with an asterisk (*) after the station number are currently operated as crest-stage partial-record stations. Some of the discontinued project stations with less than three years of record have not been included. Information regarding these stations may be obtained from the District Office at the address given on the back side of the title page of this report.

### Discontinued surface-water discharge stations

| Station name | Station number | Drainage area (square miles) | Period of record |
|---|---|---|---|
| **STREAMS TRIBUTARY TO LAKE SUPERIOR** | | | |
| Little Balsam Creek at Patzau, WI | 04024314 | 4.89 | 1976-78 |
| Little Balsam Creek near Patzau, WI | 04024315 | 5.05 | 1976-78 |
| Little Balsam Creek Tributary near Patzau, WI | 04024318 | 0.60 | 1976-78 |
| Little Balsam Creek near Foxboro, WI | 04024320 | 3.27 | 1977-78 |
| Amnicon River near Poplar (Amnicon Falls), WI | 04025000 | 110 | 1914-16 |
| Bois Brule (Brule) River near Brule, WI | 04026000 | 160 | 1914-17 |
| Sioux River near Washburn, WI | 04026300* | 33.9 | 1965-66 |
| Pine Creek at Moquah, WI | 04026347 | 6.20 | 1976-78 |
| Pine Creek Tributary at Moquah, WI | 04026348 | 0.48 | 1976-78 |
| Pine Creek near Moquah, WI | 04026349 | 19.9 | 1976-78 |
| North Fish Creek near Moquah, WI | 040263491 | 65.4 | 1990-91 |
| Bad River near Mellen, WI | 04026450* | 82.0 | 1971-75 |
| Bad River at Mellen, WI | 04026500 | 98.3 | 1948-55 |
| Alder Creek near Upson, WI | 04026870 | 22.2 | 1972-77 |
| Montreal River near Kimball, WI | 04028500 | 100 | 1924-26 |
| West Fork Montreal River at Gile, WI | 04029000 | 75.0 | 1918-26, 1943-47 |
| West Fork Montreal River near Kimball, WI | 04029500 | 86.2 | 1924-26 |
| **STREAMS TRIBUTARY TO LAKE MICHIGAN** | | | |
| North Branch Pine River at Windsor Dam nr Alvin, WI | 04063640* | 27.8 | 1967-68 |
| Pine River near Florence, WI | 04064000 | 510 | 1914-23 |
| Pine River below Pine River Power Plant near Florence, WI | 04064500 | 533 | 1924-76 |
| Peshtigo River at High Falls near Crivitz, WI | 04068000 | 537 | 1912-57 |
| Pensaukee River near Pensaukee, WI | 04071858 | 134 | 1973-96 |
| Suamico River at Suamico, WI | 04072000 | 60.7 | 1951-52 |
| Lawrence Creek near Westfield, WI | 04072750 | 13.4 | 1968-73 |
| Grand River near Kingston, WI | 04073050 | 73.5 | 1968-75 |
| West Branch White River near Wautoma, WI | 04073405 | 38.9 | 1964-75 |
| White Creek at Forest Glen Beach near Green Lake, WI | 04073462 | 3.05 | 1982-88 |
| Swamp Creek above Rice Lake at Mole Lake, WI | 04074538 | 46.3 | 1977-83, 1985-87 |
| Swamp Creek below Rice Lake at Mole Lake, WI | 04074548 | 56.8 | 1977-79, I982-85 |
| Wolf River near White Lake, WI | 04075000 | 485 | 1935-38 |
| Evergreen Creek near Langlade, WI | 04075200* | 8.09 | 1964-73 |
| Wolf River above West Branch Wolf River, WI | 04075500 | 616 | 1928-62 |
| West Branch Wolf River at Neopit, WI | 04076000 | 93.2 | 1911-17 |
| West Branch Wolf River near Keshena, WI | 04076500 | 163 | 1928-32 |
| Little Wolf River near Galloway, WI | 04079602 | 22.6 | 1974-79 |
| Spaulding Creek near Big Falls, WI | 04079700* | 5.57 | 1964-66 |
| Little Wolf River at Royalton, WI | 04080000 | 507 | 1914-70, 1983-85 |
| Emmons Creek near Rural, WI | 04080950 | 25.1 | 1977 |
| Storm Sewer to Mirror Lake at Waupaca, WI | 04080976 | 0.04 | 1971-74 |
| Waupaca River near Waupaca, WI | 04081000 | 265 | 1916-66, 1983-85 |
| Daggets Creek at Butte Des Morts, WI | 04081800 | 10.6 | 1977 |
| West Branch Fond du Lac River at Fond du Lac, WI | 04083000 | 83.1 | 1939-54 |
| East Branch Fond du Lac River near Fond du Lac, WI | 04083500 | 78.4 | 1939-54 |
| Brothertown Creek at Brothertown, WI | 04084200 | 5.10 | 1976-77 |
| East Twin River at Mishicot, WI | 04085281 | 110 | 1972-96 |
| Onion River at Hingham, WI | 04085813 | 37.2 | 1979-80 |
| Onion River near Sheboygan Falls, WI | 04085845 | 94.1 | 1979-82 |
| Milwaukee River at Kewaskum, WI | 04086150 | 138 | 1968-81 |
| East Branch Milwaukee River near New Fane, WI | 04086200 | 54.1 | 1968-81 |

## Discontinued surface-water discharge stations

| Station name | Station number | Drainage area (square miles) | Period of record |
|---|---|---|---|
| North Branch Milwaukee River near Fillmore, WI | 04086340 | 148 | 1968-81 |
| Milwaukee River at Waubeka, WI | 04086360 | 432 | 1968-81, 1994 |
| Mud Lake Outlet near Decker Corner, WI | 04086488 | 7.36 | 1983-84 |
| Milwaukee River above North Ave. Dam at Milwaukee, WI | 04087010 | 702 | 1982-84 |
| Menomonee River at Germantown, WI | 04087018 | 19.0 | 1975-77 |
| Jefferson Park Drainageway at Germantown, WI | 04087019 | 1.82 | 1976-78 |
| Menomonee River at Butler, WI | 04087040 | 60.6 | 1975-79 |
| Little Menomonee River near Freistadt, WI | 04087050* | 8.0 | 1975-79 |
| Noyes Creek at Milwaukee, WI | 04087060 | 1.94 | 1975-80, 1990 |
| Little Menomonee River at Milwaukee, WI | 04087070 | 19.7 | 1975-77 |
| Honey Creek at Wauwatosa, WI | 04087119 | 10.3 | 1975-81 |
| Schoonmaker Creek at Wauwatosa, WI | 04087125 | 1.94 | 1975-79 |
| Hawley Road Storm Sewer at Milwaukee, WI | 04087130 | 1.83 | 1975-77 |
| Menomonee River at Milwaukee, WI | 04087138 | 134 | 1982-84 |
| Kinnickinnic River at Milwaukee, WI | 04087160 | 20.4 | 1976-83 |
| **ST. CROIX RIVER BASIN** | | | |
| Namekagon River at Trego, WI | 05332000 | 433 | 1914-27 |
| Loon Creek near Danbury, WI | 05335010 | 17.6 | 1970-71 |
| Bashaw Brook near Shell Lake, WI | 05335380* | 26.6 | 1964-66 |
| Clam River near Webster, WI | 05335500 | 361 | 1941-42 |
| St. Croix River near Grantsburg, WI | 05336000 | 2,980 | 1923-70 |
| Wood River near Grantsburg, WI | 05339000 | 185 | 1939-40 |
| Rice Creek near Balsam Lake, WI | 05341375 | 12.5 | 1988-89 |
| Balsam Branch at Balsam Lake, WI | 05341402 | 52.8 | 1988-90 |
| Kinnickinnic River near River Falls, WI | 05342000 | 165 | 1917-21 |
| **CHIPPEWA RIVER BASIN** | | | |
| West Fork Chippewa River at Lessards, nr Winter, WI | 05355500 | 474 | 1912-16 |
| Couderay River near Couderay, WI | 05356121 | 169 | 1981-83 |
| Flambeau River at Flambeau Flowage (Flambeau Reservoir), WI | 05357500 | 622 | 1927-61 |
| Flambeau River near Butternut, WI | 05358000 | 688 | 1914-39 |
| Pine Creek near Oxbo, WI | 05358300 | 38.9 | 1971-75 |
| Flambeau River at Babbs Island near Winter, WI | 05358500 | 967 | 1929-75 |
| South Fork Flambeau River near Phillips, WI | 05359500 | 609 | 1929-75 |
| Price Creek near Phillips, WI | 05359600* | 16.9 | 1964-66 |
| Flambeau River near (at) Ladysmith, WI | 05360000 | 1,790 | 1903-06, 1914-61 |
| Chippewa River near Holcombe, WI | 05361000 | 3,720 | 1944-49 |
| South Fork Jump River near Ogema, WI | 05361500 | 327 | 1944-54 |
| Chippewa River at Holcombe, WI | 05362500 | 4,680 | 1943-49 |
| Fisher River at (near) Holcombe, WI | 05363000 | 81.5 | 1944-45 |
| O'Neil Creek near Chippewa Falls, WI | 05363500 | 78.1 | 1944-45 |
| Yellow River near Hannibal, WI | 05363700 | 86.7 | 1962-63 |
| Yellow River at Cadott, WI | 05364000* | 364 | 1943-61 |
| Duncan Creek at Bloomer, WI | 05364500* | 50.3 | 1944-52 |
| Duncan Creek Tributary near Tilden, WI | 05364850 | 4.17 | 1987-89 |
| Duncan Creek at Chippewa Falls, WI | 05365000 | 117 | 1943-55 |
| Eau Claire River near Augusta, WI | 05366000 | 509 | 1914-26 |
| Bridge Creek at Augusta, WI | 05366300 | 35.0 | 1980 |
| Eau Claire River near Fall Creek, WI | 05366500* | 760 | 1943-55 |
| Chippewa River at (near) Eau Claire, WI | 05367000 | 6,620 | 1903-09, 1944-54 |
| Red Cedar River near Cameron, WI | 05367425 | 442 | 1966-70 |
| Red Cedar River near Cameron, WI | 05367426 | 443 | 1971-73 |
| Red Cedar River near Colfax, WI | 05367500 | 1,100 | 1914-80, 1989-90 |
| Eau Galle River near Woodville, WI | 05369900 | 39.4 | 1978-83 |
| Eau Galle River at low water bridge at Spring Valley, WI | 05369945 | 47.9 | 1982-83, 1986-96 |
| French Creek near Spring Valley, WI | 05369955 | 6.03 | 1981-83 |
| Lousy Creek near Spring Valley, WI | 05369970 | 5.97 | 1981-83 |
| Lohn Creek near Spring Valley, WI | 05369985 | 2.53 | 1981-83 |
| Eau Galle River at Elmwood, WI | 05370500 | 91.6 | 1943-54 |
| **BUFFALO RIVER BASIN** | | | |
| Buffalo River near Tell, WI | 05372000 | 406 | 1933-51 |

## Discontinued surface-water discharge stations

| Station name | Station number | Drainage area (square miles) | Period of record |
|---|---|---|---|
| **TREMPEALEAU RIVER BASIN** | | | |
| Bruce Valley Creek near Pleasantville, WI | 05379288 | 10.1 | 1980 |
| Elk Creek near Independence, WI | 05379305 | 108 | 1980 |
| Trempealeau River near Trempealeau, WI | 05380000 | 719 | 1932-34 |
| **BLACK RIVER BASIN** | | | |
| Black River at Medford, WI | 05380806 | 48.1 | 1984-87 |
| Poplar River near Owen, WI | 05380900* | 155 | 1964-66 |
| **LA CROSSE RIVER BASIN** | | | |
| Little LaCrosse River near Leon, WI | 05382500 | 76.9 | 1934-61, 1979-81 |
| LaCrosse River near West Salem, WI | 05383000 | 396 | 1914-70 |
| **COON CREEK BASIN** | | | |
| Spring Coulee Creek near Coon Valley, WI | 05386490 | 9.01 | 1979-81 |
| Coon Creek at Coon Valley, WI | 05386500 | 77.2 | 1934-40, 1978-81 |
| Coon Creek near Stoddard, WI | 05386999 | 120 | 1934-40, 1979-81 |
| **BAD AXE RIVER BASIN** | | | |
| North Fork Bad Axe River near Genoa, WI | 05387100* | 80.8 | 1964-66 |
| **WISCONSIN RIVER BASIN** | | | |
| Wisconsin River at Conover, WI | 05390180 | 177 | 1967-71 |
| Pelican River near Rhinelander, WI | 05391226 | 101 | 1976-79 |
| Wisconsin River at Whirlpool Rapids, near Rhinelander, WI | 05392000 | 1,220 | 1906-61 |
| Bearskin Creek near Harshaw, WI | 05392350* | 31.1 | 1964-66 |
| Tomahawk River near Bradley, WI | 05392400 | 422 | 1915-27, 1929 |
| Tomahawk River at Bradley, WI | 05393000 | 544 | 1930-73 |
| New Wood River near Merrill, WI | 05394000 | 82.2 | 1953-61 |
| Rib River at Rib Falls, WI | 05396000 | 303 | 1925-57 |
| Little Rib River near Wausau, WI | 05396500 | 79.1 | 1914-16 |
| East Branch Eau Claire River near Antigo, WI | 05397000 | 81.5 | 1949-55 |
| Eau Claire River near Antigo, WI | 05397110 | 185 | 1975-81 |
| Bull Junior Creek (Bull Creek Junior) near Rothschild, WI | 05398500 | 27.4 | 1944-52 |
| Big Eau Pleine River near Colby, WI | 05399000 | 78.1 | 1941-54 |
| Hamann Creek near Stratford, WI | 05399431 | 11.3 | 1977-79 |
| Wisconsin River at Knowlton, WI | 05400000 | 4,530 | 1921-42 |
| Plover River near Stevens Point, WI | 05400500 | 145 | 1914-20, 1944-52 |
| Little Plover River near Arnott, WI | 05400600 | 2.24 | 1959-75 |
| Little Plover River at Plover, WI | 05400650 | 19.0 | 1959-87 |
| Fourmile Creek near Kellner, WI | 05400840 | 75.0 | 1964-67 |
| Buena Vista Creek near Kellner, WI | 05400853 | 53.1 | 1964-67 |
| Tenmile Creek Ditch 5 near Bancroft, WI | 05401020 | 9.73 | 1964-73 |
| Fourteenmile Creek near New Rome, WI | 05401100 | 91.1 | 1964-79 |
| Wisconsin River near Necedah, WI | 05401500 | 5,990 | 1903-14, 1944-50 |
| Big Roche a Cri Creek near Hancock, WI | 05401510 | 9.61 | 1964-67 |
| Big Roche a Cri Creek near Adams, WI | 05401535 | 52.8 | 1964-78 |
| Yellow River at Sprague, WI | 05402500 | 392 | 1927-40 |
| Yellow River at Necedah, WI | 05403000 | 491 | 1941-57 |
| Lemonweir River at New Lisbon, WI | 05403500 | 507 | 1944-87, 1994 |
| Hulbert Creek near Wisconsin Dells, WI | 05403630* | 11.2 | 1971-77 |
| Dell Creek near Lake Delton, WI | 05403700* | 44.9 | 1957-65, 1971-80 |
| Narrows Creek at Loganville, WI | 05404200* | 40.1 | 1964-66 |
| Wisconsin River at Prairie du Sac, WI | 05406000 | 9,180 | 1946-54 |
| Trout Creek at Confluence with Arneson Creek nr Barneveld, WI | 05406573 | 8.37 | 1976-78 |
| Trout Creek at Twin Parks Dam 8 nr Barneveld, WI | 05406574 | 9.02 | 1976-79 |
| Trout Creek at County Highway T nr Barneveld, WI | 05406575 | 12.1 | 1976-78 |
| Trout Creek near Ridgeway, WI | 05406577 | 13.5 | 1976-79 |
| Knight Hollow Creek near Arena, WI | 05406590 | 7.57 | 1976-78 |
| Otter Creek near Highland, WI | 05406640 | 16.8 | 1968-69, 1970-75 |
| Knapp Creek near Bloomingdale, WI | 05408500 | 8.44 | 1955-69 |
| West Fork Kickapoo River near Readstown, WI | 05409000 | 106 | 1939 |
| Kickapoo River at Soldiers Grove, WI | 05409500 | 530 | 1939 |

## Discontinued surface-water discharge stations

| Station name | Station number | Drainage area (square miles) | Period of record |
|---|---|---|---|
| North Fork Nederlo Creek near Gays Mills, WI | 05409830 | 2.21 | 1968-79 |
| Nederlo Creek near Gays Mills, WI | 05409890 | 9.46 | 1968-80 |
| Kickapoo River at Gays Mills, WI | 05410000 | 617 | 1914-34, 1964-77 |
| **GRANT RIVER BASIN** | | | |
| Pigeon Creek near Lancaster, WI | 05413400* | 6.93 | 1964-66 |
| Rattlesnake Creek near Beetown, WI | 05413451 | 45.2 | 1990-91 |
| **GALENA RIVER BASIN** | | | |
| Little Platte River near Platteville, WI | 05414213 | 79.7 | 1987-90 |
| Sinsinawa River near Hazel Green, WI | 05414800 | 24.9 | 1987-90 |
| Pats Creek near Belmont, WI | 05414894 | 5.42 | 1981-82 |
| Madden Branch Tributary near Belmont, WI | 05414915* | 2.83 | 1981-82 |
| Madden Branch near Meekers Grove, WI | 05414920 | 15.04 | 1981-82 |
| Galena River at Buncombe, WI | 05415000 | 125 | 1939-92 |
| **APPLE RIVER BASIN** | | | |
| Apple River near Shullsburg, WI | 05418731 | 9.34 | 1981-82 |
| **ROCK RIVER BASIN** | | | |
| West Branch Rock River near Waupun, WI | 05423000 | 40.7 | 1949-70, 1978-81 |
| West Branch Rock River at County Trunk Highway D near Waupun, WI | 05423100 | 43.9 | 1978-81 |
| East Branch Rock River near Mayville, WI | 05424000 | 179 | 1949-70 |
| Rock River at Hustisford, WI | 05424082 | 511 | 1978-85 |
| Johnson Creek near Johnson Creek, WI | 05425537 | 1.13 | 1978-80 |
| Johnson Creek near Johnson Creek, WI | 05425539 | 13.3 | 1978-80 |
| Pratt Creek near Juneau, WI | 05425928 | 3.54 | 1978-80 |
| Rock River at Jefferson, WI | 05426031 | 1,850 | 1978-94 |
| Whitewater Creek near Whitewater, WI | 05426500 | 11.8 | 1926-28, 1946-54 |
| Whitewater Creek at Millis Road near Whitewater, WI | 05426900 | 20.6 | 1978-81 |
| Whitewater Creek at Whitewater, WI | 05427000 | 22.8 | 1926-28, 1946-54 |
| Koshkonong Creek near Rockdale, WI | 05427507 | 150 | 1977-82 |
| Token Creek near Madison, WI | 05427800* | 24.3 | 1964-66, 1976-81 |
| Sixmile Creek near Waunakee, WI | 05427900 | 41.1 | 1976-82 |
| Pheasant Branch at Airport Road near Middleton, WI | 05427943 | 9.61 | 1977-81 |
| South Fork Pheasant Branch at Highway 14 near Middleton, WI | 05427945 | 5.74 | 1978-81 |
| Pheasant Branch at Century Avenue at Middleton, WI | 05427950 | 20.8 | 1977-81 |
| Pheasant Branch at mouth at Middleton, WI | 05427952 | 24.5 | 1978-81 |
| Willow Creek at Madison, WI | 05427970 | 3.15 | 1974-83 |
| Olbrich Park Storm Ditch at Madison, WI | 05428665 | 2.57 | 1976-80 |
| Manitou Way Storm Sewer at Madison, WI | 05429040 | 0.23 | 1971-77 |
| Nakoma Storm Sewer at Madison, WI | 05429050 | 2.30 | 1972-77 |
| Lake Wingra Outlet at Madison, WI | 05429120 | 6.00 | 1971-77 |
| Door Creek near Cottage Grove, WI | 05429580 | 15.3 | 1976-79 |
| Yahara River near Edgerton, WI | 05430000 | 430 | 1917-18 |
| Oregon Branch at Oregon, WI | 05430030 | 9.93 | 1979-81 |
| Badfish Creek at County Highway A near Stoughton, WI | 05430095 | 41.9 | 1956-66, 1986-88 |
| Badfish Creek near Stoughton, WI | 05430100 | 41.3 | 1956-66 |
| Jackson Creek at Petrie Road near Elkhorn, WI | 05431014 | 8.96 | 1984-95 |
| Livingston Branch, Pecatonica River near Livingston, WI | 05432055 | 16.4 | 1987-91 |
| Yellowstone River near Blanchardville, WI | 05433500* | 28.5 | 1954-65, 1978-79 |
| Pecatonica River at Dill, WI | 05434000 | 944 | 1914-19 |
| Steiner Branch near Waldwick, WI | 05433510 | 5.9 | 1978-79 |
| Skinner Creek at Skinner Hollow Road near Monroe, WI | 05434235 | 32.6 | 1978-81 |
| Skinner Creek at Klondyke Road near Monroe, WI | 05434240 | 35.0 | 1978-81 |
| West Branch Sugar River near Mount Vernon, WI | 05435980 | 32.7 | 1979-80 |
| Mount Vernon Creek near Mount Vernon, WI | 05436000 | 16.4 | 1954-65, 1976-80 |
| **ILLINOIS RIVER BASIN** | | | |
| White River near Burlington, WI | 05545300 | 110 | 1964-66, 1973-78 |

# CRANDON GROUND WATER, WI 00201

## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
Forest County

## PROJECT CHIEF:
James T. Krohelski

## PERIOD OF PROJECT:
October 1994-Continuing

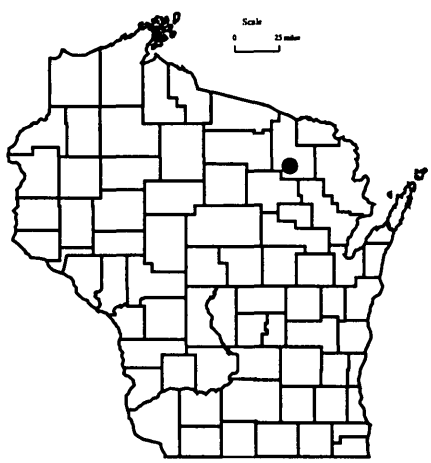
**PROBLEM:** A large underground zinc-copper mine is being proposed at a site about five miles south of Crandon, Wisconsin, in Forest County. The Wisconsin Department of Natural Resources (WDNR) requested that District staff review the development of a ground-water-flow model and associated hydrologic documents as part of a permitting process for the proposed mine.

**OBJECTIVE:** The objective is to review documents related to water resources submitted to WDNR from the Nicolet Mining Company and their consultants and to make suggestions to WDNR on studies and approaches that will improve the understanding of the hydrology and effects of mining on the water resources in the vicinity of the proposed mine.

**APPROACH:** The schedule for review of documents will be mutually agreed upon between WDNR and USGS.

**PROGRESS** (July 1999 to June 2000): Ground-water-flow model calibration and predictive simulations, based on the calibrated ground-water model were completed. Monitoring of lake stage and shallow ground-water levels adjacent to Little Sand Lake and Skunk Lake was continued.

**PLANS** (July 2000 to June 2001): Documents will be reviewed and meetings attended at the request of the WDNR. Descriptions of model development, calibration and simulation results of the flow model will be summarized and submitted to the WDNR. Monitoring of lake stage and shallow ground-water levels adjacent to Little Sand Lake will be continued.



# WISCONSIN WATER-USE DATA FILE, WI 00700

**PROBLEM:** The need for reliable water-use data by State and Federal planning agencies is increasing as the competition for use of the State's water resources increases. Water-use data in a standardized format needs to be available to assist in making decisions on future water use.

**OBJECTIVE:** The purpose of this project is to collect accurate and complete data on Wisconsin's water use, store data in the State Water-Use Data System (SWUDS), and prepare periodic reports on water use in the State.

**APPROACH:** Sources of water-use information will be evaluated. The best available data will be entered into SWUDS. Efforts will be made to upgrade the accuracy of the water-use data.

**PROGRESS** (July 1999 to June 2000): SWUDS was updated with current water-use information. These data included high-capacity well data and information on discharge from sewage-treatment plants in the State. Reformatting programs were written or updated as needed for entering data from other agencies into SWUDS.

**PLANS** (July 2000 to June 2001): Plans include: (1) continue to update and maintain SWUDS with current water-use data, (2) supply water-use data for water-resources studies currently being conducted in the State and (3) work with the Department of Natural Resources and the Wisconsin Geological and Natural History Survey in a joint effort to establish a water-use database that can be used and updated by each agency.

## REPORTS:


Ellefson, B.R., Fan, C.H., and Ripley, J.L., 1995, Water use in Wisconsin, 1995: U.S. Geological Survey Open-File Report 97-356, 1 sheet, scale 1:5,000,000.

Ellefson, B.R., Sabin, T.J., Krohelski, J.T., 1993, Water use in Wisconsin, 1990: U.S. Geological Survey Open-File Report 93-118, 1 sheet, scale 1:5,000,000.

Ellefson, B.R., Rury, K.S., and Krohelski, J.T., 1988, Water-use in Wisconsin, 1985: U.S. Geological Survey Open-File Report 87-699, 1 sheet, scale 1:5,000,000.

U.S. Geological Survey, 1990, National Water Summary, 1987–Hydrologic events and water supply and use: U.S. Geological Survey Water-Supply Paper 2350, 553 p.

Krohelski, J.T., Ellefson, B.R., and Storlie, C.A., 1987, Estimated use of ground water for irrigation in Wisconsin, 1984: U.S. Geological Survey Water-Resources Investigations Report 86-4079, 12 p., 1 pl.

Lawrence, C.L., and Ellefson, B.R., 1984, Public-supply pumpage in Wisconsin, by aquifer: U.S. Geological Survey Open-File Report 83-931, 40 p.

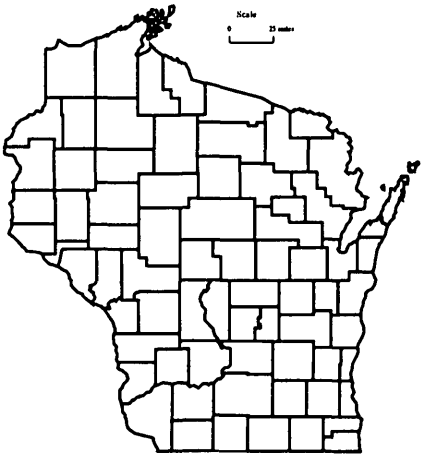
_____,1982, Water use in Wisconsin, 1979: U.S. Geological Survey Open-File Report 82-444, 98 p.


## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
Statewide

## PROJECT CHIEF:
Bernard R. Ellefson

## PERIOD OF PROJECT:
March 1978-Continuing



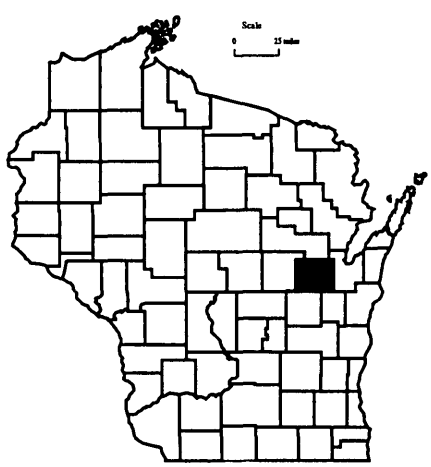
# FOX RIVER REMEDIATION, WI 14500

## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
Outagamie County

## PROJECT CHIEF:
Jeffrey Steuer

## PERIOD OF PROJECT:
August 1998 to October 2000



**PROBLEM:** Several Fox River bottom sediment deposits are being considered for remediation based upon high PCB concentrations. The pilot remediation project at deposit "N" (Kimberly) began in November 1998 and, in August 1999, pre-dredge sampling commenced at the Sediment Management Unit (SMU) 56_57 (Green Bay). There is a need, as part of the Fox River Remediation Assessment Team (FRRAT) efforts, to monitor and collect environmental data before, during, and after the remediation operation.

**OBJECTIVE:** Monitoring and sampling will be conducted to meet the project Quality Assurance Project Plan objectives. The objectives are to (1) evaluate baseline conditions prior to dredging activities, (2) evaluate short-term impacts, including PCB mass fluxes during dredge activities, and (3) evaluate conditions following the completion of dredge-related activities.

**APPROACH:** Deposit "N"—The baseline investigation consists of water column samples collected at four upstream locations and four downstream locations prior to the commencement of dredging. Bottom sediment samples will be collected from a minimum of 30 locations in Deposit N and an intermediate zone located between the sediment deposit and the silt-containment barrier.

Evaluation of short-term impact includes water-column sampling at four upstream and four downstream locations, dredge slurry samples and continuous-flow monitoring, composite samples of all on-shore processing locations, composite samples of processed solids for landfill disposal, samples of filter media, and treated carriage water samples.

Evaluation of long-term impacts will include collecting sediment core samples from the same locations as the pre-dredge sample sites and an intermediate zone characterization using visual reconnaissance and sampling.

SMU 56_57—The baseline investigation consists of water-column samples collected at four upstream locations and five downstream locations prior to the commencement of dredging.

Evaluation of short-term impact includes water-column sampling at four upstream and five downstream locations, dredge slurry samples with continuous-flow monitoring and composite samples of processed and treated carriage water samples.

**PROGRESS** (July 1999 to June 2000): Deposit "N"—Pre- and post-dredge cores have been collected and processed at 30 locations along with the intermediate zone. Over 90 PCB samples, 800 TSS samples, and over 6,400 water-quality measurements have been collected at the water-column sites. Shore-side (remediation process) samples and slurry flow data have been collected for 29 continuous days. The USGS mercury lab has completed the bottom sediment and remediation process sample analyses. The data analyses and draft report have been written evaluating the water-column transport and the shore-side processes.

SMU 56_57—Over 90 PCB samples, 800 TSS samples, and over 6,400 water-quality measurements have been collected at the water-column sites. Assistance was provided in the slurry sampling and five 80-liter effluent samples were processed. Data analysis has commenced.

**PLANS** (July 2000 to June 2001): SMU 56_57 data analysis and report writing will be conducted in conjunction with the FRRAT.

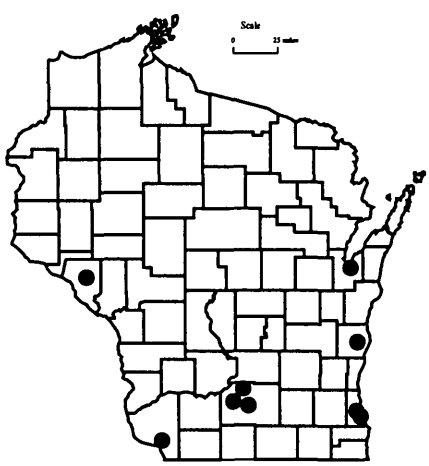
# TRENDS IN WATER QUALITY AND STREAM HABITAT FOR PRIORITY WATERSHEDS, WI 17202-17204, 17213

## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
Priority watersheds in Brown, Buffalo, Dane, Grant, Milwaukee and Sheboygan Counties

## PROJECT CHIEF:
David J. Graczyk
Steven R. Corsi
Judy Wierl

## PERIOD OF PROJECT:
October 1990-Continuing



**PROBLEM:** An evaluation strategy is needed to assess the effectiveness of nonpoint-source pollution control measures in priority watersheds. Several important processes require research including the role of ground water in nonpoint-source contamination, factors leading to dissolved-oxygen reduction in a stream during runoff events, and the impact of management practices on bedload transport. Several techniques need to be developed and/or refined, such as detecting trends in stream-water chemistry, sampling of fish and fish habitat, relation between fish/fish habitat and changes resulting from watershed management practices, and use of habitat models for determining impact of watershed management on fish populations.

**OBJECTIVE:** The overall objective of this project is to determine the trends in water quality for 10 sites during and after implementation of improved land-management practices in 7 priority watersheds.

**APPROACH:** Ten streams were selected in seven different priority watersheds. Continuous-record streamflow, water temperature, and dissolved-oxygen gaging stations were installed at each stream site. Water-quality samples will be collected during events and low flows and analyzed for selected constituents. Land-use inventories will be taken each year to help determine the cause of any changes in water quality.

**PROGRESS** (July 1999 to June 2000): Streamflow and water-quality monitoring were continued at three sites in the priority watersheds. Water-quality loads were calculated for selected parameters and storm periods. All the data were summarized and published in the report "Water-Resources Data–Wisconsin". Land-use inventories were completed for each basin.

**PLANS** (July 2000 to June 2001): Streamflow and water-quality monitoring will be continued at one site. Two sites will be monitored for streamflow and water quality beginning in October 2000, with the possibility of a third site. Water-quality loads for selected parameters and storm periods will be calculated and compared to data collected in previous years. The data will be analyzed to determine if there are any apparent trends in water quality during implementation of best management plans. At one site, water-quality samples will be collected weekly during the period of April-October, biweekly in March and November, and monthly during December, January, and February. Land use will be updated for each basin. Report on post monitoring of two sites discontinued in 1998.

## REPORTS:
Wierl, J.A., Giddings, E.M., and Bannerman, R.T., 1998, Evaluation of a method for comparing phosphorus loads from barnyards and croplands in Otter Creek Watershed, Wisconsin, U.S. Geological Survey Fact Sheet 168-98, 4 p.

Corsi, S.R., Graczyk, D.J., Owens, D.W., and Bannerman, R.T., 1997, Unit-area loads of suspended sediment, suspended solids, and total phosphorus from small watersheds in Wisconsin: U.S. Geological Survey Fact Sheet 195-97, 4 p.

Rappold, K.F., Wierl, J.A., and Amerson, F.U., 1997, Watershed characteristics and land management in the nonpoint-source evaluation monitoring watersheds in Wisconsin: U.S. Geological Survey Open-File Report 97-119, 39 p.

Wierl, J.A., Rappold, K.F., and Amerson, F.U., 1996, Summary of the land-use inventory for the nonpoint-source evaluation monitoring watershed in Wisconsin: U.S. Geological Survey Open-File Report 96-123, 23 p.

Greb, Steven R., and Graczyk, David J., 1995, Frequency-duration analysis of dissolved-oxygen concentrations in two southwestern Wisconsin streams, Water Resources Bulletin v. 31, no. 3, p. 431-438.

Walker, John F., and Graczyk, David J., 1993, Preliminary evaluation of effects of best management practices in the Black Earth Creek, Wisconsin, priority watershed: Water Science Technology, v. 28, no. 3-5, p. 539-548.

# BEST MANAGEMENT PRACTICE EVALUATION, WI 17206

## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
State of Wisconsin

## PROJECT CHIEF:
John F. Walker

## PERIOD OF PROJECT:
October 1989 to September 2000

**PROBLEM:** To date, the effectiveness of best management practices (BMPs) in Wisconsin has not been determined. The natural variability of water-quality data complicates the detection of changes due to BMP implementation. Research is needed to identify techniques for detecting changes due to BMP implementation and applying the techniques to before and after data.

**OBJECTIVE:** The objective is to investigate statistical analysis techniques for assessing trends in water quality due to Best Management Practice (BMP) implementation using data from other states. The effectiveness of BMPs in two urban basins and seven rural basins in Wisconsin will be determined using the identified statistical techniques.

**APPROACH:** A comprehensive literature search will be conducted to identify viable statistical analysis techniques and needs for method modification or development. Data for several rural and urban basins in other states will be compiled and used to test the selected techniques. Storm loads of total-suspended solids and total phosphorus will be computed and used along with rainfall data and land-use information to assess the effectiveness of the BMPs in several basins in Wisconsin.

**PROGRESS** (July 1999 to June 2000): Storm-load data through 1998 water year was compiled for annual report. Annual report was completed and sent out for review. Analysis of pre- and post-BMP data for Brewery and Garfoot Creeks began. Final report for Black Earth Creek watershed was started.

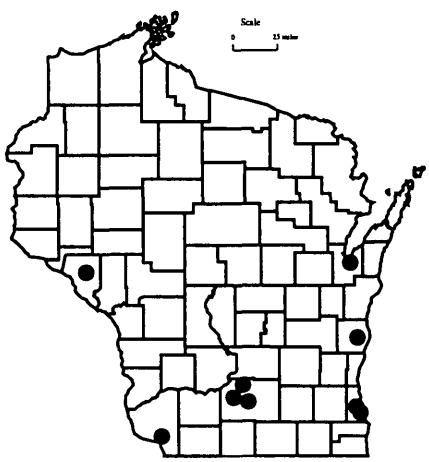
**PLANS** (July 2000 to June 2001): The annual report describing results of statistical analysis for data collected through the 1998 water year will be published. Report describing final results for the Black Earth Creek watershed will be completed and published.

## REPORTS:


Owens, D.W., Corsi, S.R., and Rappold, K.F., 1997, Evaluation of nonpoint-source contamination, Wisconsin: selected data for water year 1995, U.S. Geological Survey Open-File Report 96-661A.

Walker, J.F., Graczyk, D.J., Corsi, S.R., Owens, D.W., and Wierl, J.A., 1995, Evaluation of nonpoint-source contamination, Wisconsin: land-use and best management practices inventory, selected streamwater-quality data, urban-watershed quality assurance and quality control, constituent loads in rural streams, and snowmelt-runoff analysis, water year 1994: U.S. Geological Survey Open-File Report 95-320, 21 p.

Corsi, S.R., Walker, J.F., Graczyk, D.J., Greb, S.R., Owens, D.W., and Rappold, K.F., 1995, Evaluation of nonpoint-source contamination, Wisconsin: selected streamwater-quality data, land-use and best-management practices inventory, and quality assurance and quality control, water year 1993: U.S. Geological Survey Open-File Report 94-707, 57 p.

Walker, J.F., 1994, Statistical techniques for assessing water-quality effects of BMPs, ASCE J. of Irrigation and Drainage Engineering, v. 120, no. 2, p. 334-347.

Walker, J.F., and Graczyk, D.J., 1993, Preliminary evaluation of effects of best management practices in the Black Earth Creek, Wisconsin, priority watershed: Water Science and Technology, v. 28, no. 3-5, p. 539-548.

Walker, J.F., 1993, Techniques for detecting effects of urban and rural land-use practices on stream-water chemistry inlected watersheds in Texas, Minnesota, and Illinois: U.S. Geological Survey Open-File Report 93-130, 16 p.

Graczyk, D.J., Walker, J.F., Greb, S.R., Corsi, S.R., Owens, D.W., 1993, Evaluation of nonpoint-source contamination, Wisconsin: Selected data for 1992 water year: U.S. Geological Survey Open-File Report 93-630, 48 p.

# SINGLE SOURCE SITES, WI 17214

## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
State of Wisconsin

## PROJECT CHIEF:
Todd D. Stuntebeck

## PERIOD OF PROJECT:
March 1994-Continuing

**PROBLEM:** Much work has been done to assess the effectiveness of nonpoint-source pollution-control strategies known as best management practices (BMPs). Most of this work to date has had a basin-wide scope and is focused on evaluating the cumulative effectiveness of several different types of BMPs. Research targeted at evaluating the effectiveness of a single type of BMP would assist resource managers responsible for planning BMP implementation programs.

**OBJECTIVE:** The objective is to determine the significance of a single nonpoint-pollution source and evaluate the effectiveness of BMPs in treating that same source.

**APPROACH:** Water-quality samples will be collected upstream and downstream from a single nonpoint-pollution source before and after implementation of BMPs. Water-quality samples are generally collected biweekly during open-water periods, and monthly during the winter months. In addition, water-quality samples are collected with automated water samplers during selected periods of storm runoff. Water-surface levels are continuously monitored at the sites, and a continuous discharge record is determined from water-surface/discharge relations.

Two barnyard-runoff sites have been fully investigated–Otter Creek in the Sheboygan River Priority Watershed and Halfway Prairie Creek in the Black Earth Creek Priority Watershed. The study concluded that implementation of barnyard BMPs at each site has significantly reduced the loadings of most constituents coming from the barnyards. Currently two additional sites are being investigated–Parsons Creek in the Lake Winnebago Priority Watershed and Hutchinson Creek in the Buffalo River Watershed. Each of these sites is designed to evaluate both a barnyard BMP and a streambank erosion BMP.

**PROGRESS** (July 1999 to June 2000): Samples were collected for two storm-runoff periods at Parsons Creek. Streambank stabilization work was completed in September 1999. Water samples for one snowmelt period have been collected for the first post-BMP period. Water discharge, water temperature, rainfall records and water-quality loads have been worked up for water years 1998 and 1999 for the upstream, middle, and downstream sites and will be published in the 2000 data report.

Samples were collected for four storm-runoff periods at Hutchinson Creek. Baseflow samples were collected according to schedule and measurements of streamflow were made when appropriate.

**PLANS** (July 2000 to June 2001): Biweekly baseflow and storm-runoff samples will be collected at Parsons Creek. Storm-event data analysis for pre-BMP period at Parsons Creek will begin. Sampling will be discontinued at Hutchinson Creek after June 1, 2000, due to site limitations. Equipment will be installed and sampling will begin at a site in LaCrosse County to evaluate the effectiveness of rotational grazing.

## REPORTS:

Stuntebeck, T.D., and Bannerman, R.T., 1998, Effectiveness of barnyard best management practices in Wisconsin: U.S. Geological Survey Fact Sheet 051-98, 4 p.

Stuntebeck, T.D., 1995, Evaluating barnyard best management practices in Wisconsin using upstream-downstream monitoring: U.S. Geological Survey Fact Sheet 221-95, 4 p.

# MULTI-STREAM EXPERIMENTAL DESIGN, WI 17223

## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
Fond du Lac, Manitowoc, Ozaukee, Sheboygan, Washington, and Walworth Counties

## PROJECT CHIEF:
John F. Walker

## PERIOD OF PROJECT:
October 1997 to June 2000

**PROBLEM:** The amount of best management practice (BMP) implementation at evaluation monitoring sites is currently much less than anticipated, and implementation is taking longer than expected. Results on a shorter time scale are needed to evaluate the overall nonpoint-source program.

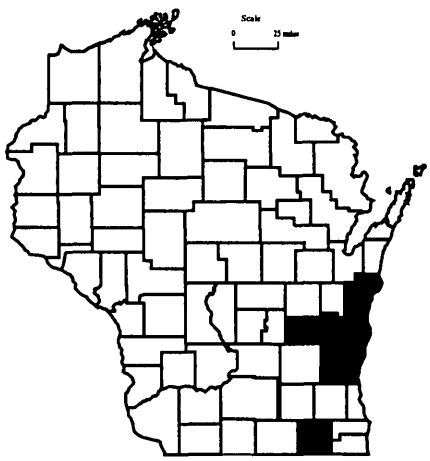
**OBJECTIVE**: The objective is to investigate feasibility of sampling a large number of sites (20-60) for a short period of time (1-2 years) to determine the effectiveness of BMPs.

**APPROACH:** The sites to be considered are chosen to cover a wide range of BMP implementation. For selected evaluation-monitoring sites, annual loads will be computed with a reduced data set and compared to the actual load to determine uncertainty in annual loads for a particular sampling scheme. A statistical analysis will determine the minimum number of sites needed to demonstrate a significant relation between load reduction and BMP implementation.

**PROGRESS** (July 1999 to June 2000): Data collection at the eight index stations was completed through November 1999. Daily streamflow records and annual sediment and phosphorus loads at the eight index sites were estimated. The accuracy of estimated daily records from the index-site method was evaluated.

**PLANS** (July 2000 to June 2001): The accuracy of annual loads using a combination of index sites and the sampling strategies determined previously (Robertson and Roerish) was evaluated. Overall statistical analysis evaluating multi-stream approach for evaluation of BMP effectiveness was performed. Results will be published in an open-file report.

## REPORTS:
Robertson, Dale M., and Roerish, Eric D., Influence of different sampling strategies on load estimations for small streams, journal article (submitted to Water Resources Research).



# HYDROLOGY AND WATER QUALITY OF THREE PASTURES IN SOUTHWESTERN WISCONSIN, WI 17229

**PROBLEM:** Nonpoint-source pollution is a major concern in Wisconsin. There are approximately 24,000 dairy farms in Wisconsin which may be sources of sediment, nutrients and pesticides to surface and ground water. Managed Intensive Rotational Grazing (MIRG) is a system that uses pastures as a major source of feed for milking cows (Jackson-Smith and others, 1996). MIRG farmers rely on pastures for their dairy herds' forage needs and move their cows to a new pasture at least once a week (Jackson-Smith and others, 1996). In 1992, roughly 7 percent of Wisconsin dairy farms used MIRG but, in 1994, 14 percent of Wisconsin dairy farms used MIRG (Jackson-Smith and others, 1996). MIRG can be used as a best management practice (BMP) and may reduce the amount of sediments, nutrients and pesticides to receiving waters. In a study in Oklahoma, rotational grazed pastures evidenced a reduction in average annual runoff and sediment discharges when compared to a continuously grazed basin (Menzel and others, 1978).

This study will compare surface-water runoff and water quality from three small pastured watersheds. The pastures will be located at the USDA Dairy Forage Research Center at Prairie du Sac.

**OBJECTIVE:** The overall objective of this study is to determine differences in quantity and quality of surface-water runoff from three different pasture-management strategies. These strategies consist of a variety of practices which are available to pasture managers, both during the growing and dormant seasons. Combinations of management practices have been chosen to represent commonly used strategies. In addition to examining differences in overall management strategies, differences related to individual seasonal practices will be determined. A secondary objective will be to determine a water budget for each pasture. The water budget will be determined by measuring surface-water runoff and precipitation. Evaporation and transpiration will be estimated by using empirical equations and ground-water flow will be estimated as a residual.

**APPROACH**: The management practices to be examined include (1) intensive rotational grazing and continuous grazing during the growing season; (2) pasture "stockpiling" during late summer and continued grazing throughout the summer; and (3) two outwintering practices and no outwintering.

An artificial hydraulic control was installed at each pasture outlet. The control is a three-inch Parshall flume. Each site will use a pressure transducer to measure stage and a CR-10 data recorder. Daily, monthly and annual surface-water runoff will be calculated at each pasture.

## COOPERATOR:

Wisconsin Department of Natural Resources

## LOCATION

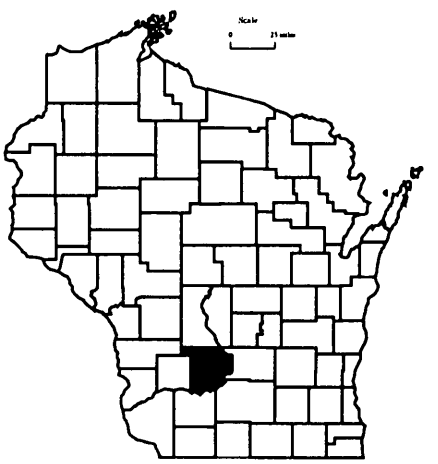
Sauk County

## PROJECT CHIEF:

David J. Graczyk

## PERIOD OF PROJECT:

October 1997 to September 2000



A tipping-bucket rain gage was installed at each site. Evapotranspiration will be estimated using empirical equations. Air temperature and solar radiation will be collected at one of the pastures for use in the evapotranspiration calculation. Meteorological data collected at the USDA Research Station will supplement data collected at this pasture. Ground-water flow will be calculated as a residual. An ISCO automatic water-quality sampler was installed at each site. The sampler will collect discrete samples. These samples will be composited on a flow-weighted basis. One composite sample per rainfall or snowmelt event will be sent to the Wisconsin State Laboratory of Hygiene for analysis. All events will be monitored. Approximately 5-10 samples per pasture will be collected. All samples will be analyzed for soluble reactive phosphorus, total phosphorus, ammonia nitrogen, nitrate and nitrite nitrogen, total kjeldahl nitrogen, total suspended solids, and volatile suspended solids.

**PROGRESS** (July 1999 to June 2000): Three small basins were monitored for continuous streamflow and rainfall. One runoff sample was collected at one site, five samples at another site and four runoff samples at the other site. Total-phosphorus concentrations ranged from 0.142 mg/l to 1.48 mg/l at the three sites. The storm loads for total phosphorus ranged from 0.003 lb to 0.18 lb. The suspended-solids concentrations ranged from 5 mg/l to 1440 mg/l at the three sites with suspended-solids loads ranging from 0.03 lb to 116 lb. Samples of the runoff were a result of early winter rainfall and snowmelt events. No summer rainstorms or intense thunderstorms resulted in runoff. All data was summarized and published in the report "Water Resources Data–Wisconsin, 1999".

**PLANS** (July 2000 to June 2001): Monitoring at all three sites will be continued. Water-quality samples will be collected at the three sites for all storms that produce runoff and water-quality loads will be calculated for each storm. Animal grazing will be allowed according to the Managed Intensive Rotational Grazing Plan for each site. All streamflow and water-quality data will be summarized and published in the annual report "Water Resources Data–Wisconsin, 2000".

# EVALUATION OF THE EFFECTIVENESS OF URBAN CONSERVATION DESIGN PRACTICES, WI 17233

**PROBLEM:** Farmland in Wisconsin is rapidly being converted to urban land uses. This urban development, with the associated increase in impervious area, generally impacts the water quality and increases the runoff volume that is delivered to the receiving waterbody. When new site plans are proposed, many of the plans use "end-of-pipe" structural Best Management Practices (BMPs) such as wet and dry detention ponds. These structural BMPs, however, are primarily designed to reduce the flood peak of a runoff event. They have limited water-quality and -quantity benefits.

A non-structural type of BMP called urban stormwater-conservation design is being developed for urban land uses. This BMP involves reducing stormwater-runoff quantity and improving the stormwater-runoff quality. These conservation designs include the reduction of impervious surfaces, redirection of downspouts to grassed areas, using grass infiltration swales and rain gardens to infiltrate runoff, and using cluster developments to encourage smaller lot sizes.

**OBJECTIVE:** The objective is to evaluate the effectiveness of urban conservation design for reducing runoff quantity and improving runoff water quality.

**APPROACH:** Two separate sites have been selected in Cross Plains, Wisconsin. The first site, which was developed from 1988 to 1991, used traditional urban design practices such as storm sewers, curbs and gutters, and a wet detention basin. The second site, currently a farm field, will be developed in May 1999 using urban stormwater-conservation design practices. Both sites are finger valleys that are approximately a quarter mile apart.

Equipment at both sites will be installed and maintained to continuously monitor water level, precipitation, and water temperature. An automatic water-quality sampler will be installed at each site to take flow proportional samples. Water-quality samples for the majority of the runoff events will be analyzed for total and suspended solids, and total phosphorus. Periodically, samples from each site will be processed for particle-size distribution and selected total metals. All equipment at each site will be installed in a gaging station that will have phone telemetry and electrical power.

Comparisons will be made between the BMPs based on unit-area runoff and unit-area loads. Furthermore, the data collected during the seven-year period will document the changes in water quality and quantity during the construction cycle (from platting to site closeout).

**PROGRESS** (July 1999 to June 2000): Both sites were monitored during the subdivision platting phase and initial home construction was monitored at the rural site. A digital camera was installed to photodocument construction activities. These photos are displayed on the USGS web site.

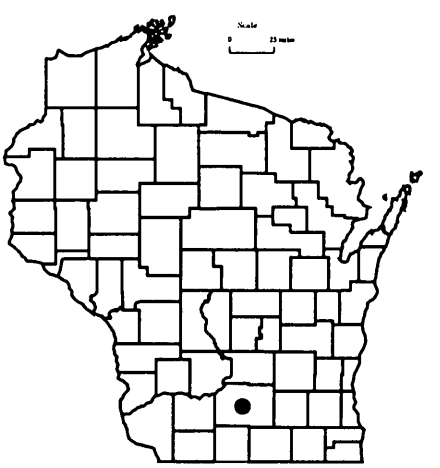
**PLANS** (July 2000 to June 2001): Monitoring at both sites will continue. Additional monitoring equipment will be installed at the three pond inlets, the pond outlet and in the infiltration practice. Solids loads will be computed for all monitored runoff events at both sites.

## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
Cross Plains

## PROJECT CHIEF:
David W. Owens

## PERIOD OF PROJECT:
July 1998 to September 2005



# TEMPERATURE MODELING OF URBAN STORMWATER RUNOFF, WI 17234

## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
Cross Plains

## PROJECT CHIEF:
David W. Owens

## PERIOD OF PROJECT:
July 1998 to September 2000

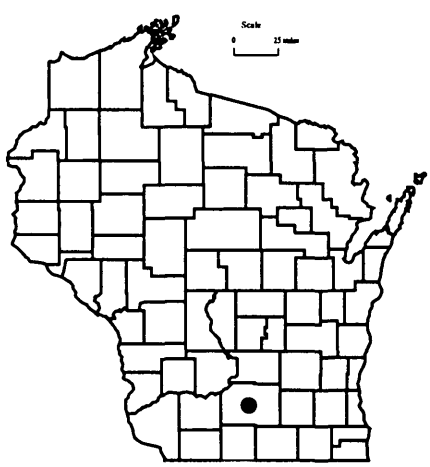
**PROBLEM:** Rainwater that falls on urban surfaces during the warm summer months tends to collect heat from those urban surfaces. The heated rainwater tends to drain quickly to storm sewers and then into streams or lakes. When the receiving water body is a cold water fishery, the thermal load can have a detrimental effect.

**OBJECTIVE:** The objective is to develop a model that can estimate the thermal heating of rainwater from urban surfaces during the summer months.

**APPROACH:** Sensors will be installed to monitor surface temperatures at a wide variety of thermal source areas in a drainage basin in Cross Plains, Wisconsin. These thermal source areas include roofs, streets, driveways and lawns. Furthermore, a variety of source area materials (asphalt, concrete, metal, etc.) and colors (light and dark) will also be monitored. The continuously collected data will document the changes in surface temperature and in the runoff water as the runoff water moves through the conveyance system. The data collected will be used to develop a model that will estimate the thermal impact of different urban surfaces.

**PROGRESS** (July 1999 to June 2000): Several sensors were installed and modified throughout the basin. Intensive data collection started in early June 1999 and continued until the end of September 1999. During this monitoring period, a worst-case thermal loading event did not occur. The equipment was activated in May 2000 to attempt to capture the worst-case thermal event. A water temperature model was developed to predict thermal loads to a cold-water-receiving stream based on the data collected during the summer of 1999 and 2000.

**PLANS** (July 2000 to September 2000): Additional temperature data will be collected until August 2000. New data collected will be used to calibrate the thermal runoff model. Model documentation will be completed during this time frame.



# ROCK RIVER PHOSPHORUS, WI 17236

**PROBLEM:** Water quality of the Rock River depends on the load of nutrients contributed to the river by various sources. Sound management of water quality requires knowledge of the contributions of various sources to the total load of the river.

**OBJECTIVE:** The objective is to determine concentrations of various water-quality constituents at nine sites in the Rock River Basin in Wisconsin and to calculate loads for dissolved reactive phosphorus, total phosphorus and suspended solids

**APPROACH:** Water-quality samples will be collected by staff of the cooperating treatment works twice each month, and at additional times when there is significant runoff. These data will be used to compute loads of the following constituents until August 1999:

5-day Biological Oxygen Demand
Dissolved Chloride
Chlorophyll *a*
Fecal Coliform
Dissolved Ammonia
Nitrate + Nitrite
Dissolved Reactive Phosphorus
Total Dissolved Solids
Total Kjeldahl Nitrogen
Total Phosphorus
Suspended Solids
Volatile Suspended Solids

Data will be used to compute loads for the following constituents from September 1999 to August 2000:

5-day Biological Oxygen Demand
Nitrate + Nitrite
Total Phosphorus
Dissolved Reactive Phosphorus
Suspended Solids
Volatile Suspended Solids

**PROGRESS** (July 1999 to June 2000): Water-quality samples were collected and analyzed twice each month, with additional samples during significant runoff. Loads for three constituents were calculated for the period August 1998 through September 1999, and published in the annual data report. Sampling was continued for a second year, with the shortened list of constituents.

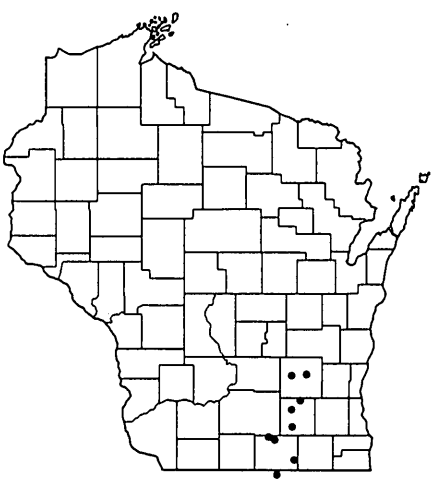
**PLANS** (July 2000 to September 2000): When a second full year of data has been collected (by the end of August 2000), the data will be used to compute loads of phosphorus and sediment.These will be published in the annual data report. A brief final report will be prepared explaining the data-collection procedures and summarizing the loads computed.

## COOPERATORS:
City of Fort Atkinson
Rock River Watershed POTW (66.30) Group
Wisconsin Department of Natural Resources

## LOCATION:
Rock River Basin

## PROJECT CHIEF:
William R. Krug

## PERIOD OF PROJECT:
July 1998 to September 2000



# TRACE METAL LOADING TO LAKES MICHIGAN AND SUPERIOR, WI 18301

## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
United States portion of Lake Michigan and Lake Superior Basins

## PROJECT CHIEF:
Dale M. Robertson

## PERIOD OF PROJECT:
October 1997-December 1999

**PROBLEM:** The delivery of trace metals from point and nonpoint sources poses serious concerns for the coastal and offshore ecosystem of the Great Lakes. Though point-source loadings can be significant, evidence suggests that nonpoint-source contributions of metals exceed that of point sources. The tributary monitoring component of the Lake Michigan Mass Balance (LMMB) study will provide total loads of selected metals from the selected tributaries, but will not support source reconciliation.

**OBJECTIVE:** The objectives of this study are to (1) develop tributary load estimates of selected metal constituents to Lake Michigan and the U.S. portion of Lake Superior from both monitored and unmonitored watersheds, (2) describe what environmental factors influence the relative loading, and (3) separate the load into urban and nonurban components.

**APPROACH:** The approach used is as follows: (1) Develop GIS coverages of the environmental factors thought to influence the distribution of the selected metals; (2) subdivide the entire basin into areas of relatively homogeneous environmental characteristics; (3) sample sites representing areas that have not been previously sampled; (4) compute loads for selected metals for the main tributaries and daily loads (high flow and base flow) for smaller indicator streams from relatively homogeneous areas; (5) use GIS to determine environmental characteristics of main tributary basins and smaller indicator streams; (6) use multiple regression to relate loads from indicator sites to environmental characteristics; (7) use loads from smaller indicator areas with regression relations to estimate loading from ungaged areas and total regional loading; and (8) subtract the estimated watershed contribution from the total tributary load to estimate the urban inputs.

**PROGRESS** (July 1999 to June 2000): GIS data were obtained for land use, surficial deposits, and bedrock types for the complete Lake Michigan and U.S. part of the Lake Superior watershed. Multiple regression was used to relate copper, lead, mercury, and zinc loads from indicator sites to environmental characteristics. The loads from smaller indicator areas were used to determine which environmental variables were most strongly related to loading for each constituent and used to estimate loading from ungaged areas and total regional loading to Lakes Michigan and Superior. Localized urban inputs were estimated by subtracting the watershed contributions from the total tributary load from indicator areas. A final report was submitted to the Environmental Protection Agency.

**PLANS**: Project is completed.

# TRANSPORT OF PCBs AT TWO SITES ON CEDAR CREEK, WI 19101

**PROBLEM:** High concentrations of polychlorinated biphenyls (PCBs) have been found in the Cedar Creek bed sediments. water column, and fish tissues. Partial remediation (Ruck Impoundment) was completed in 1994. PCB transport trends are needed to assist in future management decisions.

**OBJECTIVE:** The objective is to determine PCB loading changes at Columbia Avenue (downstream of Ruck Impoundment) and Highland Road.

**APPROACH:** From August 1994 to August 1995, 24 PCB samples were collected at Columbia Avenue and Highland Road. Total suspended solids, chlorophyll *a*, and discharge data were used in conjunction with the PCB data to establish PCB concentration regression relations.

When sampling does begin, a total of 24 80-liter PCB samples (along supporting constituents) will be collected at the two Cedar Creek sites. Utilizing these data, residuals from the 1994/1995 regression relations will be examined to determine if PCB concentrations have changed over time.

**PROGRESS** (April 2000 to June 2000): Project planning has been completed and field sampling was planned to start in April 2000. Approval of a Quality Assurance Project Plan (QAPP) by EPA has been delayed and sampling will likely be delayed until the fall of 2000.

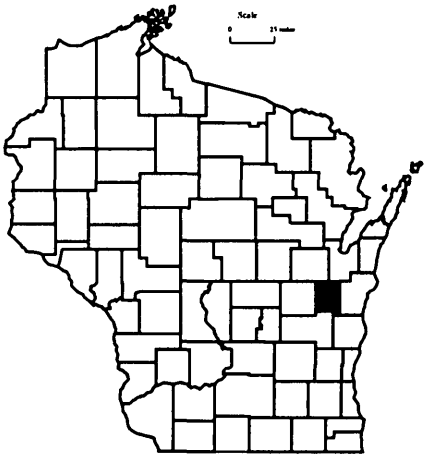
**PLANS** (July 2000 to June 2001): Field operations will be continued.

## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
Calumet County

## PROJECT CHIEF:
Jeffrey J. Steuer

## PERIOD OF PROJECT:
April 2000 to September 2001



# MITIGATION OF FUTURE NORTH FORK URBANIZATION IMPACTS ON THE PHEASANT BRANCH HYDROLOGIC SYSTEM, WI 20200, 20202, 20203

## COOPERATOR:

City of Middleton
Wisconsin Department of Natural Resources

## LOCATION:

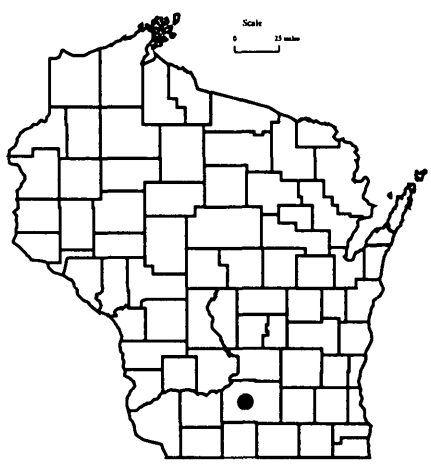
Dane County

## PROJECT CHIEFS:

Jeffrey J. Steuer
Randy Hunt

## PERIOD OF PROJECT:

July 1996 to September 2002



**PROBLEM:** As Middleton and its surroundings continue to develop, the Pheasant Branch North Fork Basin is expected to undergo significant urbanization. For the downstream city of Middleton, headwater urbanization can mean increased flood peaks, increased water volume and increased pollutant loads. It may also adversely effect down-gradient ecosystems such as Pheasant Branch Marsh and reduce ground-water recharge. Previous work has often not included the transient interaction between surface and ground water. The proposed work will combine ground- and surface-water modeling in the analysis of the Pheasant Branch system.

**OBJECTIVE:** Objectives are to (1) locate potential sites for runoff controls and/or enhanced infiltration to ensure future flood peaks do not exceed the present condition flood peaks, (2) quantify the flood peak and ground-water recharge differences resulting from a fully-urbanized condition with and without treatment or runoff controls, (3) use the ground-water model to assess North Fork basin urbanization impacts on Pheasant Branch Marsh, and (4) construct a ground-water model able to address future needs such as siting future water supply.

**APPROACH:** The overall approach will combine ground- and surface-water models to locate an effective combination of stormwater treatment or control sites within the North Fork basin which may be developed to produce minimal effects on the Pheasant Branch hydrologic system. The surface-water component will build upon the simulations detailed in "Effects of urbanization on streamflow, sediment loads, and channel morphology in Pheasant Branch Basin near Middleton, Wisconsin" (Krug and Goddard, 1985, WRIR 85-4068). To achieve the objectives of this project, the model will contain a spatial resolution to simulate 1 to 4 developments per square mile (approximately 40 model sub-areas). Significant development has occurred in the South Fork basin since 1981. Two of the areas simulated as not generating runoff in 1981 have developed and presently drain to the South Fork. It will be necessary to update the South Fork basin model to ensure that shifting of the North Fork hydrograph peak (due to runoff controls) will not produce an enhanced peak downstream of the confluence (Krug and Goddard, pages 16, 17). The new model efforts will calibrate to recently collected Pheasant Branch discharge and precipitation data collected at Highway 12.

The ground-water component will use a model constructed at a smaller scale than the recently developed Dane County model (Krohelski, et.al., in press) to have the appropriate resolution for the stormwater control alternatives. Similar to Krohelski, et.al., the model will be constructed using MODFLOW (McDonald and Harbaugh, 1988). Recharge results from the surface-water model will be input into the ground-water-flow model to assess the effects of management alternatives on ground-water recharge distribution and magnitude. The model will also calculate the changes in ground-water-derived baseflow in the system for the different alternatives and assess the effectiveness of recharge enhancement scenarios.

In February 2000, the project was expanded when the models were accepted as part of an Environmental Protection Agency (EPA)-National Science Foundation (NSF) research grant. The expanded research will be coordinated by the WDNR and UW-Madison. To further that effort, the surface-water model will be modified to incorporate research findings in local infiltration and temperature pollution. The ground-water model will be refined to include additional geologic data and hydrologic features near the Pheasant Branch Marsh. The refined model will then be used for optimization to further assess the effects of development on surface-water resources in the area.

**PROGRESS** (July 1999 to June 2000): Shallow well sites have been established in Pheasant Branch Marsh along with two continuous flow-monitoring and precipitation sites on the Pheasant Branch North and South Forks. Three additional rain gages have been added to the network. Double-ring infiltration tests (36) have been conducted with the results incorporated into the surface-water model. Discharge and water-quality loads (phosphorus and total suspended solids) have been published in the 1998 annual data report. Calibration is complete on a 50-flow plane, 21-hydrologic-response unit model. Simulations have been conducted for moderate and heavy development scenarios.

Results from the initial modeling using the Dane County regional flow model showed that regional water (away from the immediate highlands) was needed to simulate measured spring flow. Porewaters within the wetland-creek complex were sampled for major ions and water isotopes. The fact sheet and supporting water-resources investigations reports (WRIRs) have been initiated.

Planning of work with the EPA-NSF research group began.

**PLANS** (July 2000 to June 2001): The fact sheet and supporting WRIRs will be completed. The calibrated surface-water model with the PRMS framework will be converted to the Modular Modeling System framework to allow incorporation of the infiltration and temperature pollution research. Additional physical and geochemical hydrologic data will be collected in the site area. The ground-water-flow model will be modified to include the insight gained from the new data.

# DATABASE APPLICATIONS, WI 21000

## COOPERATOR:
City of Milwaukee
U.S. Environmental Protection Agency
U.S. Geological Survey, CAPP and WRD
Wisconsin Department of Natural Resources (WDNR)

## LOCATION:
United States

## PROJECT CHIEF:
Harry House

## PERIOD OF PROJECT:
July 1998-Continuing

**PROBLEM:** Natural resources agencies are having difficulty organizing, storing, and distributing their information products using existing resources (staff, hardware, and software).

**OBJECTIVE:** The purpose of this project is to provide our cooperators, the USGS, and other agencies with modern alternatives to their existing information technology resources. The objective is to provide customers with high-quality data processing methods.

**APPROACH:** The Database Unit in the Wisconsin District is dedicated to the design, development, and deployment of relational database systems geared to address water resources-related data management problems being faced by our cooperators and other federal agencies. Systems developed are centered on Oracle Corporation technology at this time. The focus is on fewer but larger projects in terms of workload and funding levels. The unit provides an alternative resource for these customers to compliment their in-house information technology staff and/or outside consultants.

The unit attempts to apply cutting-edge technology in the resolution of the data management problems, within the limitations of available funding and staff. It is assumed that lower-end technology or approaches are more widely available to our customers already, and that we will provide a more valuable service by making higher-end solutions obtainable. The study has six subprojects.

**PROGRESS** (July 1999 to June 2000): For subproject 21005, a series of meetings was held with the administrators of the 6 legacy databases and other data management personnel at WDNR to identify which WDNR data should be entered into the new database. Documentation for data in the 6 legacy systems was obtained and user requirements for the new system were discussed. A third-normal design for the new database has been completed, and reference tables are being populated. The WDNR Biology Database Project website has been created and a number of data input forms and reports are now mounted on the site. Data reporting capabilities include parameterized dynamic database query, customized reports, and downloading of data in an Excel format. When necessary, data are protected by passwords and assigned privileges.

**PLANS** (July 2000 to June 2001): For subproject 21005, the WDNR Biology Database will be initially sited at USGS offices in Middleton, Wisconsin, during testing and deployment, with plans to export the database to WDNR facilities in Madison, Wisconsin, in the near future. After reference tables are populated, forms will be prepared to enable input and retrieval of WDNR field data over the internet. It is expected that forms development will be an iterative process as user requirements are refined. As the database becomes populated with new data and also historical data, performance of the transactional database will be evaluated. If data reporting performance is inadequate, a system to deploy a denormalized version (star schema) and associated data-movement programming will be developed and implemented.

# THE EFFECT OF NEAR-SHORE DEVELOPMENT ON CONSTITUENT LOADING TO LAKES IN NORTHERN WISCONSIN, WI 21800

**PROBLEM:** Additions of nutrients, pesticides and sediment from near-shore developments to lakes may seriously degrade lake water quality. Shoreline-zoning regulations such as required setbacks, cutting restrictions and buffers between the lake and development have been developed in the hope that these requirements can mitigate the effects of sediment and nutrient runoff.

Previous studies have estimated the amount of these loadings from the lake watershed but few studies have determined the processes and pathways in which these constituents are delivered to the lake at a site-specific scale (e.g., one-acre parcel). The effectiveness of buffers or cutting restrictions on reducing the amount of chemical constituent loads and sediment has yet to be demonstrated.

**OBJECTIVE:** The objectives of the study are to (1) estimate the quantity of surface-water runoff and ground water that flows into a lake from developed and undeveloped lands and (2) determine the water quality of surface-water runoff and ground water that flows into a lake from developed and undeveloped lands.

**APPROACH:** Effects of shoreline development on water and nutrient loading will be assessed using a paired approach. The comparison will focus on developed and undeveloped sites on four lakes in Vilas and Forest Counties in northern Wisconsin. Developed sites may include runoff from lawns, driveways, sidewalks and roofs; undeveloped sites consist of mostly immature woods having woody and non-woody vegetation and relatively undistributed ground. Both surface-water runoff and ground-water components will be characterized where appropriate.

Sites were divided into those where the lakes have ground-water inflow and those that do not. Those that had ground-water inflow will be instrumented to characterize the ground- and surface-water components. Sites with ground-water flow away from the lake will be instrumented to characterize surface-water components only. Each site will be surveyed and a detailed map will be prepared to determine the areas that contribute to surface runoff.

A tipping bucket rain gage will be installed at each site. Precipitation will be measured during the non-freezing portion of the year. Precipitation from a nearby National Weather Service gage will be used during freezing periods.

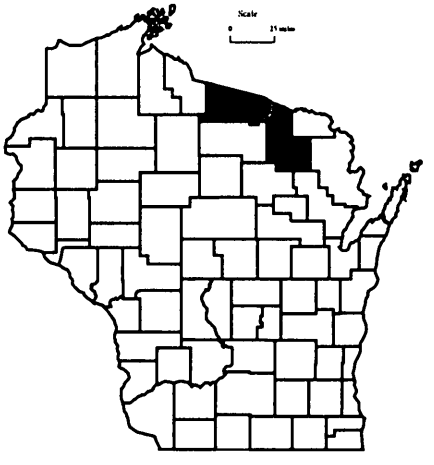
Surface-water runoff will be measured by using two types of monitors depending on the site. An automatic collection monitor will be installed at four sites. A passive collection monitor will be installed at two sites. The quality of surface water will be determined from analyses of the runoff collected by both automated and non-automated systems.

## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
Vilas and Forest Counties

## PROJECT CHIEFS:
David J. Graczyk
Randall J. Hunt

## PERIOD OF PROJECT:
October 1999 to September 2001



Ground-water flow will be monitored by the installation of piezometer nests. The nests will be distributed along the topographic gradient. The most down-gradient nest will be installed adjacent to the lakeshore. The quality of ground water will be determined from a subset of water table wells and piezometers located at the nest sites. In addition, the water quality of the ground water that discharge to the lake will be characterized using seepage meters and pore-water diffusion equilibrators.

All surface- and ground-water samples will be analyzed for total dissolved phosphorus, total phosphorus, ammonia nitrogen, nitrate and nitrite nitrogen and total Kjeldahl nitrogen. Approximately seven surface-water samples per site will be collected and 5-10 ground-water samples will be collected. The Wisconsin State Laboratory of Hygiene will analyze all samples.

**PROGRESS** (October 1999 to June 2000): Sites were selected for study and five automated surface-water runoff data-collection sites were installed. These sites include three lawn and two wood-land uses. Non-automated samplers at five woods and one lawn site were installed. Five ground-water data-collection systems were installed. Five tipping-bucket rain gages were also installed. Seven surface-water samples were collected. A detailed topographic map was prepared for each site.

**PLANS** (July 2000 to June 2001): Samples will be collected and analyzed at selected ground-water wells. Samples will be collected and analyzed at the surface-water data-collection sites. Seepage meters and pore-water equilibrators will be installed and water-quality samples will be collected. All water-quality data will be summarized and published in the annual report "Water Resources Data–Wisconsin, 2000".

# APPENDIX A

# STREAM-GAGING STATIONS PROPOSED FOR 2001 FISCAL YEAR

**PROBLEM**: Surface-water information is needed for surveillance, planning, design, hazard warning, operation, and management in water-related fields such as water supply, hydroelectric power, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water-resources development. An appropriate data base is necessary to provide this information.

**OBJECTIVE:** The objectives of this project are to provide continuous-discharge records for selected rivers at specific sites to supply the need for regulation, analytical studies, definition of statistical properties, trends analysis, and determination of the occurrence and distribution of water in streams for planning. The project is also designed to determine lake levels and to provide discharge for flood and low-flow conditions and for water-quality investigations. Requests for streamflow data and information relating to streamflow in Wisconsin are answered. Basic data are published annually in the report "Water Resources Data–Wisconsin".

**APPROACH**: A network of streamflow-gaging stations and lake-level stations will be maintained throughout Wisconsin. This includes operating the equipment at the gaging station to record river or lake stage, making periodic discharge measurements at each streamflow station to establish or verify a stage-discharge rating curve, reducing the periodic stage readings to instantaneous and daily discharges, compilation of monthly and annual discharges, and preparing data for publication in the annual report, "Water Resources Data–Wisconsin".

Requests for streamflow data from other government agencies, consultants, and private parties will be processed.

**PROGRESS** (July 1999 to June 2000): Thirty-six continuous-record gaging stations were operated in cooperation with the Wisconsin Department of Natural Resources (WDNR) during the 2000 fiscal year. Twenty-four of these were funded through the Hydropower Data program and two were funded by other outside sources. Lake stage and precipitation data was collected on Devils Lake near Baraboo. Water temperature data was collected on the Prairie River and was funded by another source. More than 100 requests for streamflow data were answered; WDNR, other State, Federal, and county agencies, consultants, municipalities, and the general public requested data. Streamflow records for the 1999 water year were published in the annual report, "Water Resources Data–Wisconsin".

**PLANS** (July 2000 to June 2001): Streamflow records for the 2000 water year will be computed and published in the annual report, "Water Resources Data–Wisconsin". Present plans are to operate the same stations that were operated in the 2000 fiscal year except for the Fox River at Oshkosh station. The Detroit Corps of Engineers continued funding the operation of this station beginning January 1, 2000. Requests for streamflow information will be answered.

## COOPERATOR:
Wisconsin Department of Natural Resources

## LOCATION:
Statewide

## PROJECT CHIEF:
Barry K. Holmstrom

## PERIOD OF PROJECT:
July 1913-Continuing

# PROPOSED PROGRAM FOR THE PERIOD 7/1/00-6/30/2001

USGS Gaging Stations
Wisconsin Department of Natural Resources

| STREAMFLOW FOR HYDROPOWER DATA | | Record began (water year) |
|---|---|---|
| 04027500 | 1/ White River near Ashland | 1948 |
| 04029990 | 1/ Montreal River at Saxon Falls | 1987 |
| 04064500 | 2/ Pine River below Pine River powerplant near Florence | 1924-76, 1996 |
| 04066003 | 2/ Menominee River near Pembine | 1950 |
| 04067958 | 5/ Peshtigo River near Wabeno | 1998 |
| 04077400 | 3/ Wolf River near Shawano | 1907-09, 1911 |
| 05332500 | 1/ Namekagon River near Trego | 1928-70, 1987 |
| 05340500 | 1/ St. Croix River at St. Croix Falls | 1902 |
| 05341500 | 1/ Apple River near Somerset | 1901-70, 1987 |
| 05356000 | 1/ Chippewa River at Bishops Bridge near Winter | 1912 |
| 05356500 | 1/ Chippewa River near Bruce | 1914 |
| 05360500 | 1/ Flambeau River near Bruce | 1951 |
| 05365500 | 1/ Chippewa River at Chippewa Falls | 1888-1983, 1987 |
| 05369000 | 1/ Red Cedar River at Menomonie | 1913 |
| 05391000 | 4/ Wisconsin River near Lake Tomahawk | 1936 |
| 05393500 | 4/ Spirit River at Spirit Falls | 1942 |
| 05394500 | 4/ Prairie River near Merrill | 1914-31, 1939 |
| 05395000 | 4/ Wisconsin River at Merrill | 1903 |
| 05397500 | 4/ Eau Claire River near Kelly | 1914-27, 1939 |
| 05398000 | 4/ Wisconsin River at Rothschild | 1945 |
| 05399500 | 4/ Big Eau Pleine River near Stratford | 1914 |
| 05400760 | 4/ Wisconsin River at Wisconsin Rapids | 1914 |
| 05402000 | 4/ Yellow River at Babcock | 1944 |
| 05404000 | 4/ Wisconsin River near Wisconsin Dells | 1935 |

1/ WDNR cooperates with Northern States Power Company
2/ WDNR cooperates with Wisconsin Electric Power Company
3/ WDNR cooperates with Northwoods Hydropower
4/ WDNR cooperates with Wisconsin Valley Improvement Company
5/ WDNR cooperates with Wisconsin Public Service

Wisconsin Electric Power Company (WEPCO) funds two stations at a cost of $10,080. Complete records are collected at nine stations and partial records at one station for the Wisconsin Valley Improvement Company (WVIC); total cost of the WVIC program is $47,880. Partial records are collected at some of the Northern States Power Company stations; total cost of Northern States Power Company program is $38,680. Northwoods Hydropower funds one station at a cost of $5,040. Wisconsin Public Service funds one station at a cost of $5,040.

| CONTINUOUS-RECORD MONITORING–RIVERS | Cost |
|---|---|
| 04024430 Nemadji River near South Superior | $ 5,040* |
| 04067500 Menominee River near McAllister | 5,040 |
| 04071765 Oconto River near Oconto | 5,040 |
| 04085200 Kewaunee River near Kewaunee | 5,040 |
| 04085395 South Branch Manitowoc River at Hayton | 5,040 |
| 04085427 Manitowoc River at Manitowoc | 5,040 |
| 04086000 Sheboygan River at Sheboygan | 5,040 |
| 04086500 Cedar Creek near Cedarburg | 5,040 |
| 05401050 Tenmile Creek near Nekoosa | 5,040 |
| 05383075 LaCrosse River near LaCrosse | 5,040 |
| TOTAL | $50,400 |

## OTHER MONITORING

| | | |
|---|---|---|
| 05404500 | Devil's Lake near Baraboo (stage-precipitation data) | 1,950 |
| 04084500 | Fox River at Rapide Croche Dam near Wrightstown<br>(WDNR cooperates with Lower Fox River Dischargers' Association) | 2,100 |
| 05394500 | Prairie River near Merrill<br>Water-temperature monitoring<br>(WDNR cooperates with Friends of Prairie River) | 650 |
| | TOTAL | $4,700 |

# APPENDIX B

## FUNDING SUMMARY PROPOSED FOR GENERAL COOPERATIVE PROGRAM WITH WISCONSIN DEPARTMENT OF NATURAL RESOURCES 2001 FISCAL YEAR

| | Actual 99-2000 DNR Share | Proposed 2000-2001 DNR Share | Total | Remarks |
|---|---|---|---|---|
| Streamflow for Hydropower Data (WI 00-001) Holmstrom/Addis | 102,900 | 106,720 | 203,300 | DNR receives 47,880 from WVIC, 9,120 from WEPCO, 38,680 from NSP, 5,040 from WP&L and 5,040 from WPSC. |
| Continuous Record Monitoring - Rivers | | | | |
| Fox River at Oshkosh (AVM) (WI 00-001) Holmstrom/Rasman, Weisensel | 3,100 | 0 | 0 | |
| Cedar Cr nr Cedarburg (WI 00-001) Holmstrom/Jaeger | 4,850 | 5,040 | 9,600 | |
| South Branch Manitowoc River at Hayton (WI00-001) Steuer/Velleux | 4,850 | 5,040 | 9,600 | |
| Tenmile Creek near Nekoosa (WI00-001) Garn/Zimmerman) | 4,850 | 5,040 | 9,600 | |
| Sheboygan River at Sheboygan (WI00-001) Holmstrom/Jaeger | 4,850 | 5,040 | 9,600 | |
| Kewaunee River near Kewaunee (WI00-001) Holmstrom/Jaeger | 4,850 | 5,040 | 9,600 | |
| Manitowoc River at Manitowoc (WI00-001) Holmstrom/Jaeger | 4,850 | 5,040 | 9,600 | |
| Menominee River near McAllister (WI00-001) Holmstrom/Jaeger | 4,850 | 5,040 | 9,600 | |
| Oconto River near Oconto (WI00-001) Holmstrom/Jaeger | 4,850 | 5,040 | 9,600 | |
| LaCrosse River near LaCrosse (WI00-001) Holmstrom/Jaeger | 3,820 | 5,040 | 9,600 | |
| Nemadji River near Superior (WI00-001) Holmstrom/Jaeger | 5,020 | 5,040 | 9,600 | |
| Other Monitoring | | | | |
| Wrightstown Gage (LFRDA) (WI00-001) Holmstrom/Jaeger | 2,050 | 2,100 | 4,200 | DNR receives funds from Lower Fox River Dischargers' Association. |
| Devils Lake (WI 00-001) Holmstrom/Miller | 1,870 | 1,950 | 3,900 | |
| Prairie River near Merrill (WI 00-001) Holmstrom/Jaeger/Wissink | 650 | 650 | 1,300 | DNR receives funds from "Friends of the Prairie River". |

| | Actual 99-2000 | Proposed 2000-2001 | | |
|---|---|---|---|---|
| | DNR Share | DNR Share | Total | Remarks |
| Rock River @ Hustisford (WI 17317) Garn/Congdon | 2,925 | 0 | 0 | |
| Dead Pike Lake Rose/Knauer | 0 | 16,800 | 28,000 | |

| | Actual 99-2000 DNR Share | Proposed 2000-2001 DNR Share | Total | Remarks |
|---|---|---|---|---|
| Crandon (WI 00-201) Krohelski/Tans | 350,000 | 50,000 | 50,000 | |
| Water-Use Data (WI 78-007) Ellefson/Baker | 75,000 | 75,000 | 150,000 | 75,000 direct state services. |
| Nonpoint Trends (WI 91-172) Hughes/Bannerman | | | | 2000-2001 under discussion. |
| 17202 - Bower/Otter | 18,200 | | | |
| 17204 - Eagle/Joos | 22,200 | | | |
| 17206 - Evaluation BMP | 32,200 | | | |
| 17213 - GIS Data Base | 59,400 | | | |
| 17214 -Single-Source Site | 69,200 | | | |
| 17223 - Multi-Stream Exp. Design | 54,900 | | | |
| 17233 - Urban Conservancy Design | 30,100 | | | |
| 17220 - Ruby Street Report Milwaukee | 1,500 | | | |
| Rotational Grazing (WI 17229) Hughes/Greb | 13,700 | 13,700 | 26,000 | |
| Regional Trace Metal (WI 18301) Robertson/Hurley | 3,000 | 0 | 0 | |
| Temperature Modeling (WI 17234) Owens/Greb | 16,000 | 0 | 0 | |
| Fox River (WI 14500) Steuer/Paulson | 442,050 | | | 2000-2001 under discussion. |
| LaCrosse Brownfield (WI 00204) Saad/Brumberg, Amerson | 10,470 | 0 | 0 | |
| Prototype Database System (WI-21000) Hall, House/Staggs, Emmons | 125,000 | 125,000 | 125,000 | |
| Riparian Vegetative Zones (WI-21800) Graczyk, Hunt/Knauer, Greb | 64,200 | 43,200 | 72,000 | |
| Cedar Creek PCB (WI-19100) Steuer, Westebrook | 26,000 | 0 | 0 | |
| Mercury Loons (WI-19701) Krabbenhoft/Meyer, Knauer | 20,000 | 0 | 0 | |
| Fish Creek Vanes (WI-19300) Fitzpatrick/Walls | 0 | 26,340 | 43,900 | |
| Urban Filtration BMP (WI-17208) Corsi/Bannerman | 0 | 51,000 | 81,300 | |
| Rock River Phosphorus (WI-17236) Krug/Johnson | 13,000 | 0 | 0 | |

# WISCONSIN DISTRICT PUBLICATIONS

The reports listed below are a partial list of reports prepared by the Wisconsin District in cooperation with other agencies since 1948. The list contains reports that are relevant and contribute significantly to understanding the hydrology of Wisconsin's water resources.

The reports published in a U.S. Geological Survey series are for sale by the U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225. Prepayment is required. Remittance should be sent by check or money order payable to the U.S. Geological Survey. Prices can be obtained by writing to the above address or by calling 1-888-ASK-USGS. Copies of reports published by the University of Wisconsin, Geological and Natural History Survey, can be obtained from their office at 3817 Mineral Point Road, Madison, WI 53705.

## WATER-SUPPLY PAPERS


Kammerer, P.A., Jr., and Krug, W.R., 1993, Wisconsin stream water quality, in U.S. Geological Survey, National water summary 1990–91—Hydrologic events and stream water quality: U.S. Geological Survey Water-Supply Paper 2400, p. 561–568.

Melcher, N.B., and Walker, J.F., 1992, Evaluation of selected methods for determining streamflow during periods of ice effect: U.S. Geological Survey Water-Supply Paper 2378, 47 p.

U.S. Geological Survey, 1991, National water summary 1988-89—Hydrologic Events and Floods and Droughts: U.S. Geological Survey Water-Supply Paper 2375, 591 p.

U.S. Geological Survey, 1990, National water summary 1987—Hydrologic events and water supply and use: U.S. Geological Survey Water-Supply Paper 2350, 553 p.

_____1988, National water summary 1986—Hydrologic events, selected water-quality trends, and ground-water quality: U.S. Geological Survey Water-Supply Paper 2325, 569 p.

_____1986, National water summary 1985—Hydrologic events and surface-water resources: U.S. Geological Survey Water-Supply Paper 2300, 506 p.

_____1985, National water summary 1984—Hydrologic events, selected water-quality trends, and ground-water resources: U.S. Geological Survey Water-Supply Paper 2275, 467 p.

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Batten, W.G., and Hindall, S.M., 1980, Sediment deposition in the White River Reservoir, northwestern Wisconsin: U.S. Geological Survey Water-Supply Paper 2069, 30 p.

Sherrill, M.G., 1978, Geology and ground water in Door County, Wisconsin, with emphasis on contamination potential in the Silurian dolomite: U.S. Geological Survey Water-Supply Paper 2047, 38 p.

Hurtgen, D.C., 1975, Summary of floods, June 29-30 in southwestern Wisconsin, in Summary of floods in the United States during 1969: U.S. Geological Survey Water-Supply Paper 2030, p. 116-119.

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Oakes, Edward, Field, S.J., and Seeger, L.P., 1973, The Pine-Popple River basins—hydrology of a wild river area, northeastern Wisconsin: U.S. Geological Survey Water-Supply Paper 2006, 57 p.

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Hurtgen, D.C., 1972, Floods of March 27-April 4, 1967, in northwestern and west-central Wisconsin, in summary of floods in the United States during 1967: U.S. Geological Survey Water-Supply Paper 1880-C, p. 7-10.

Hutchinson, R.D., 1970, Ground-water resources of Racine and Kenosha Counties, Wisconsin: U.S. Geological Survey Water-Supply Paper 1878, 63 p.

Olcott, P.G., 1966, Geology and water resources of Winnebago County, Wisconsin: U.S. Geological Survey Water-Supply Paper 1814, 61 p.

Weeks, E.P., Erickson, D.W., and Holt, C.L.R., Jr., 1965, Hydrology of the Little Plover River basin, Portage County, Wisconsin, and the effects of water-resources development: U.S. Geological Survey Water-Supply Paper 1811, 78 p.

Green, J.H., and Hutchinson, R.D., 1965, Ground-water pumpage and water-level changes in the Milwaukee-Waukesha area, Wisconsin, 1950-61: U.S. Geological Survey Water-Supply Paper 1809-I, 19 p.

Summers, W.K., 1965, Geology and ground-water resources of Waushara County, Wisconsin: U.S. Geological Survey Water-Supply Paper 1809-B, 32 p.

Holt, C.L.R., Jr., and Knowles, D.B., 1963, The water situation in Wisconsin in the role of ground water in the national water situation: U.S. Geological Survey Water-Supply Paper 1800, p. 943-960.

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Holt, C.L.R., Jr., 1965, Geology and water resources of Portage County, Wisconsin: U.S. Geological Survey Water-Supply Paper 1796, 77 p.

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Knowles, D.B., 1964, Ground-water conditions in the Green Bay area, Wisconsin, 1950-60: U.S. Geological Survey Water-Supply Paper 1669-J, 37 p.

Cline, D.R., 1963, Hydrology of upper Black Earth Creek basin, Wisconsin, with a section on surface water by M.W. Busby: U.S. Geological Survey Water-Supply Paper 1669-C, 27 p.

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Hughes, P.E., Hannuksela, J. S., and Danchuk, W.J., 1981, Flood of July 1-5, 1978, on the Kickapoo River, South-western Wisconsin: U.S. Geological Survey Hydrologic Investigations Atlas HA-653, 7 sheets.

Oakes, E.L., and Cotter, R.D., 1975, Water resources of Wisconsin—upper Wisconsin River basin: U.S. Geological Survey Hydrologic Investigations Atlas HA-536, 3 sheets.

Young, H.L., and Skinner, E.L., 1974, Water resources of Wisconsin—Lake Superior basin: U.S. Geological Survey Hydrologic Investigations Atlas HA-524, 3 sheets.

Hindall, S.M., and Borman, R.G., 1974, Water resources of Wisconsin—lower Wisconsin River basin: U.S. Geological Survey Hydrologic Investigations Atlas HA-479, 3 sheets.

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Young, H.L., and Hindall, S.M., 1972, Water resources of Wisconsin—Chippewa River basin: U.S. Geological Survey Hydrologic Investigations Atlas HA-386, 4 sheets.

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# WISCONSIN DISTRICT PERSONNEL

**DISTRICT OFFICE-MIDDLETON 53562**
8505 Research Way
Phone: (608) 828-9901
FAX: (608) 821-3817
Office Hours: 0800 to 1630

## Office of the District Chief

Gebert, Warren A., District Chief
(608) 821-3801 (wagebert@usgs.gov)
Elder, John F., Research Hydrol/Biol
(608) 821-3854

**Administrative Services Unit**
Grover, Richard L., Admin Off
(608) 821-3803 (rlgrover@usgs.gov)
Maertz, Diane E., Admin Opers Asst
(608) 821-3801
Fuller, Jan M., Admin Opers Asst
(608) 821-3802
Urben, Julie A., Admin Opers Asst
(608) 821-3804
Moore, Merry E., Admin Opers Asst
(608) 828-9901 or 0

**Computer Applications Unit**
Bodoh, Robert B., Comp Prog Analyst
(608) 821-3805 (rbbodoh@usgs.gov)
Gill, Gary W., Comp Asst
(608) 821-3866

**Publications Unit**
Greenwood, Michelle M., Chief, Pub Unit
(608) 821-3812 (mmgreenw@usgs.gov)
Jones, Susan Z., Edit Asst
(608) 821-3815

**Environmental Studies Section**
Hughes, Peter E., Chief Supv Hydrol/Biol
(608) 821-3833 (pehughes@usgs.gov)
Walker, John F., Research Hydrol/Engr
(608) 821-3853
Graczyk, David J., Hydrol/For
(608) 821-3840
Hall, David W., Hydrol
(608) 821-3875
Krug, William R., Hydrol/Engr
(608) 821-3829
Steuer, Jeffrey J., Hydrol/Eng
(608) 821-3830
Corsi, Steven R., Hydrol/Eng
(608) 821-3835
House, Harold R., Hydrol/Eng
(608) 821-3876
Owens, David W., Hydr Engr
(608) 821-3863
Stuntebeck, Todd D., Phys Sci
(608) 821-3872
Waschbusch, Robert J., Hydrol
(608) 821-3868
Booth, Nathaniel, Hydr Eng
(608) 821-3822
Selbig, Willaim, Hydrol
(608) 821-3823
Goddard, Gerald L., Hyd Tech
(608) 821-3841
Hanson, Halward L., Hyd Tech
(608) 821-3862
Housner, David E., Hyd Tech
(608) 827-6255, ext. 15
Rutter, Troy D., Hyd Tech
(608) 821-3848
Wierl, Judy A., Hydr Eng
(608) 821-3874

**Hydrogeologic Studies and Data Section**
Krohelski, James T., Chief Supv Hydrol
(608) 821-3850 (jtkrohel@usgs.gov)
Krabbenhoft, David P., Research Hydrol/GeoChem
(608) 821-3843
Hunt, Randall J., Hydrol/Geol
(608) 821-3847
Feinstein, Daniel T., Hydrol
(414) 297-3172
Olson, Mark L., Biol
(608) 821-3878
Ellefson, Bernard R., Hyd Tech
(608) 821-3849
Dunning, Charles D., Physical Scientist
(608) 821-3827
Sabin, Ty, Physical Scientist
(608) 821-3873
DeWild, John F., Hyd Tech
(608) 821-3846
Rauman, James M., Hyd Tech
(608) 821-3871

**Hydrologic Systems and Data Section**
Garn, Herbert, Chief Supv Hydrol
(608) 821-3828 (hsgarn@usgs.gov)
Rose, William J., Hydrol/Engr
(608) 821-3834
Holmstrom, Barry K., Hydrol/Engr
(608) 821-3831
Olson, Daniel L., Hyd Tech
(608) 821-3852
Homant, Paulette, Hyd Tech
(715) 356-9494
Stark, Patricia A., Hyd Data Asst
(608) 821-3838

**National Water Quality Assessment Program**
Peters, Charles A., Chief Supv Hydrol
(608) 821-3810 (capeters@usgs.gov)
Fitzgerald, Sharon A., Research Hydrol/Biol
(813) 893-3100, ext. 3082
Robertson, Dale P., Research Hydrol/Chem
(608) 821-3867
Fitzpatrick, Faith A., Hydrol
(608) 821-3818
Sullivan, Daniel J., Hydrol
(608) 821-3869
Scudder, Barbara C., Research Hydrol/Biol
(608) 821-3832
Saad, David A., Hydrol/Geol
(608) 821-3865
Schmidt, Morgan, Hydrol
(608) 821-3820
Richards, Kevin E., Hyd Tech
(608) 821-3861
Stewart, Jana S., Geographer
(608) 821-3855

**FIELD HEADQUARTERS-MIDDLETON 53562**
8551 Research Way, Suite 120
Phone: (608) 827-6255
Office Hours: 0800 to 1630

Habale, Josef, Hyd Tech, ext. 10
Koenig, Kenneth R., Hyd Tech, ext. 13
March, Steven A., Hyd Tech, ext. 12
Wittwer, Thomas A., Hyd Tech, ext. 14

**FIELD HEADQUARTERS-RICE LAKE 54868**
313 W. Knapp St., P.O. Box 506
Phone: (715) 234-4015
Office Hours: 0800 to 1630

Popowski, Thomas J., Hyd Tech
Schuler, Josef G., Hyd Tech
Bernard Lenz, Hydraulic Engineer

**FIELD HEADQUARTERS-MERRILL 54452**
2011 East Main Street
Phone: (715) 536-2200
Office Hours: 0800 to 1630

Hanig, Jeffrey J., Hyd Tech
Esser, Brett M., Hyd Tech