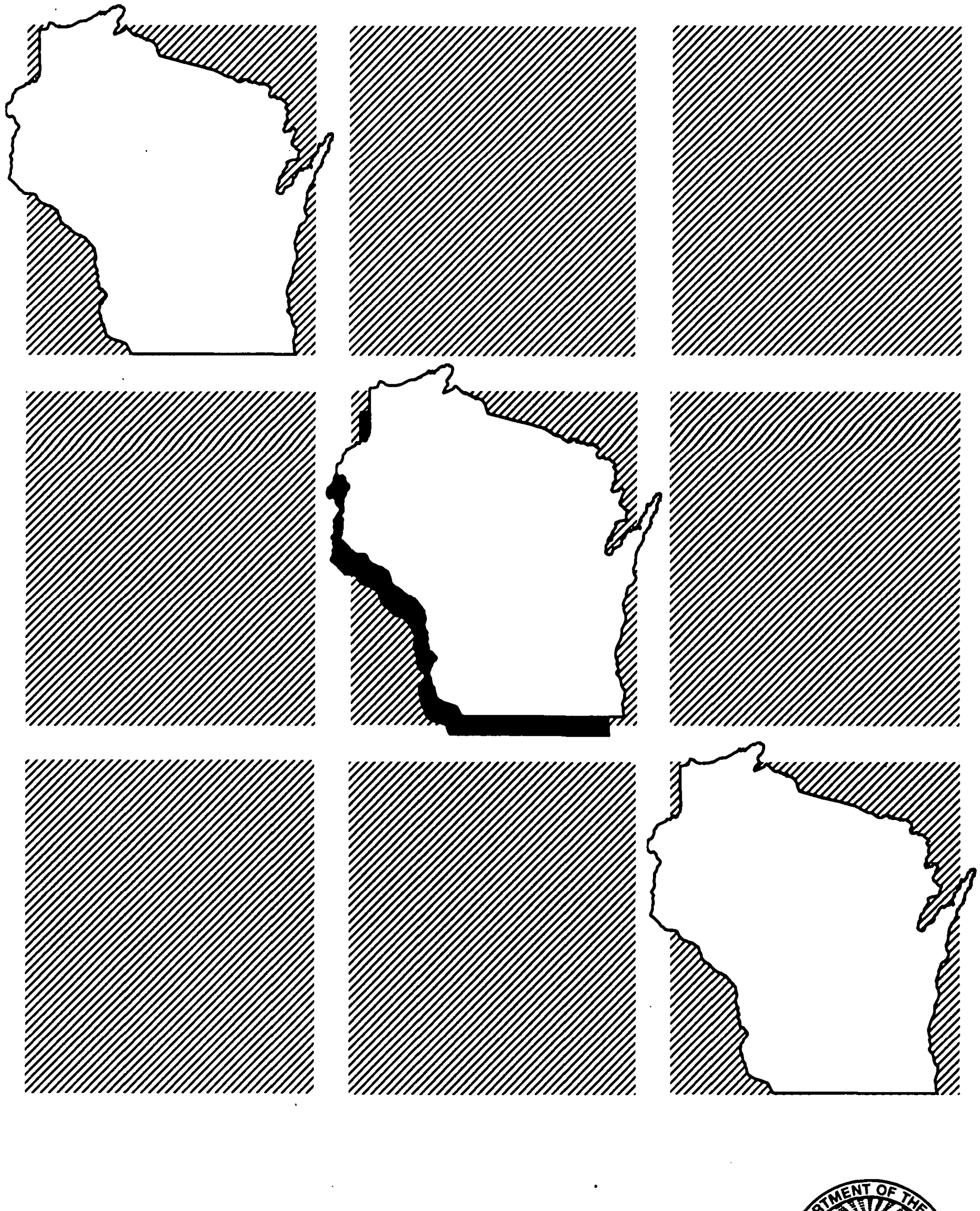
WISCONSIN

A Summary of Cooperative Water-Resources Investigations

■

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



1995

A SUMMARY OF COOPERATIVE WATER-RESOURCES INVESTIGATIONS

U.S. GEOLOGICAL SURVEY
Water Resources Division
6417 Normandy Lane
Madison, Wisconsin 53719-1133

and

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

1995

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

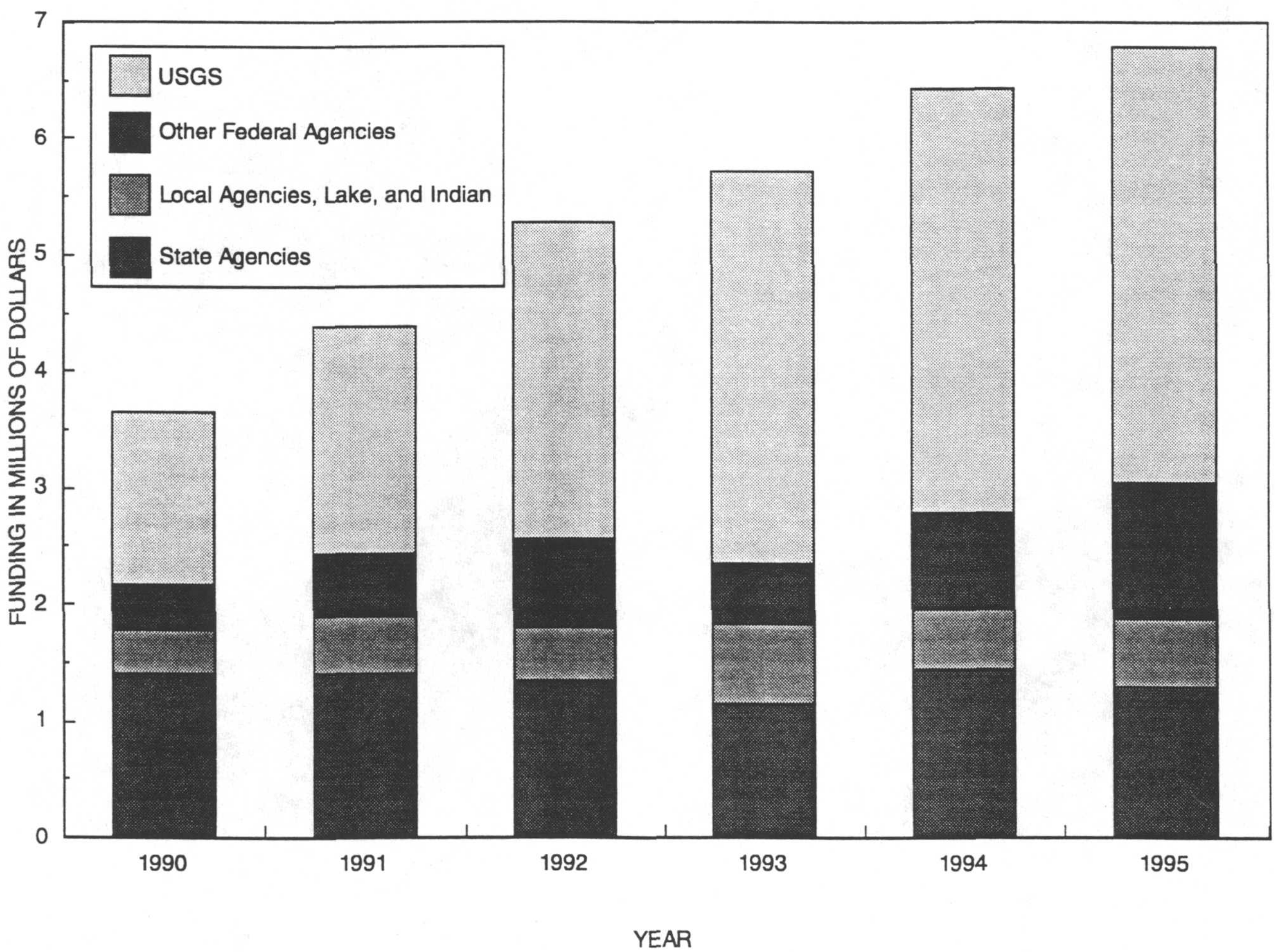
1995

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 1994 to June 1995 fiscal year. Each project summary includes a brief description of the objectives, approach, and progress during the 1995 fiscal year, and plans for the 1996 fiscal year.

The appendixes include a detailed listing of proposed stream-monitoring stations for 1995 and a summary of the requests received for low-flow information and responses since the 1994 program summary report. Also included is the proposed funding summary for the 1995-96 fiscal year.

During the past year, Wisconsin District funding increased from $6,445,000 to $6,792,000. Most of this is due to increased work funded by the USGS on mercury cycling and environmental studies for the Department of Defense at Fort McCoy, Wisconsin.

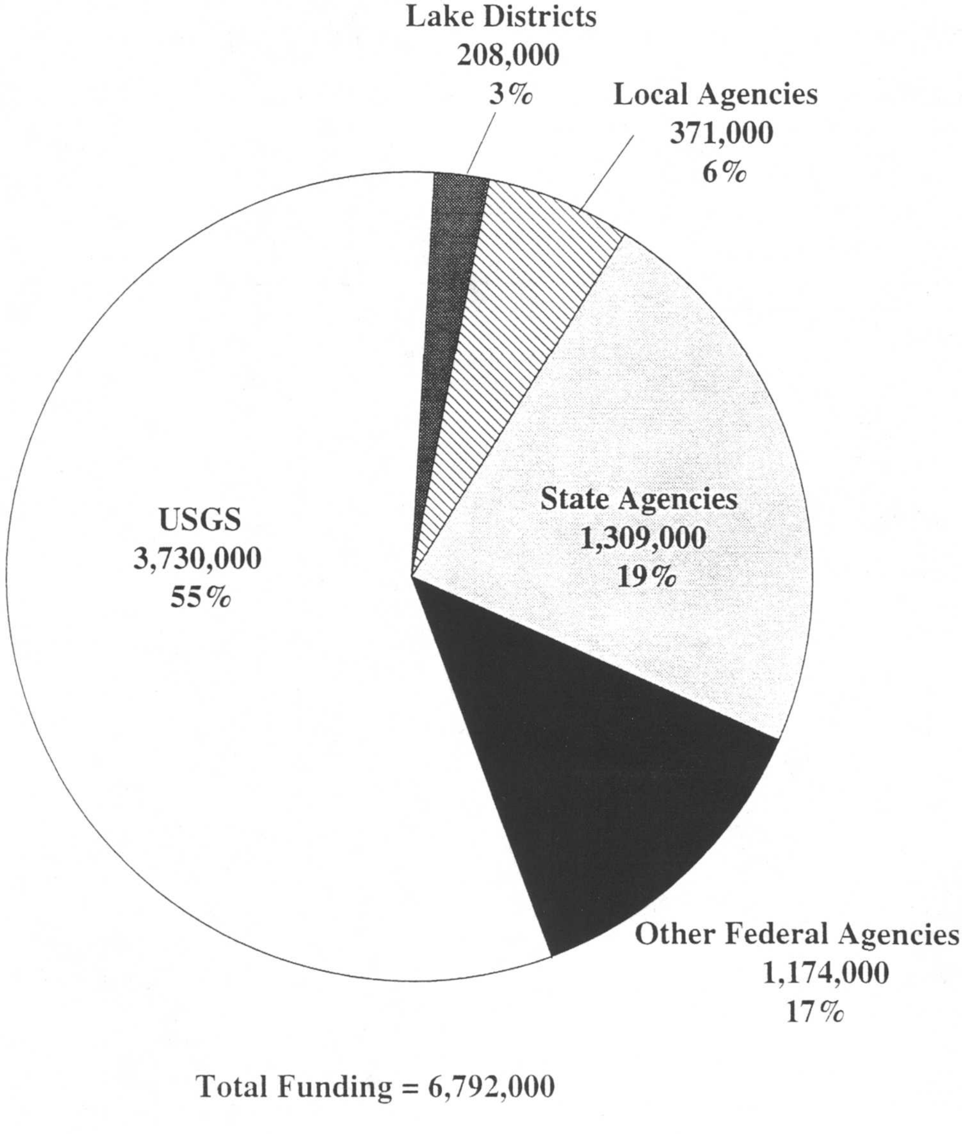


During that period, the District has been able to acquire more funding from USGS sources. In 1990, the USGS contribution was $1,470,000 dollars and, in 1995, it is $3,730,000 which is an increase of $2,260,000 or a 154 percent increase. Most of the increase is due to the funding of the Western Lake Michigan NAWQA study, Northern Wisconsin Temperate Lakes (WEBB) study, mercury cycling, and increased matching funds for non-point studies and two lake eutrophication studies.

Project personnel, liaison contacts, and administrative people from both agencies have established good working relationships that have allowed us to receive this increased funding.

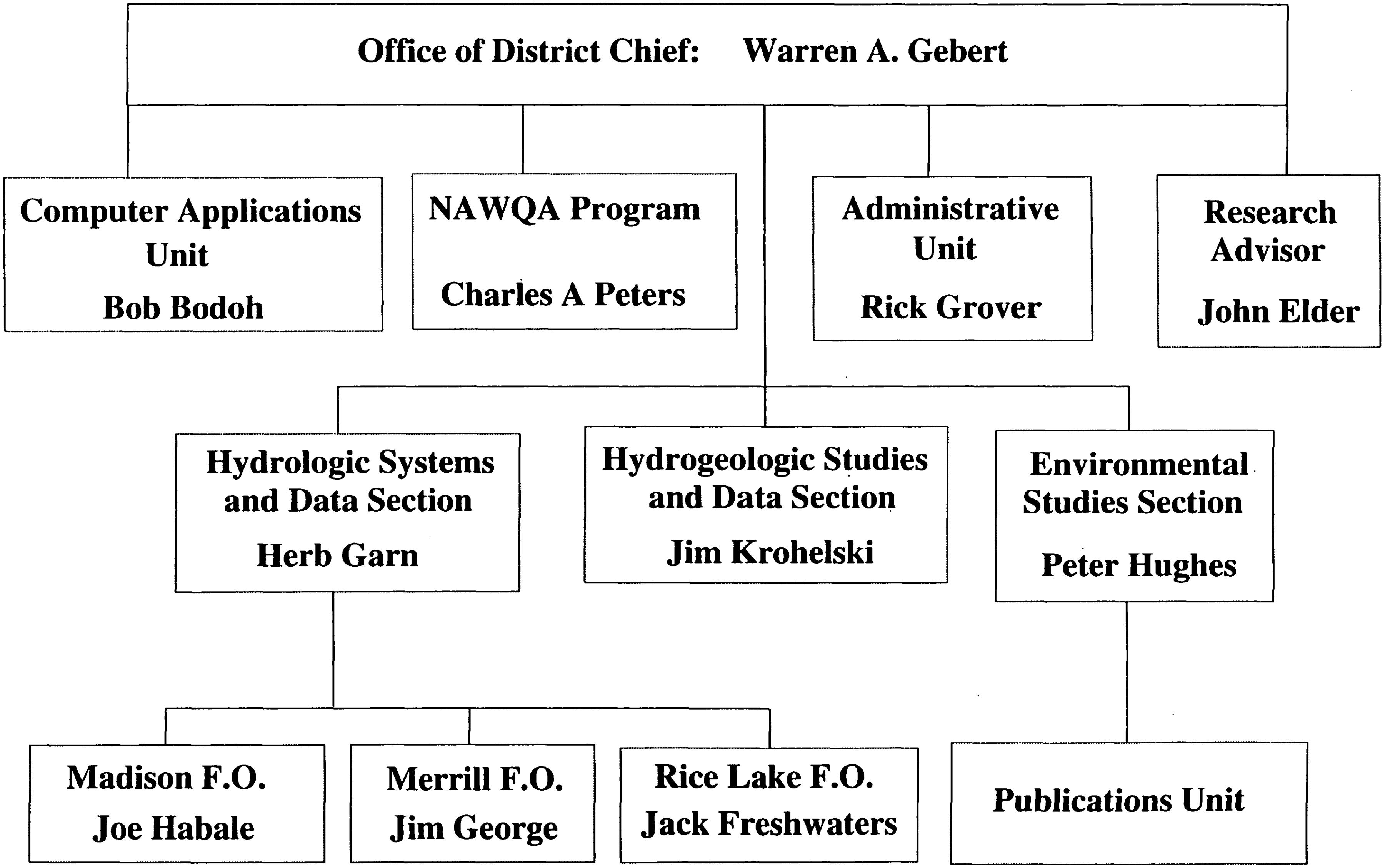
While some of the projects that have contributed to this increased activity are not part of our formal cooperative funding program, most have input from DNR personnel. In addition, the projects address critical or important water issues in the State and bring in additional dollars from out-of-State sources.

Funding sources for the Wisconsin District program for FY 1995 are shown on the following chart:



Total Funding = 6,792,000

Water Resources Division, Wisconsin District



CONTENTS

COLLECTION OF BASIC RECORDS—SURFACE WATER, WI 001

COOPERATORS:

Wisconsin Department of Natural Resources
U.S. Army Corps of Engineers
Southeastern Wisconsin Regional Planning Commission
Federal (Regular)
Madison Metropolitan Sewerage District
Dane County Department of Public Works
Federal Energy Regulatory Commission Licensees
Lac du Flambeau Band of Lake Superior Chippewa
Illinois Department of Transportation
City of Barron
City of Beaver Dam
City of Brookfield
City of Hillsboro
City of Peshtigo
City of Sparta
City of Thorp
City of Waupun
Village of Wittenberg
Fontana/Walworth Water Pollution Control Commission
Rock County Public Works Department
Menominee Indian Tribe of Wisconsin
Oneida Tribe of Indians of Wisconsin
Stockbridge-Munsee Band of Mohican Indians

LOCATION:

Statewide

PROJECT CHIEF:

Barry K. Holmstrom

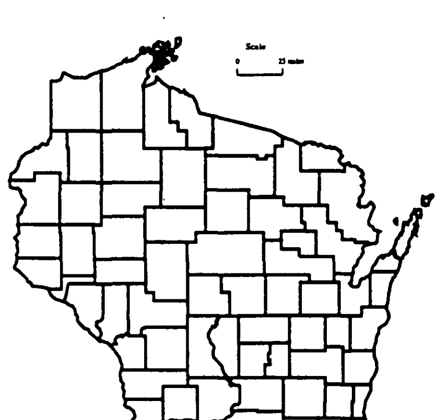
PERIOD OF PROJECT:

July 1913-Continuing

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 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 "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 1994 to June 1995): During the current fiscal year, streamflow data were collected at a total of 98 sites: 40 sites for the Wisconsin Department of Natural Resources (WDNR), 7 sites for the Corps of Engineers, 14 sites for the Southeastern Wisconsin Regional Planning Commission, 6 sites for the Federal program, 2 sites for Federal Energy Commission Licensees, 2 sites for the Madison Metropolitan Sewerage District, and 1 site each for the Lac du Flambeau Band of Lake Superior Chippewa, Menominee Indian Tribe of Wisconsin, Oneida Tribe of Indians of Wisconsin, Stockbridge-Munsee Band of Mohican Indians, Illinois Department of Transportation, cities of Barron, Beaver Dam, Brookfield, Hillsboro, Peshtigo, Sparta, Thorp, Waupun, village of Wittenberg, and Fontana/Walworth Water Pollution Control Commission. Streamflow data were also collected at 12 sites for agencies working jointly with the USGS. Lake-level data were collected at two sites for the Dane County Department of Public Works, at two sites for the Corps of Engineers, at one site for Rock County Public Works Department, and one site for the WDNR.

Two gaging stations from the Federal program and one Corps of Engineers station were discontinued October 1, 1994. These stations were:

04086360 Milwaukee River at Waubeka
05403500 Lemonweir River at New Lisbon
05426031 Rock River at Jefferson

Computation of streamflow and lake-level records for all the network stations for the 1994 water year was completed, stored in our WATSTORE computer data base, and published in the annual report "Water Resources Data-Wisconsin, water year 1994: Volume 1, St. Lawrence River Basin and Volume 2, Upper Mississippi River Basin." More than 100 requests for streamflow information were answered.

PLANS (July 1995 to June 1996): Data will be collected at 96 continuous-streamflow stations (see the following list) and lake levels at 6 stations. Streamflow records will be computed and data published for the 1995 water year. Requests for streamflow information will be answered.

Due to budget constraints by the WDNR, the operation of the following stations will have to be reduced. All stations will be operated at a reduced level for the period July 1, 1995 to September 30, 1995. For the period October 1, 1995 to June 30, 1996, only nine stations will be operated as part of the USGS/WDNR agreement. If funding arrangements can be made with other cooperators, it would be desirable to operate all 20 stations. Which nine stations will be funded by the USGS/WDNR agreement is dependent upon pending arrangements with other cooperators.

04071858 Pensaukee River near Pensaukee
04078500 Embarrass River near Embarrass
04084500 Fox River at Rapide Croche Dam near Wrightstown
04085200 Kewaunee River near Kewaunee
04085281 East Twin River at Mishicot
04085427 Manitowoc River at Manitowoc
04086000 Sheboygan River at Sheboygan
05333500 St. Croix River near Danbury
05362000 Jump River at Sheldon
05381000 Black River at Neillsville
05394500 Prairie River near Merrill
05397500 Eau Claire River at Kelly
05404000 Wisconsin River near Wisconsin Dells
05406500 Black Earth Creek at Black Earth
05408000 Kickapoo River at LaFarge
05427570 Rock River at Indianford
05429500 Yahara River at McFarland
05430500 Rock River at Afton
05431486 Turtle Creek at Carvers Rock Road near Clinton
05436500 Sugar River near Brodhead

Partial funding for the publication of data may also be lost due to budget constraints in the WDNR for the following stations as of July 1, 1995:

04073500 Fox River at Berlin
04079000 Wolf River at New London
05369500 Chippewa River at Durand
05379500 Trempealeau River at Dodge
05382000 Black River near Galesville
05407000 Wisconsin River at Muscoda
05410490 Kickapoo River at Steuben
05413500 Grant River at Burton
05414000 Platte River near Rockville
05425500 Rock River at Watertown
05426000 Crawfish River at Milford

For the period July 1, 1995 to June 30, 1996, only seven stations will be continued as part of the USGS/WDNR agreement. If funding arrangements can be made with other cooperators, it would be desirable to continue all 11 stations.

SURFACE-WATER GAGING STATIONS EXPECTED TO BE OPERATED IN 1996 FY

Station number	Name and location	Period of record (water year)	Cooperator
04024430	Nemadji River - South Superior	1974	WDNR
04025500	Bois Brule River - Brule	1943-81, 1984-	Fed.
04027500	White River - Ashland	1948-	WDNR
04029990	Montreal River - Saxon Falls	1987	WDNR
04063700	Popple River - Fence	1964-	Fed.
04065106	Menominee River - Niagara	1993-	FERC
04066003	Menominee River - Pembine	1950-	WDNR
04069500	Peshtigo River - Peshtigo	1953-	City of Peshtigo
04071000	Oconto River - Gillett	1906-09, 1914-	Fed.
04071858	Pensaukee River - Pensaukee	1973-	WDNR
04072150	Duck Creek - Howard	1988-	Oneida Tribe of Indians of WI
04073500	Fox River - Berlin	1898-	C of E, Detroit
04074950	Wolf River - Langlade	1966-79, 1981-	Menominee Indian Tribe of WI
04077400	Wolf River - Shawano	1907-09, 1911-	FERC
04077630	Red River - Morgan	1993	Stockbridge-Munsee Band of Mohican Indians
04078500	Embarrass River - Embarrass	1919-85, 1994-	Fed.
04079000	Wolf River - New London	1896-	C of E, Detroit
04082400	Fox River - Oshkosh	1991	WDNR
04084445	Fox River - Appleton	1986-	C of E, Detroit
04084500	Fox River - Wrightstown	1896-	WDNR
04085200	Kewaunee River - Kewaunee	1964-	WDNR
04085281	East Twin River - Mishicot	1972-	WDNR
04085427	Manitowoc River - Manitowoc	1972-	WDNR
04086000	Sheboygan River - Sheboygan	1916-24, 1951	WDNR
04086500	Cedar Creek - Cedarburg	1930-70, 73-81, 1983-87, 1991 -	WDNR
04086600	Milwaukee River - Pioneer Road	1982-	SEWRPC
04087000	Milwaukee River - Milwaukee	1914-	SEWRPC
04087030	Menomonee River - Menomonee Falls	1975-77, 1979-	SEWRPC
04087088	Underwood Creek - Wauwatosa	1975-	SEWRPC
04087120	Menomonee River - Wauwatosa	1962-	SEWRPC
04087160	Kinnickinnic River - Milwaukee	1976-	SEWRPC
04087204	Oak Creek - South Milwaukee	1964-	SEWRPC
04087220	Root River - Franklin	1964-	SEWRPC
04087233	Root River Canal - Franklin	1964-	SEWRPC
04087240	Root River - Racine	1963-	SEWRPC
04087257	Pike River - Racine	1972-	SEWRPC
05332500	Namekagon River - Trego	1928-70, 1988	WDNR
05333500	St. Croix River - Danbury	1914-81, 1985-	WDNR
05340500	St. Croix River - St. Croix Falls	1902-	WDNR
05341500	Apple River - Somerset	1901-70, 1987	WDNR
05356000	Chippewa River - Winter	1912-	WDNR
05356500	Chippewa River - Bruce	1914-	WDNR
05357335	Bear River - Manitowish Waters	1991	Lac du Flambeau Band of Lake Superior Chippewa
05360500	Flambeau River - Bruce	1951-	WDNR, FERC
05362000	Jump River - Sheldon	1915-	WDNR
05365500	Chippewa River - Chippewa Falls	1888-1983, 1987	WDNR
05365707	North Fork Eau Claire River - Thorp	1986	City of Thorp
053674464	Yellow River - Barron	1991	City of Barron
05368000	Hay River - Wheeler	1951-	Fed.
05369000	Red Cedar River - Menomonie	1907-08, 1913-	WDNR
05369500	Chippewa River - Durand	1928-	C of E, St. Paul
05369945	Eau Galle River - low water bridge	1982-83, 1986-	C of E, Vicksburg
05370000	Eau Galle River - Spring Valley	1944-	C of E, St. Paul
05379500	Trempealeau River - Dodge	1914-19, 1934	C of E, St. Paul
05381000	Black River - Neillsville	1905-09, 1914-	WDNR

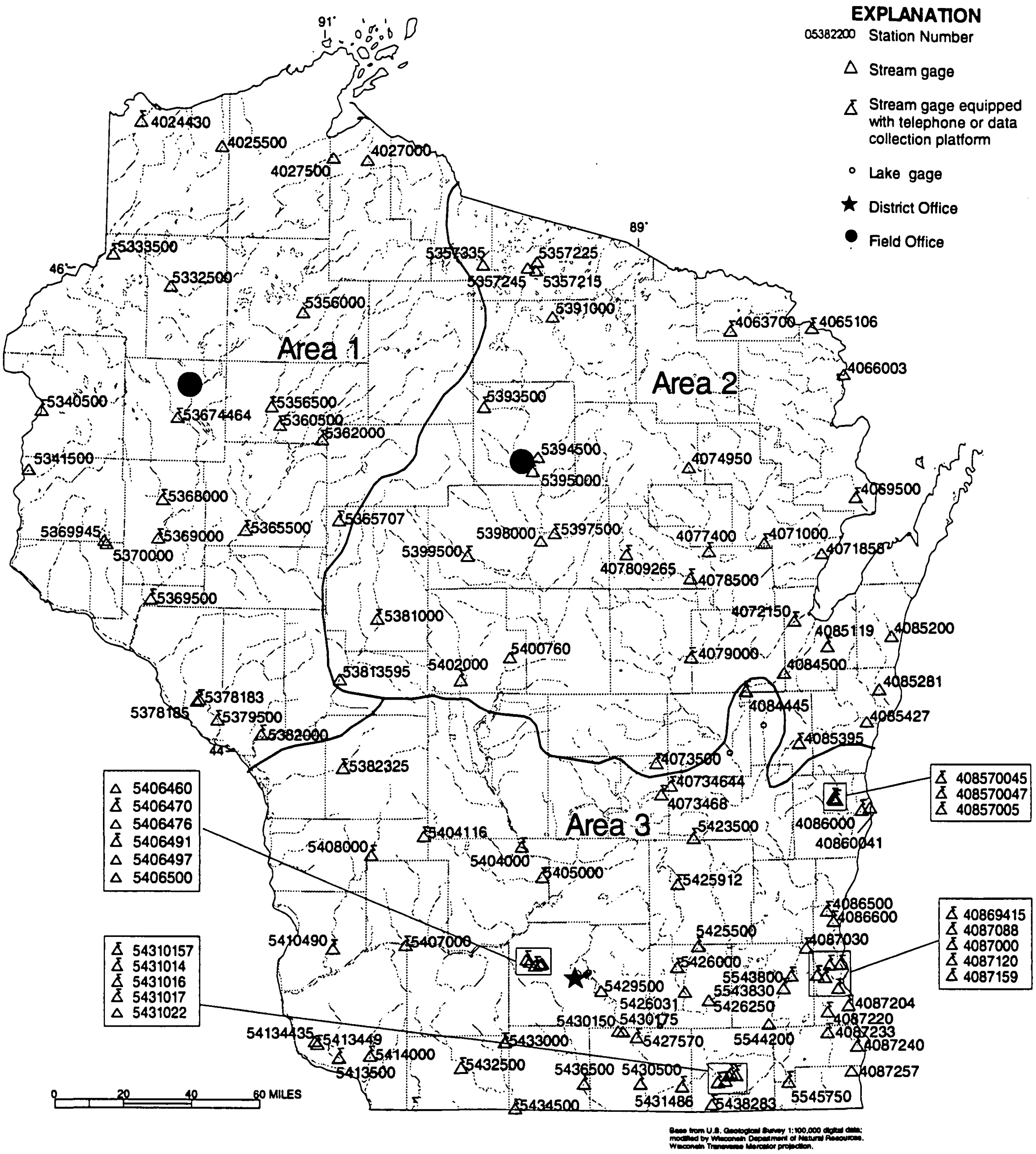
SURFACE-WATER GAGING STATIONS EXPECTED TO BE OPERATED IN 1996 FY

Station number	Name and location	Period of record (water year)	Cooperator
05382000	Black River - Galesville	1932-	C of E, St. Paul
05382325	La Crosse River - Sparta	1992-	City of Sparta
05391000	Wisconsin River - Lake Tomahawk	1936-	WDNR
05393500	Spirit River - Spirit Falls	1942-	WDNR
05394500	Prairie River - Merrill	1914-31, 1939-	WDNR
05395000	Wisconsin River - Merrill	1903-	WDNR
05397500	Eau Claire River - Kelly	1914-27, 1939-	WDNR
05398000	Wisconsin River - Rothschild	1945-	WDNR
05399500	Big Eau Pleine River - Stratford	1914-26, 1937-	WDNR
05400760	Wisconsin River - Wisconsin Rapids	1914-50, 1958-	WDNR
05401050	Tenmile Creek - Nekoosa	1963-79, 1987	WDNR
05402000	Yellow River - Babcock	1944-	WDNR
05404000	Wisconsin River - Wisconsin Dells	1935-	WDNR
05404116	S. Br. Baraboo River - Hillsboro	1988-	City of Hillsboro
05405000	Baraboo River - Baraboo	1914-22, 1943-	Fed.
05406500	Black Earth Creek - Black Earth	1954	WDNR
05407000	Wisconsin River - Muscoda	1903-04, 1914-	C of E, St. Paul
05408000	Kickapoo River - LaFarge	1939-	WDNR
05410490	Kickapoo River - Steuben	1933-	C of E, St. Paul
05413500	Grant River - Burton	1935-	C of E, R. Island
05414000	Platte River - Rockville	1935-	C of E, R. Island
05423500	S. Br. Rock River - Waupun	1948-69, 1987	City of Waupun
05425500	Rock River - Watertown	1931-70, 1977-	C of E, R. Island
05425912	Beaverdam River - Beaver Dam	1984-	City of Beaver Dam
05426000	Crawfish River - Milford	1931-	C of E, R. Island
05426250	Bark River - Rome	1980-	SEWRPC
05427570	Rock River - Indianford	1975-	Rock County
05429500	Yahara River - McFarland	1930-	DCDPW
05430150	Badfish Creek - Cooksville	1977-	MMSD
05430175	Yahara River - Fulton	1977	MMSD
05430500	Rock River - Afton	1914-	Rock County
05431486	Turtle Creek - Clinton	1939-	Rock County
05432500	Pecatonica River - Darlington	1939-	C of E, R. Island
05433000	E. Br. Pecatonica River - Blanchardville	1939-1986, 1988	C of E, R. Island
05434500	Pecatonica River - Martintown	1940-	C of E, R. Island
05436500	Sugar River - Brodhead	1914-	Rock County
05438283	Piscasaw Creek - Walworth	1992-	Fontana/Walworth WPCC
05543800	Fox River -Watertown Road - Waukesha	1993-	City of Brookfield
05543830	Fox River - Waukesha	1963-	SEWRPC
05544200	Mukwonago River - Mukwonago	1973-	SEWRPC
05545750	Fox River - New Munster	1940-	IL. DOT

LAKES

04082500	Lake Winnebago - Oshkosh	1882-	C of E, Detroit
04084255	Lake Winnebago - Stockbridge	1983-	C of E, Detroit
05404500	Devil's Lake - Baraboo	1922-30, 1932, 1934-81, 1985-	WDNR
05427235	Lake Koshkonong - Newville	1987	Rock County
05428000	Lake Mendota - Madison	1903, 1916-	DCDPW
05429000	Lake Monona - Madison	1915-	DCDPW

WDNR–Wisconsin Department of Natural Resources
C of E, Detroit–Corps of Engineers, Detroit, Michigan
C of E, R. Island–Corps of Engineers, Rock Island, Illinois
C of E, St. Paul–Corps of Engineers, St. Paul, Minnesota
SEWRPC–Southeastern Wisconsin Regional Planning Commission
Fed.–USGS Federal Program
FERC–Federal Energy Regulatory Commission Licensees
MMSD–Madison Metropolitan Sewerage District
DCDPW–Dane County Department of Public Works
IL. DOT–Illinois Department of Transportation
Fontana/Walworth WPCC–Fontana/Walworth Water Pollution Control Commission



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
Bad River near Odanah	04027000	597	1914-23, 1948-95
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
Pike River at Amberg, WI	04066500	255	1914-70
Menominee River near McAllister, WI	04067500	3,930	1945-61, 1979-86, 1988-90
Peshtigo River at High Falls near Crivitz, WI	04068000	537	1912-57
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, 1982-85
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
Middle Branch Embarrass River near Wittenberg	0407809265	76.3	1990-95
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
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
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

Discontinued surface-water discharge stations

Station name	Station number	Drainage area (square miles)	Period of record
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
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
TREMPEALEAU RIVER BASIN			
Bruce Valley Creek near Pleasantville, WI	05379288	10.1	1980
Elk Creek near Independence, WI	05379305	108	1980
Trempealeau River at Arcadia, WI	05379400	553	1960-77
Trempealeau River near Trempealeau, WI	05380000	719	1932-34

Discontinued surface-water discharge stations

Station name	Station number	Drainage area (square miles)	Period of record
		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 Ameson Crk 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
Kickapoo River at Ontario, WI	05407500	151	1939, 1973-77
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
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

Discontinued surface-water discharge stations

Station name	Station number	Drainage area (square miles)	Period of record
		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
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, 1973-8

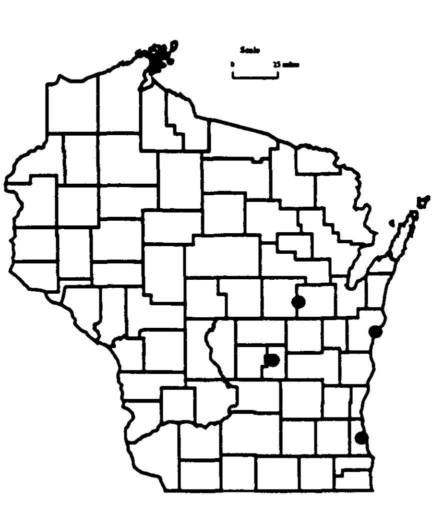
INTERGOVERNMENTAL TASK FORCE ON MONITORING– WISCONSIN WATER RESOURCES COORDINATION PILOT PROJECT, WI 00301

COOPERATOR:
Federal Program
(Interagency Personnel Agreement with the Wisconsin Department of Natural Resources)

LOCATION:
Statewide

PROJECT CHIEF:
Phil A. Kammerer

PERIOD OF PROJECT:
August 1993 to March 1996



PROBLEM: Protocols for water-sample collection and processing for USGS and the Wisconsin Department of Natural Resources (DNR) water-quality monitoring programs in Wisconsin differ, and samples from each agency are analyzed by different laboratories. There are no data available to show whether or not the differences in sample collection and processing protocols cause differences in monitoring results.

OBJECTIVE: The objective of this study is to identify interagency differences in monitoring results caused by differences in sample collection and processing protocols.

APPROACH: Concurrent samples are collected by both agencies at visits to three stream sites and one lake site, split between laboratories, and analyzed in triplicate for concentrations of a suite of constituents common to their respective monitoring programs. The constituents chosen for analysis are total phosphorus, dissolved orthophosphate, dissolved chloride and suspended sediment/ suspended solids for streams and total phosphorus, dissolved orthophosphate and chlorophyll *a* for the lake. For streams, two sample-collection methods (flow-integrated sampling and grab sampling) were compared for a range of flow conditions. Laboratories used in the study are the USGS National Water Quality Laboratory and the Wisconsin State Laboratory of Hygiene.

PROGRESS (July 1994 to June 1995): Data collection was completed.

For streams, there were no statistically significant (p=0.05) concentration differences between sampling methods for total phosphorus, dissolved orthophosphorus, or dissolved chloride for any of the flow conditions sampled. There were significant concentration differences between sampling methods for suspended sediment and total suspended solids for some high-flow samples. Where there were differences, concentrations were higher in flow-integrated samples than in grab samples. Concentrations of total phosphorus, dissolved orthophosphorus, and dissolved chloride differed significantly and consistently between laboratories. Differences in concentrations of dissolved orthophosphorus between samples filtered in the field and samples filtered in the laboratory were not significant

PLANS (July 1995 to June 1996): Data analysis will be completed and an interpretive report describing the results of the study will be prepared.

COLLECTION OF BASIC RECORDS—SEDIMENT, WI 004

PROBLEM: Water-resources planning and water-quality assessment require a knowledge of the quantity and quality of sediment being transported in rivers and streams in Wisconsin.

OBJECTIVE: This project will provide sediment data for use in specific planning and action programs and will develop a data base for determining trends in sediment discharge and yield. Streams will be characterized according to range of concentration and particle size of suspended sediment.

APPROACH: Sediment-monitoring stations will be operated at selected stream sites throughout the State, including sites of specific interest to cooperating agencies.

The extent of monitoring at a given site will depend on the characteristics of the basin and the needs of the cooperating agency. Some sites will be sampled manually at infrequent intervals; other sites, where flow responds rapidly to precipitation, will be sampled by automatic samplers.

At sites where bedload or unmeasured sediment discharge may be a significant part of the total sediment discharge, suspended- and bed-sediment particle size will be determined from samples collected concurrently with hydraulic data. These data will be used to estimate total sediment discharge using one of several techniques such as the modified Einstein procedure.

PROGRESS (before July 1993): Sediment data have been collected at more than 200 stream sites in Wisconsin since 1968. The sampling intensity and length of sampling period varies considerably from site to site. At some sites, only a few samples a year were collected at irregular intervals for concentration analysis; at other sites, hundreds of samples per year were collected with stage-activated automatic samplers. Suspended and bed-material particle-size data are available for many of the sites. Except for data collected as part of the National Stream Quality Accounting Network program, data collection at most sites has been of relatively short (less than 4 years) duration. Most sediment data collection has been in the southern one-third of the State and associated with local special problem studies except for about a five-year period in the early 1970's when there was a Statewide network of sediment monitoring stations. All data have been published annually in the data report, "Water Resources Data–Wisconsin."

PROGRESS (July 1994 to June 1995): The 1994 monitoring program is as follows:

CORPS OF ENGINEERS–Suspended sediment was sampled at the Grant River at Burton. Daily loads were determined from these data.

COOPERATORS:

Wisconsin Department of Natural Resources
U.S. Army Corps of Engineers
Dane County Regional Planning Commission

LOCATION:

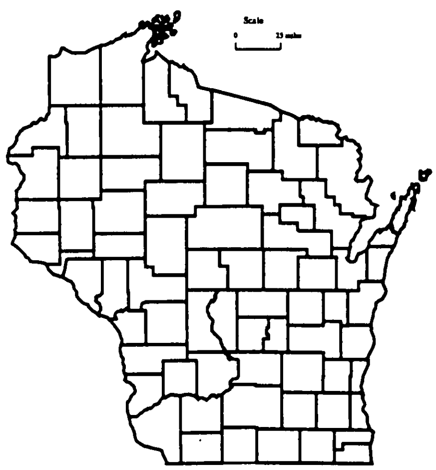
Statewide

PROJECT CHIEF:

William J. Rose

PERIOD OF PROJECT:

March 1968-Continuing



WISCONSIN DEPARTMENT OF NATURAL RESOURCES (WDNR)–A study whose objective was to estimate the coarse-material sediment load at three sites on North Fork Fish Creek near Ashland, Wisconsin, began on July 1, 1989. Monitoring for this study was completed in October 1991. Preliminary load estimates have been provided to the WDNR. The report summarizing the study is in the review stage.

PLANS (July 1995 to June 1996):

CORPS OF ENGINEERS–Operation of the Grant River monitoring station will continue.

WISCONSIN DEPARTMENT OF NATURAL RESOURCES–The brief report summarizing the results of the North Fork Fish Creek study will be completed.

Efforts will continue to establish a long-term sediment-monitoring network. About 10 sites areally distributed to sample runoff from the major geographic provinces would provide an adequate network.

REPORTS:

Rose, William J., 1992, Sediment transport, particle sizes, and loads in the lower reaches of the Chippewa, Black, and Wisconsin Rivers in western Wisconsin, U.S. Geological Survey Water-Resources Investigations Report 90-4124, 38 p.

Rose, William J., and Graczyk, David J., Sediment transport, particle size, and loads in North Fish Creek in Bayfield County, Wisconsin, 1989-91 (in review).

WISCONSIN WATER-USE DATA FILE, WI 007

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, to store data in the State Water-Use Data System (SWUDS), and to 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 the SWUDS. Efforts will be made to upgrade the accuracy of the water-use data.

PROGRESS (July 1994 to June 1995): The 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 1995 to June 1996): Plans include: (1) continue to update and maintain the SWUDS data base with current water-use data, (2) explore the possibility of a cooperative project with Wisconsin Department of Natural Resources to meter selected industrial users to better estimate consumptive water use, (3) supply water-use data for water-resources studies currently being conducted in the State, and (4) start data collection for the 1995 water-use publication, "Water use in Wisconsin, 1995".

REPORTS:

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.

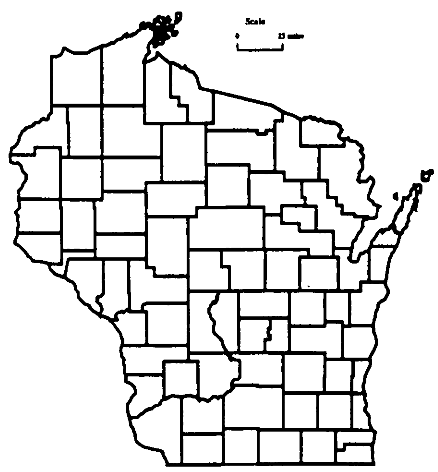
____1982, Water use in Wisconsin, 1979: U.S. Geological Survey Open-File Report 82-444, 98 p.

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Statewide

PROJECT CHIEF:
Bernie R. Ellefson

PERIOD OF PROJECT:
March 1978-Continuing



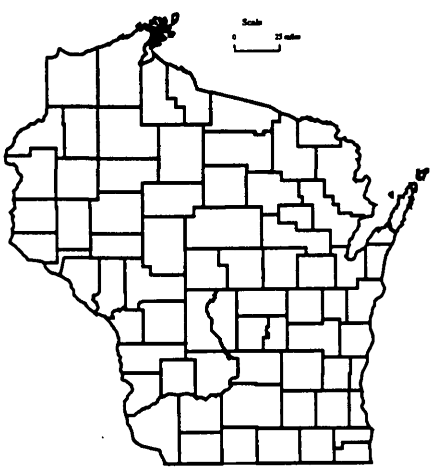
LOW FLOW AT OUTFALL SITES, WI 035

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Selected sites throughout Wisconsin

PROJECT CHIEF:
Barry K. Holmstrom

PERIOD OF PROJECT:
April 1972-Continuing



PROBLEM: Water-quality standards have been adopted for all surface waters of the State. To implement these standards, the Wisconsin Department of Natural Resources (WDNR) has to evaluate the sewage effluent from all waste sources in relation to the low-flow characteristics of the receiving stream. Water-quality standards in Wisconsin are based on a number of streamflow characteristics. These include the annual minimum 7-day consecutive mean flow that occurs on the average of once every 2 years ($Q_{7,2}$) and once every 10 years ($Q_{7,10}$), the annual minimum 30-day consecutive mean flow that occurs on the average of once every 5 years ($Q_{30,5}$), $Q_{7,10}$ values for selected months ($Q_{7,10}$-month), 10-year low mean monthly flows for October, November, April, and May, and the mean annual discharge.

OBJECTIVE: The purpose of this study is to determine the following streamflow characteristics:

1. $Q_{7,10}$ for receiving streams at sewage-treatment plants and industrial plants discharging wastes.
2. $Q_{7,2}$ for selected streams.
3. The 10-year low mean monthly flows for October (Oct. MMQ_{10}), November (Nov. MMQ_{10}), April (Apr. MMQ_{10}), and May (May MMQ_{10}) for sites at fill-and-draw wastewater-treatment lagoons or waste-stabilization ponds.
4. $Q_{30,5}$ for selected streams.
5. The mean annual discharge (MAQ) for selected streams.
6 $Q_{7,10}$ for selected months for selected streams.

APPROACH: Low-flow characteristics of selected streams will be determined by drainage-area/discharge relations, graphical-regression methods, regression equations, Log-Pearson Type III frequency analysis, and other statistical and graphical methods.

PROGRESS (July 1994 to June 1995): Low-flow estimates were determined at approximately 65 sites in response to requests for information from the Surface Waters and Monitoring Section of the WDNR.

PLANS (July 1995 to June 1996): Low-flow characteristics at approximately 50 sites will be determined in response to WDNR requests for information. The low-flow characteristics, in most instances, will be determined by drainage-area/discharge relations or by regression equations. Biological design flows and other flow characteristics may also be determined.

OCCURRENCE, TRANSPORT, AND SIMULATION OF PCB'S IN THE LOWER FOX RIVER, WI 145

PROBLEM: Polychlorinated biphenyls (PCB's) in the Lower Fox River have been identified and classified as "in-place pollutants" by the Wisconsin Department of Natural Resources (WDNR) due to the high concentrations found in the bottom sediments (up to 250 milligrams per kilogram). These PCB deposits are believed to be a significant source of continuing PCB loading to Green Bay and Lake Michigan. The WDNR is developing a remedial action plan to reduce the PCB presence in the Fox River and Green Bay. Information is needed regarding the location of PCB deposits and transport rate of PCB's within the Fox River to support this remedial action effort.

OBJECTIVE: The objectives of this study are to estimate the total mass of PCB's present in the study reach bottom sediments, compute the total PCB load carried by the river, and simulate present and future PCB transport in the river. The study is being coordinated with and will compliment the U.S. Environmental Protection Agency's mass-balance study of PCB's in Green Bay.

APPROACH: Streamflow-monitoring and automated-suspended-sediment sampling equipment is installed on the Fox River between Neenah/Menasha and DePere. Fox River discharge and suspended-sediment data were collected through September 1990.

Acoustical-velocity-meter (AVM) systems were used to determine discharge in the Fox River at Appleton and DePere. Automated sediment samplers were operated at Appleton, Little Rapid, and DePere, and samples were collected on a daily basis.

Water samples were analyzed to obtain PCB concentrations with congener resolution of hundreths of a nano-gram/liter. Dissolved and particulate PCB concentrations were determined separately so the PCB partition coefficients could be computed. Water samples were also analyzed to determine total and dissolved organic carbon and other parameters. Samples were collected every two weeks, except in winter. Winter sampling was done about once per month.

The total mass of PCB's present in the study reach was estimated by use of an unconsolidated sediment thickness contour map and sediment-core analysis. The sediment cores were divided into several sections by visual inspection and analyzed for PCB concentration. Sediment cores were also analyzed to determine density of the bottom deposits.

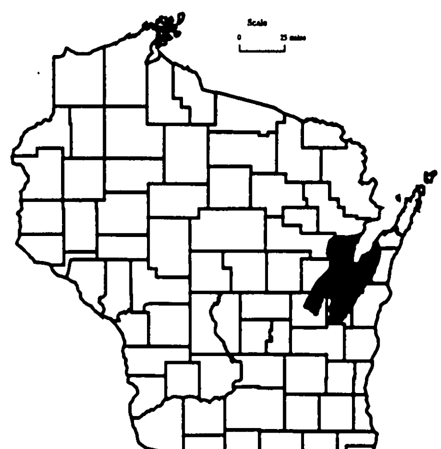
The Water Analysis Simulation Program (WASP) model has been used to simulate PCB kinetics and transport. This modeling effort is done by a USGS employee on loan to the WDNR. Water-column data collected during the summer and fall of 1992, along with high-flow data collected during the summer of 1993, has been used to validate the transport model.

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Lower Fox River, East Central Wisconsin

PROJECT CHIEF:
Jeffrey J. Steuer

PERIOD OF PROJECT:
July 1985 to June 1995



PROGRESS (July 1994 to June 1995): The WASP4 modeling effort by the USGS/WDNR has been completed, accompanied by model documentation and transference.

PLANS (July 1995 to June 1996): The project is completed. Reports will be published.

REPORTS:

House, Leo B., 1993, Distribution, concentration, and transport of polychlorinated biphenyls in Little Lake Butte des Morts, Fox River, Wisconsin 1987-88, U.S. Geological Survey Open-File Report 93-31 (pending water-supply paper).

Steuer, Jeffrey J., and others, Long-term simulation of PCB export from the Fox River to Green Bay (JA–in review).

Steuer, Jeffrey J., A deterministic PCB transport model for the Fox River between Lake Winnebago and the DePere Dam (in review).

TRENDS IN WATER QUALITY AND STREAM HABITAT FOR PRIORITY WATERSHEDS, WI 17201-17205, 17208-17210, 17213, 17214

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 1994 to June 1995): Streamflow and water-quality monitoring was continued at 10 sites in the priority watersheds. Dissolved oxygen was monitored at 7 sites in the priority watersheds. All data was summarized and will be published in the report "Water Resources Data-Wisconsin" water year 1995. Water-quality loads were calculated for selected parameters and storm periods for the 10 sites. Land-use inventories were done for each basin.

PLANS (July 1995 to June 1996): Streamflow, water-quality (for the 10 sites), and dissolved-oxygen (at 4 sites) monitoring will be continued. 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 the best management plans. Land-use inventories will be updated for each basin.

REPORTS:

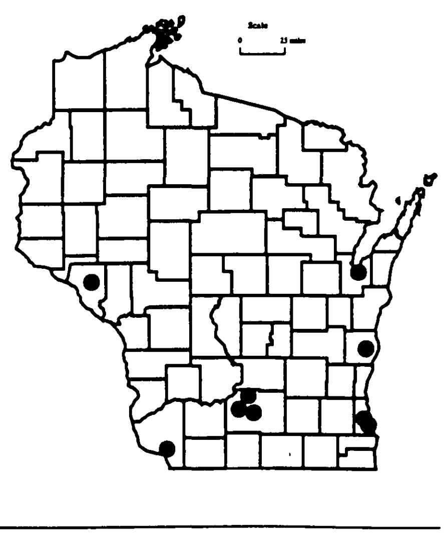
Walker, J.F., Graczyk, D.J., Corsi, S.R., Owens, D.W., and Wierl, J.A., 1995, Evaluation of nonpoint-source contamination, Wisconsin: Land-use and best management practices inventory, selected streamwater-quality data, urban quality assurance and quality control, constituent loads in rural streams, and snowmelt-runoff analysis: U.S. Geological Survey Open-File Report (in press).

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, David W. Owens, and Todd D. Stuntebeck

PERIOD OF PROJECT:
October 1990 to September 1997



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: U.S. Geological Survey Open-File Report 94-707, 57 p.

Greb, Steven R., and Graczyk, David J., 1995, Frequency-duration analysis of dissolved-oxygen concentrations in two southwestern Wisconsin streams, Water Resources Bulletin (in press).

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.

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.

Bannerman, R.T., Owens, D.W., Dodds, R.B., and Hornewer, N.J., 1993, Sources of pollutants in Wisconsin stormwater: Water Science Technology, v. 28, no. 3-5, p. 241-259.

BEST MANAGEMENT PRACTICE EVALUATION, WI 17206

PROBLEM: To date, the effectiveness of best management practices (BMP's) 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: 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 BMP's 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 identify 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 BMP's in several basins in Wisconsin.

PROGRESS (July 1994 to June 1995): Publication process for journal article was completed (Walker, 1994). Work continued on incorporating snowmelt events into statistical analyses. Preliminary regression analyses of pre-BMP data for all rural sites were completed. Annual progress report for water year 1994 (Walker and others, 1995) was completed.

PLANS (July 1995 to June 1996): Work on snowmelt events will be continued. Refinement of regression analyses by incorporating additional variables will continue and a closer examination of processes affecting storm and snowmelt loads will be made.

REPORTS:

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.

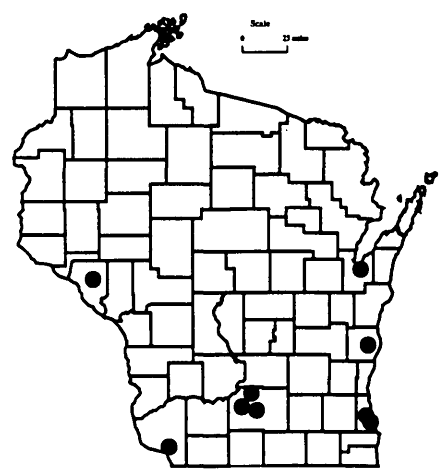
Walker, J.F., 1993, Techniques for detecting effects of urban and rural land-use practices on stream-water chemistry in selected watersheds in Texas, Minnesota, and Illinois: U.S. Geological Survey Open-File Report 93-130, 16 p.

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
State of Wisconsin

PROJECT CHIEF:
John F. Walker

PERIOD OF PROJECT:
October 1989 to September 1997



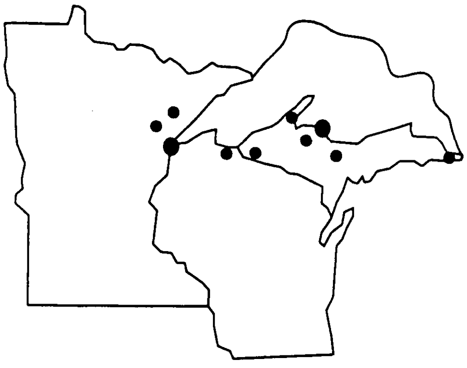
LAKE SUPERIOR URBAN STORM-WATER DEMONSTRATION PROJECT, WI 17212

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Eleven cities in Lake Superior Basin (Minnesota, Wisconsin, Michigan)

PROJECT CHIEF:
Jeffrey J. Steuer

PERIOD OF PROJECT:
April 1993 to December 1995



PROBLEM: The Lake Superior Binational Program requires an understanding of the sources and amount of urban storm-water pollution in the Lake Superior Basin.

OBJECTIVE: The objective is to provide water-quality data necessary to construct storm-water management plans as required under the Binational Program. In addition to discharge, these data will include nutrients, metals, poly-aromatic hydrocarbons (PAH's) and eight organic bioaccumulative substances identified by the Binational Program.

APPROACH: One storm sewer in each of two cities (Marquette, Michigan and Superior, Wisconsin) will be intensively monitored (15 events) for precipitation, runoff flow and constituent concentrations. Within the Marquette basin, runoff from nine discrete source areas (streets, parking lots, roof tops, driveways and lawns) will be sampled. These data will be used to calibrate an urban model for the Marquette flume site.

One storm sewer in each of eight smaller municipalities will be monitored over four events for constituent concentrations. Constituent concentrations will be monitored (6 events) at two bulk storage piles in the Duluth/Superior area.

In Duluth, Minnesota, and Superior, Wisconsin, water-quality sites will be installed at an urban undeveloped space, recreational park, golf course, and a gas station. The concentration and discharge data collected at these sites will be used to further refine the source-area loading model (SLAMM).

PROGRESS (July 1994 to June 1995): Data collection, from storm sewers in Marquette, Michigan, Superior, Wisconsin, and the eight smaller municipalities, has been completed and the 2,887 samples analyzed. At Superior, Wisconsin, runoff from the Tower Avenue basin (22 acres), as measured during 63 events, was generally 55 percent. At Marquette, Michigan, runoff from the Tower Avenue basin (288 acres) as measured during 65 events, was generally 15 percent. At Marquette and Superior, event loadings for nutrients, metals, and poly-aromatic hydrocarbons (PAH's) have been calculated based upon flume-measured discharge and flow-weighted composite sampling.

Within the Marquette basin, data collection from 9 source areas has been completed, resulting in 3,186 samples being analyzed. Initial assessment of these source-area data indicate that parking lots generate high concentrations of PAH's. There is also a relation between traffic density on a street and the resulting PAH concentration in street runoff.

PLANS (July 1995 to June 1996): Data will continue to be collected at the Superior Tower Avenue site. Equipment will be installed and data collected at the urban undeveloped space, recreational park, golf course and gas station sites. Journal articles detailing the storm-sewer and source-area work will be written.

SOURCES OF STORM-WATER POLLUTANTS WASHED OFF CITY STREETS, WI 17215

PROBLEM: High loadings of heavy metals, polycyclic aromatic hydrocarbons (PAH's) and phosphorus have been observed in storm water nationwide. City streets in Madison contribute a large percentage of the heavy metal and phosphorus loadings measured at storm-sewer outfalls. If we know how these pollutants are deposited on the streets, prevention could be an important approach to controlling these pollutants. Controlling the pollutants at their source could be more cost-effective than implementing expensive end-of-pipe practices like detention ponds.

OBJECTIVES: The objectives are to (1) identify storm-water pollutant loadings that are related to traffic volume, (2) identify the sources of phosphorus to city streets, (3) assess the toxicity of the storm-water pollutants washed off city streets, and (4) estimate storm-water loading reductions by controlling the sources of pollutants to city streets.

APPROACH: Twelve storm-water runoff samples will be collected from each of five streets with different traffic volumes. Sheet-flow samplers will be installed in the streets representing the four lowest traffic volumes of around 500, 6,100, 18,600 and 25,500 cars per day. Samples will also be collected from the Madison Beltline which has a traffic volume of about 80,000 cars per day. A sampler will be installed to collect storm water in a storm sewer that collects only water that runs directly from the Beltline into the storm sewer. These samples will be analyzed for heavy metals, phosphorus, PAH's and acute toxicity. In addition to storm-water runoff samples, six street dirt samples will be collected from each of the four lowest traffic volume streets. These street dirt samples will be sieved into four different size fractions. Each of these size fractions will be analyzed for phosphorus content and vegetative fraction. Regression analyses will be done to determine if there is a relation between pollutant concentration and traffic volume and also between phosphorus concentration and vegetative content.

PROGRESS (July 1994 to June 1995): Approximately nine runoff samples have been collected and analyzed from each of the five different traffic volume streets. Six street dirt samples have been collected.

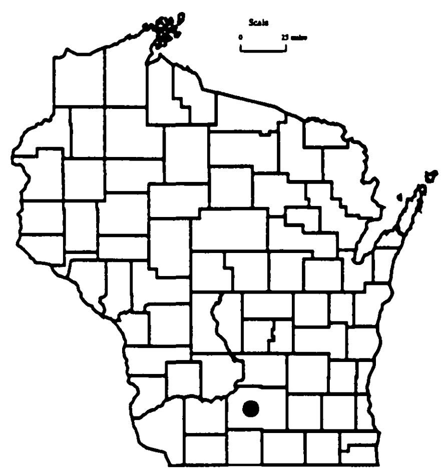
PLANS (July 1995 to September 1995): The remaining runoff samples were collected in the spring of 1995. The street dirt samples will be sieved and analyzed. The analyses results will be used to determine if relations exist between pollutant concentration and traffic volume and also between phosphorus concentration and vegetative content. The results will be published in an interpretive report.

COOPERATOR:
Wisconsin Department of Natural Resources.

LOCATION:
Madison, Wisconsin

PROJECT CHIEF:
Robert J. Waschbusch

PERIOD OF PROJECT:
July 1994-September 1995



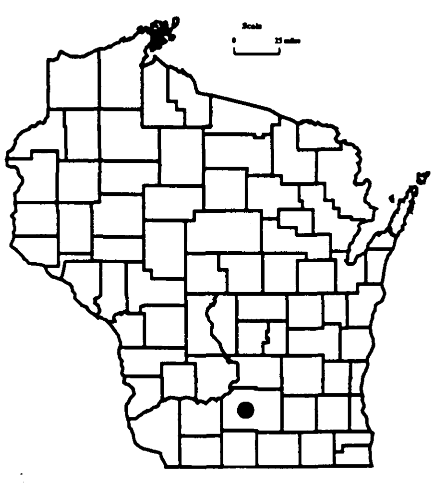
TRIBUTARY PHOSPHORUS LOADING TO LAKE MENDOTA AND EVALUATION OF LOAD DETERMINATION METHODS, WI 17217

COOPERATORS:
Wisconsin Department of Natural Resources

LOCATION:
Lake Mendota, Madison, Wisconsin

PROJECT CHIEF:
David J. Graczyk

PERIOD OF PROJECT:
October 1994 to June 1996



PROBLEM: Traditionally, monitoring of streamflow and phosphorus loading is done upstream from the lake (sometimes several miles) where the hydraulic gradient is sufficiently steep to employ conventional stream-gaging techniques. These monitoring sites, equipped with automatic samplers, provide data for accurate load determination, but at considerable cost. Usually, the load at the stream's mouth is assumed to be the same as at the monitoring site or adjusted by the ratio of the watershed areas of the two sites. The validity of this assumption is open to question because it is unknown whether the stream reach and watershed between the upstream monitoring site and the lake is a source or a sink for phosphorus. Various data-collection and analysis techniques must be tested to determine the most cost-effective methods for estimating loading at mouths of tributaries to lakes. These methods would then be employed in long-term monitoring on tributaries to selected lakes in priority-watershed projects.

OBJECTIVE: The objectives are to (1) determine the most cost-effective method for estimating total-phosphorus loading at mouths of streams flowing into lakes and (2) determine the annual total-phosphorus loading to Lake Mendota.

APPROACH: Four major tributaries (Yahara River, Pheasant Branch Creek, Sixmile Creek, and Spring Creek) to Lake Mendota will be monitored. These tributaries account for 214 of the 233 square-mile of the drainage basin of Lake Mendota. The lower reaches of all these tributaries are low gradient and flow through adjacent wetlands to Lake Mendota. Two of these tributaries, the Yahara River and Pheasant Branch, have continuous-discharge-gaging stations and automatic water-quality samplers upstream of reaches with adjacent wetlands. Water sampling for analysis of total-phosphorus concentration and determination of stream discharge will be done at or very near the mouths of these streams. Annual loads at the four major tributaries will be estimated. The annual loads will be estimated first by using the complete data set of all concentration data. Subsets of the complete data set will be used to estimate annual loads. The annual load estimates by using the subsets will be compared to the annual loads estimated using the complete data sets in order to determine the minimum sampling intensity that still yields sufficiently accurate load estimates. Pollutant loadings to Lake Mendota will be estimated by summing the loads from the four major tributaries and other sources to Lake Mendota. The other sources include loading from storm sewers, other smaller tributaries, ground-water inflow and direct precipitation to the lake. The loads from these sources will be provided by other agencies, programs and from literature reviews.

PROGRESS (July 1994 to June 1995): Water samples were collected and discharge measurements were made weekly at the four tributaries to Lake Mendota. Samples were collected more frequently during storms. The water samples were analyzed for total phosphorus and dissolved phosphorus. All data for water year 1994 were summarized and input into the USGS data base. An acoustic-velocity meter (AVM) was installed at the mouth of the Yahara River in September 1994. The AVM was calibrated and appears to be operating reliably.

PLANS (July 1995 to June 1996): Collection of water quality samples and streamflow data will continue through September 1995. Annual loads for the four tributaries will be estimated as outlined in the "Approach" above in order to evaluate load calculation methods. Total-phosphorus loading to Lake Mendota will be estimated.

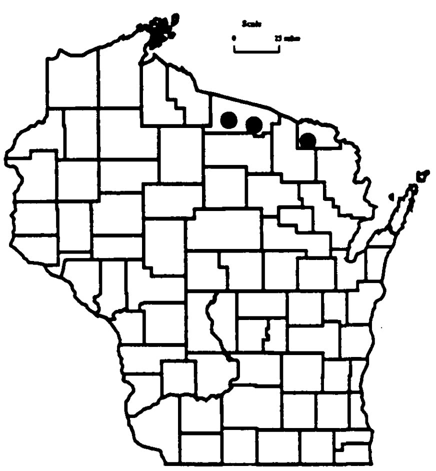
MERCURY CYCLING IN LAKES, WI 18001

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Florence and Vilas Counties, northern Wisconsin

PROJECT CHIEF:
William J. Rose

PERIOD OF PROJECT:
March 1987 to September 1997



ACIDIC LAKES

PROBLEM: Acid deposition has damaged lakes in Canada and in the northeastern United States. The pH of precipitation in northern Wisconsin averages 4.6 to 4.7, and Wisconsin has more susceptible lakes than any State east of the Mississippi. Many of these lakes are seepage lakes, whose chemistry is closely associated with precipitation chemistry. Previous studies addressing hydrologic and chemical budgets in northern Wisconsin have concentrated on lakes with alkalinities greater than 20 μeq/L; however, to truly address the potential effects of acid deposition on sensitive lake ecosystems, it is necessary to study lakes with alkalinities less than 20 μeq/L.

OBJECTIVE: Determine the hydrologic and chemical budgets for Honeysuckle, Max, and Morgan Lakes in northern Wisconsin to provide information about mechanisms of acid loadings to these lakes. Investigate differences between bog lakes and clear-water lakes. Evaluate the feasibility of, and develop an approach for, pumping ground water in an acid lake to raise its pH and alkalinity. Continue limited hydrologic monitoring at Vandercook Lake, which has a data base going back to October 1980.

APPROACH: Lake inflows from precipitation and ground-water discharge, and lake outflows from evaporation and ground-water recharge will be quantified. Alkalinity, pH, major cations and anions, nutrients, and mercury plus other trace elements in selected flow paths will be quantified. The lakes will be evaluated for their potential for acidification.

The ground-water-pumping study will be done at Max Lake where a well will be installed to draw water from the lower part of the sand and gravel aquifer adjacent to the lake. The chemical quality and quantity of pumped water will be monitored as well as the effects of the pumping on the lake.

PROGRESS (July 1994 to June 1995): Most monitoring emphasis was at Max Lake; lake stage and a single recorder-equipped well were monitored at Morgan Lake; and lake stage, precipitation, and the ground-water-well network were monitored at Vandercook Lake.

Ground water was pumped into Max Lake to raise and maintain its pH to 7.0. Ground water was pumped from May 5 to August 2, and from September 19 to November 11 at a 25 gallons-per-minute pumping rate. Preliminary water budgets were computed for the lake.

PLANS (July 1995 to June 1996): Routine data collection will continue at approximately the same level as last year. Max Lake's pH will be maintained at 7.0 by intermittent ground-water pumping. Preliminary water budgets will be computed for Max Lake.

REPORTS:

Webster, Katherine E., Kratz, Timothy K., Bowser, Carl J., Magnuson, John J., and Rose, William J., The influence of landscape position on lake chemical responses to drought in northern Wisconsin, USA (in review).

HYDROLOGIC CONSIDERATIONS ASSOCIATED WITH THE ARTIFICIAL ACIDIFICATION OF LITTLE ROCK LAKE IN VILAS COUNTY, WI

PROBLEM: A multi-agency group will study biological chemical responses to artificial acidification of one basin of two-basin Little Rock Lake by artificially lowering the pH incrementally over an 8-year period. The basins will be separated by a barrier; one basin will be acidified, the other will function as a control. A detailed understanding of the lake hydrology is needed by the group to (1) determine which of the basins to acidify; (2) estimate the amount of acid required to achieve a given pH level; (3) characterize the lake hydrologically to increase the transfer value of the study's results to other lakes; (4) monitor the effects of the acidification on the local ground water; and (5) provide basic hydrologic information on lake hydrology that would be input to any acidification models that may be tested.

OBJECTIVE: The goal of this project is to determine monthly water budgets for each basin (the control and acidified basins) of Little Rock Lake, define ground-water-flow paths, and monitor ground-water quality.

APPROACH: Inflow to the lake from precipitation, overland flow, and ground-water discharge, and outflow from the lake from evaporation and ground-water recharge will be determined. Ground-water gradients determined from a piezometer network will be evaluated to define flow paths of ground water discharging to and recharging from the lake. Ground water discharging to and recharging from the lake will be sampled from piezometers situated in the appropriate flow paths. Concentrations of major chemical constituents, including hydrogen ion and alkalinity, nutrients, and trace elements, including aluminum and lead, will be determined. Monthly water budgets will be calculated.

PROGRESS (July 1994 to June 1995): Routine hydrologic monitoring continued. Some instrumentation and equipment from previous periods of more intensive monitoring than the present were removed from the study area.

PLANS (July 1995 to June 1996): A skeleton hydrologic monitoring network will be maintained to track the exchange of lake and ground water. This network consists of continuous measurement of lake stage and precipitation and intermittent measurement of about six piezometers.

REPORTS:

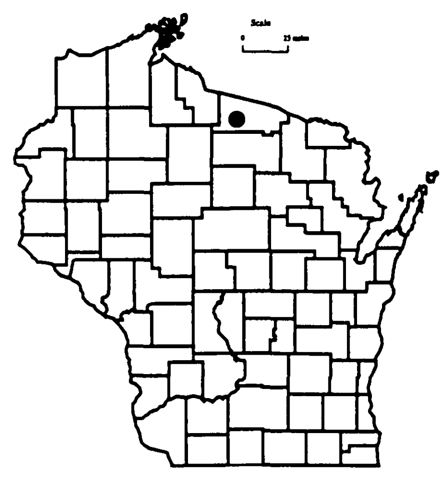
Rose, William J., 1993, Hydrology of Little Rock Lake in Vilas County, north-central Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 93-4139, 22 p.

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Florence and Vilas Counties, northern Wisconsin

PROJECT CHIEF:
William J. Rose

PERIOD OF PROJECT:
March 1987 to September 1997



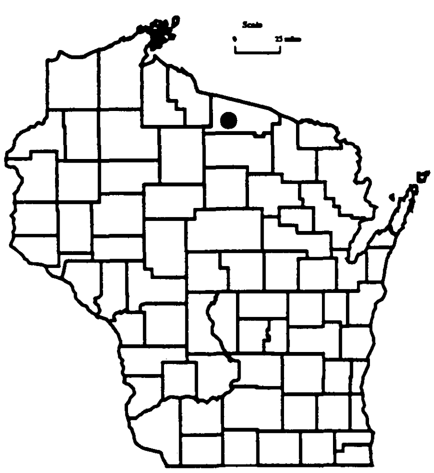
MERCURY ACCUMULATION, PATHWAYS, AND PROCESSES, WI 18003

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
North-central Wisconsin

PROJECT CHIEF:
David P. Krabbenhoft

PERIOD OF PROJECT:
January 1992 to June 1995



PROBLEM: Analytical data from the waters and biota of many Wisconsin lakes has indicated that there is a Statewide problem of mercury contamination in natural water systems. Elevated concentrations of mercury, coupled with the high toxicity of the element, has led to issuance of fish consumption advisories for many Wisconsin lakes. The causes of mercury contamination and processes affecting mercury cycling within the lake systems are not well understood. An intensive study of mercury biogeochemistry in the lakes is needed to provide information that can be applied to develop appropriate management practices.

OBJECTIVE: The project will be one part of a team research program whose overall objective is to understand the processes responsible for aquatic transport and transformation of mercury. Goals of this subproject are to determine net accumulation rates of mercury in lake sediments, qualify advective and diffusive fluxes of mercury from sediments, determine spatial and temporal variations in mercury accumulation and remineralization below the sediment-water interface, and assess the role of complexation and precipitation in controlling the fate of mercury.

APPROACH: The approaches used in this study will be novel, as no previous methods can yield samples without contamination. Methods developed will focus on various near-sediment, sediment, pore-water, and ground-water-sampling techniques.

PROGRESS (July 1994 to June 1995): Sampling of pore waters at small scale (centimeter) and small volume (about 50 ml) were carried out on about a monthly basis for the ice-free season (May-October) and once during ice cover. Samples were analyzed for total mercury and methylmercury content as well as other important ancillary parameters. Results show that the littoral-zone pore waters have some of the highest concentrations of methylmercury anywhere at the study site, and that the sediment/water interface is a primary site for methylmercury production in lake systems.

PLANS (July 1995 to June 1996): Results from this study will be written and published as two journal papers. One paper describing the importance of wetlands in the aquatic mercury cycle is completed and a second paper on methylation processes at the sediment/water interface is being prepared.

REPORTS:

Krabbenhoft, D.P., 1995, Mercury cycling in the Allequash Creek Watershed, northern Wisconsin (approved to publish as a journal article)

WETLAND RETENTION OF SURFACE-WATER NUTRIENT AND SUSPENDED-SEDIMENT LOADS INFLOWING TO A EUTHOPHIC LAKE IN SOUTHEASTERN WISCONSIN, WI 18102

PROBLEM: Jackson Creek is the major inflowing tributary to Delavan Lake in southeastern Wisconsin. An artificial wetland has been constructed on the creek as a means of trapping nutrients and sediments that would otherwise flow to the lake and contribute to its eutrophication. Other studies have shown that the trapping function of wetlands is not consistent and depends on little-known processes and particular conditions of the system. More information about the wetland functions is needed to assess and predict the effectiveness of the Jackson Creek wetland construction as a management strategy.

OBJECTIVE: Assess the effectiveness of the Jackson Creek wetland as a nutrient and sediment-retention system, with emphasis on retention of phosphorus. Quantify nutrient and suspended-sediment loads in surface-water inflows and outflows of the wetland. Characterize effects of water flow through the wetland on variability of these loads. Describe phosphorus cycling processes and dominant phosphorus partitioning reservoirs in the wetland.

APPROACH: Phosphorus partitioning and transformation are investigated in mesocosms–enclosures containing sediments and water from the wetland and set in the wetland environment to simulate natural conditions. Phosphorus partitioning and retention in the mesocosms, and the roles of sediments and vegetation in such processes, are investigated. Additional samples from selected points within the wetland are analyzed for phosphorus and other constituents to provide comparisons between observations in the natural system and in the mesocosms.

PROGRESS (July 1994 to June 1995): Results of the mesocosm experiments, completed in the previous year, were analyzed. Reports in the literature of similar work were studied and compared with the current study. This information was collected and written in a report.

PLANS (July 1995 to June 1996): Review will be completed, revisions made, and report finalized.

REPORTS (planned; subject to change):

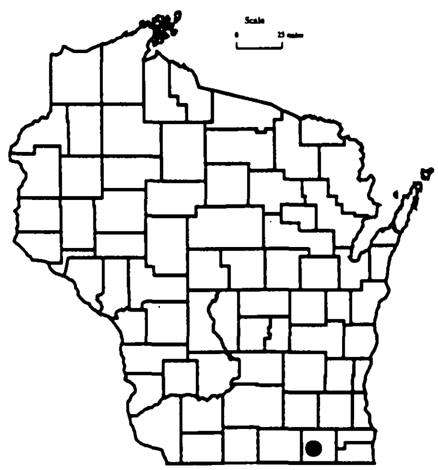
Elder, J.F., and Manion, B.J., Phosphorus retention and partitioning in mesocosms of a constructed wetland in southeastern Wisconsin.

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Delavan Lake and Jackson Creek, southeast Wisconsin

PROJECT CHIEF:
John F. Elder

PERIOD OF PROJECT:
October 1991 to September 1996



LAKE MICHIGAN TRIBUTARY LOADING, WI 183

COOPERATORS:
Environmental Protection Agency
Wisconsin Department of Natural Resources

LOCATION:
Cities of Marinette, Green Bay, Milwaukee and Sheboygan

PROJECT CHIEF:
David W. Hall

PERIOD OF PROJECT:
July 1992 to October 1996

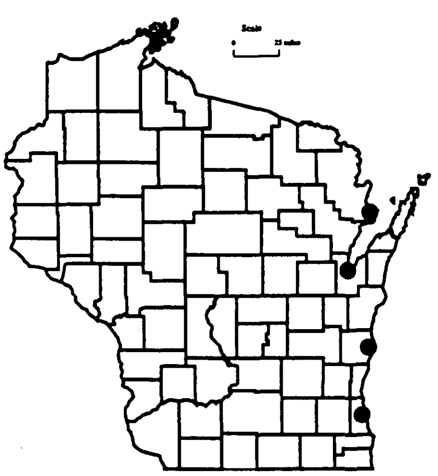
PROBLEM: Concern about the potential negative health and biologic effects of toxic chemicals and heavy metals being transported into Lake Michigan has increased with growing evidence of links between the presence of these contaminants and carcinogens in fish, genetic defects in fish-eating birds, and reproductive disorders in biota. Adequate management of chemical loads requires that the total contribution of contaminants from atmospheric, ground water, and tributary rivers be quantified.

OBJECTIVE: Objectives of this project are to build a streamflow and water-quality data base for 11 Lake Michigan tributaries to act as a baseline for evaluation of future remediation activities; estimate loads of PCB's, transnonachlor, atrazine, trace metals, nutrients, and suspended solids to Lake Michigan; compare loads between tributaries to target basins of major concern; identify contaminants of greatest concern; and describe the mobility of contaminants.

APPROACH: The Wisconsin District will install acoustic-velocity-metering (AVM) stations at the mouths of the Milwaukee, Sheboygan, Fox, and Menominee Rivers to provide real-time flow and water-quality data. Field sampling will be scheduled to obtain approximately 75 percent of the samples during non-baseflow periods. Composited samples for analyses of congener-specific PCB's and pesticides will be field filtered and processed through XAD-2 resin columns. Composited samples for analyses of particulate and dissolved trace metals will be obtained using clean sampling protocols. Data will be entered into the WATSTORE and ADAPS data bases.

PROGRESS (July 1994 to June 1995): The Quality Assurance Project Plan was granted conditional approval by EPA Region V and field sampling began in March 1994. As of May 1995, approximately 375 samples have been collected from 11 tributaries to Lake Michigan for analysis of congener-specific PCB's, 11 pesticides and pesticide-degradation products, trace metals, nutrients, and major ions. Approximately 3,700 samples have been collected and analyzed for total suspended solids. AVM data from the Fox River were successfully calibrated with Doppler measurements to estimate discharge. Preliminary data summaries and analyses are in progress.

PLANS (July 1995 to June 1996): Plans are being made to extend field sampling through September 1995. Preliminary data analyses will continue as data become available from laboratories, and existing estimates of contaminant loading from the tributaries will be updated. A final report outline will be prepared and sent out for review.



TRACE-METAL TRANSPORT TO STREAMS, WI 18301

PROBLEM: Recent investigations on trace-metal concentrations in surface waters have revolutionized scientists' views of the trace-metal cycle in aquatic ecosystems. Ultra-clean methodologies must be employed at all steps of this research, and even then it is difficult to acquire contamination-free samples. Although we now have a better understanding of trace-metal concentrations in the environment, very little is known about how the metals are delivered to the stream and the processes that affect the transport of trace metals once in the stream.

OBJECTIVE: The principal objective is to gain a better understanding of the processes that control trace-metal transport to streams. Under this broad objective, we propose to (1) develop ultra-clean sampling methods for ground water, pore water at the near sediment/water interface, springs, and stream water, and (2) examine the temporal variability of trace-metal concentrations in stream/ground-water ecosystems.

APPROACH: A variety of sampling methods will be employed, all of which adhere to the strict protocols for trace-metal sampling. A site along the North Branch of the Milwaukee River has been chosen as the location for intensive investigations of stream-, ground-, pore- and spring-water concentrations of trace metals (mercury, lead, zinc, copper, cadmium) as well as other chemical ancillary measurements. Stream discharge and ground-water levels will be monitored to relate hydrologic conditions to trace-metal concentrations in each part of the hydrologic system. Sampling will be conducted on about a bimonthly basis.

PROGRESS (July 1994 to June 1995): Samples from the Milwaukee River, ground water, springs, and pore waters have been taken on about a bimonthly basis and analyzed for mercury, copper, and zinc. In addition, a synoptic survey of 10 locations along the first 12 miles of the Milwaukee River basin was conducted to examine potential trace-metal contributing points.

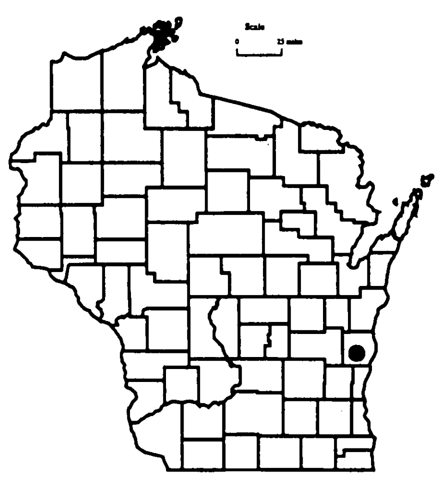
PLANS (July 1995 to June 1996): Results will be presented at professional meetings and written up in two journal papers.

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
North Branch of the Milwaukee River at Cascade, Wisconsin

PROJECT CHIEF:
David Krabbenhoft

PERIOD OF PROJECT:
October 1992 to September 1995



LAKE SUPERIOR TRIBUTARY LOADING, WI 18302

COOPERATORS:

U.S. Environmental Protection Agency
Wisconsin Department of Natural Resources
Minnesota Pollution Control Agency

LOCATION:

Cities of Duluth, Minnesota and Superior, Wisconsin

PROJECT CHIEF:

Peter E. Hughes

PERIOD OF PROJECT:

July 1993 to October 1996

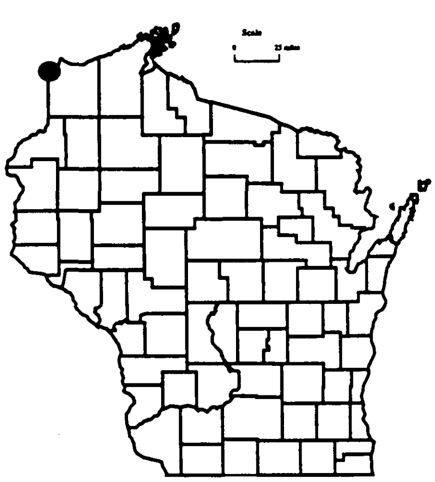
PROBLEM: Concern about the potential negative health and biologic effects of toxic chemicals and heavy metals being transported into Lake Superior has increased with growing evidence of links between the presence of these contaminants and carcinogens in fish, genetic defects in fish-eating birds and reproductive disorders in biota. Adequate management of chemical loads requires that the total contribution of contaminants from atmospheric, ground water, and tributary rivers be quantified.

OBJECTIVE: Objectives of this project are to build a streamflow and water-quality data base for two Lake Superior tributaries to act as a baseline for evaluation of future remediation activities, estimate loads of targeted contaminants to Lake Superior, compare loads between tributaries to target basins of major concern, identify contaminants of greatest concern, and describe the mobility of contaminants.

APPROACH: The Wisconsin and Minnesota Districts will install acoustic-velocity-metering (AVM) stations at the two St. Louis River harbor exits to Lake Superior and instrument the Nemadji River for water-quality sampling. The AVM sites will be calibrated using Doppler discharge measurements. Infiltrex automated organic samplers will be installed to obtain flow-composited samples for organic analyses. Data will be entered into the WATSTORE and ADAPS data bases.

PROGRESS (July 1994 to June 1995): Equipment has been installed and plans established to start water-quality sampling by the end of May 1995. Calibration of the AVM's will continue and storm sampling using automated ISCO suspended-solids samplers will continue.

PLANS (July 1995 to June 1996): Calibration of the AVM's will be completed and the sites operated for water quality and streamflow.



WATER-QUALITY MONITORING OF INDUSTRIAL STORM-WATER RUNOFF, WI 185

PROBLEM: The United States Environmental Protection Agency (USEPA) is requiring industries to monitor storm-water runoff for given chemical constituents. Sampling techniques need to be developed for industries with and without well-defined drainage networks.

OBJECTIVE: Objectives are to (1) compare and evaluate different storm-water sampling schemes, (2) estimate storm-event mean concentrations and annual chemical constituent loads from selected industries using appropriate modeling techniques, (3) design and operate a monitoring program to collect representative storm-water-quality samples, and (4) design and test an electronic impervious source-area sheet-flow sampler.

APPROACH: Paired sampling techniques will be used to determine whether time-composite sampling can be substituted for flow-composite sampling. Furthermore, passive source-area sheet-flow sample results will be used to calculate a loading value which will be compared to the flow-composite loading value. Electronic impervious source-area sheet-flow samplers will be tested to determine whether representative flow-composite samples are taken by the new sampler.

PROGRESS (July 1994 to June 1995): Storm loads and flow data from the first phase of the project has been summarized in a data report. Design and testing of the electronic impervious source-area sheet-flow sampler has been completed at a site in Madison.

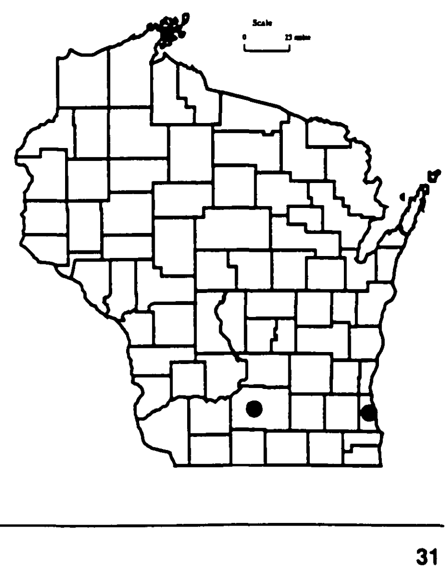
PLANS (July 1995 to June 1996): Results from the electronic impervious source-area sheet-flow sampler tests will be summarized in a data report

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Madison and Milwaukee, Wisconsin

PROJECT CHIEF:
David W. Owens

PERIOD OF PROJECT:
June 1992 to April 1994



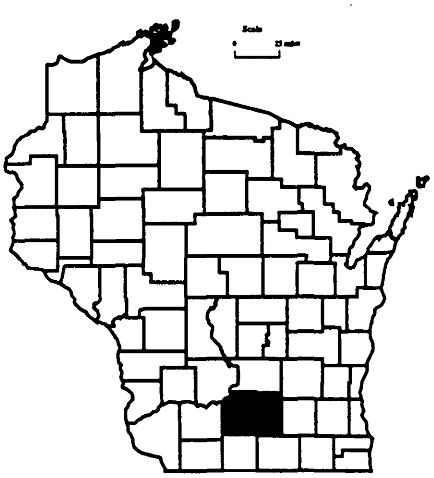
DANE COUNTY REGIONAL HYDROLOGIC STUDY, WI 189

COOPERATORS:
City of Middleton
Dane County Regional Planning Commission
Madison Metropolitan Sewerage District
Wisconsin Department of Natural Resources
Wisconsin Geological and Natural History Survey

LOCATION:
Dane County and parts of surrounding counties

PROJECT CHIEF:
William G. Batten

PERIOD OF PROJECT:
October 1992 to December 1995



PROBLEM: Officials at all levels of government are concerned about the effects of increasing urban growth and development on the surface- and ground-water resources in Dane County. The relationship between surface water and ground water must be understood to allow for increased ground-water withdrawals while protecting the quality and quantity of surface-water resources in the county. A comprehensive study that combines existing water data with new data is needed to provide government and planning agencies with a tool to aid in managing the water resources of the Dane County area.

OBJECTIVE: The objective is to provide a better understanding of the regional ground-water system and the effects of urban development, ground-water withdrawals and inter-basin diversions on Dane County's ground- and surface-water resources.

APPROACH: Existing and new data will be compiled to update potentiometric and water-table surfaces, subsurface geology, and aquifer parameters. New data will be collected in areas critical to understanding ground-water flow and direction. A regional ground-water-flow model will be developed to simulate changes in ground-water levels caused by increased pumpage, to identify critical recharge and discharge areas and to show the direction and rate of ground-water flow. The model will then be used as a management tool to simulate and evaluate the effects of management strategies designed to mitigate adverse effects of increased ground-water withdrawals on the surface- and ground-water systems in the Dane County area.

PROGRESS (July 1994 to June 1995): Boundaries of the ground-water-flow system were identified from a screening model. These boundaries plus all existing and new geologic, hydraulic, and pumpage data were then used to construct a three-dimensional ground-water-flow model to simulate ground-water flow in the Dane County area. Water levels and discharges from the aquifers to streams were simulated using this regional model. These water levels and stream discharges were then compared to historical water-level data and stream flow to calibrate the model.

PLANS (July 1995 to June 1996): The calibrated ground-water-flow model will be used with estimates of future ground-water pumpage rates and locations to simulate the effects these changes may have on water levels in the aquifer and on surface water in Dane County. A report that includes water-table and potentiometric-surface maps, hydrogeologic cross sections, values of aquifer parameters, and a conceptual description of the ground-water-flow system will be published. A second report describing the regional ground-water-flow model design, calibration, and results of model simulations of the flow system will also be published.

EFFECTS OF MICROBIAL ACTIVITY ON SEDIMENT/WATER EXCHANGE OF POLYCHLORINATED BIPHENYL CONGENERS IN THE LOWER FOX RIVER, WISCONSIN, WI 190

PROBLEM: The lower Fox River, the principal tributary of Green Bay and Lake Michigan, flows through a heavily industrialized area. More than 100 contaminants have been identified in the system; among the most significant of these are PCB's. To predict possible toxicological effects and downstream transport of these contaminants, it is important to take into account not only their source concentrations, but also the factors that can affect their partitioning, especially their transfer from bottom sediments (the principal repository) to water (the principal medium of transport). There is a scarcity of this kind of information at present.

OBJECTIVE: Describe the role of microbial activity in controlling sediment/water exchange of PCB congeners and determine the extent to which microbially-mediated exchange is dependent on total PCB concentration and congener composition.

APPROACH: Sediment and water samples from the lower Fox River are used in controlled microcosm experiments in elution columns, applying an experimental design similar to that used in previous work. A specific PCB congener, labeled with carbon-14, is mixed uniformly into a measured quantity of sediment which is used to fill a vertical column that is connected to a precision metering pump. Ambient river water is pumped through the system, and carbon-14 activity is monitored over time in the outflow water. The results include data that can be used to calculate observed distribution coefficient–a measure of partitioning of the PCB congener between sediments and water mobility. The elution column experiments will be tested under different conditions to assess effects of microbial activity and presence or absence of oxygen.

PROGRESS (July 1994 to June 1995): Experiments with sediment core samples from bottom sediment deposits in the lower Fox River were completed. Results were analyzed to determine rates of sediment-water transfer of 2,2'5,5'-tetrachlorobiphenyl and 2,2',4,4',5,5'-hexachlorobiphenyl and how such transfer is affected by presence or absence of oxygen and presence or absence of bacterial action. Report outlines and parts of report drafts were written.

PLANS (July 1995 to September 1995): Report writing, reviews, and revisions will be completed.

REPORTS (planned; subject to change):

Elder, J.F., James, R.V., Godsy, E.M., and Steuer, J.J., Microbial enhancement of PCB congener mobility at the sediment/water interface in the lower Fox River, Wisconsin.

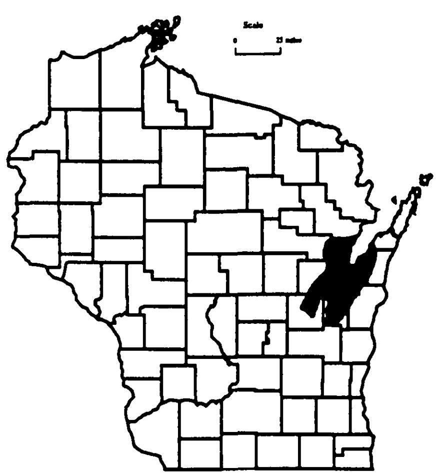
James, R.V., and Elder, J.R., Procedures for elution column experimentation to determine mobility of polychlorinated biphenyls using carbon-14-labeled congeners.

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Northeastern Wisconsin

PROJECT CHIEF:
John F. Elder

PERIOD OF PROJECT:
October 1992 to September 1995



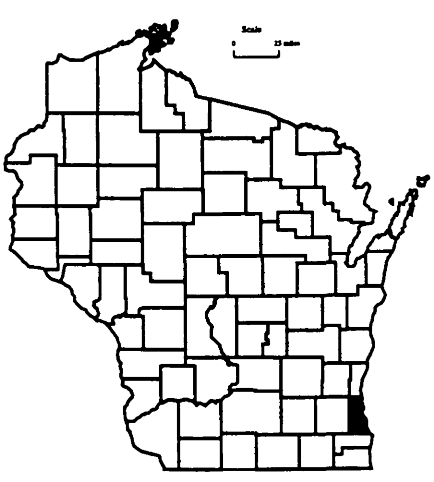
TRANSPORT AND BIOGEOCHEMICAL CYCLING OF PCB'S IN THE MILWAUKEE RIVER–THE IMPORTANCE OF ALGAL DYNAMICS, WI 191

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Milwaukee County, eastern Wisconsin

PROJECT CHIEF:
Jeffrey J. Steuer

PERIOD OF PROJECT:
February 1993 to December 1996



PROBLEM: The Milwaukee Harbor is identified as an area of concern by the International Joint Commission because it is highly contaminated by toxic synthetic organic chemicals and trace metals. A plan is being developed to restore and revive the surface waters of this area, but little is known about the upstream transport of contaminated in-place sediments. Knowledge of the processes that control cycling and transport of polychlorinated biphenyls (PCB's) is essential to the remediation effort. Algal incorporation of PCB's may be a quantitatively important process in this transport.

OBJECTIVE: The objective is to determine the link between algal dynamics and PCB transport by: characterizing total suspended solids (TSS) in the river as biogenic (algal) and detrital components, and determine PCB, organic carbon and lipid concentrations of each fraction; evaluating the link between algal uptake of PCB's and concentration of PCB's in TSS and resuspendable surficial bottom sediments. Milwaukee River PCB loading will be determined at Estabrook Park, Thiensville, and Pioneer Road. PCB loading will also be determined on Cedar Creek, a tributary entering upstream of Pioneer Road. Due to high bottom sediment and fish PCB concentrations, a fourth site has been selected on the South Branch of the Manitowoc River at Hayton.

APPROACH: Monitor the three Milwaukee River sites and one Manitowoc River site for two years during event and base-flow conditions. Automated water-quality samples will be used to obtain daily total suspended solids (TSS) samples; more intensive samples will be obtained on the rising hydrograph limb. Between June 1993 and June 1995, 26 manual organic samples (80 liters) will be collected at the Milwaukee sites and 18 samples will be collected at the Hayton site. Measured water-column characteristics include PCB (dissolved and particulate), TSS, VSS, particulate and dissolved organic carbon, chlorophyll *a*, sand/silt split and chloride.

Water column and bed algae will be seasonally collected and a biomass determined. Dominant algal species will be laboratory cultured and PCB uptake subsequently measured. These data will be used to calculate the algal and detrital PCB fractions.

Seasonal samples will also be collected from the surficial sediment layer at each of the four sites. Total organic carbon, congener-specific PCB, porosity, particle density, bulk density, and chlorophyll *a* will be determined during each of the four seasons.

PROGRESS (June 1994 to July 1995): Seventy-five percent of the field data have been collected. Water-column PCB concentrations on the Milwaukee River range from 3 to 113 ng/L resulting in transported PCB loads of 4 to 260 grams per day. Hayton water-column PCB concentrations range from 44 to 227 ng/L, producing transported PCB loads of 4 to 166 grams per day. The algal identification effort has been completed and laboratory PCB uptake experiments have begun.

PLANS (July 1995 to June 1996): Field data collection and laboratory PCB uptake experiments will be completed. An algal dynamic journal article and a PCB transport data report will be written.

WATER RESOURCES AT WILD ROSE FISH HATCHERY, WAUSHARA COUNTY, WISCONSIN, WI 192

PROBLEM: The Wild Rose State Fish Hatchery is one of the oldest and largest cold-water hatcheries in the State. The water supply for the hatchery consists of scattered springs, seeps, and many small-diameter flowing wells screened in sand and gravel. Combined flow from springs and wells is approximately 3 million gallons per day. Water from these sources requires treatment to remove nitrate. Water is treated at each raceway because of the diffuse nature of the water supply. Water from this supply system is expensive to treat and may be contaminated.

OBJECTIVE: The study will evaluate the ground-water system at the hatchery, provide estimates of the hydraulic properties of the sand and gravel aquifer, and recharge area for water captured by hatchery wells, and predictions of the effects of pumping from several large-diameter wells on spring flow and ground-water levels.

APPROACH: Using wells at the hatchery, slug and aquifer tests will be performed to estimate the hydraulic conductivity of the sand and gravel aquifer. Environmental isotopes will be used to estimate the recharge area for the aquifer. Seismic-refraction data will be collected to determine the thickness of the aquifer. A ground-water-flow model, calibrated to ground-water levels and streamflow measured at the hatchery, will predict the effect of pumping from wells on water levels in the sand and gravel aquifer and the effect on spring flow.

PROGRESS (July 1994 to June 1995): The thickness of the glacial aquifer at the hatchery is approximately 200 feet. Seismic velocities of the bedrock indicate that sedimentary rock below the hatchery is thin or not present. An analytic element model was developed to simulate existing flow conditions of the glacial aquifer in the area. Preliminary results of modeling suggest that flow under or from the Pine River is necessary to maintain the discharge of ground-water from springs at the hatchery. Water samples were collected and analyzed for oxygen and hydrogen isotopes which may help in determining the source and age of water flowing to wells at the hatchery.

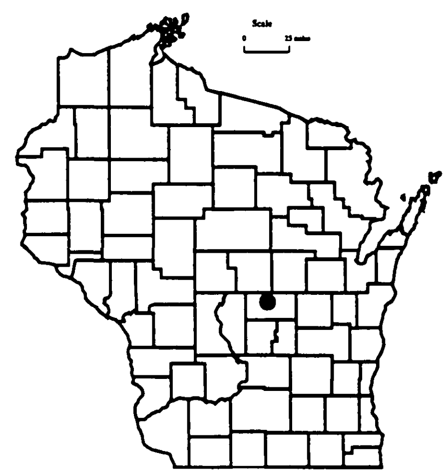
PLANS (July 1995 to June 1996): An aquifer test will be performed to better determine the aquifer properties at the hatchery and the model will be revised, if necessary. The effect of future pumping at the hatchery will be evaluated using distance- and time-drawdown curves and modeling. Results of the study will be published in a report.

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
2 miles north of Wild Rose, Waushara County, Wisconsin

PROJECT CHIEF:
Terrence Conlon

PERIOD OF PROJECT:
June 1993 to September 1996



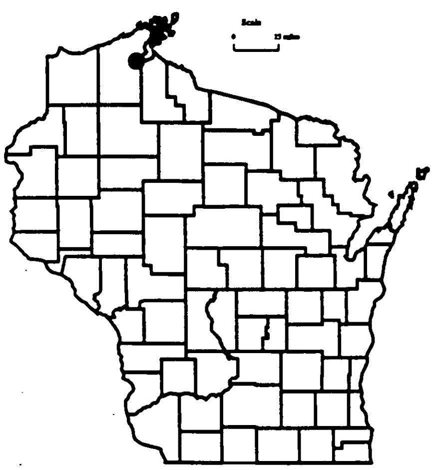
NORTH FISH CREEK SEDIMENT, WI 193

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
East-central Bayfield County near Ashland, Wisconsin

PROJECT CHIEF:
Faith Fitzpatrick

PERIOD OF PROJECT:
June 1994 to September 1996



PROBLEM: North Fish Creek has been identified as having an excessive sediment load that is causing major sedimentation problems in its lower reaches and in Chequamegon Bay. The sediment may be limiting spawning habitat for steelhead, coho salmon, and trout, and also may be impacting important wetland aquatic habitat in the coastal wetland located at the mouth of Fish Creek.

OBJECTIVES: The objectives are to (1) identify sedimentation rates in the floodplain and channel prior to European settlement, (2) identify variations in historical sedimentation rates, (3) identify extrinsic and intrinsic factors leading to destabilization of the fluvial system, and (4) identify the effects of variations in storm runoff on channel hydraulic processes of sediment erosion, transport, and deposition.

APPROACH: Cores of channel, floodplain, and back-water sediment will be examined and dated using indirect and radiometric techniques. Channel geometry of relict cutoff meanders will be compared to channel geometry of the active channel along several reaches of the stream characterized by erosional, transitional, and depositional processes. Historical records such as Government Land Office Surveys, bridge designs, maps, aerial photographs, and field notes will be used to supplement field data. Rates of bluff retreat will be quantified using aerial photographs from 1938, 1950, and 1990.

PROGRESS (July 1994 to June 1995): Approximately 100 cores in the floodplain and 20 stream-bank exposures were examined. Surveying of channel geometry of active and relict channels has begun. Supplemental data from historical records have been collected. A gaging station at Moquah, Wisconsin, was reactivated in October 1994. Preliminary analysis of the data suggests that (1) a pre-European settlement surface can be identified in floodplain deposits, (2) sedimentation is episodic and occurs almost exclusively during large floods, (3) episodic sedimentation in the lower reach of North Fish Creek occurred prior to European settlement but increased after European settlement, and (4) both the texture of the sediment and the rate of historical sedimentation has changed since the area was first settled by Europeans.

PLANS (July 1995 to June 1996): Obtain sediment cores from Chequamegon Slough and relict channels. Complete surveys of channel geometry of active and relict channels. Submit sediment samples for dating and particle-size analysis. Calculate amount of bluff retreat. Begin analysis of relation between runoff and channel hydraulic processes.

REPORTS:

Fitzpatrick, F.A., and Knox, J.C., Effects of variations in vegetation, climate, and isostatic rebound on hydrology and sedimentation of North Fish Creek, Bayfield County, Wis. (in preparation).

Completed Projects

The following is a list of completed projects with reports that are in various stages of preparation.

WI093	Ground-water flow and quality in Wisconsin's shallow aquifer system
	Geology, ground-water flow, and dissolved-solids concentrations along hydrogeologic sections through Wisconsin's aquifers
WI15401	Transient hydrogeological controls on the chemistry of a seepage lake
WI1167	Mobility of 2,2'5,5' tetrachlorobiphenyl in model systems containing bottom sediments and water from an industrialized river basin in northeastern Wisconsin
WI169	Types and concentrations of contaminants measured in Wisconsin storm sewers and urban streams
WI171	Application of habitat-suitability index models to assess effects of fine-grained sediment on brook trout and brown trout habitat
WI17211	A method for analyzing the effects of storm-water discharge on contaminant concentrations in urban streams
WI17304	Development of a hydrologic budget model to simulate Devils Lake stage, Sauk County, WI (JA)
	Simulation of stage and the hydrologic budget of Devils Lake, Sauk County, WI (OFR)
WI178	Hydrogeology of southwestern Sheboygan County, Wisconsin, in the vicinity of the Kettle Moraine Springs fish hatchery

APPENDIX A

STREAM-GAGING STATIONS PROPOSED FOR 1996 FISCAL YEAR

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Statewide

PROJECT CHIEF:
Barry K. Holmstrom

PERIOD OF PROJECT:
July 1913-Continuing

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 1994 to June 1995): Thirty-three continuous-record gaging stations were operated in cooperation with the Wisconsin Department of Natural Resources (WDNR) during the 1995 fiscal year. Data were analyzed and published for 11 stations that were partially funded by the U.S. Army Corps of Engineers and one by a FERC licensee. Partial-record data were collected and published at seven stations. 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 1994 water year were published in the annual report, "Water Resources Data–Wisconsin, water year 1994, volume 1, St. Lawrence River Basin and volume 2, Upper Mississippi River Basin."

PLANS (July 1995 to June 1996): Streamflow records for the 1995 water year will be computed and published in the annual report, "Water Resources Data–Wisconsin, water year 1995." Continuous streamflow data will be collected at 13 gaging stations. Partial records will be collected and published at an additional six stations. Stage and precipitation data will be collected at one lake station. Requests for streamflow information will be answered.

PROPOSED PROGRAM FOR THE PERIOD 7/1/95-6/30/96

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
04066003	2/ Menominee River near Pembine	1950
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	3/ Wisconsin River near Lake Tomahawk	1936
05393500	3/ Spirit River at Spirit Falls	1942
05395000	3/ Wisconsin River at Merrill	1903
05398000	3/ Wisconsin River at Rothschild	1945
05399500	3/ Big Eau Pleine River near Stratford	1914
05400760	3/ Wisconsin River at Wisconsin Rapids	1914
05402000	3/ Yellow River at Babcock	1944

1/ WDNR cooperates with Northern States Power Co.
2/ WDNR cooperates with Wisconsin Electric Power Co.
3/ WDNR cooperates with Wisconsin Valley Improvement Co.

Wisconsin Electric Power Company funds one station at a cost of $4,250. Complete records are collected at six stations and partial records at one station for the Wisconsin Valley Improvement Company (WVIC); total cost of the WVIC program is $27,625.

Partial records are collected at some of the Northern States Power Company stations and total cost of Northern States Power Company program is $32,800.

CONTINUOUS-RECORD MONITORING–RIVERS

The following stations have been operated in the past as part of the USGS/WDNR cooperative program. Due to budget constraints by the WDNR, the operation will have to be reduced. All 20 stations will be operated at a reduced level for the period July 1, 1995 to September 30, 1995. For the period October 1, 1995 to June 30, 1996, only nine stations will be operated as part of the USGS/WDNR agreement. If funding arrangements can be made with other cooperators, it would be desirable to operate all 20 stations. Which nine stations will be funded by the USGS/WDNR agreement hasn't been determined and is dependent upon pending arrangements with other cooperators.

04071858	Pensaukee River near Pensaukee	1973
04078500	Embarrass River near Embarrass	1919
04084500	Fox River at Rapide Croche Dam near Wrightstown	1896
04085200	Kewaunee River near Kewaunee	1964
04085281	East Twin River at Mishicot	1972
04085427	Manitowoc River at Manitowoc	1972
04086000	Sheboygan River at Sheboygan	1951
05333500	St. Croix River near Danbury	1914
05362000	Jump River at Sheldon	1915
05381000	Black River at Neillsville	1914
05394500	Prairie River near Merrill	1914

05397500	Eau Claire River at Kelly	1914
05404000	Wisconsin River at Wisconsin Dells	1935
05406500	Black Earth Creek at Black Earth	1954
05408000	Kickapoo River at LaFarge	1939
05427570	Rock River at Indianford	1975
05429500	Yahara River near McFarland	1930
05430500	Rock River at Afton	1914
05431486	Turtle Creek near Clinton	1939
05436500	Sugar River near Brodhead	1914
	Cost of 9 stations x $4,250 each	$38,250

CEDAR CREEK NEAR CEDARBURG

04086500	Cedar Creek near Cedarburg	4,250

DEVIL'S LAKE NEAR BARABOO

05404500	Devil's Lake near Baraboo (stage-precipitation data)	1,900

OCONTO RIVER - TELEMARK

04071000	Oconto River near Gillett (WDNR cooperates with Scott Paper Co.)	570
	TOTAL	$44,970

ANALYZE AND PUBLISH DATA FOR STATIONS PARTIALLY FUNDED BY U.S. ARMY CORPS OF ENGINEERS

The following stations have been partially funded in the past as part of the USGS/WDNR cooperative program. Due to budget constraints by the WDNR, the number will have to be reduced. For the period July 1, 1995 to June 30, 1996, only seven stations will be continued as part of the USGS/WDNR agreement. If funding arrangements can be made with other cooperators, it would be desirable to continue all 11 stations. Which seven stations will be funded by the USGS/DNR agreement hasn't been determined and is dependent upon pending arrangements with other cooperators.

		Record began (water year)
04073500	Fox River at Berlin	1898
04079000	Wolf River at New London	1896
05369500	Chippewa River at Durand	1928
05379500	Trempealeau River at Dodge	1914
05382000	Black River at Galesville	1932
05407000	Wisconsin River at Muscoda	1914
05410500	Kickapoo River at Steuben	1933
05413500	Grant River at Burton	1935
05414000	Platte River near Rockville	1935
05425500	Rock River at Watertown	1931
05426000	Crawfish River at Milford	1931
	Total 7 stations	$7,500

APPENDIX B
SUMMARY OF REQUESTS RECEIVED FROM THE WISCONSIN DNR IN 1994 FISCAL YEAR FOR LOW-FLOW INFORMATION, WI 035

COOPERATOR:
Wisconsin Department of Natural Resources

LOCATION:
Statewide

PROJECT CHIEF:
Barry K. Holmstrom

PERIOD OF PROJECT:
April 1972-Continuing

PROBLEM: Water-quality standards have been adopted for all surface waters of the State. To implement these standards, the Wisconsin Department of Natural Resources (WDNR) has to evaluate the sewage effluent from all waste sources in relation to the low-flow characteristics of the receiving stream. Water-quality standards in Wisconsin are based on a number of streamflow characteristics. These include the annual minimum 7-day consecutive mean flow that occurs on the average of once every 2 years ($Q_{7,2}$) and once every 10 years ($Q_{7,10}$), the annual minimum 30-day consecutive mean flow that occurs on the average of once every 5 years ($Q_{30,5}$), $Q_{7,10}$ values for selected months ($Q_{7,10}$-month), 10-year low mean monthly flows for October, November, April, and May, and the mean annual discharge.

OBJECTIVE: The purpose of this study is to determine the following streamflow characteristics:

1. $Q_{7,10}$ for receiving streams at sewage-treatment plants and industrial plants discharging wastes.
2. $Q_{7,2}$ for selected streams.
3. The 10-year low mean monthly flows for October (Oct. MMQ_{10}), November (Nov. MMQ_{10}), April (Apr. MMQ_{10}), and May (May MMQ_{10}) for sites at fill-and-draw wastewater-treatment lagoons or waste-stabilization ponds.
4. $Q_{30,5}$ for selected streams.
5. The mean annual discharge (MAQ) for selected streams.
6. $Q_{7,10}$ for selected months for selected streams.

APPROACH: Low-flow characteristics of selected streams will be determined by drainage-area/discharge relations, graphical-regression methods, regression equations, Log-Pearson Type III frequency analysis, and other statistical and graphical methods.

PROGRESS (July 1994 to June 1995): Low-flow estimates were determined for 65 sites in response to requests for information from the WDNR from March 9, 1994 through February 23, 1995, and are tabulated in the following list.

PLANS (July 1995 to June 1996): Low-flow characteristics for approximately 50 sites will be determined in response to WDNR requests for information. The low-flow characteristics, in most instances, will be determined by drainage-area/discharge relations or by regression equations. Biological design flows and other flow characteristics may be determined.

REQUESTS FOR INFORMATION
(March 1994 through February 1995)

Stream	Drainage Area (mi^2)	Estimate of Streamflow Characteristics	Method	Date of Request
South Br Oconto R at confluence with Dalton Cr	24.0	$Q_{7,2}$ = 8.2 to 13 ft^3/s, 10 ft^3/s (mean); $Q_{7,10}$ = 5.4 to 10 ft^3/s, 7.3 ft^3/s (mean); $Q_{30,5}$ = 7.3 to 12 ft^3/s, 9.5 ft^3/s (mean); MAQ = 20 to 30 ft^3/s, 24 ft^3/s (mean)	Cfsm, AvsQ, reg eqn	3-9-94
Dalton Cr - fish hatchery	10.6	$Q_{7,2}$ = 2.8ft^3/s; $Q_{7,10}$ = 1.4 ft^3/s; $Q_{30,5}$ = 2.2 ft^3/s; MAQ = 6.7 to 18 ft^3/s, 9.1 ft^3/s (mean)	Cfsm, graph reg, AvsQ	3-9-94
Sheboygan R - Sheboygan Falls	306	$Q_{7,10}$(Dec-Feb) = 15 to 18 ft^3/s, 16 ft^3/s (mean); $Q_{7,10}$(Mar-May) = 31 ft^3/s; $Q_{7,10}$(June-Aug) = 11 to 15 ft^3/s, 14 ft^3/s (mean) $Q_{7,10}$(Sep-Nov) = 13 to 15 ft^3/s, 14 ft^3/s (mean)	Cfsm, AvsQ, LvsQ	3-16-94
Spring Cr - Springfield	1.87	$Q_{7,10}$ = 0.00 to 0.11 ft^3/s, 0.02 ft^3/s (mean)	Cfsm, AvsQ, reg eqn	3-17-94
Somo R - mouth	139	$Q_{7,10}$ = 2.9 to 4.5 ft^3/s, 3.6 ft^3/s (mean)	Cfsm, AvsQ	3-25-94
Little Pine Cr - mouth	35.0	$Q_{7,10}$ = 3.8 to 5.5 ft^3/s, 5.0 ft^3/s (mean), 5.5 ft^3/s (best estimate)	Cfsm, AvsQ	3-25-94
Wisconsin R - Spring Green	9,780	$Q_{7,10}$ = 2,200 to 2,600 ft^3/s, 2,400 ft^3/s (mean)	Cfsm, AvsQ	3-28-94
Koshkonong Cr - Deerfield	74.0	$Q_{7,10}$ = 3.4 ft^3/s	Cfsm, AvsQ	4-6-94
Blue R trib - Montfort	0.58	$Q_{7,10}$ (Dec-Feb) = 0.14 ft^3/s; $Q_{7,10}$(Mar-May) = 0.20 ft^3/s; $Q_{7,10}$(June-Aug) = 0.15 ft^3/s; $Q_{7,10}$(Sep-Nov) = 0.17 ft^3/s	Graph reg	4-8-94
Schoolhouse Cr - Fairchild	11.4	$Q_{7,10}$(Jan) = 1.5 ft^3/s; $Q_{7,10}$(Feb) = 1.7 ft^3/s; $Q_{7,10}$(Mar) = 2.4 ft^3/s; $Q_{7,10}$(Apr) = 3.8 ft^3/s; $Q_{7,10}$(May) = 2.7 ft^3/s; $Q_{7,10}$(June) = 2.4 ft^3/s; $Q_{7,10}$(July) = 2.0 ft^3/s; $Q_{7,10}$(Aug) = 1.8 ft^3/s; $Q_{7,10}$(Sep) = 2.0 ft^3/s; $Q_{7,10}$(Oct) = 2.1 ft^3/s; $Q_{7,10}$(Nov) = 2.3 ft^3/s; $Q_{7,10}$(Dec) = 1.8 ft^3/s	Graph reg, Cfsm	4-26-94
Wolf R - upstream from Swamp Cr	118	$Q_{7,2}$ = 6.9 to 32 ft^3/s, 22 ft^3/s (mean) ; $Q_{7,10}$ = 4.4 to 26 ft^3/s, 17 ft^3/s (mean); $Q_{30,5}$ = 6.3 to 27 ft^3/s, 20 ft^3/s (mean); MAQ = 96 to 120 ft^3/s, 110 ft^3/s (mean)	Cfsm, AvsQ, reg eqn	4-26-94
Swamp Cr - upstream from Hemlock Cr	16.2	$Q_{7,2}$ = 1.0 to 3.7 ft^3/s, 2.4 ft^3/s (mean)' $Q_{7,10}$ = 0.5 to 2.5 ft^3/s, 1.5 ft^3/s (mean); $Q_{30,5}$ = 1.9 to 3.1 ft^3/s, 2.0 ft^3/s (mean); MAQ = 12 ft^3/s	Cfsm, AvsQ, reg eqn, LvsQ	4-26-94
Hemlock Cr - mouth	6.96	$Q_{7,2}$ = 2.6 to 6.4 ft^3/s, 4.5 ft^3/s (mean); $Q_{7,10}$ = 1.9 to 4.9 ft^3/s, 3.3 ft^3/s (mean); $Q_{30,5}$ = 2.4 to 6.2 ft^3/s, 4.3 ft^3/s (mean); MAQ = 5.2 ft^3/s	Cfsm, AvsQ, reg eqn	4-26-94
Swamp Cr - NW1/4Sec 32, T3SN, R12E	57.5	$Q_{7,2}$ = 25 ft^3/s; $Q_{7,10}$ = 19 ft^3/s; $Q_{30,5}$ = 24 ft^3/s; MAQ = 47 ft^3/s	Cfsm, AvsQ, reg eqn	4-26-94
Swamp Cr - mouth	77.3	$Q_{7,2}$ = 28 ft^3/s; $Q_{7,10}$ = 21 ft^3/s; $Q_{30,5}$ = 27 ft^3/s; MAQ = 62 ft^3/s	Cfsm, AvsQ, reg eqn, LvsQ	4-26-94
Blue R - Montfort	19.4	$Q_{7,10}$(Dec-Feb) = 2.1 to 7.1 ft^3/s, 4.0 ft^3/s (mean); $Q_{7,10}$(Mar-May) = 2.9 to 7.8 ft^3/s, 4.9 ft^3/s (mean); $Q_{7,10}$(June-Aug) = 2.3 to 7.1 ft^3/s, 4.1 ft^3/s (mean); $Q_{7,10}$(Sep-Nov) = 2.5 to 7.6 ft^3/s, 4.5 ft^3/s (mean)	Cfsm, AvsQ	4-27-94
Pecatonica R - South Wayne	521	$Q_{7,10}$ = 59 to 113 ft^3/s, 72 ft^3/s (mean)	Cfsm, AvsQ	4-29-94
Pheasant Br - Middleton	6.51	$Q_{7,2}$ = 0.42 ft^3/s, $Q_{7,10}$ = 0.22 ft^3/s; $Q_{30,5}$ = 0.35 ft^3/s; MAQ = 1.0 to 1.6 ft^3/s, 1.2 ft^3/s (mean)	Log Pearson Type III Frequency Analyses on extended record, Cfsm, AvsQ	5-9-94

REQUESTS FOR INFORMATION
(March 1994 through February 1995)

Stream	Drainage Area (mi^2)	Estimate of Streamflow Characteristics	Method	Date of Request
Black Earth Cr - partial record site 1	3.32	$Q_{7,2}$ = 0.46 ft^3/s; $Q_{7,10}$ = 0.26 ft^3/s; $Q_{30,5}$ = 0.36 ft^3/s; MAQ = 1.4 to 2.6 ft^3/s, 2.2 ft^3/s (mean), 1.4 to 2.2 ft^3/s (best estimate)	Cfsm, AvsQ, graph reg	5-16-94
Black Earth Cr - low-flow site 3	9.53	$Q_{7,2}$ = 0.58 ft^3/s; $Q_{7,10}$ = 0.32 ft^3/s; $Q_{30,5}$ = 0.48 ft^3/s; MAQ = 1.6 to 7.4 ft^3/s, 5.2 ft^3/s (mean), 1.6 to 5.2 ft^3/s (best estimate)	Cfsm, AvsQ, graph reg	5-16-94
Badfish Cr - County Trunk A	40.9	$Q_{7,10}$ = 53 ft^3/s (includes effluent); $Q_{7,10}$ = 5.7 ft^3/s (without effluent)	Cfsm, graph reg	5-19-94
Wausaukee R - Athelstane	19.5	$Q_{7,10}$ = 2.7 to 4.4 ft^3/s, 3.4 ft^3/s (mean)	Cfsm, AvsQ, reg eqn	5-27-94
Huebler Cr - Athelstane	1.16	$Q_{7,10}$ = 0.06 to 0.25 ft^3/s, 0.15 ft^3/s (mean)	Cfsm, AvsQ, reg eqn	5-27-94
Coldwater Br - Athelstane	3.80	$Q_{7,10}$ = 0.31 to 0.86 ft^3/s, 0.56 ft^3/s (mean)	Cfsm, AvsQ$_{7,10}$, reg eqn	5-27-94
Pike R - Amberg	255	$Q_{7,10}$ = 72 ft^3/s	Log Pearson Type III Frequency Analyses	5-27-94
K.C. Cr - Amberg	5.55	$Q_{7,10}$ = 0.44 to 0.95 ft^3/s, 0.72 ft^3/s (mean), 0.72 to 0.95 ft^3/s (best estimate)	Cfsm, AvsQ, reg eqn	5-27-94
Little Silver Cr - Pembine	2.33	$Q_{7,10}$ = 0.09 to 0.40 ft^3/s, 0.20 ft^3/s (mean)	Cfsm, AvsQ, reg eqn	5-27-94
South Br Miscanno Cr - Beecher	7.59	$Q_{7,10}$ = 0.78 to 1.3 ft^3/s, 1.1 ft^3/s (mean)	Cfsm, AvsQ, reg eqn	5-27-94
Fishers Cr - Goodman	2.39	$Q_{7,10}$ = 0.17 to 0.33 ft^3/s, 0.23 ft^3/s (mean)	Cfsm, AvsQ, reg eqn	5-27-94
Rock R - Beloit	3,460	$Q_{7,10}$(Dec-Feb) = 390 ft^3/s; $Q_{7,10}$(Mar-May) = 570 ft^3/s; $Q_{7,10}$(June-Aug) = 260 ft^3/s; $Q_{7,10}$(Sep-Nov) = 250 ft^3/s	Cfsm	6-13-94
Branch R trib - Whitelaw	11.2	$Q_{7,2}$ = 0 to 0.57 ft^3/s, 0.20 ft^3/s (mean); $Q_{7,10}$ = 0 to 0.34 ft^3/s, 0.09 ft^3/s (mean); $Q_{30,5}$ = 0 to 0.47 ft^3/s, 0.12 ft^3/s (mean); MAQ = 5.1 ft^3/s	Cfsm, AvsQ, reg eqn	6-15-94
Brown Deer Park Cr - Glendale	0.40	$Q_{7,10}$ = 0 to 0.01 ft^3/s, <0.01 ft^3/s (mean)	Cfsm, AvsQ	6-22-94
Fox R - Waukesha	126	$Q_{7,2}$ = 19 ft^3/s; $Q_{7,10}$ = 8.0 ft^3/s; $Q_{30,5}$ = 13 ft^3/s; $Q_{7,10}$(Jan) = 10 ft^3/s; $Q_{7,10}$(Feb) = 13 ft^3/s; $Q_{7,10}$(Mar) = 23 ft^3/s; $Q_{7,10}$(Apr) = 58 ft^3/s; $Q_{7,10}$(May) = 28 ft^3/s; $Q_{7,10}$(June) = 21 ft^3/s; $Q_{7,10}$(July) = 12 ft^3/s; $Q_{7,10}$(Aug) = 12 ft^3/s; $Q_{7,10}$(Sep) = 9.9 ft^3/s; $Q_{7,10}$(Oct) = 11 ft^3/s; $Q_{7,10}$(Nov) = 15 ft^3/s; $Q_{7,10}$(Dec) = 12 ft^3/s	Log Pearson Type III Frequency Analyses	6-22-94
Pine Cr Valley - Pine Cr	4.19	$Q_{7,10}$ = 0.8 ft^3/s	Cfsm, AvsQ, reg eqn	7-5-94
Badger Mill Cr - Verona	14.9	MAQ = 0.6 to 4.7 ft^3/s, 2.6 ft^3/s (mean)	Cfsm, AvsQ	7-25-94
Pine Cr - Richland Center	190	$Q_{7,2}$ = 82 ft^3/s, $Q_{7,10}$ = 66 ft^3/s, $Q_{30,5}$ = 78 ft^3/s	Graph reg	8-1-94
Spring Cr - Brillion	5.17	$Q_{7,10}$ = 0 to 0.09 ft^3/s, 0.01 ft^3/s (mean); MAQ = 1.8 to 2.7 ft^3/s, 2.2 ft^3/s (mean)	Cfsm, AvsQ	8-2-94
Spring Cr trib - Brillion	1.02	$Q_{7,10}$ = 0 to 0.02 ft^3/s, <0.01 ft^3/s (mean); MAQ = 0.32 to 0.53 ft^3/s, 0.4 ft^3/s (mean)	Cfsm, AvsQ	8-2-94
South Fk Thunder R - Thunder R Fish Hatchery	21.0	$Q_{7,10}$ = 5.8 ft^3/s	Graph reg	10-5-94
Fox R - Rochester	447	$Q_{30,5}$ = 39 to 57 ft^3/s, 47 ft^3/s (mean); MAQ = 290 to 370 ft^3/s, 300 ft^3/s (best estimate)	Graph reg, Cfsm, AvsQ	10-5-94

REQUESTS FOR INFORMATION
(March 1994 through February 1995)

Stream	Drainage Area (mi^2)	Estimate of Streamflow Characteristics	Method	Date of Request
Poplar R - Poplar	27.5	$Q_{7,10}$ = 0.08 to 0.37 ft^3/s, 0.16 ft^3/s (mean); $Q_{30,5}$ = 0.27 to 0.49 ft^3/s, 0.40 ft^3/s (mean); MAQ = 21 to 37 ft^3/s, 27 ft^3/s (mean)	Cfsm, AvsQ, reg eqn	10-5-94
Trib to Honey Cr trib - Plain	4.20	$Q_{7,2}$ = 0.35 to 0.98 ft^3/s, 0.48 ft^3/s (mean); $Q_{7,10}$ = 0.23 to 0.73 ft^3/s, 0.33 ft^3/s (mean); $Q_{30,5}$ = 0.32 to 0.88 ft^3/s, 0.43 ft^3/s (mean); MAQ = 2.1 ft^3/s	Cfsm, AvsQ, reg eqn	10-5-94
Branch R - Cato	78.8	$Q_{50\%}$ flow duration = 14 ft^3/s	Graph reg	10-11-94
South Fk Lemonweir R - Tomah	48.9	$Q_{7,10}$ = 4.0 to 9.4 ft^3/s, 5.1 ft^3/s (mean), 4.2 to 5.2 ft^3/s (best estimate)	Cfsm, AvsQ, reg eqn	10-13-94
Milwaukee R - North Avenue Dam - Milwaukee	702	$Q_{7,10}$(Dec-Feb) = 46 ft^3/s; $Q_{7,10}$(Mar-May) = 94 ft^3/s; $Q_{7,10}$(June-Aug) = 30 ft^3/s; $Q_{7,10}$ (Sep-Nov) = 38 ft^3/s	Cfsm	10-21-94
Genesee Cr - Saylesville Mill Pond	27.9	$Q_{7,10}$ = 1.5 to 4.3 ft^3/s, 3.4 ft^3/s (mean)	Cfsm, reg eqn	10-25-94
Lyndon Cr - Lyndon Station	6.93	$Q_{7,10}$ = 0.93 ft^3/s, MAQ = 3.1 ft^3/s	Cfsm, AvsQ	10-31-94
Garners Cr - Kimberly	--	$Q_{7,10}$ = 0 ft^3/s	Cfsm	11-3-94
South Br Peshtigo R - Crandon	2.27	$Q_{7,10}$ = 0.04 to 0.48 ft^3/s, 0.25 ft^3/s (mean)	Cfsm, AvsQ, reg eqn	11-18-94
White R - Wautoma	69.6	$Q_{7,10}$ = 34 to 65 ft^3/s, 51 ft^3/s (mean)	Cfsm, AvsQ, reg eqn, graph reg	12-9-94
Sheboygan R - Johnsonville	194	$Q_{7,10}$ = 1.1 to 8.4 ft^3/s, 2.8 ft^3/s (mean); $Q_{30,5}$ = 2.0 to 13 ft^3/s, 5.5 ft^3/s (mean); $Q_{7,10}$(Dec-Feb) = 1.5 to 11 ft^3/s, 4.2 ft^3/s (mean); $Q_{7,10}$(Mar-May) = 3.4 to 20 ft^3/s, 9.0 ft^3/s (mean); $Q_{7,10}$(June-Aug) = 1.3 to 9.7 ft^3/s, 3.3 ft^3/s (mean); $Q_{7,10}$(Sep-Nov) = 1.3 to 9.7 ft^3/s, 3.3 ft^3/s (mean) MAQ = 120 ft^3/s	Cfsm, AVsQ, LvsQ, reg eqn	12-13-94
Lake Michigan trib - mouth - Crestview	3.38	$Q_{7,10}$ = 0 to 0.10 ft^3/s, MAQ = 2.4 to 3.8 ft^3/s, 3.3 ft^3/s (mean)	Cfsm, AvsQ	12-16-94
Fox R - Wheatland	816	$Q_{7,10}$ = 60 ft^3/s	Cfsm	1-9-95
Menomonee R - 70th Street - Wauwatosa	123	$Q_{7,2}$ = 13 ft^3/s; $Q_{7,10}$ = 5.9 ft^3/s; $Q_{30,5}$ = 11 ft^3/s; MAQ = 102 ft^3/s	Log Pearson Type III Frequency Analyses	1-24-95
Humphrey Cr - Wild Rose	27.1	$Q_{7,10}$(May) = 9.6 ft^3/s	Graph reg	1-24-95
Fox River trib - Burlington	0.63	Drainage area = 0.63 mi^2	Topographic map	1-24-95
Hunting R - USH 45 & STH 47	10.7	$Q_{7,10}$ = 3.3 ft^3/s	Graph reg	1-25-95
Hunting R - Fitzgerald Dam Rd	26.1	$Q_{7,10}$ = 8.0 to 26 ft^3/s, 22 ft^3/s (mean)	Cfsm, AvsQ, reg eqn	1-25-95
Sucker Cr - Sucker Rd	4.87	$Q_{7,10}$ = 0.06 to 0.52 ft^3/s, 0.08 ft^3/s (mean)	Cfsm, AvsQ	1-25-95
Brewery Cr - Mineral Point	6.74	$Q_{7,10}$ = 0.72 ft^3/s	Graph reg	1-25-95
Menomonee R - NW1/4 Sec36, T7N, R21E	134	$Q_{7,2}$ = 15 ft^3/s, $Q_{7,10}$ = 6.8 ft^3/s, $Q_{30,5}$ = 13 ft^3/s, MAQ = 114 ft^3/s	Graph reg	1-26-95
Dodge Br - Dodgeville	2.36	$Q_{7,10}$ = 0.02 to 0.51 ft^3/s, 0.26 ft^3/s (mean)	Cfsm, AvsQ, reg eqn	2-14-95

REQUESTS FOR INFORMATION
(March 1994 through February 1995)

Stream	Drainage Area (mi^2)	Estimate of Streamflow Characteristics	Method	Date of Request
Muskego Cr - at outlet from Wind Lake	39.6	$Q_{7,10}$ = 0 ft^3/s	Numerous no flows observed	2-17-95
Bog Brook - Freeman	10.8	$Q_{7,10}$ = 2.4 to 5.8 ft^3/s, mean = 4.0 ft^3/s; was based on similar-type streams in surrounding area. There have been observations of no flow downstream from Bog Cr Dam; $Q_{7,10}$ would be 0 ft^3/s if based on evapotranspiration of impoundment and minimal releases to maintain pond level	Cfsm, AvsQ, reg eqn	2-23-95

A brief description of methods used to determine the streamflow-characteristic values in the tables and abbreviations are as follows:

a. Regression equations (reg eqn)–The regression equations were developed to estimate $Q_{7,2}$ and $Q_{7,10}$ values for 10 of the 12 major basins in Wisconsin.

b. Cfsm analysis–The estimates were obtained by using the ratio (streamflow characteristic/drainage area) of stations in the same or adjacent basins where the streamflow characteristics have been determined and multiplying this ratio by the drainage area for the site of interest.

c. Graphical regression analysis (graph reg)–This method used three or more base-flow discharge measurements at site of interest that were plotted against concurrent discharges at continuous-record gaging stations in the area. The streamflow-characteristic value at the gaging station was transferred through this relation line to determine the streamflow characteristic at the site of interest.

d. Drainage area versus discharge analysis (AvsQ)–Previously determined streamflow-characteristic values for gaging stations, low-flow partial-record stations, and miscellaneous stations in the basin and adjacent basins were plotted with their drainage areas on log log paper. Straight-line relationships were drawn through the data points. The drainage areas at sites of interest were transferred through these relation lines to obtain the streamflow-characteristic estimates. When discharge measurements were available at sites of interest, a log offset analysis was also done.

e. Log Pearson Type III frequency analysis at gaging stations–This method uses the Log Pearson Type III frequency analysis to determine the low- flow characteristic values at gaging stations.

APPENDIX C

FUNDING SUMMARY PROPOSED FOR GENERAL COOPERATIVE PROGRAM WITH WISCONSIN DEPARTMENT OF NATURAL RESOURCES 1996 FISCAL YEAR

	Actual 94-95 DNR Share	Proposed 95-96 DNR Share	Total	Remarks
Streamflow for Hydropower Data (WI 00-001) Holmstrom/Dumke, Devereaux	63,125	64,675[2]	129,350	DNR receives 27,625 from WVIC, 4,250 from WEPCO, and 32,800 from NSP.
Continuous Record Monitoring–Rivers	80,669	54,500[4]	109,000	WRM - 42,500. 12,000 direct State services.
Corps of Engineers shortfall (WI 00-001) Holmstrom/Devereaux, Baker	9,930	7,700[4]	15,400	WRM - 7,700.
Oconto Falls–River Flow (WI 00-001) Holmstrom/Baker	570	570[2]	1,140	DNR receives funds from Scott Paper.
Fox River at Oshkosh (AVM) (WI 00-001) Holmstrom/Rasman, Weisensel	5,150	5,150[4]	10,300	Possible funding from Mercury Marine.
Cedar Creek nr Cedarburg (WI 00-001) Holmstrom/Westenbroek	4,150	0	0	Included in CBR Rivers.
Devils Lake (WI 00-001) Holmstrom/Lathrop	4,500	1,900[1]	3,800	
Continuous Record Monitoring–GW (WI 00-002) Rauman/Stowell	0	1,200[4]	2,400	
Crandon (WI 00-201) Krohelski/Tans	35,000	25,000[1]	25,000	Unmatched offering.
Water-Use Data (WI 78-007) Ellefson/Baker	75,000	75,000[2]	150,000	75,000 direct state services.
Low Flow at Outfall Sites (WI 72-035) Holmstrom/Baker, Roden	11,000	0	0	
Lower Fox PCB Transport Model (WI 86-145) Steuer/Baker, Patterson	14,000	0	0	

	Actual 94-95 DNR Share	Proposed 95-96 DNR Share	Total	Remarks
Nonpoint Trends (WI 91-172) Hughes/Bannerman				
17201 - Waumandee	38,000	36,200[2]	72,400	
17202 - Bower/Otter	36,000	20,000[2]	40,000	
17203 - Menomonee	11,450	0	0	
17204 - DO Reduction	37,500	30,000[2]	60,000	
17205 - Black Earth	30,250	28,500[2]	57,000	
17206 - Evaluation BMP	19,250	29,000[2]	58,000	
17208 - Detention Pond	13,200	0	0	
17209 - Fixed Interval	52,325	23,100[2]	46,200	
17210 - Lincoln Creek	34,000	0	0	
17211 - Lincoln Creek WW	6,250	0	0	
17212 - Lake Superior	37,000	5,500[2]	11,000	
17213 - GIS Data Base	75,750	48,000[2]	96,000	
17214 - Single source sites	20,625	66,200[2]	132,400	Name change from lake evaluation gage.
17215 - Traffic Volume	23,000	0	0	
17217 - Lake Mendota	17,000	17,500[2]	35,000	
17218 - Signs of Success	17,682	0	0	
17219 - SLAMM	140,000	0	0	
17220 - Milwaukee Filtration	0	53,000[2]	65,000	USGS will match 12,000 of this offering.
17221 - Nonpoint Reference Site	0	5,100[2]	10,200	
Fish Lake (WI 92-17301) Rose/Marshall	1,000	1,000[2]	2,000	
Max and Vandercook Lakes (WI 92-18001) Rose/Knauer	40,000	40,000[2]	80,000	DNR to provide 20,000 in direct services.
Little Rock Lake (WI 92-18001) Rose/Knauer, Garrison	5,000	5,000[2]	10,000	
Lake Michigan Mass Balance	0	0	0	
Infiltrex (WI 183) Hughes/Patterson	0	12,341[2]	12,341	Unmatched.
Lake Michigan Trace Metals (WI 93-18301) Krabbenhoft/Hurley	0	0	0	Funded with USGS funds in 1995.
Industrial NPDES (WI 92-185) Hughes/Bannerman	24,740	0	0	
Microbial Effects (WI 190) Elder/	0	0	0	Funded with USGS funds in 1995.
Milwaukee River PCBs	38,000	20,000[1]	40,000	
(WI 191)		4,000[2]	8,000	Data analysis.
Steuer/Patterson		2,500[2]	5,000	EWI sampling, Milw/Cedar Creek.
		6,000[2]	6,000	Unmatched PCB sampling/ Milwaukee River at Highway T.

	Actual 94-95 DNR Share	Proposed 95-96 DNR Share	Total	Remarks
Hayton Mill Pond (WI 19101) Steuer/Patterson	4,940	6,800[2]	13,600	
Wild Rose Fish Hatchery (WI 94-192) Conlon/Opgenorth	19,000	1,000[1]	2,000	
North Fish Creek Sediment (WI 94-193) (Fitzpatrick/Swanson)	33,000	55,000[4]	110,000	Partial funding may be included in initial agreement.
Lower Fox Optimization (WI 95-) Conlon/Krill	0	34,375[4]	68,750	
St. Croix Trib (WI 95-) Rose/Sorge	0	??[4]	??	Approval pending.
Cranberry Bog Hydrology (WI 95-) Hughes/Greb	0	??[4]	?	Approval pending.

1 Funds firm.

2 Funds expected to be firm by June 1, 1995.

3 Funds expected to be firm for amendment #1 by July 30, 1995.

4 Funds uncertain.

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 25425, 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 (303) 236-7476. 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

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.

_____1984, National water summary 1983–Hydrologic events and issues: U.S. Geological Survey Water-Supply Paper 2250, 243 p.

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.

Bell, E.A., and Sherrill, M.G., 1974, Water availability in central Wisconsin–an area of near-surface crystalline rock: U.S. Geological Survey Water-Supply Paper 2022, 32 p.

Novitzki, R.P., 1973, Improvement of trout streams in Wisconsin by augmenting low flows with ground water: U.S. Geological Survey Water-Supply Paper 2017, 52 p.

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.

Hamilton, L.J., 1971, Water for cranberry culture in the Cranmoor area of central Wisconsin: U.S. Geological Survey Water-Supply Paper 1999-I, 20 p.

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.

Cline, D.R., 1965, Geology and ground-water resources of Dane County, Wisconsin: U.S. Geological Survey Water-Supply Paper 1779-U, 64 p.

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

Berkstresser, C.F., Jr., 1964, Ground-water resources of Waupaca County, Wisconsin: U.S. Geological Survey Water-Supply Paper 1669-U, 38 p.

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.

Collier, C.R., 1963, Sediment characteristics of small streams in southern Wisconsin, 1954-59: U.S. Geological Survey Water-Supply Paper 1669-B, 34 p.

LeRoux, E.F., 1963, Geology and ground-water resources of Rock County, Wisconsin: U.S. Geological Survey Water-Supply Paper 1619-X, 50 p.

Newport, T.G., 1962, Geology and ground-water resources of Fond du Lac County, Wisconsin: U.S. Geological Survey Water-Supply Paper 1604, 52 p.

Knowles, D.B., Dreher, F.C., and Whetstone, G.W., 1964, Water resources of the Green Bay area, Wisconsin: U.S. Geological Survey Water-Supply Paper 1499-G, 66 p.

LeRoux, E.F., 1957, Geology and ground-water resources of Outagamie County, Wisconsin: U.S. Geological Survey Water-Supply Paper 1421, 57 p.

Harger, A.H., and Drescher, W.J., 1954, Ground-water conditions in south-western Langlade County, Wisconsin: U.S. Geological Survey Water-Supply Paper 1294, 39 p.

Foley, F.C., Walton, W.D., and Drescher, W.J., 1953, Ground-water conditions in the Milwaukee-Waukesha area, Wisconsin: U.S. Geological Survey Water-Supply Paper 1229, 96 p.

HYDROLOGIC INVESTIGATIONS ATLASES

Gebert, W.A., Graczyk, D.J., and Krug, W.R., 1987, Average annual runoff in the United States, 1951-80: U. S. Geological Survey Hydrologic Investigations Atlas HA-710, 1 sheet.

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.

Young, H.L., and Borman, R.D., 1973, Water resources of Wisconsin–Trempealeau-Black River basin: U.S. Geological Survey Hydrologic Investigations Atlas HA-474, 4 sheets.

Oakes, E.L., and Hamilton, L.J., 1973, Water resources of Wisconsin–Menominee-Oconto-Peshtigo River basin, U.S. Geological Survey Hydrologic Investigations Atlas HA-470, 4 sheets.

Hindall, S.M., and Skinner, E.L., 1973, Water resources of Wisconsin–Pecatonica-Sugar River basin: U.S. Geological Survey Hydrologic Investigations Atlas HA-453, 3 sheets.

Young, H.L., and Hindall, S.M., 1973, Water resources of Wisconsin–St. Croix River basin: U.S. Geological Survey Hydrologic Investigations Atlas HA-451, 4 sheets.

Skinner, E.L., and Borman, R.G., 1973, Water resources of Wisconsin–Lake Michigan basin: U.S. Geological Survey Hydrologic Investigations Atlas HA-432, 4 sheets.

Shearman, J.O., and Holmstrom, B.K., 1971, Floods on Rock River in southwestern Jefferson County, Wisconsin: U.S. Geological Survey Hydrologic Investigations Atlas HA-413, 1 sheet.

_____1971, Floods on Rock River in northeastern Jefferson County, Wisconsin: U.S. Geological Survey Hydrologic Investigations Atlas HA-394, 1 sheet.

Shearman, J.O., 1970, Floods on Rock River in northern Rock County, Wisconsin: U.S. Geological Survey Hydrologic Investigations Atlas HA-393, 1 sheet.

Gebert, W.A., 1971, Low-flow frequency of Wisconsin streams: U.S. Geological Survey Hydrologic Investigations Atlas HA-390, 1 sheet.

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.

Hindall, S.M., and Flint, R.F., 1970, Sediment yields of Wisconsin streams: U.S. Geological Survey Hydrologic Investigations Atlas HA-376, 1 sheet.

Devaul, R.W., and Green, J.H., 1971, Water resources of Wisconsin–central Wisconsin River basin: U.S. Geological Survey Hydrologic Investigations Atlas HA-367, 4 sheets.

Cotter, R.D., Hutchinson, R.D., Skinner, E.L., and Wentz, D.A., 1969, Water resources of Wisconsin–Rock-Fox River basin: U.S. Geological Survey Hydrologic Investigations Atlas HA-360, 4 sheets.

Olcott, P.G., 1968, Water resources of Wisconsin–Fox-Wolf River basin: U.S. Geological Survey Hydrologic Investigations Atlas HA-321, 4 sheets.

U.S. Geological Survey, 1965, Preliminary map of the conterminuous United States showing depth to and quality of shallowest ground water containing more than 1,000 parts per million dissolved solids: U.S. Geological Survey Hydrologic Investigations Atlas HA-199, 31 p., 2 sheets.

PROFESSIONAL PAPERS

Green, J.H., 1968, The Troy Valley of southeastern Wisconsin: U.S. Geological Survey Professional Paper 600-C, p. 135-139.

Carey, K.L., 1967, The underside of river ice, St. Croix River, Wisconsin: U.S. Geological Survey Professional Paper 575-C, p. 195-199.

_____1966, Observed configuration and computed roughness of the underside of river ice, St. Croix River, Wisconsin: U.S. Geological Survey Professional Paper 550-B, p. 192-198.

Weeks, E.P., 1964, Field methods for determining vertical permeability and aquifer anisotropy: U.S. Geological Survey Professional Paper 501-D, p. 193-198.

_____1964, Use of water-level recession curves to determine the hydraulic properties of glacial outwash in Portage County, Wisconsin: U.S. Geological Survey Professional Paper 501-B, p. 181-184.

WATER-RESOURCES INVESTIGATIONS REPORTS

Goddard, Gerald L., and Field, Stephen J., 1994, Hydrology and water quality of Whitewater and Rice Lakes in southeastern Wisconsin, 1990-91: U.S. Geological Survey Water-Resources Investigations Report 94-4101, 36 p.

Krohelski, James T., Kammerer, Jr., Phil A., and Conlon, Terrence D., 1994, Water resources of the Menominee Indian Reservation of Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 93-4053, 54 p., 4 pl.

Rose, William J., 1993, Hydrology of Little Rock Lake in Vilas County, north-central Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 93-4139, 22 p.

Graczyk, D.J., 1993, Surface-water hydrology and quality, and macroinvertebrate and smallmouth bass populations in four stream basins in southwestern Wisconsin, 1987-90: U.S. Geological Survey Water-Resources Investigations Report 93-4024, 70 p.

Batten, W.G., and Conlon, T.D., 1993, Hydrogeology of glacial deposits in a preglacial bedrock valley, Waukesha County, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 92-4077, 15 p.

House, L.B., 1993, Simulation of the effects of hypothetical residential development on water levels in Graber Pond, Middleton, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 92-4029, 10 p.

Krohelski, J.T., and Lidwin, R.A., 1993, Hydrology and water quality of the Forest County Potawatomi Indian Reservation, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 91-4136, 24 p.

Rose, William J., 1993, Water and phosphorus budgets and trophic state, Balsam Lake, northwestern Wisconsin, 1987-1989: U.S. Geological Survey Water-Resources Investigations Report 91-4125, 28 p.

Field, S.J., 1993, Hydrology and water quality of Powers Lake, southeastern Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 90-4126, 36 p.

Field, Stephen J., 1993, Hydrology and water quality of Wind Lake in southeastern Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 91-4107, 61 p.

Hughes, P.E., 1993, Hydrology, water quality, trophic status, and aquatic plants of Fowler Lake, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 91-4076, 44 p.

Krug, William R., Conger, Duane H., and Gebert, Warren A., 1992, Flood-frequency characteristics of Wisconsin streams: U.S. Geological Survey Water-Resources Investigations Report 91-4128, 185 p., 2 pls.

Rose, W.J., 1992, Sediment transport, particle sizes, and loads in lower reaches of the Chippewa, Black, and Wisconsin Rivers in western Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 90-4124, 38 p.

Wentz, D.A., and Rose, W.J., 1991, Hydrology of Lakes Clara and Vandercook in North-Central Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 89-4204, 24 p.

Patterson, G. L., 1990, Ground-water levels and quality at Crex Meadows Wildlife Area, Burnett County, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 89-4129, 19 p.

Field, S.J., and Graczyk, D.J., 1990, Hydrology, aquatic macrophytes, and water quality of Black Earth Creek and its tributaries, Dane County, Wisconsin, 1985-86: U.S. Geological Survey Water-Resources Investigations Report 89-4089, 44 p.

Krug, W.R., Gebert, W.A., Graczyk, D.J., Stevens, D.L., Jr., Rochelle, B.P., Church, M.R., and Campbell, W.G., 1988, Runoff map for the Northeastern, Southeastern, and Mid-Atlantic United States for water years 1951-80: U.S. Geological Survey Water-Resources Investigations Report 88-4094, 44 p.

Rose, William J., 1988, Water resources of the Apostle Islands National Lakeshore, Northern Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 87-4220, 44 p.

Field, Stephen J., and Duerk, Marvin D., 1988, Hydrology and water quality of Delavan Lake in southeastern Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 87-4168, 61 p.

Walker, J.F., Osen, L.L., and Hughes, P.E., 1987, Cost effectiveness of the U.S. Geological Survey's stream-gaging program in Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 86-4125, 44 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.

House, L.B., 1987, Simulation of unsteady flow in the Milwaukee Harbor Estuary at Milwaukee, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 86-4050, 19 p.

Conger, D.H., 1986, Estimating magnitude and frequency of floods for Wisconsin urban streams: U.S. Geological Survey Water-Resources Investigations Report 86-4005, 18 p.

Graczyk, D.J., 1986, Water quality in the St. Croix National Scenic Riverway, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 85-4319, 48 p.

Field, S.J., 1986, Relations between precipitation, streamflow, and water quality in the Galena River basin, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 85-4214, 48 p.

Emmons, P.J., 1987, An evaluation of the bedrock aquifer system in northeastern Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 85-4199, 48 p.

Krug, W.R., and Goddard, G.L., 1986, Effects of urbanization on streamflow, sediment loads, and channel morphology in Pheasant Branch basin near Middleton, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 85-4068, 82 p.

Cotter, R.D., 1986, Hydrogeology and ground-water quality of Lannon-Sussex Area, northeastern Waukesha County, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 84-4213, 28 p.

Field, S.J., 1985, Nonpoint-source discharges and water quality of Elk Creek basin, west-central Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 84-4094, 38 p.

Field, S.J., and Lidwin, R.A., 1984, An assessment of nonpoint-source discharges, streamflow, and water quality in Onion River, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 84-4066, 78 p.

House, L.B., 1984, Effects of urbanization on three ponds in Middleton, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 84-4051, 17 p.

Kammerer, P.A., Jr., 1984, An overview of ground-water-quality data in Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 83-4239, 58 p.

Krug, W.R., and House, L.B., 1984, Evaluation of alternative reservoir-management practices in the Rock River basin, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 83-4186, 21 p.

Duerk, M.D., 1983, Automatic dilution gaging of rapidly varying flow: U.S. Geological Survey Water-Resources Investigations Report 83-4088, 17 p.

Kammerer, P.A., Jr., Lidwin, R.A., Mason, J.W., and Narf, R.P., 1983, Aquatic biology in Nederlo Creek, southwestern Wisconsin: U.S. Geological Survey Water Resources Investigations 82-56, 27 p.

Lawrence, C.L., and Ellefson, B.R., 1982, Water use in Wisconsin, 1979: U.S. Geological Survey Water Resources Investigations 82-444, 98 p.

Wentz, Dennis A., and Graczyk, David J., 1982, Effects of a Floodwater-Retarding Structure on the Hydrology and Ecology of Trout Creek in Southwestern Wisconsin: U.S. Geological Survey Water-Resources Investigations 82-23, 68 p.

Holmstrom, B.K., 1982, Low-flow characteristics of streams in the Lake Michigan basin, Wisconsin: U.S. Geological Survey Water Resources Investigations Open-File Report 81-1193, 102 p.

House, Leo B., 1981, An assessment of streamflow, water quality, and the effects of construction on impoundment on Bridge Creek at Augusta, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Report 81-1192, 25 p.

Field, S.J., and Lidwin, R.A., 1982, Water-quality assessment of Steiner Branch basin, Lafayette County, Wisconsin: U.S. Geological Survey Water-Resources Investigations 81-52, 58 p.

Gebert, W.A., 1982, Low-flow characteristics of streams in the Central Wisconsin River basin, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Report 81-495, 99 p.

Conger, Duane H., 1981, Techniques for estimating magnitude and frequency of floods for Wisconsin streams: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-1214, 116 p.

House, Leo B., and Skavroneck, Steven, 1981, Comparison of the propane-area tracer method and predictive equations for determination of stream-reaeration coefficients on two small streams in Wisconsin: U.S. Geological Survey Water-Resources Investigations 80-105, 18 p.

Krug, William R., 1981, Hydrologic effects of proposed changes in management practices, Winnebago Pool, Wisconsin: U.S. Geological Survey Water-Resources Investigations 80-107, 19 p.

Krug, William R., and House, Leo B., 1980, Streamflow model of Wisconsin River for estimating flood frequency and volume: U.S. Geological Survey Water-Resources Investigations 80-1103, 44 p.

Holmstrom, B.K., 1980, Low-flow characteristics of streams in the Menominee-Oconto-Peshtigo River basin, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-749, 82 p.

______1980, Low-flow characteristics of streams in the St. Croix River basin, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-696, 62 p.

Gebert, W.A., 1980, Low-flow characteristics of streams in the upper Wisconsin River basin, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-691, 60 p.

Kontis, A.L., and Mandle, R.J., 1980, Data-base system for northern Midwest regional aquifer-system analysis: U.S. Geological Survey Water-Resources Investigations 80-104, 27 p.

Grant, R.S., and Goddard, Gerald, 1980, Channel erosion and sediment transport in Pheasant Branch basin near Middleton, Wisconsin, a preliminary report: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-161, 19 p., 11 figs., 3 tables.

McLeod, R.S., 1980, The effects of using ground water to maintain water levels of Cedar Lake, Wisconsin: U.S. Geological Survey Water-Resources Investigations 80-23, 35 p.

Grant, R.S., and Skavroneck, Steven, 1980, Comparison of tracer methods and predictive models for determination of stream-reaeration coefficients on three small streams in Wisconsin: U.S. Geological Survey Water-Resources Investigations 80-19, 36 p.

Hindall, S.M., 1979, Ground-water quality in selected areas of Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Report 79-1594, 20 p.

Stedfast, D.A., 1979, Low-flow characteristics of streams in the Pecatonica-Sugar River basin, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Report 79-1274, 92 p.

Grant, R.S., and Goddard, Gerald, 1979, Urban storm-runoff modeling—Madison, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Report 79-1273, 20 p.

Novitzki, R.P., and Holmstrom, B.K., 1979, Monthly and annual water budgets of Lake Wingra, Madison, Wisconsin, 1971-77: U.S. Geological Survey Water-Resources Investigations 79-100, 31 p.

Kammerer, P.A., and Sherrill, M.G., 1979, Hydrology and water quality in the Nederlo Creek basin before construction of two water-retention structures: U.S. Geological Survey Water-Resources Investigations 79-95, 42 p.

Gebert, W.A., 1979, Low-flow characteristics of streams in Lake Superior basin, Wisconsin: U.S. Geological Survey Water-Resources Investigations 79-38, 74 p.

Holmstrom, B.K., 1979, Low-flow characteristics of Wisconsin streams at sewage-treatment plants and industrial plants: U.S. Geological Survey Water-Resources Investigations 79-31, 123 p.

Gebert, W.A., 1979, Red Cedar River basin, Wisconsin: Low-flow characteristics: U.S. Geological Survey Water-Resources Investigations 79-29, 12 p.

Holmstrom, B.K., 1979, Low-flow characteristics of streams in the Trempealeau-Black River basin, Wisconsin: U.S. Geological Survey Water-Resources Investigations 79-9, 79 p.

Sherrill, M.G., 1979, Contamination potential in the Silurian dolomite aquifer, eastern Wisconsin: U.S. Geological Survey Water-Resources Investigations 78-108, 2 pls.

Holmstrom, B.K., 1978, Low-flow characteristics of streams in the Rock-Fox River basin, Wisconsin: U.S. Geological Survey Water-Resources Investigations 78-85, 98 p.

Rathbun, R.E., and Grant, R.S., 1978, Comparison of the radioactive and modified techniques for measurement of stream reaeration coefficients: U.S. Geological Survey Water-Resources Investigations 78-68, 65 p.

Field, S.J., 1978, Ten-year low mean monthly discharge determinations for ungaged streams near waste-stabilization ponds in Wisconsin: U.S. Geological Survey Water-Resources Investigations 78-49, 16 p.

Novitzki, R.P., 1978, Hydrology of the Nevin wetland near Madison, Wisconsin: U.S. Geological Survey Water-Resources Investigations 78-48, 25 p.

Grant, R.S., 1978, Reaeration capacity of the Rock River between Lake Koshkonong, Wisconsin, and Rockton, Illinois: U.S. Geological Survey Water-Resources Investigations 77-128, 33 p.

Gebert, W.A., 1978, Low-flow characteristics of streams in the lower Wisconsin River basin: U.S. Geological Survey Water-Resources Investigations 77-118, 80 p.

Gebert, W.A., and Holmstrom, B.K., 1977, Low-flow characteristics at gaging stations on the Wisconsin, Fox, and Wolf Rivers, Wisconsin: U.S. Geological Survey Water-Resources Investigations 77-27, 20 p.

Rose, W.J., 1977, Hydrologic considerations associated with dredging spring ponds in Wisconsin: U.S. Geological Survey Water-Resources Investigations 77-18, 35 p.

Krug, W.R., 1976, Simulation of streamflow of Flambeau River at Park Falls, Wisconsin, to define low-flow characteristics: U.S. Geological Survey Water-Resources Investigations 76-116, 14 p.

Grant, R.S., 1976, Reaeration of coefficient measurements of 10 small streams in Wisconsin using radioactive tracers–with a section on the energy-dissipation model: U.S. Geological Survey Water-Resources Investigations 76-96, 50 p.

Novitzki, R.P., 1976, Recycling ground water in Waushara County, Wisconsin: Resource management for cold-water fish hatcheries: U.S. Geological Survey Water-Resources Investigations 76-20, 60 p.

Hindall, S.M., 1976, Measurement and prediction of sediment yields in Wisconsin streams: U.S. Geological Survey Water-Resources Investigations 54-75, 27 p.

Oakes, E.L., Hendrickson, G.E., and Zuehls, E.E., 1975, Hydrology of the Lake Wingra basin, Dane County, Wisconsin: U.S. Geological Survey Water-Resources Investigations 17-75, 31 p.

Gebert, W.A., and Holmstrom, B.K., 1974, Low-flow characteristics of Wisconsin streams at sewage-treatment plants: U.S. Geological Survey Water-Resources Investigations 45-74, 101 p.

Hendrickson, G.E., Knutilla, R.L., and Doonan, C.J., 1973, Hydrology and recreation of selected cold-water rivers of the St. Lawrence River basin in Michigan, New York, and Wisconsin: U.S. Geological Survey Water-Resources Investigations 8-73, 73 p.

OPEN-FILE REPORTS

Maertz, D.E., 1994, Water-resources investigations in Wisconsin, 1994: U.S. Geological Survey Open-File Report 94-321.

Graczyk, D.J., Walker, J.F., Greb, S.R., Corsi, S.R., and 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.

House, Leo B., Waschbusch, Robert J., and Hughes, Peter E., 1993, Water quality of an urban wet detention pond in Madison, Wisconsin, 1987-88: U.S. Geological Survey Open-File Report 93-172, 57 p.

House, L.B., Hughes, P.E., and Waschbusch, R.J., 1993, Concentrations and loads of polychlorinated biphenyls in major tributaries entering Green Bay, Lake Michigan, 1989-90: U.S. Geological Survey Open-File Report 93-132, 41 p.

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

Maertz, D.E., 1993, Water-resources investigations in Wisconsin, 1993: U.S. Geological Survey Open-File Report 93-129, 91 p.

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

Maertz, D.E., 1992, Water-resources investigations in Wisconsin: Programs and activities of the U.S. Geological Survey, 1991-1992: U.S. Geological Survey Open-File Report 92-125, 93 p.

Elder, J.F., Krabbenhoft, D.P, and Walker, J.F., 1992, Water, energy, and biogeochemical budgets (WEBB) program: Data availability and research at the northern temperate lakes site, Wisconsin: U.S. Geological Survey Open-File Report 92-48, 15 p.

Krabbenhoft, D.P., and Krohelski, J.T., 1992, Data on water quality, lake sediment, and lake-level fluctuation, St. Croix Indian Reservation, Wisconsin, 1981-87: U.S. Geological Survey Open-File Report 92-26, 53 p.

Hughes, P.E., 1993, Hydrologic and water-quality data for the East River Basin of northeastern Wisconsin: U.S. Geological Survey Open-File Report 89-245, 91 p.

Setmire, J.G., 1991, National Water-Quality Assessment Program - Western Lake Michigan Drainage Basin: U.S. Geological Survey Open-File Report 91-161, Water Fact Sheet, 2 p.

Melcher, N.B. and Walker, J.F., 1990, Evaluation of selected methods for determining streamflow during periods of ice effect: U.S. Geological Survey Open-File Report 90-554, 51 p.

U.S. Geological Survey, 1990, The effects of the 1988 drought on the water resources of Wisconsin: U.S. Geological Survey Open-File Report 90-149, Water Fact Sheet, 2 p.

House, L.B., 1990, Data on polychlorinated biphenyls, dieldrin, lead, and cadmium in Wisconsin and upper Michigan tributaries to Green Bay, July 1987 through April 1988: U.S. Geological Survey Open-File Report 89-52, 11 p.

Gebert, Warren A., Graczyk, David J., and Krug, William R., 1988, Runoff for selected sites in Shenandoah National Park, Virginia, July 18, 1981 through July 17, 1982: U.S. Geological Survey Open-File Report 88-98, 13 p.

Ellefson, B.R., Rury, Kraig S., and Krohelski, James T., 1988, Water use in Wisconsin, 1985: U.S. Geological Survey Open-File Report 87-699.

Krug, W.R., Gebert, W.A., and Graczyk, D.J., 1989, Preparation of average annual runoff map of the United States, 1951-80: U.S. Geological Survey Open-File Report 87-535, 414 p.

Krug, William R., Ostenso, Nile A., and Krohelski, James T., 1988, Prediction of the effects of mine dewatering on four lakes near Crandon, Wisconsin, by use of a water-budget model: U.S. Geological Survey Open-File Report 87-471, 63 p.

Graczyk, David J., Gebert, Warren A., Krug, William R., and Allord, G.J., 1987, Maps of runoff in the Northeastern Region and southern Blue Ridge Province of the United States during selected time periods in 1983-85: U.S. Geological Survey Open-File Report 87-106, 8 p., 3 pl.

Graczyk, David J., Krug, William R., and Gebert, Warren A., 1986, A history of annual streamflows from the 21 water-resource regions in the United States and Puerto Rico, 1951-83: U.S. Geological Survey Open-File Report 86-128, 30 p.

Henrich, E.W., 1984, Drainage area data for Wisconsin Streams: U.S. Geological Survey Open-File Report 83-933, 322 p.

Lawrence, C.L., Ellefson, B.R., and Cotter, R.D., 1984, Public-supply pumpage in Wisconsin in 1979: U.S. Geological Survey Open-File Report 83-931, 40 p.

Lawrence, C.L., and Ellefson, B.R., Water use in Wisconsin, 1979, U.S. Geological Survey Open-File Report 82-444, 98 p.

Novitzki, R.P., 1979, Streamflow estimates in selected Wisconsin streams: U.S. Geological Survey Open-File Report 79-1282, 11 p.

Harr, C.A., and Novitzki, R.P., 1979, Availability of supplemental water supplies at salmonid fish-propagation stations in Wisconsin: U.S. Geological Survey Open-File Report 79-1170, 13 p.

Krug, W.R., 1979, Simulation of streamflow of Rock River at Lake Koshkonong, Wisconsin, to determine effects of withdrawal of powerplant-cooling water: U.S. Geological Survey Open-File Report 79-253, 21 p.

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

Field, S.J., 1978, Low-flow characteristics of small streams in proposed Public Law 566 basins: U.S. Geological Survey Open-File Report 78-664, 32 p.

Hindall, S.M., 1978, Suspended-sediment transport in the Big Eau Pleine River basin, central Wisconsin: U.S. Geological Survey Open-File Report 78-313, 12 p.

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

Krug, W.R., 1976, Probable maximum flood at Lake Chippewa near Winter, Wisconsin: U.S. Geological Survey Open-File Report 76-800, 14 p.

Grant, R.S., 1976, Waste-assimilation study of Koshkonong Creek below sewage-treatment plant at Sun Prairie, Wisconsin: U.S. Geological Survey Open-File Report 76-655, 44 p.

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

Holmstrom, B.K., 1976, Low-flow characteristics and mean annual discharge of North Branch Manitowoc River at Potter, Wisconsin: U.S. Geological Survey Open-File Report 76-204, 20 p.

Krug, W.R., 1976, Flood-plain delineation for regional flood in Dane County, Wisconsin: U.S. Geological Survey Open-File Report 76-164, 168 p.

Field, S.J., 1975, Low-flow study of the Pike River basin, Racine and Kenosha Counties, Wisconsin: U.S. Geological Survey Open-File Report 75-653, 10 p.

Green, J.H., 1975, Flow characteristics of the lower Wisconsin River: U.S. Geological Survey Open-File Report 75-582, 9 p.

Holmstrom, B.K., 1975, Streamflow characteristics of Klawitter Creek basin near Westfield, Wisconsin: U.S. Geological Survey Open-File Report 75-527, 14 p.

Krug, W.R., 1975, Analysis of operational plan for Lake Chippewa near Winter, Wisconsin: U.S. Geological Survey Open-File Report 75-487, 17 p.

Holmstrom, B.K., 1975, Low-flow characteristics of the Eau Claire River basin near Antigo, Wisconsin: U.S. Geological Survey Open-File Report 75-336, 19 p.

Gebert, W.A., 1974, Streamflow characteristics of Little Wolf River–Holt Creek basin near Galloway, Wisconsin: U.S. Geological Survey Open-File Report, 10 p.

Lawrence, C.L., and Holmstrom, B.K., 1973, Floods on Yahara River tributaries, Dane County, Wisconsin: U.S. Geological Survey Open-File Report, 19 p.

Grant, R.S., Krug, W.R., and Duerk, M.D., 1973, Floodplain and floodway delineation for regional flood in central Marathon County, Wisconsin: U.S. Geological Survey Open-File Report, 33 p.

Holmstrom, B.K., Gebert, W.A., and Borman, R.G., 1973, Alder Creek hydrology, Wisconsin: U.S. Geological Survey Open-File Report, 28 p.

Lawrence, C.L., and Holmstrom, B.K., 1972, Flood in Starkweather Creek basin, Madison, Wisconsin: U.S. Geological Survey Open-File Report, 15 p.

Holmstrom, B.K., 1972, Drainage-area data for Wisconsin streams: U.S. Geological Survey Open-File Report, 74 p. (Updated 1973, 1974, 1978, and 1979.)

Hindall, S.M., 1972, Sediment yields of Wisconsin streams: U.S. Geological Survey Open-File Report, 2 p.

Weeks, E.P., and Stangland, H.G., 1971, Effects of irrigation on streamflow in the central sand plains of Wisconsin: U.S. Geological Survey Open-File Report, 113 p.

Conger, D.H., 1971, Estimating magnitude and frequency of floods in Wisconsin: U.S. Geological Survey Open-File Report, 200 p.

Holmstrom, B.K., and Lawrence, C.L., 1971, Floods on Yahara River, Lake Mendota to Lake Kegonsa, Dane County, Wisconsin: U.S. Geological Survey Open-File Report, 12 p.

Lawrence, C.L., and Holmstrom, B.K., 1971, Floods on Yahara River, Lake Kegonsa dam to countyline, Dane County, Wisconsin: U.S. Geological Survey Open-File Report, 10 p.

Shearman, J.O., and Lawrence, C.L., 1971, Floods on Yahara River upstream from Lake Mendota, Dane County, Wisconsin: U.S. Geological Survey Open-File Report, 7 p.

Gebert, W.A., 1971, Hydrology of Pine Creek: U.S. Geological Survey Open-File Report, 6 p.

_____1971, Hulbert Creek hydrology, southwestern Wisconsin: U.S. Geological Survey Open-File Report, 11 p.

Gonthier, J.B., 1970, Water resources of southeastern Wisconsin–Milwaukee River basin: U.S. Geological Survey Open-File Report, 138 p. (Extensively used in preparation of "A comprehensive plan for the Milwaukee River watershed", vol. 1 and 2, 1970 and 1971, Southeastern Wisconsin Regional Planning Commission Report No. 13, vol. 1, 514 p. and vol. 2, 623 p.)

Hamilton, L.J., 1970, Availability of ground water in the lower Wisconsin River Valley, Wisconsin: U.S. Geological Survey Open-File Report, 45 p.

Campbell, R.E., and Dreher, F.C., 1970, A proposed stream-flow data program for Wisconsin: U.S. Geological Survey Open-File Report, 55 p.

Shearman, J.O., 1969, Evaluation of flood potential, part 2 of Flood-plain management—Lake Koshkonong: U.S. Geological Survey Open-File Report, 6 p.

Young, K.B., 1965, Effect of treated effluent diversion on Yahara River flow: U.S. Geological Survey Open-File Report, 81 p.

_____1965, Supplement to report on flow characteristics of Wisconsin streams: U.S. Geological Survey Open-File Report, 81 p.

U.S. Geological Survey, 1964, Water-quality records in Michigan and Wisconsin: U.S. Geological Survey Open-File Report, 61 p.

Young, K.B., 1963, Flow characteristics of Wisconsin streams: U.S. Geological Survey Open-File Report, 151 p.

Erickson, D.W., 1961, Floods in Wisconsin, magnitude and frequency: U.S. Geological Survey Open-File Report, 109 p.

_____1961, Wisconsin River near Dekorra, Wisconsin, flood-flow characteristics at proposed bridge site on the Wisconsin Freeway in Columbia County: U.S. Geological Survey Open-File Report, 13 p.

Spicer, H.C., and Edwards, G.J., 1955, Electrical resistivity measurements in the Neillsville area, Wisconsin: U.S. Geological Survey Open-File Report, 34 p.

_____1954, A resistivity survey to locate an aquifer in the glacial deposits near Marshfield, Wisconsin: U.S. Geological Survey Open-File Report, 76 p.

Drescher, W.J., 1948, Results of pumping tests on artesian wells in the Milwaukee-Waukesha area, Wisconsin: U.S. Geological Survey Open-File Report, 22 p.

OPEN-FILE MAPS

Gonthier, J.B., 1979, Water-table map of Waukesha County, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Map 79-43, 1 pl.

Sherrill, M.G., and Erickson, J.R., 1979, Water-table map of Walworth County, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Map 79-42, 1 pl.

Sherrill, M.G., and Schiller, J.J., 1979, Water-table map of Racine County, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Map 79-41, 1 pl.

Sherrill, M.G., Schiller, J.J., and Erickson, J.R., 1979, Water-table map of Milwaukee County, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Map 79-40, 1 pl.

Sherrill, M.G., and Schiller, J.J., 1979, Water-table map of Kenosha County, Wisconsin: U.S. Geological Survey Water-Resources Investigations Open-File Map 79-39, 1 pl.

Borman, R.G., 1976, Thickness of unconsolidated materials of Walworth County, Wisconsin: U.S. Geological Survey Open-File Report 76-465, scale 1:62,500.

_____1976, Water-table map of Walworth County, Wisconsin: U.S. Geological Survey Open-File Report 76-464, scale 1:62,500.

_____1976, Bedrock topography of Walworth County, Wisconsin: U.S. Geological Survey Open-File Report 76-463, scale 1:62,500.

_____1976, Bedrock geology of Walworth County, Wisconsin: U.S. Geological Survey Open-File Report 75-462, scale 1:62,500.

Gonthier, J.B., 1975, Bedrock topography of Waukesha County, Wisconsin: U.S. Geological Survey Open-File Report 75-572, scale 1:62,500.

_____1975, Water-table map of Waukesha County, Wisconsin: U.S. Geological Survey Open-File Report 75-571, scale 1:62,500.

_____1975, Bedrock geology of Waukesha County, Wisconsin: U.S. Geological Survey Open-File Report 75-570, scale 1:62,500.

Borman, R.G., 1971, Preliminary map showing thickness of glacial deposits in Wisconsin: U.S. Geological Survey Open-File Report, scale 1:2,500,000.

_____1971, Preliminary map of probable well yields from bedrock in Wisconsin: U.S. Geological Survey Open-File Report, scale 1:2,500,000.

_____1971, Preliminary map of probable well yields from glacial deposits in Wisconsin: U.S. Geological Survey Open-File Report, scale 1:2,500,000.

ADMINISTRATIVE REPORTS

Rose, W.J., 1979, Bedload in northwestern Wisconsin's Nemadji River: U.S. Geological Survey Administrative Report, 12 p.

Kammerer, P.A., and Lidwin, R.A., 1977, Water quality in the Pine River basin Richland and Vernon Counties, Wisconsin: U.S. Geological Survey Administrative Report, 93 p.

Novitzki, R.P., 1971, Hydrologic investigations of Heart Lake, Green Lake County, Wisconsin: U.S. Geological Survey Administrative Report, 9 p.

_____1971, Hydrologic investigations for the Woodruff Fish Hatchery, Oneida County, Wisconsin: U.S. Geological Survey Administrative Report, 4 p.

_____1971, Hydrologic investigations of a proposed reservoir site in Trempealeau County, Wisconsin: U.S. Geological Survey Administrative Report, 4 p.

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY INFORMATION CIRCULARS

Batten, W.G., 1989, Hydrogeology of Wood County, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 60, 27 p., 2 pls.

Patterson, G.L., and Zaporozec, Alexander, 1988, Analysis of water-level fluctuations in Wisconsin wells: Wisconsin Geological and Natural History Survey Information Circular 63, 38 p.

Batten, W.G., 1987, Water resources of Langlade County, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 58, 28 p., 1 pl.

Krohelski, J.T., 1986, Hydrogeology and ground-water use and quality, Brown County, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 57, 42 p.

House, L.B., 1986, Stage fluctuations of Wisconsin Lakes: Wisconsin Geological and Natural History Survey Information Circular No. 49, 84 p.

Devaul, R.W., Harr, C.A., and Schiller, J.J., 1983, Ground-water resources and geology of Dodge County, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 44, 34 p.

Erickson, R.M., and Cotter, R.D., 1983, Trends in ground-water levels in Wisconsin through 1981: Wisconsin Geological and Natural History Survey Information Circular 43, 139 p.

Novitzki, R.P., 1982, Hydrology of Wisconsin Wetlands: Wisconsin Geological and Natural History Survey Information Circular 40, 22 p.

Kammerer, Phil A., Jr., Ground-water quality atlas of Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 39, 39 p.

Young, H.L., and Batten, W.G., 1980, Ground-water resources and geology of Washington and Ozaukee Counties, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 38, 37 p.

Harr, C.A., Trotta, L.C., and Borman, R.G., 1978, Ground-water resources and geology of Columbia County, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 37, 30 p.

Hindall, S.M., 1978, Effects of irrigation on water quality in the sand plain of central Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 36, 50 p.

Borman, R.G., 1976, Ground-water resources and geology of Walworth County, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 34, 45 p.

Borman, R.G., and Trotta, L.C., 1976, Ground-water resources and geology of Jefferson County, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 33, 31 p.

Borman, R.G., 1976, Ground-water resources and geology of St. Croix County, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 32, 30 p.

Bell, E.A., and Hindall, S.M., 1975, The availability of ground water for irrigation in the Rice Lake-Eau Claire area, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 31, 65 p.

McLeod, R.S., 1975, A digital-computer model for estimating hydrologic changes in the aquifer system in Dane County, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 30, 40 p.

Gonthier, J.B., 1975, Ground-water resources of Waukesha County, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 29, 47 p.

McLeod, R.S., 1975, A digital-computer model for estimating drawdown in the sandstone aquifer in Dane County, Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 28, 91 p.

Holt, C.L.R., Jr., and Skinner, E.L., 1973, Ground-water quality in Wisconsin through 1972: Wisconsin Geological and Natural History Survey Information Circular 22, 148 p.

Erickson, R.M., 1972, Trends in ground-water levels in Wisconsin, 1967-71: Wisconsin Geological and Natural History Survey Information Circular 21, 40 p. (Supplement to Information Circular 9).

Holt, C.L.R., Jr., Cotter, R.D., Green, J.H., and Olcott, P.G., 1970, Hydrogeology of the Rock-Fox River basin of southeastern Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 17, 47 p. (Prepared for the Annual Meeting of the Geological Society of America-Field Trip Guidebook).

Devaul, R.W., 1967, Trends in ground-water levels in Wisconsin through 1966: Wisconsin Geological and Natural History Survey Information Circular 9, 109 p.

Ryling, R.W., 1961, A preliminary study of the distribution of saline water in the bedrock aquifers of eastern Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 5, 23 p.

Drescher, W.J., 1956, Ground water in Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 3, 37 p.

____1955, Some effects of precipitation on ground water in Wisconsin: Wisconsin Geological and Natural History Survey Information Circular 1, 17 p.

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY MISCELLANEOUS PAPERS

Patterson, G.L., 1989, Water resources of Vilas County, Wisconsin: Wisconsin Geological and Natural History Survey Miscellaneous Paper 89-1, 46 p.

OTHER PUBLICATIONS

Elder, John F., 1994, Distribution and grain-size partitioning of metals in bottom sediments of an experimentally acidified Wisconsin lake: Water Resources Bulletin, vol. 30, no. 2, p. 251-259.

Krabbenhoft, David P., Bowser, Carl J., Kendall, Carol, and Gat, Joel R., 1994, Use of oxygen-18 and deuterium to assess the hydrology of groundwater-lake systems: American Chemical Society Advances in Chemistry Series No. 237, Environmental Chemistry of Lakes and Reservoirs, p. 67-90.

Walker, John F., 1994, Methods for measuring discharge under ice cover: Journal of Hydraulic Engineering, vol. 120, no. 11, p. 1327-1336.

Walker, John F., 1994, Statistical techniques for assessing water-quality effects of BMPs: Journal of Irrigation and Drainage Engineering, vol. 120, no. 2, p. 334-347.

Bannerman, R.T., Owens, D.W., Dodds, R.B., and Hornewer, N.J., 1993, Sources of pollutants in Wisconsin stormwater: Water Science Technology, v. 28, no. 3-5, p. 241-259.

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.

Krabbenhoft, D.P., and Babiarz, C.L., 1992, The role of groundwater transport in aquatic mercury cycling: Water Resources Research, v. 29, no. 12, December 1992, p. 3119-3128.

Elder, J.F., and Collins, J.J., 1991, Freshwater molluscs as indicators of bioavailability and toxicity of metals in surface-water systems: Reviews of Environmental Contamination and Toxicology, v. 122, no. 4, p. 37-79.

Walker, J.F., Pickard, S.A., and Sonzogni, W.C., 1989, Spreadsheet watershed modeling for nonpoint-source pollution management in a Wisconsin basin: Water Resources Bulletin, v. 25, no. 1, p. 139-147.

Wentz, D.A., Garrison, P.J., and Bockheim, J.G., 1989, Section 7–Chemical input-output budgets, in Knauer, D., and Brouwer, S.A., eds., The Wisconsin Regional Integrated Lake-Watershed Acidification Study (RILWAS): 1981-1983: Palo Alto, California, Electric Power Research Institute Report EA-6214, p. 7-1 to 7-30.

Wentz, D.A., and Rose, W.J., 1989, Interrelationships among hydrologic-budget components of a northern Wisconsin seepage lake and implications for acid-deposition modeling: Archives of Environmental Contamination and Toxicology, v. 18, p. 147-155.

Wentz, D.A., Rose, W.J., and Krohelski, J.T., 1989, Section 5–Hydrologic component, in Knauer, D., and Brouwer, S.A., eds., The Wisconsin Regional Integrated Lake-Watershed Acidification Study (RILWAS): 1981-1983: Palo Alto, California, Electric Power Research Institute Report EA-6214, p. 5-1 to 5-77.

Rochelle, B.P., Church, M.R., Gebert, W.A., Graczyk, D.J., and Krug, W.R., 1988, Relationship between annual runoff and watershed area for the eastern United States: Water Resources Bulletin, vol. 24, no. 1, February 1988, p. 35-41.

Walker, J.F., 1988, General two-point method for determining velocity in open channel: ASCE J. of Hydraulic Engineering, v. 114, no. 7, p. 801-805.

WISCONSIN DISTRICT PERSONNEL

GREAT LAKES-OHIO VALLEY PROGRAM (IL, IN, KY, MI, WI)

Bauer, Daniel B., Area Hydrologist
(608) 276-3811
Barr, Karen, Secretary
(608) 276-3813

DISTRICT OFFICE-MADISON 53719
6417 Normandy Lane
Phone: (608) 274-3535
FAX: (608) 276-3817
Office Hours: 0800 to 1630

Office of the District Chief
Gebert, Warren A., District Chief
(608) 276-3801
Elder, John F., Research Hydrol/Biol
(608) 276-3854
Maertz, Diane E., Sec(Steno)
(608) 276-3801

Administrative Services Unit
Grover, Richard L., Admin Off
(608) 276-3803
Evans, Kaye M., Admin Opers Asst
(608) 276-3802
Mayer, Kathleen M., Acc Tech
(608) 276-3804
Urben, Julie A., Admin Clerk
(608) 274-3535

Computer Applications Unit
Bodoh, Robert B., Comp Prog Analyst
(608) 276-3805
Gill, Gary W., Comp Asst
(608) 276-3866
Zahn, Jeannette K., Comp Asst
(608) 276-3806

Environmental Studies Section
Hughes, Peter E., Chief Supv Hydrol/Biol
(608) 276-3833
Walker, John F., Research Hydrol/Engr
(608) 276-3853
Graczyk, David J., Hydrol/For
(608) 276-3840
Hall, David W., Hydrol
(608) 276-3875
Krug, William R., Hydrol/Engr
(608) 276-3829
Steuer, Jeffrey J., Hydrol/Eng
(608) 276-3830
Corsi, Steven R., Hydrol/Eng
(608) 276-3835
House, Harold R., Hydrol/Eng
(608) 276-3876
Owens, David W., Hydr Engr
(608) 276-3863
Stuntebeck, Todd D., Phys Sci
(608) 276-3830
Waschbusch, Robert J., Hydrol
(608) 276-3868
Goddard, Gerald L., Hyd Tech
(608) 276-3841
Hanson, Halward L., Hyd Tech
(608) 276-3862
Housner, David E., Hyd Tech
(608) 276-3815
Rutter, Troy D., Hyd Tech
(608) 276-3830
Lonsdorf, Karen A., Pub Graph Spec
(608) 276-3814
Jones, Susan Z., Edit Asst
(608) 276-3856

Hydrogeologic Studies and Data Section
Krohelski, James T., Chief Supv Hydrol
(608) 276-3850
Krabbenhoft, David P., Research Hydrol/GeoChem
(608) 276-3843
Batten, William G., Hydrol/Geol
(608) 276-3851
Conlon, Terrence D., Hydrol/Geol
(608) 276-3847
Hunt, Randall J., Hyrol/Geol
(608) 276-3847
Olson, Mark L., Biol
(608) 276-3878
Ellefson, Bernard R., Hyd Tech
(608) 276-3849
Sabin, Ty, Physical Scientist
(608) 276-3873
DeWild, John F., Hyd Tech
(608) 276-3856
Rauman, James M., Hyd Tech
(608) 276-3871

Hydrologic Systems and Data Section
Garn, Herbert, Chief Supv Hydrol
(608) 276-3828
Rose, William J., Hydrol/Engr
(608) 276-3834
Field, Stephen J., Biologist
(608) 276-3842
Holmstrom, Barry K., Hydrol/Engr
(608) 276-3831
Kammerer, Phil A. Jr., Hydrol/Chem
(608) 276-3848
Olson, Daniel L., Hyd Tech
(608) 276-3852
Stark, Patricia A., Hyd Data Asst
(608) 276-3838

National Water Quality Assessment Program
Peters, Charles A., Chief Supv Hydrol
(608) 276-3810
Fitzgerald, Sharon A., Research Hydrol/Biol
(608) 276-3816
Robertson, Dale P., Research Hydrol/Chem
(608) 276-3867
Fitzpatrick, Faith A., Hydrol
(608) 276-3818
Sullivan, Daniel J., Hydrol
(608) 276-3869
Scudder, Barbara C., Research Hydrol/Biol
(608) 276-3832
Saad, David A., Hydrol/Geol
(608) 276-3865
Richards, Kevin E., Hyd Tech
(608) 276-3855
Stewart, Jana S., Geographer
(608) 276-3855

FIELD HEADQUARTERS-MADISON 53719
6606 Seybold Road
Phone: (608) 276-3856
Office Hours: 0800 to 1630

Habale, Josef, Hyd Tech
Koenig, Kenneth R., Hyd Tech
March, Steven A., Hyd Tech
Wittwer, Thomas A., Hyd Tech

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

Freshwaters, Jack T., Hyd Tech
Popowski, Thomas J., Hyd Tech
Schuler, Josef G., Hyd Tech

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

George, James W., Hyd Tech
Hanig, Jeffrey J., Hyd Tech
Esser, Brett M., Hyd Tech

A Summary of Cooperative Water-Resources Investigations in Wisconsin, 1995