

**MCES and MSU-Mankato Water Monitoring Programs
In Support of the
Interagency Water Monitoring Initiative,
2004 – 2005 Biennial Progress Report**

Interagency Water Monitoring Initiative (IWMI)

Background

In May 1997, the Minnesota Legislature provided \$575,000 to the Metropolitan Council, via the Interagency Water Monitoring Initiative (IWMI), for an expansion of Metropolitan Council Environmental Services (MCES) water quality monitoring efforts. The funding was provided to the Metropolitan Council via the Minnesota Pollution Control Agency (MPCA) budget. Monitoring efforts began in 1998 and focused on two programs: the “Metropolitan Area Watershed Outlet Monitoring Program” and “Mercury and PCB Inputs to the Minnesota River Monitoring Program.” Both programs are being conducted in cooperation with local, state, and federal partners with a mutual interest in the monitoring information.

In May 1999, the Minnesota Legislature provided an additional \$600,000 to the Metropolitan Council for the 2000-2001 biennium, via the MPCA’s budget. This funding allowed for continuation of the “Metropolitan Area Watershed Outlet Monitoring Program” and the “Mercury and PCB Inputs to the Minnesota River Monitoring Program” through June 2001. A 2000-2001 work plan for both programs was prepared by MCES Water Quality staff and submitted to the MPCA in September 1999. In September 2000, a business item was approved by the Environment Committee of the Metropolitan Council authorizing the Metropolitan Council to enter into the joint powers agreement with the MPCA, and to accept and expend the state funding. In November 2000, the MPCA and Metropolitan Council executed the joint powers agreement for the 2000-2001 monitoring work and funding. In August 2001, MCES submitted the “2000-2001 Biennial Progress Report” to the MPCA.

In June 2001, the Minnesota Legislature again appropriated \$600,000 to the Metropolitan Council (via the MPCA), for continuation of the “Metropolitan Area Watershed Outlet Monitoring Program” and the “Mercury and PCB Inputs to the Minnesota River Monitoring Program” during the 2002-2003 biennium. A 2002-2003 work plan for both programs was prepared by MCES Water Quality staff and submitted to the MPCA in July 2001. In August 2001, a business item was approved by the Environment Committee of the Metropolitan Council authorizing the Metropolitan Council to enter into a grant contract with the MPCA, and to accept and expend the state funding. In February 2002, the MPCA and Metropolitan Council executed the grant contract for the 2002-2003 monitoring work and funding. In May 2003, MPCA extended the term of the grant contract for an additional year (to June 30, 2004), thereby allowing MCES to spend the remainder of the 2002-2003 funding (Table 9) on Minnesota River-related monitoring work.

In May 2003, the Minnesota Legislature appropriated \$500,000 to the Metropolitan Council (via the MPCA), for continuation of the “Metropolitan Area Watershed Outlet Monitoring Program” and the “Mercury and PCB Inputs to the Minnesota River Monitoring Program” during the 2004-2005 biennium. A 2004-2005 work plan for both programs was prepared by MCES Water Quality staff and submitted to the MPCA in July 2003. Given the monitoring work to date on mercury and PCB sources in the Minnesota River Basin, the considerable cost and labor for analysis of these variables, and a reduction in available funding for the “Mercury and PCB Inputs to the Minnesota River Monitoring Program” during the 2004-2005 biennium, very minimal monitoring of mercury and PCB was proposed as a part of the Minnesota River work plan. Rather, monitoring focused on conventional water quality pollutants contributing to exceedances of water quality standards/criteria and impairment of designated uses in the Minnesota River Basin. With a somewhat different emphasis to the monitoring work, the program was re-named the “Minnesota River Watershed Monitoring Program”. In August 2003, a business item was approved by the Environment Committee of the Metropolitan Council authorizing the Metropolitan Council to enter into a grant contract with the MPCA, and to accept and expend the state funding. In September 2003, the MPCA and Metropolitan Council executed the grant contract for the 2004-2005 monitoring work and funding. During the 2004-2005 biennium, MCES, MPCA, and Minnesota State University-Mankato (MSU-Mankato) discussed an opportunity to transfer responsibility and implementation of the “Minnesota River Watershed Monitoring Program” to the Water Resources Center at MSU-Mankato. The program transfer from MCES to MSU-Mankato occurred on January 1, 2005. In conjunction with the program transfer, the MPCA and Metropolitan Council executed a grant contract amendment in December 2004 that reduced Metropolitan Council funding by \$76,700. Under a separate grant contract between MPCA and MSU-Mankato, this funding was transferred to MSU-Mankato for operation of the “Minnesota River Watershed Monitoring Program” during the January 1-June 30, 2005 period. The MSU-Mankato Water Resources Center has become a leader and advocate for Minnesota River Basin education and outreach, research, data management and assessment, technical support, and planning and coordination; so transfer of the MCES Minnesota River monitoring program to MSU-Mankato will further enhance the Water Resources Center mission and emphasize the importance of water quality monitoring in the Minnesota River Basin.

In late August 2005, the MPCA indicated that a total of \$500,000 will be provided to the Metropolitan Council and the MSU-Mankato Water Resources Center, for continuation of the “Metropolitan Area Watershed Outlet Monitoring Program” and the “Minnesota River Watershed Monitoring Program” during the 2006-2007 biennium. In September 2005, MCES and MSU-Mankato will prepare 2006-2007 work plans and budgets for both programs, for submittal to the MPCA. With 2006-2007 work plans and budgets in place, MPCA can then execute grant contracts with MCES and MSU-Mankato.

IWMI Progress During the 2004-2005 Biennium

A number of regional, state, and federal agencies participate in the Interagency Water Monitoring Initiative (IWMI), including MCES, MPCA, MDNR, MDH, MDA, BWSR, the Minnesota Office of Planning, USGS, USACE, USDA, and NOAA¹. As a long-term goal, the IWMI is working to achieve increased interagency coordination and cooperation for statewide water monitoring programs, as well as increased capability for sharing water monitoring data and environmental information. The IWMI surface water and ground water workgroups, with active MCES participation, continue to meet regularly to achieve this goal.

Several highlights during the 2004-2005 biennium include:

- Meetings of the IWMI Surface Water Monitoring Technical Workgroup were held in October 2003, May 2004, and October 2004. A combined meeting of the IWMI Surface and Ground Water Monitoring Technical Workgroups was held in February 2005. Topics for discussion at these meetings included:
 1. MPCA's report to the EPA on Minnesota's monitoring and assessment strategy
 2. Monitoring design for assessment of stormwater impacts and BMP effectiveness
 3. Development of stream IBIs and use for assessment of aquatic life impairment
 4. Current status of Minnesota's impaired waters program (TMDL development and implementation)
 5. Use of satellite and aerial imagery for evaluation of lake and river water quality
 6. Monitoring precipitation in Minnesota
 7. MPCA's proposal to the LCMR for accelerating and enhancing surface water monitoring in Minnesota
 8. Volunteer lake and stream monitoring programs and the use of volunteer-collected data for surface water assessment
 9. Emerging contaminants in Minnesota's environment
- In June 2005, IWMI participants (including MCES) prepared a summary of Monitoring Action Steps taken in 2004, related to the Goals and Milestones from Chapter 5 of the Minnesota Nonpoint Source Management Plan (NSMPP). Submittal to the US Environmental Protection Agency of Monitoring Action Step updates is a condition for continuing receipt of federal Section 319 funds by the MPCA.

¹ See Table 1 for complete agency names.

Table 1. Acronyms of Agency Names

BWSR	Minnesota Board of Water and Soil Resources
MCES	Metropolitan Council Environmental Services
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
NOAA	National Oceanographic and Atmospheric Administration
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey

MCES and MSU-Mankato Water Monitoring Programs

The two water monitoring programs that comprise the MCES and MSU-Mankato contributions to the Interagency Water Monitoring Initiative include the “Metropolitan Area Watershed Outlet Monitoring Program”, implemented by MCES, and the “Minnesota River Watershed Monitoring Program”, implemented cooperatively by MCES and MSU-Mankato during the 2004-2005 biennium. Both programs use the same monitoring technology and the same data format for reporting the monitoring results. However, each program has a slightly different objective.

Metropolitan Area Watershed Outlet Monitoring Program

The “Metropolitan Area Watershed Outlet Monitoring Program,” implemented in early 1998, significantly expanded the existing stream monitoring network in the Twin Cities Metropolitan Area (TCMA). Eight new monitoring sites (Bassett Creek, Cannon River, Crow River, Eagle Creek, Minnehaha Creek, Riley Creek, Valley Creek, and Willow Creek) were established in eight TCMA watersheds. The physical and chemical data from these eight monitoring sites are being used by MCES to develop target pollutant loads for these watersheds, and to measure water quality improvements as best management practices are implemented.

Local partners conduct the monitoring at these locations with guidance and oversight from the MCES program coordinator, Leigh Harrod. Local partners include the Bassett Creek Watershed Management Organization, Black Dog Watershed Management Organization, Dakota County Soil and Water Conservation District (SWCD), Lower Minnesota River Watershed District, Minneapolis Park and Recreation Board, Riley-Purgatory-Bluff Creek Watershed District, St. Croix Watershed Research Station (Science Museum of Minnesota), Valley Branch Watershed District, and Wright County SWCD. To support and encourage the participation of local partners, MCES provides \$4,000.00 of state funding per year for each monitoring site, to help offset each local partner’s costs for monitoring labor, mileage, and materials and supplies. MCES then uses the remainder of the state funding to pay all costs for monitoring equipment, monitoring station maintenance, utilities, laboratory analysis of water samples, program coordination, data management, and report preparation.

Minnesota River Watershed Monitoring Program

The “Minnesota River Watershed Monitoring Program,” implemented in the fall of 1998, expanded the existing MCES river and stream monitoring network in the Minnesota River Basin. The objective of this program is to investigate sources and measure loads of mercury, PCB, and other conventional non-point source pollutants in the Minnesota River Basin. Sources of mercury and PCB are contributing to fish consumption advisories in the Minnesota River, and sources of sediment, nutrients, and bacteria are contributing to a general degradation of Minnesota River water quality. Six monitoring sites are operating in the Mankato, MN area. Monitoring sites are located on the Minnesota River at Judson and St. Peter, and within the Blue Earth and Le Sueur River Watersheds. The monitoring work for this program is being conducted in cooperation with the Minnesota Department of Agriculture (MDA), the U.S. Geological Survey (USGS), and the Minnesota Pollution Control Agency (MPCA).

Metropolitan Area Watershed Outlet Monitoring Program

Introduction

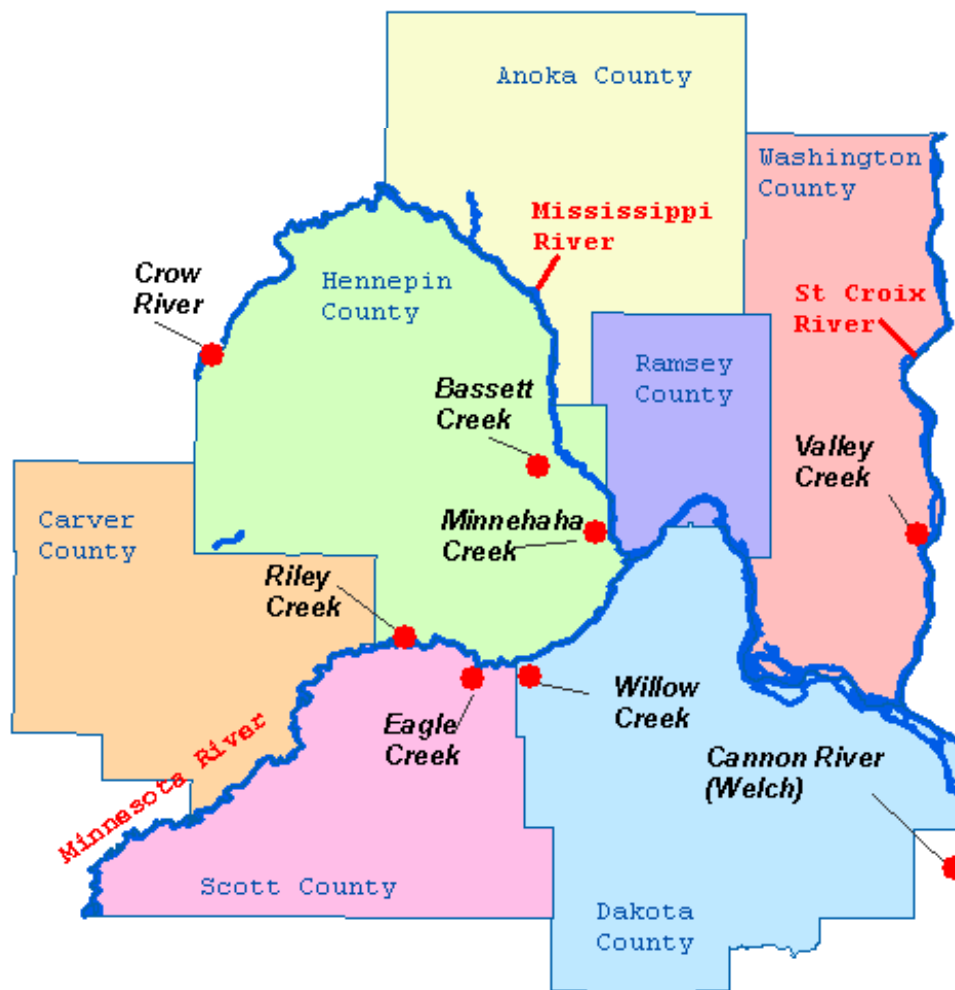
The “Metropolitan Area Watershed Outlet Monitoring Program (WOMP)”, implemented in early 1998, has significantly expanded the existing MCES stream monitoring network in the Metropolitan Area. In February 1998, MCES hired Leigh Harrod as a Senior Environmental Scientist to coordinate the program, including establishment of up to ten new stream monitoring stations in Metropolitan Area watersheds. The objective of this program is to collect the water quality data needed to assess current watershed conditions and develop target pollutant loads. As the target loads are developed, the monitoring stations can measure progress toward achievement of the target loading goals as non-point source best management practices (BMPs) are implemented in these watersheds.

In 1998, continuous monitoring stations in seven different Metropolitan Area watersheds were constructed near the outlets of five streams and two rivers, which are tributaries of the Mississippi, Minnesota, and St. Croix Rivers. Continuous year-round monitoring began in 1999. These seven stations are located near the outlets of the Cannon River, Crow River, Eagle Creek, Minnehaha Creek, Riley Creek, Valley Creek, and Willow Creek. In 2000, an eighth station was established on Bassett Creek. Locations of the eight WOMP stations are indicated in Figure 1. All eight stations were fully functional during the 2004-2005 biennium. A ninth WOMP station (Cottage Grove Ravine) was scheduled for construction in the fall of 2001. However, the South Washington County Watershed District decided to implement its own monitoring program, without MCES support.

The fieldwork for this program is provided through cooperative, cost-share grant agreements with a number of local units of government in the Metropolitan Area. Local partners conduct the monitoring at these locations with guidance and oversight from the MCES project coordinator, Leigh Harrod. Local partners include the Bassett Creek Watershed Management Organization, Black Dog Watershed Management Organization, Dakota County Soil and Water Conservation District (SWCD), Lower Minnesota River Watershed District, Minneapolis Park and Recreation Board, Riley-Purgatory-Bluff Creek Watershed District, St. Croix Watershed Research Station (Science Museum of Minnesota), Valley Branch Watershed District, and Wright County SWCD. To support and encourage the participation of local partners, MCES provides \$4,000.00 of state funding per year for each monitoring site, to help offset each local partner’s costs for monitoring labor, mileage, and materials and supplies. MCES then uses the remainder of the state funding to pay all costs for monitoring equipment, monitoring station maintenance, utilities, laboratory analysis of water samples, program coordination, data management, and report preparation.

This portion of the biennial report will describe the status of the “Metropolitan Area Watershed Outlet Monitoring Program (WOMP)” during the 2004-2005 biennium. Measures of monitoring success are described in terms of monitoring activity, number of samples obtained, number of analyses conducted, monitoring lessons learned, the continuation and enhancement of cooperative partnerships, data management and reporting, and uses and requests for WOMP data. The budget and financial accounting of funds used to date for this program are included in the **Budget** section of this report, which provides budget and financial information for both monitoring programs.

Figure 1
MCES Watershed Outlet Monitoring Station Locations



The streams enrolled in the “Metropolitan Area Watershed Outlet Monitoring Program” (WOMP) are characterized by a multitude of land uses within their watersheds. Twin Cities Metropolitan Area (TCMA) watersheds have been altered into a heterogeneous mix, ranging from the high-density urban corridors of Bassett Creek, to the suburban environs of Willow Creek, to the agricultural landscape of the Crow River basin, to the predominantly native vegetation that provides habitat for trout in Valley and Eagle Creeks. The variation in water quality among watersheds is dramatic. The monitoring results from each WOMP watershed, as distinguished by its land use characteristics, can therefore serve as a baseline for other watersheds that are not actively monitored but share similar characteristics.

Monitoring Site Locations and Descriptions

1. Bassett Creek in Minneapolis, MN

BS 1.9 The Bassett Creek monitoring station is located in Minneapolis, MN, 1.9 miles upstream from the creek confluence with the Mississippi River and 0.25 mile upstream of a storm sewer tunnel that flows under downtown Minneapolis until it discharges into the Mississippi River. The station, located in T118N R24W Sec.13, was activated in March 2000. Watershed area is approximately 43 square miles. Land use is urban, with 60% residential, 18% commercial-industrial, 14% open space, and 5% open water.

A digital sonic ranging sensor continuously recorded water stage measurements during the 2000-2002 period. Electrical interference from nearby power lines prompted the installation of a gas-purge bubbler system in 2003 to measure stage, although the sonic sensor still remains active to serve as a check on the bubbler stage. A Campbell datalogger records precipitation from a tipping bucket rain gage, as well as 15-minute stage, temperature, and conductivity measurements. An automatic sampler captures event-generated, flow-weighted composite samples to supplement monthly grab samples. The local cooperater is the Minneapolis Park and Recreation Board, which is assisted by the Bassett Creek Watershed Management Organization through its technical consultant, Barr Engineering. Barr Engineering maintains the rating curve at this location.

2. Cannon River in Welch, MN

CN 11.9 The Cannon River monitoring station is located in Welch, MN, 11.9 miles upstream from the river confluence with the Mississippi River, in. The station, located in T113N, R16W, Sec.27, was activated in 1999. It shares a shelter and stilling well with USGS Station No. 05355200. Watershed area is approximately 1,340 square miles. Land use is predominantly agricultural with some forest and scattered urbanized areas.

Instruments coupled to a Campbell datalogger include a digital shaft encoder installed in the stilling well to continuously measure stage, a tipping bucket rain gauge, in-stream temperature and conductivity probes, and an automatic sampler that captures event-generated flow-weighted composite samples to supplement monthly grab samples. A

mechanical wire-weight gauge serves as an independent reference point to assure that the shaft encoder is accurately measuring stage. The local cooperater is the Dakota County Soil and Water Conservation District (SWCD), with assistance from the Goodhue County SWCD. The site rating curve is maintained by the USGS.

3. Crow River in Rockford, MN

CW 23.1 The Crow River monitoring station is located in Rockford, MN, 23.1 miles upstream from the river confluence with the Mississippi River and 1 mile below the confluence of the North and South Branches of the Crow River. The station, located on the northwest bank of the MN Highway 55 Bridge in T119N, R24W, Sec.29, was activated in 1999. Watershed area is approximately 2,620 square miles. Land use is 87% agricultural with 8% open water and wetland areas. In both Wright and Hennepin Counties, urbanization is increasing within the watershed and along the riparian corridor.

A digital dry-gas pressure system continuously measures stage, which is recorded by a Campbell datalogger. Other monitoring equipment includes a staff gauge mounted to the MN Highway 55 Bridge footing, a wire weight gage, a tipping bucket rain gauge, in-stream temperature and conductivity probes, and a refrigerated automatic sampler that captures event-generated flow-weighted composite samples to supplement monthly grab samples. The local cooperater is the Wright County SWCD. The site rating curve is derived from the USGS rating curve table for Station No. 05280000 at Rockford.

4. Eagle Creek in Savage, MN

EA 0.8 The Eagle Creek monitoring station is located in Savage, MN, 0.8 mile upstream from the creek confluence with the Minnesota River. The station, located under the 126th Street Bridge in T118N, R21W, Sec.7, was activated in 1999. Eagle Creek is an MDNR Class 2A designated trout stream. Its perennial base flow is supplied by artesian groundwater discharging at Boiling Springs. The native habitat and vegetation is largely intact along the stream corridor. Watershed area is approximately 3.4 square miles. Despite the small watershed area, monitoring at this location provides an ideal control site because land use is largely native vegetation, despite increasing development pressure in this area of Scott County. The City of Savage has implemented a 100-foot buffer strip along the stream corridor as a best management practice (BMP) to prevent urban runoff from discharging into the creek.

A Campbell datalogger continuously captures stage readings from a digital dry-gas pressure system. Other monitoring instruments include a staff gauge, a tipping bucket rain gauge, in-stream temperature and conductivity probes, and an automatic sampler that captures event-generated flow-weighted composite samples to supplement monthly grab samples. The local cooperater is the Lower Minnesota River Watershed District, which uses the Scott County SWCD to conduct the monitoring work on behalf of the watershed district. The site rating curve was initially developed by the MDNR, but maintenance and checking of the rating curve is achieved by periodic in-stream wading rod measurements conducted by MCES and Scott County SWCD staff.

5. Minnehaha Creek in Minneapolis, MN

MH 1.7 The Minnehaha Creek monitoring station is located in Minneapolis, MN, 1.7 miles upstream from the creek confluence with the Mississippi River. The station is located in T117N, R24W, Sec.14, on City of Minneapolis park property at 32nd Avenue South, approximately 1500 feet west (upstream) of MN Highway 55. The station was activated in 1999. Watershed area is 181 square miles, including Lake Minnetonka. Land use in the watershed is predominantly urban, with a substantial amount of upland lake and riparian wetland storage. The urbanized, lower watershed area below Lake Minnetonka is 55 square miles, or 31% of the total watershed area. The lower watershed area contributes most of the creek's annual pollutant loading into the Mississippi River at the confluence near Ft. Snelling. Above Lake Minnetonka, the predominant land use is agriculture and open space, with developing suburban areas.

Stage and flow are measured by a digital dry-gas pressure system and recorded by a Campbell datalogger. There is no rain gauge at this station. Other monitoring instruments include in-stream temperature and conductivity probes and an automatic sampler that captures event-generated flow-weighted composite samples to supplement monthly grab samples. The local cooperator is the Minneapolis Park and Recreation Board. Site rating curve measurements have been regularly obtained since 1999, and the rating curve is currently maintained by MCES staff.

6. Riley Creek in Eden Prairie, MN

RI 1.3 The Riley Creek monitoring station is located in Eden Prairie, MN, 1.3 miles upstream from the creek confluence with the Minnesota River. The monitoring station is located in T116N, R22W, Sec.33, at the base of a steep river terrace bluff. A box culvert situated underneath Flying Cloud Drive (MN Highway 212) serves as the site control structure. The station was activated in 1999. Watershed area is approximately 13 square miles. Land use in the watershed is dramatically transitioning from a former agricultural base to a suburban residential and commercial community. In 2000, about 31% of the watershed area was categorized as undeveloped or open space.

A Campbell datalogger continuously captures stage measurements from a digital sonic ranging sensor mounted under the box culvert. A staff gauge mounted on a wing of the box culvert serves as a reference stage. Other monitoring instruments include a tipping bucket rain gauge, in-stream temperature and conductivity probes, and an automatic sampler that captures event-generated flow-weighted composite samples to supplement monthly grab samples. Barr Engineering operates the station and maintains the rating curve on behalf of the Riley-Purgatory-Bluff Creek Watershed District.

7. Valley Creek in Afton, MN

VA 1.0 The Valley Creek monitoring station is located in Afton, MN, 1.0 mile upstream from the creek confluence with the St. Croix River. The station is located in T28N, R20W, Sec.15, on the southeast corner of the Putnam Boulevard Bridge. The station was activated in 1999. Valley Creek is an MDNR-designated trout stream situated in a groundwater discharge zone. Watershed area is approximately 16.8 square miles. Land use in the watershed is largely a mix of agriculture and rural residential development, although large tracts have been set aside in land trusts and restored to prairie. In addition, much of the riparian corridor is re-developing into floodplain forest following cessation of agriculture in the stream valley 30-40 years ago.

A Campbell datalogger continuously captures stage readings from a digital dry-gas pressure system. Other monitoring instruments include a staff gauge, in-stream temperature and conductivity probes, and an automatic sampler that captures event-generated flow-weighted composite samples to supplement monthly grab samples. Precipitation data is collected by a tipping bucket rain gauge on the Belwin property west of the station. The St. Croix Watershed Research Station (part of the Science Museum of Minnesota) operates the station and maintains the rating curve on behalf of the Valley Branch Watershed District.

8. Willow Creek in Burnsville, MN

WI 1.0 The Willow Creek monitoring station is located in Burnsville, MN, 1.0 mile upstream from the creek confluence with the Minnesota River. The station is located in T115N, R21W, Sec.14, behind the former Cub Foods store on MN Highway 13. The station was activated in 1999. Watershed area is approximately 10 square miles. Land use in the watershed is predominantly residential, with 20% open space and agriculture remaining.

A Campbell datalogger continuously captures stage readings from a digital sonic ranging sensor. Other monitoring instruments include a tipping bucket rain gauge, in-stream temperature and conductivity probes, and an automatic sampler that captures event-generated flow-weighted composite samples to supplement monthly grab samples. The automatic sampler and Campbell datalogger are housed in an above-ground shelter, while the other monitoring instruments are mounted in an underground box culvert. The rating curve at this site is based upon a Manning's equation, because it is too hazardous to enter the culvert with a wading rod during high flows due to confined space safety issues. Flow at this site is particularly "flashy" during storm events, due to the predominance of impervious cover in the watershed. Barr Engineering developed the Manning's equation and operated the station on behalf of the Black Dog Watershed Management Organization during the 2003-2004 period. During the 2004-2005 period, the Lower Minnesota River Watershed District assumed responsibility for the Willow Creek station and contracted with the Dakota County SWCD to conduct the monitoring work.

Additional information on the eight MCES WOMP sites is presented in **Appendix A.**

Monitoring Activity and Analyses

Since July 1999, seven WOMP stations have continuously logged stream flow, temperature and conductivity, with 15-minute average values reported. Bassett Creek was added to the network and activated in March 2000. All stations captured both water quality samples and continuous discharge data for snowmelt and storm-generated runoff during the 2004-2005 biennium. In addition, monthly base flow samples were collected at all sites. Six of the eight stations are equipped with rain gauges.

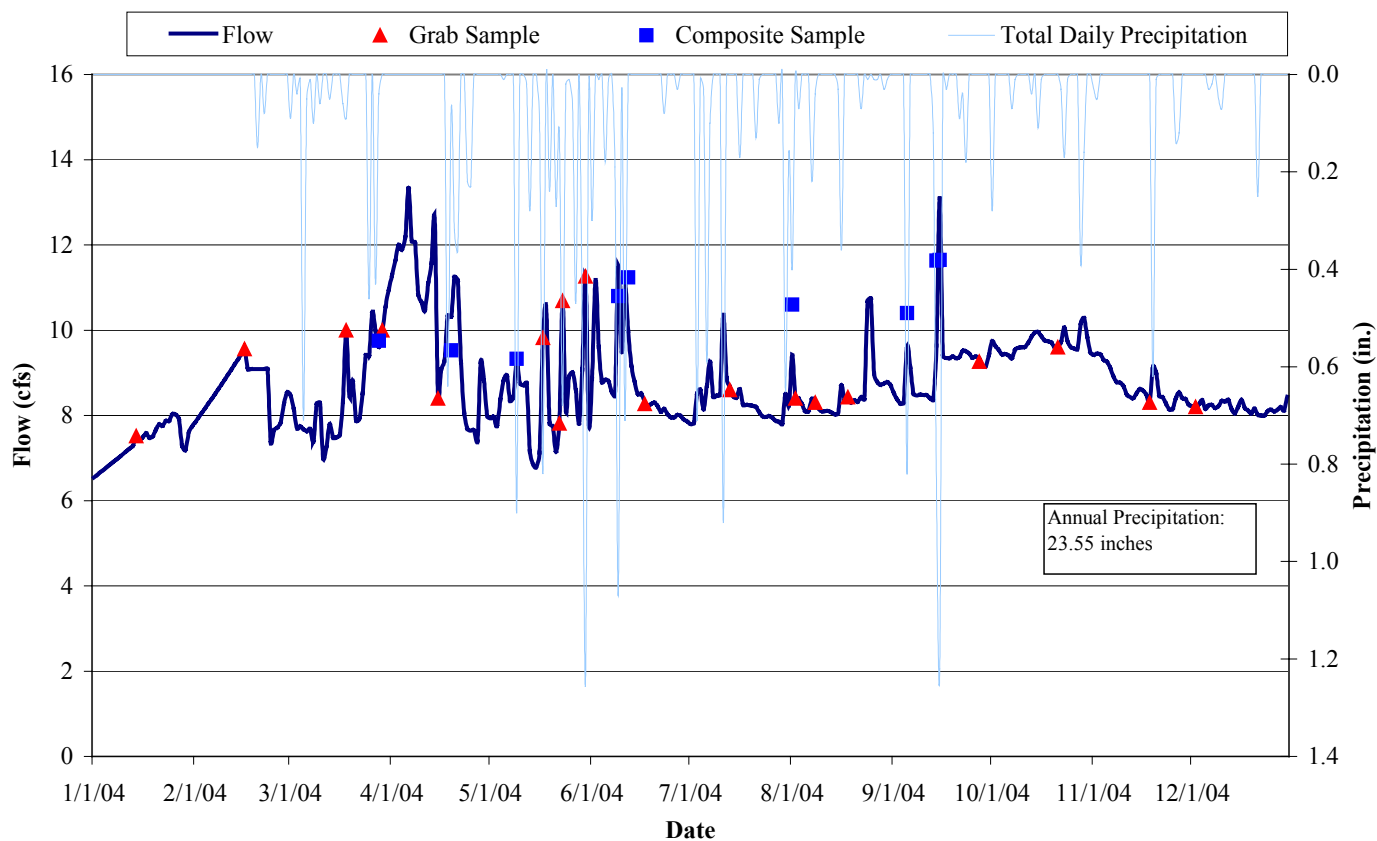
Table 2 summarizes the numbers of grab and composite samples obtained at each WOMP site during the 2004-2005 biennium.

Table 2. Numbers of Grab and Composite Samples Obtained at WOMP Monitoring Sites during the 2004-2005 Biennium

Station	No. of samples: COMPOSITES	No. of samples: GRABS
BASSETT CREEK	23	27
CANNON RIVER	23	33
CROW RIVER	23	26
EAGLE CREEK	19	31
MINNEHAHA CREEK	24	23
RILEY CREEK	21	22
VALLEY CREEK	24	24
WILLOW CREEK	28	27
TOTALS	185	213

Figure 2 illustrates the 2004 hydrograph for Eagle Creek. This hydrograph depicts the sampling strategy used for the collection of grab and composite samples. Composite samples are collected during periods of storm-generated runoff and higher flows. Grab samples are obtained during baseflow conditions, and are also collected as needed to supplement composite samples during high-flow periods.

Figure 2. 2004 Hydrograph, with Sampling Information, for Eagle Creek



All grab and composite samples are transported by the WOMP cooperators to the MCES Laboratory Services Section in St. Paul, MN. In addition to field measurements recorded at the time of collection, each sample can be analyzed for water transparency, total and volatile suspended solids, turbidity, alkalinity, hardness, metals, chlorides and sulfides, nitrogen, phosphorus, chlorophyll-a, total organic carbon (TOC), chemical oxygen demand (COD), biochemical oxygen demand (BOD), and fecal coliform bacteria. Table 3 shows the types and numbers of chemical analyses that were conducted on water samples from the eight WOMP sites during the 2004-2005 biennium.

Table 3. Types and Numbers of Chemical Analyses Conducted for WOMP Monitoring Sites during the 2004 – 2005 Biennium

	Bassett Creek	Cannon River	Crow River	Eagle Creek	Minnehaha Creek	Riley Creek	Valley Creek	Willow Creek	Total Analyses
Total Submissions									
Analytes									
Alkalinity	48	43	46	47	48	41	49	50	372
5-day BOD	44	25	35	36	42	27	30	38	277
Total Chlorophyll-a	17	12	15	23	16	18	10	15	126
Total Chlorides	48	43	46	47	48	41	48	50	371
Chemical Oxygen Demand	49	43	46	47	48	41	49	50	373
Fecal Coliform Bacteria	25	32	19	24	21	18	22	23	184
Hardness	49	43	46	47	48	41	49	50	373
Metals (Cu, Ni, Pb, Zn, Cd, Cr)	13	5	10	7	16	12	17	16	96
Nitrate and Nitrite Nitrogen	49	42	46	47	48	41	49	50	372
Ammonia Nitrogen	49	43	46	47	48	41	49	50	373
Total Kjeldahl Nitrogen	49	43	46	47	48	41	49	50	373
Total Phosphorus	49	43	46	47	48	40	48	50	371
Ortho Phosphorus	45	25	29	36	41	29	29	41	275
Dissolved Phosphorus	49	43	46	45	47	41	48	50	369
Total Sulfates	48	43	46	47	48	41	49	50	372
Total Organic Carbon	48	43	46	47	48	41	49	50	372
Total Suspended Solids	49	42	45	46	48	40	47	48	365
Volatile Suspended Solids	49	42	45	46	48	40	47	48	365
Turbidity	47	28	32	37	43	30	37	43	297
Total Analyses	824	683	736	770	802	664	775	822	6076

Cooperative Monitoring Partnerships

Local Monitoring Partners

With direction and oversight provided by MCES staff, local cooperators are conducting much of the field work associated with WOMP monitoring. Watershed districts, watershed management organizations, soil and water conservation districts, cities, and non-profit organizations participate as WOMP cooperators through sub-grant agreements with MCES. To support and encourage the participation of local partners, MCES provides \$4,000.00 of state funding per year for each monitoring site, to help offset each local partner's costs for monitoring labor, mileage, and materials and supplies. Since the flat reimbursement of \$4,000.00 per site does not cover all cooperator expenses, the local partners are also making significant investments in the monitoring program. MCES uses the remainder of the state funding to pay all costs for monitoring equipment, monitoring station maintenance, utilities, laboratory analysis of water samples, program coordination, data management, and report preparation.

Cooperators have been participating in a WOMP "user group" forum, which serves as a network for coordinating stream monitoring efforts and for facilitating training when new sampling protocols are introduced. MCES staff facilitate the meetings, which inform cooperators about any changes in data management, monitoring equipment, and technology. MCES will continue to conduct these meetings in response to cooperators' requests for training.

Appendix A provides a list of all WOMP cooperators and their contact information.

New Partnerships with Watershed Districts

The presence of MCES WOMP stations in watersheds throughout the Metropolitan Area has stimulated an increasing interest in stream monitoring by local governments. In 2002, the Nine Mile Creek and Riley-Purgatory-Bluff Creek Watershed Districts approached MCES with a request to build six new permanent water monitoring stations in the Nine Mile and Purgatory Creek Watersheds, and committed to pay for all construction, operating, and laboratory costs. These two watershed districts expressly asked that the new stations be modeled after the eight state-funded MCES WOMP stations. Both districts indicated a willingness to follow WOMP monitoring protocols and use the MCES laboratory for chemical analysis of all water samples.

Under a contract for services agreement, MCES built six new WOMP-style stations, including three new stations in the Nine Mile Creek watershed, and another three in the Purgatory Creek watershed. MCES trades staff built the stations in 2003, with guidance and oversight from Leigh Harrod. Monitoring began in 2004, and has been implemented according to WOMP protocols. The watershed districts reimbursed all MCES costs, thereby paying 100% of construction and equipment costs, representing a significant financial commitment to long-term continuous monitoring of their watersheds.

The fact that these local governments chose to model their monitoring program after the MCES WOMP program is a testament to the high regard they hold for this program, and to the value they place upon the need for reliable stream monitoring data.

Data Management and Reporting

Every six months, the continuous monitoring data from the WOMP stations are collected from the local cooperators and compiled by the MCES WOMP Coordinator in a specified file format. The WOMP Coordinator checks the data, removes anomalies, and corrects or estimates stream flow where appropriate.

Excel is currently the software tool that local cooperators use to store and report the continuous monitoring data from their stations. All the cooperators have been trained in the use of Campbell Scientific software so that they can download data in an identical manner. A pre-formatted Excel template has been developed for storage of their data. After the WOMP Coordinator checks the quality of the continuous monitoring data, the 15-minute data are condensed to daily average values for stage, flow, conductivity, and temperature, and total daily rainfall. These files are placed on a Metropolitan Council intranet location, where they can be easily accessed by MCES personnel, who can then provide the data to whoever may request it.

The results of all WOMP field measurements obtained by the local cooperators and all WOMP water quality analyses conducted by the MCES Laboratory are similarly subject to quality-checking by the WOMP coordinator. The field data and water quality analytical results are transferred into the MCES Water Quality Oracle database, which is linked to the Metropolitan Council's Environmental Information Management System (EIMS). The WOMP water quality data in EIMS are accessible to the public via the internet, at <http://es.metc.state.mn.us/eims/>.

A further analysis of the 2003 monitoring information from all MCES WOMP and Minnesota River sites can be found in the report: "Metropolitan Council Environmental Services 2003 Stream Monitoring Report". This report was prepared by MCES staff and distributed to the MPCA, other state and federal agencies, and the local WOMP partners at the end of 2004. For each monitoring station, the report provides a watershed land use map, an annual hydrograph with rainfall and sampling information, a summary of water chemistry information, annual loading information for suspended solids and nutrients, and macroinvertebrate monitoring results and metrics. The "Metropolitan Council Environmental Services 2004 Stream Monitoring Report" is currently being prepared for distribution at the end of 2005. Previous annual reports for 2001 and 2002 are also available on the Metropolitan Council website at: www.metrocouncil.org/environment/RiversLakes/Streams/StreamResults.htm.

Use of WOMP Monitoring Data

The number of requests for WOMP monitoring data continues to escalate as awareness of the program grows among the scientific community and general public. Consultants and agencies often report that they now focus the design of their hydrologic studies upon watersheds that have WOMP stations, because the WOMP datasets are purportedly the best available.

During the 2004-2005 biennium, the following public entities and private data users requested WOMP data:

Agency making Request	Area of Interest	Purpose of Request
2003		
Cannon River JPO	Cannon River @ Welch, flow and water quality data	Assess nonpoint source pollution loading into Lake Pepin
University of Minnesota	All WOMP data, all stations, full period of record	Graduate Thesis
U.S. NOAA	Precipitation and flow data, all stations, full period of record	Used to calibrate flood model for NOAA's Advanced Hydrologic Prediction Service

2004		
MCES staff	Flow data for Eagle, Riley and Willow Creeks	Water quality model for the Minnesota River
City of Minneapolis	Bassett and Minnehaha Creeks	Unknown
Crow River JPO	Crow River @ Rockford, all data	Watershed planning
Barr Engineering	Vermillion and Cannon River data	Watershed planning
MPCA staff	Crow River @ Rockford	Impaired Waters Program
MPCA staff	Riley Creek	Unknown
Cannon River Watershed Partners	Cannon River @ Welch	TMDL assessment, Impaired Waters program
Minnehaha Creek Watershed District	Minnehaha Creek data, all years	Hydrologic model
MN River Joint Powers Board	All WOMP stations in the MN River Valley	River modeling
EOR Consulting Engineers	Riley Creek	Assess impact of Hwy. 212 expansion on wetlands in Chaska, Chanhassen, and Eden Prairie, MN
USGS	Riley, Eagle, and Willow Creek data	Project planning for the MN River water quality model
Washington County	Valley Creek data, full period of record	Unknown

Agency making Request	Area of Interest	Purpose of Request
2005		
Riley-Purgatory-Bluff Creek Watershed District	Riley, Eagle, Willow Creek data	Watershed planning
Cannon River Watershed Partners	Cannon River @ Welch	TMDL assessment, Impaired Waters program
Black Dog WMO	Willow Creek data	Watershed planning
Lower Minnesota Watershed District	Eagle and Willow Creek data	Watershed planning
City of Minneapolis	Bassett and Minnehaha Creek	Stormwater planning
Scott County SWCD	Vermillion River	Scott County WMO planning

The list above summarizes only those requests for WOMP data received during the 2004-2005 biennium. However, it does not include another 14 requests received during 2004 for water quality data only. It also does not include data requests from previous bienniums, some of which were described in the 2002-2003 Biennial Progress Report.

In addition to external agency use, the local cooperators use WOMP data for their own watershed projects. Barr Engineering is cataloging Riley Creek, Willow Creek, and Bassett Creek WOMP data in anticipation of target pollutant loads development by MCES, TMDL studies by the MPCA, and implementation of MPCA Phase II stormwater rules in Hennepin County municipalities. Baseline data are directly supplied by the local cooperators for frequent use by their client base, such as developers, and municipalities. The local cooperators also make frequent use of WOMP data for their own internal purposes.

Contact Information for the Metropolitan Area Watershed Outlet Monitoring Program

Questions or comments about this report or the Metropolitan Area Watershed Outlet Monitoring Program may be directed to:

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Minnesota River Watershed Monitoring Program

Introduction

The “Mercury and PCB Inputs to the Minnesota River Monitoring Program” (now “Minnesota River Watershed Monitoring Program”) began in the fall of 1998, with the establishment of six monitoring stations in the vicinity of Mankato, MN. The program’s objective is to investigate sources and measure loads of mercury, PCB, and other nonpoint source pollutants in the Middle Minnesota River, Blue Earth River, and Le Sueur River Watersheds of the Minnesota River Basin. Two monitoring stations are located on the Minnesota River at Judson and St. Peter in the Middle Minnesota River Watershed. One monitoring station is located near the mouth of the Blue Earth River in the Blue Earth River Watershed. The three remaining monitoring stations are all located in the Le Sueur River Watershed. One station is located near the mouth of the Le Sueur River, and two stations are located on smaller tributaries (Little Cobb River and Little Beauford Ditch) in the Le Sueur River Watershed. Locations of the six Mankato Area monitoring stations are presented in Figure 3.

MCES Research and Development Section staff members (Steve Balogh and Tom Franz) in St. Paul provided support for the mercury and PCB monitoring components of the program, which concluded at the close of the 2002-2003 biennium. Results of the mercury monitoring work have been presented in numerous professional journal publications (references are listed in Appendix B). Results of the PCB monitoring work are summarized in the report: “PCBs in the Minnesota River Basin: 2001” (Franz and Reardon, 2003), which was included as Appendix B of the 2002-2003 Biennial Progress Report.

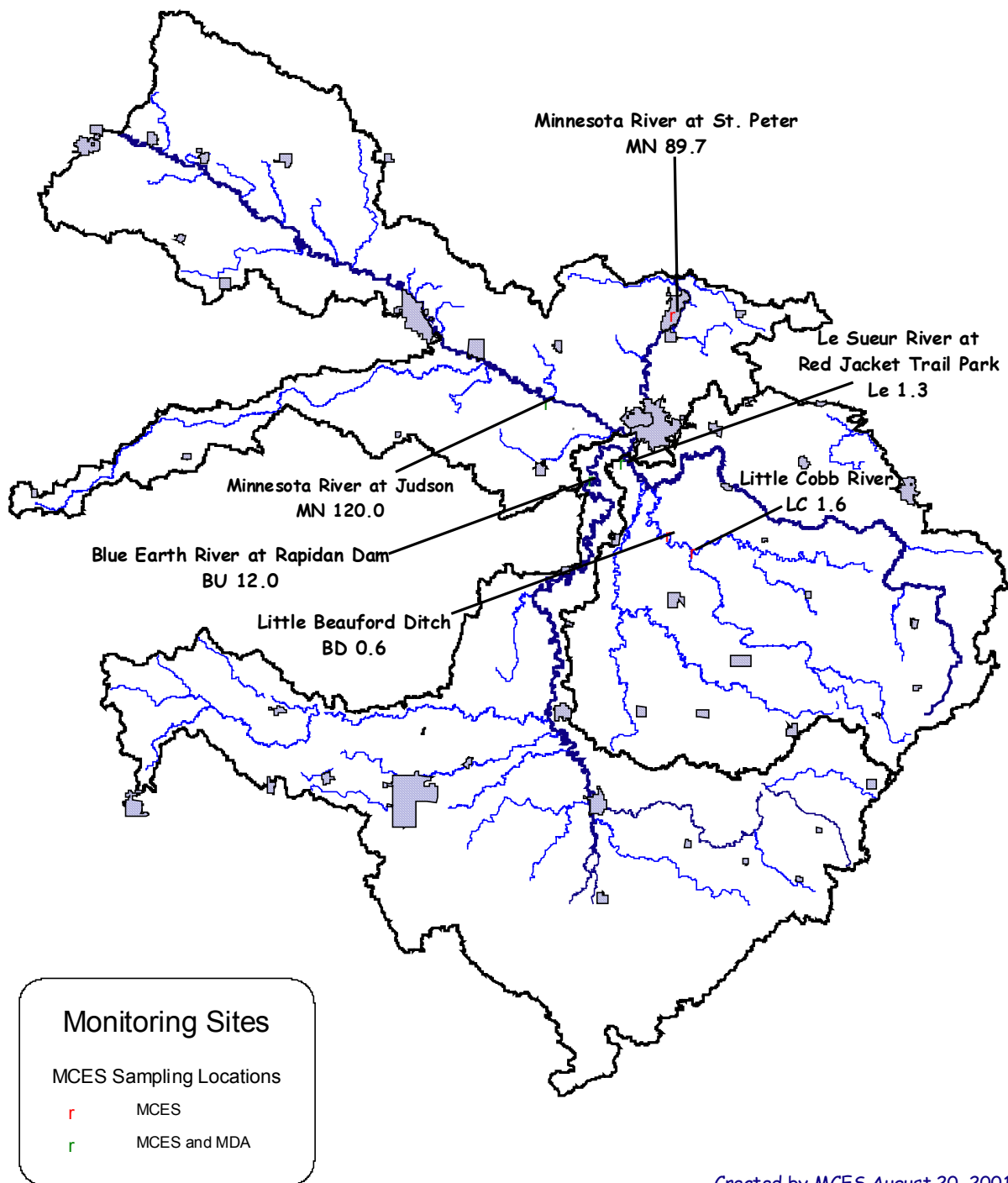
An MCES Environmental Monitoring and Assessment Section staff member (Heather Offerman) in the Mankato and St. Paul Field Offices provided support for conventional pollutant monitoring until November 2004. With program transfer to Minnesota State University-Mankato (MSU-Mankato) in January 2005, a staff member (Zachary Pagel) at the Water Resources Center (WRC) is now providing ongoing support for conventional pollutant monitoring.

This portion of the biennial report will describe the status of the “Minnesota River Watershed Monitoring Program” during the 2004-2005 biennium. No mercury or PCB monitoring was conducted during the 2004-2005 biennium. For conventional pollutant monitoring, information is provided about the monitoring site locations, monitoring equipment, rating curve development, monitoring results, cooperative monitoring partnerships, and data management, analysis, and reporting. The budget and financial accounting of funds used to date for this program are included in the **Budget** section of this report, which provides budget and financial information for both monitoring programs.

Figure 3

MCES Mankato Area Monitoring Sites

Blue Earth, Le Sueur, and Middle Minnesota Watersheds



Monitoring Site Locations and Descriptions

Land use in the Middle Minnesota River, Blue Earth River, and Le Sueur River Watersheds where the six monitoring stations are located is dominated by row crop agriculture, primarily corn and soybeans. A brief description of each monitoring station is provided below.

Middle Minnesota River Watershed:

Minnesota River near Judson, MN

MN 120.0 This Minnesota River monitoring station is located near Judson, MN, 120.0 miles upstream from the mouth of the Minnesota River, in T109, R28, S33, at the Minnesota Department of Natural Resources boat landing near Nicollet County Road 23 in Nicollet Township, Nicollet County. Watershed area is approximately 11,400 square miles

Minnesota River in St. Peter, MN

MN 89.7 This Minnesota River monitoring station is located in St. Peter, MN, 89.7 miles upstream from the mouth of the Minnesota River, in T110, R26, S21, behind the Chamber of Commerce Building near the MN Highway 99 Bridge in Oshawa Township, Nicollet County. Watershed area is approximately 15,500 square miles, encompassing 11 of the 12 major watersheds in the Minnesota River Basin.

Blue Earth River Watershed:

Blue Earth River near Rapidan, MN

BU 12.0 The Blue Earth River monitoring station is located near Rapidan, MN, 12.0 miles upstream from the confluence with the Minnesota River, in T107, R 27, S6, on the left descending river bank, 0.2 mile downstream from the power plant, in Rapidan Township, Blue Earth County. Watershed area is approximately 2,430 square miles.

Le Sueur River Watershed:

Little Beauford Ditch near Beauford, MN

BD 0.6 The Little Beauford Ditch monitoring station is located about 0.5 mile north of Beauford, MN, 0.6 mile upstream from the ditch confluence with the Little Cobb River, in T106, R26, S4, on MN Highway 22, in Beauford Township, Blue Earth County. Watershed area is approximately 7 square miles.

Little Cobb River near Beauford, MN

LC 1.6 The Little Cobb River monitoring station is located near Beauford, MN, 1.6 miles upstream from the river confluence with the Le Sueur River, in T106, R26, between S11 and S12, adjacent to the bridge on County Road 16, in Beauford Township, Blue Earth County. Watershed area is approximately 130 square miles.

Le Sueur River in Red Jacket Trail County Park

LE 1.3 The Le Sueur River monitoring station is located in the Red Jacket Trail County Park, 1.3 miles upstream from the river confluence with the Blue Earth River, in T108, R27, S34, 20 feet downstream from the MN Highway 66 Bridge, in South Bend Township, Blue Earth County. Watershed area is approximately 1,100 square miles.



The Le Sueur River
Monitoring Location,
May 2003

Monitoring Equipment

The following is a general description of the monitoring equipment at each site, with exceptions noted.

All six monitoring sites have AC power and phone line connections to the shelter. Power is converted to DC with a Campbell Scientific Inc. (CSI) CH12R regulator charger. The data collection platform consists of a CSI CR10X datalogger with extended memory. The system operates with a 60-second execution interval and data are averaged and saved as output on a 15-minute basis. Stage is measured using a Design Analysis (DA) H350 Pressure Transducer and H355 dry gas bubbler system. The orifice for the bubbler is typically located in the stream, except at the Blue Earth River site below the Rapidan Dam, where the bubbler orifice is located in a USGS stilling well below the USGS building. Adjustments are made to the bubbler when readings deviate from actual stage by more than 0.02 foot. At several sites, stage measurements are also recorded as a backup on a PCMCIA flash memory card in the H350 instrument. Continuous in-stream temperature and conductivity are also recorded at most sites. Rainfall data are collected at all sites using a TE525 tipping bucket rain gauge. Regular or Refrigerated Sigma 900 autosamplers are used to collect storm runoff samples on an Equal Flow Increment (EFI) basis.

At the Judson and St. Peter sites on the Minnesota River, and at the Blue Earth River site below the Rapidan Dam, in-stream pumps are used to transfer water from the river to the monitoring shelter because of the large lift between the river and the shelters. The water is pumped into a reservoir in the shelter and the autosamplers sample from the reservoir. The in-stream pump is activated by the datalogger several minutes ahead of the actual sample collection, allowing the system to effectively purge prior to sample collection. Sample tubing connecting the shelter to the stream consists of both polypropylene and Teflon-lined polypropylene. All sites are equipped with heat tape to keep sample lines from freezing during cold weather.



Blue Earth River Monitoring Site, August 2002. The PVC pipe contains the gas bubbler line, pump line, and temperature and conductivity probes, which run from the river up to the monitoring station.

Conventional Pollutant Monitoring

The conventional pollutant monitoring component of the program has been successfully operating since 1998. A unique aspect of this component is the joint partnership between MCES, the Minnesota State University-Mankato Water Resources Center (MSU-Mankato WRC), and the Minnesota Department of Agriculture (MDA). Through November 2004, MCES and MDA staff shared office space in Mankato and monitoring responsibilities at three of the six monitoring locations. With program transfer in January 2005, the MSU-Mankato WRC continues to provide office space for the MDA staff member (Bill VanRyswyk). MDA shares monitoring duties and collects samples at the Le Sueur River, Blue Earth River, and Minnesota River at Judson sites, to quantify the long-term trends and impacts of normal pesticide use on surface water quality. This partnership is a functional template that illustrates the effectiveness of different government agencies working together toward a common goal, and how resources can be used in the most beneficial manner, with minimal duplication.

All six Mankato Area monitoring sites remain fully operational. Data are logged continuously for water stage and flow, temperature, conductivity, and precipitation. Flow-composited samples are generated automatically during runoff events, and a bi-weekly grab sampling routine has been established at all sites. Grab samples characterize water quality under base flow conditions and supplement the automated composite samples taken during runoff events. Grab sampling is conducted year round as conditions permit, while composite sampling is typically conducted during the open-water season (March – October). Due to re-construction of the Nicollet County Road 23 Bridge in 2004, the Judson (Minnesota River) monitoring station had to be relocated in 2003, and automated sampling was not possible for most of the year. To circumvent this problem, frequent grab samples were collected to fully characterize water quality during runoff events at this location.

The monitoring record for the six Mankato Area sites has grown each year, beginning in 1999. In 1999, only a partial monitoring record is available for all sites, since the flow monitoring equipment was not installed until the summer months. Due to high water conditions at the two Minnesota River sites, monitoring equipment was not installed until October 1999. Thus, the year 2000 marked the first complete year of water quality monitoring at all six sites.

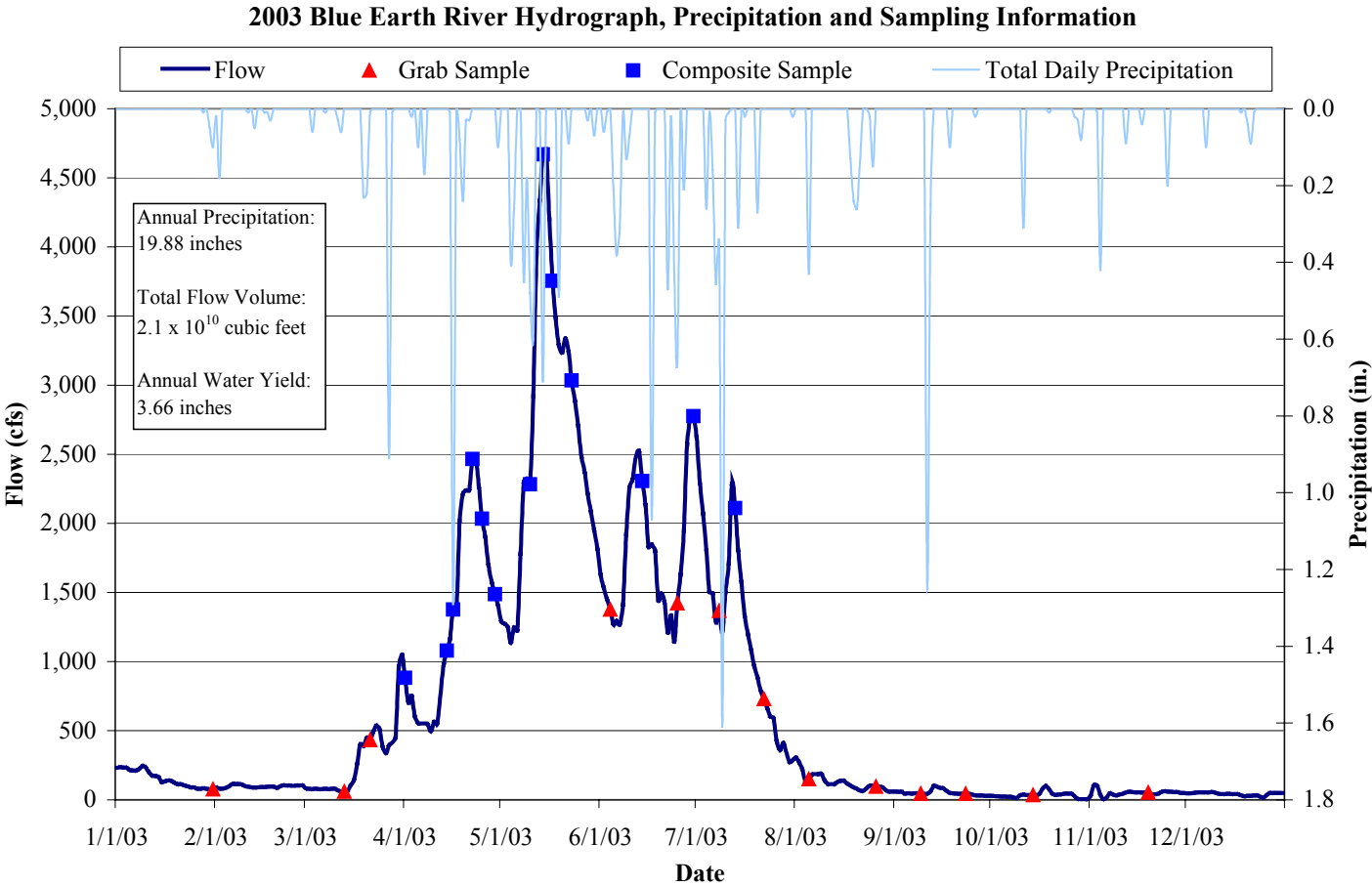
Table 4 summarizes the numbers of grab and composite samples obtained at each site during the 2004-2005 biennium. As of June 30, 2005, approximately 1,570 grab and composite samples have been collected from the six monitoring locations since the program began in 1999.

Table 4. Numbers of Grab and Composite Samples Obtained at Mankato Area Monitoring Sites during the 2004-2005 Biennium

Station	No. of samples: COMPOSITES	No. of samples: GRABS
Beauford Ditch	18	38
Blue Earth River	9	53
Le Sueur River	31	64
Little Cobb River	25	33
MN River @ Judson	6	55
MN River @ St. Peter	16	50
TOTALS	105	293

Figure 4 illustrates the 2003 hydrograph for the Blue Earth River. This hydrograph depicts the sampling strategy used for the conventional pollutant monitoring component of the program. Composite samples are collected during periods of storm-generated runoff and higher flows. Grab samples are obtained during baseflow conditions, and are also used as needed to supplement composite samples during high-flow periods.

Figure 4. 2003 Hydrograph, with Sampling Information, for the Blue Earth River



All grab and composite samples are transported by project personnel or by courier to the MCES Laboratory Services Section in St. Paul, MN. Each sample can be analyzed for water transparency, total and volatile suspended solids, turbidity, alkalinity, hardness, metals, chlorides, nitrogen, phosphorus, chlorophyll-a, total organic carbon (TOC), chemical oxygen demand (COD), and biochemical oxygen demand (BOD). Table 5 shows the types and numbers of chemical analyses that have been conducted on water samples from the six monitoring sites during the 2004 – 2005 biennium.

Table 5. Types and Numbers of Chemical Analyses Conducted for Mankato Area Monitoring Sites during the 2004 – 2005 Biennium

	Beauford Ditch	Blue Earth River	Le Sueur River	Little Cobb River	Minnesota River at St. Peter	Minnesota River at Judson	Total Analyses
Total Submissions							
<i>Analytes</i>							
Alkalinity	48	59	72	61	57	59	356
5-day BOD	23	22	28	25	30	28	156
Total Chlorophyll-a	40	45	47	45	51	48	276
Total Chlorides	47	51	64	58	54	55	329
Chemical Oxygen Demand	38	43	41	45	48	44	259
Hardness	25	34	31	33	36	33	192
Metals (Cu, Ni, Pb, Zn, Cd, Cr)	25	34	32	34	36	32	193
Nitrate and Nitrite Nitrogen	52	59	73	62	57	59	362
Ammonia Nitrogen	52	58	72	62	56	59	359
Total Kjeldahl Nitrogen	53	59	73	62	57	59	363
Total Phosphorus	53	59	73	62	57	59	363
Ortho Phosphorus	52	60	78	59	57	62	368
Dissolved Phosphorus	53	61	79	61	58	63	375
Total Sulfates	37	45	47	46	49	46	270
Total Organic Carbon	38	45	45	45	51	47	271
Total Suspended Solids	53	59	93	62	57	59	383
Volatile Suspended Solids	53	59	93	62	57	59	383
Turbidity	52	59	73	61	57	59	361
Total Analyses	794	911	1114	945	925	930	5619

Rating Curve Development

To ensure the ongoing collection of good stream flow information, rating curves have been developed for all six Mankato Area sites and are continually being refined. Some of the rating curves are based upon historical USGS data or other historical data, such as measurements made by the National Weather Service. Rating curves have also been developed based upon field stage measurements and interpolated flow measurements.

Flow measurements are obtained by a variety of methods. Flows at the two Minnesota River sites (Judson and St. Peter) and higher flows at the LeSueur and Blue Earth River sites are measured with an Acoustic Doppler Current Profiler (ADCP), which gives a complete picture of the channel geometry and flow velocity across a river transect. When the streams are wadeable, a USGS Price Meter with Aqua Calc 5000 is used to calculate the discharge. Because important high flow measurements were being missed, a USGS bridge board with accompanying sounding reel was acquired in 2001. This allows MCES, MSU-Mankato, and MDA field personnel to take measurements during higher flow conditions.

Manual flow measurements will continue to be made as time and resources permit. Special emphasis will be placed upon collecting low-flow and high-flow measurements, which are needed at all sites to better refine rating curves.

Initial Results: Conventional Pollutant Monitoring

Estimates of 2003 total suspended solids, nitrate-nitrite nitrogen, total phosphorus, and ortho-phosphorus loads at all Mankato Area monitoring sites are presented in Table 6. Analysis of 2004 results is currently in progress. MCES uses FLUX software and a manual method to calculate these annual pollutant loads. FLUX is an interactive program that allows a user to estimate loads and flow-weighted mean concentrations (FWMCs) by combining grab sample concentration data and continuous flow measurements for the annual sampling period.

Because FLUX is designed to use mean daily flows coupled with grab sample chemistry data, flow-composited samples that were collected over a period of greater than one day required slight adjustments when the FLUX input files were prepared. This adjustment consisted of selecting a day to represent the sample (generally the last full day of the composite) and calculating an instantaneous flow. Instantaneous sample flows were derived by dividing the total flow volume (in cubic feet) for the composite sample by the total number of seconds elapsed during the composite sample collection period, thereby providing an average composite flow in cubic feet per second. A potential complication of this methodology is that the concentration range from low to high is theoretically smaller with composite samples than with grab samples. As such, automated composite samples, while better at characterizing total flow concentrations, do not represent either the maximum or minimum concentration at one point in time on an event hydrograph.

The manual method was used to calculate 2003 loads for Little Beauford Ditch and the Little Cobb River. The manual method determines loads and FWMCs by calculating discrete flow period (stormflow and baseflow) volumes and assigning concentrations to the discrete volumes based upon samples collected during that flow period. Equal flow increment stormflow sampling lends itself well to this sort of analysis, since stormflow sample concentrations represent flow-based averages over the respective hydrograph period. Concentrations are assumed static during flow periods (base flow and stormflow) until another sample is collected.

Table 6. 2003 Pollutant Loads (in Tons) at Mankato Area Monitoring Sites

Monitoring Site	Total Suspended Solids	Nitrate- Nitrite Nitrogen	Total Phosphorus	Ortho- Phosphorus
Minnesota River at St. Peter*	356,000	17,565	669	165
Minnesota River at Judson*	184,000	6,028	373	112
Blue Earth River near Rapidan	74,500	7,520	138	36
Le Sueur River in Blue Earth County	80,800	4,330	114	28
Little Cobb River near Beauford (Hwy 16)	4,870	470	9	3
Little Beauford Ditch near Beauford (Hwy 22)	460	55	1	0.4

* Growing season (April-September) loads

A much more in-depth analysis of the monitoring data from the Mankato Area monitoring sites can be found in the annual (2000-2003) “State of the Minnesota River: Summary of Surface Water Quality Monitoring” reports, jointly prepared by MCES, MDA, MPCA, and the Minnesota State University-Mankato Water Resources Center. Additional data and information on the Mankato Area monitoring sites can be found in the annual (2001-2003) “Metropolitan Council Environmental Services Stream Monitoring Report”, prepared by MCES.

Cooperative Monitoring Partnerships

Minnesota Department of Agriculture (MDA)

MCES and MSU-Mankato have established an important monitoring partnership with the Minnesota Department of Agriculture (MDA). Initially, MCES and MDA cooperatively established a shared field office in Mankato, and the two agencies worked closely together to further develop the Le Sueur River, Blue Earth River, and the Minnesota River at Judson monitoring stations. The MDA conducts pesticide monitoring at these three stations and has been sharing responsibility with MCES and MSU-Mankato for collection of the conventional water quality samples associated with the Minnesota River Watershed Monitoring Program.

United States Geological Survey (USGS)

The U.S. Geological Survey (USGS) is an invaluable source of historical stage and flow information. All of the MCES/MSU-Mankato monitoring stations are located at or near sites which are currently being gauged by the USGS, or which have been gauged by the USGS in the past. This USGS information is the basis for the preliminary rating curves for all six monitoring stations. At the Little Cobb River and the Blue Earth River sites, the MCES/MSU-Mankato monitoring stations are located next to the USGS stations, where stream stage and flow are being measured. Because of the close proximity, USGS is able to draw from the electrical power in the MCES/MSU-Mankato stations to power their own equipment, eliminating the need for heavy, awkward marine batteries.

The USGS publishes its stage and flow information on the web. For the Little Cobb River site, information can be found at:

http://waterdata.usgs.gov/mn/nwis/uv/?site_no=05320270&PARAMeter_cd=00065,00060

For the Blue Earth River site, information can be found at:

http://waterdata.usgs.gov/mn/nwis/uv/?site_no=05320000&PARAMeter_cd=00065,00060

The Le Sueur River monitoring station is located one mile downstream from USGS stream gauging station number 05320500. The data from the USGS station are used to help develop the rating curve for the Le Sueur River monitoring station. The preliminary stage and real-time flow data for this USGS station can be found at:

http://waterdata.usgs.gov/mn/nwis/uv/?site_no=05320500&PARAMeter_cd=00065,00060

Minnesota Pollution Control Agency (MPCA)

MCES has been supporting a monitoring study conducted by Laurie Sovell from the MPCA office in Mankato. The study is determining the effectiveness of a new piece of monitoring equipment, the transparency tube. Volunteer citizen monitoring groups are using the tube to assess water clarity in streams and rivers. The MPCA is trying to establish a relationship between transparency tube measurements of water clarity and laboratory measurements of turbidity and total suspended solids concentrations. MCES incorporated transparency tube measurements into the sampling routine, and has been contributing all relevant data to the MPCA study.

Minnesota State University-Mankato

MCES has been working cooperatively with the Water Resources Center (WRC), which is housed at Minnesota State University-Mankato. Since July 1, 2003, the WRC has been providing office space for MCES and MDA staff. The benefits of having three organizations housed in the same facility have greatly enhanced collaboration on projects addressing Minnesota River Basin issues.

During the 2004-2005 biennium, MCES, MPCA, and Minnesota State University-Mankato discussed an opportunity to transfer responsibility and implementation of the “Minnesota River Watershed Monitoring Program” to the Water Resources Center at MSU-Mankato. The program transfer from MCES to MSU-Mankato occurred on January 1, 2005. The MSU-Mankato Water Resources Center has become a leader and advocate for Minnesota River Basin education and outreach, research, data management and assessment, technical support, and planning and coordination; so transfer of the MCES Minnesota River monitoring program to MSU-Mankato will further enhance the Water Resources Center mission and emphasize the importance of water quality monitoring in the Minnesota River Basin.

Local Cooperators

MCES and MSU-Mankato have established important monitoring partnerships with many local cooperators in the Mankato Area. Among these are staff from the local MDNR, MPCA, and MNDOT offices, staff from the Blue Earth County Roads and Parks Departments, Blue Earth and Nicollet County water planners, and several private citizens.

Data Management, Analysis, and Reporting

All of the flow and water quality data collected by the dataloggers have been summarized in an Excel database, and have been made accessible to the MPCA and other water resource professionals. The Excel database for each site is organized into monthly worksheets. Data are reported as 15-minute average values for stage, flow, temperature, and conductivity, and as 15-minute total values for precipitation. In addition, a special line of data is written each time the autosampler collects a water sample. This detailed information is summarized into daily, monthly, and annual averages.

All of the analytical chemistry results from the MCES laboratory are currently stored in the MCES Water Quality Oracle database and are web-accessible via the Metropolitan Council's Environmental Information Management System (EIMS), at <http://es.metc.state.mn.us/eims/>. This information is also summarized in Excel spreadsheets and can be readily provided to the MPCA and other water resource professionals. Annual pollutant load estimates for all six Mankato Area monitoring sites have been calculated for the 2000-2003 period, using FLUX and the manual load estimation method.

Further analysis of all MCES and MSU-Mankato monitoring data and information, along with information from other agency monitoring sites in the Minnesota River Basin, can be found in the annual (2000-2003) "State of the Minnesota River: Summary of Surface Water Quality Monitoring" reports, jointly prepared by MCES, MDA, MPCA, and the Minnesota State University-Mankato Water Resources Center. Additional data and information on the Mankato Area monitoring sites can be found in the annual (2001-2003) "Metropolitan Council Environmental Services Stream Monitoring Report", prepared by MCES.

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Monitoring Lessons Learned

Experience gained since establishment of the WOMP and Mankato Area monitoring stations in 1998 continues to be valuable. Lessons learned in hindsight frequently lead to changes in procedures and station design. Had some of the lessons learned through hindsight initially been known when the program started, they could have been incorporated from the outset.

Through each biennium since 1998, the list of monitoring lessons learned has grown. Below are several important lessons gained through experience, which in the end have not only strengthened the existing program, but can be applied to development of future stream monitoring networks.



- **Flow-weighted Composites vs. Grab Samples --- You Need Both:**

The water quality data clearly indicate that most nonpoint source pollution loading occurs during large, prolonged runoff events generated by snowmelt or heavy rainfall. Because the monitoring stations are equipped with automated samplers, it is feasible to collect a flow-weighted composite sample that characterizes stream water quality for the entire duration of each runoff event. Grab samples alone do not characterize the water quality of a major runoff event as well as a composite sample of the entire event, because a single grab sample is reflective of the water quality at the time of its collection only, regardless of where it fits within the scope of the entire event.

Grab samples of runoff events are also more labor intensive and difficult to schedule, particularly in smaller streams with “flashy” flow regimes. Grab sampling depends upon field personnel to be available on short notice whenever a major runoff event occurs, which often is at night and/or on weekends. However, grab samples are an important part of the sampling protocol because they can readily characterize water quality when the flow regime is stable. Grab samples collected monthly and interspersed between the major runoff events greatly improve the data distribution needed for reliable FLUX modeling. FLUX calculations estimate the total sediment and nutrient loads for a watershed, on an annual or seasonal basis.

- **Expect the Unexpected:**

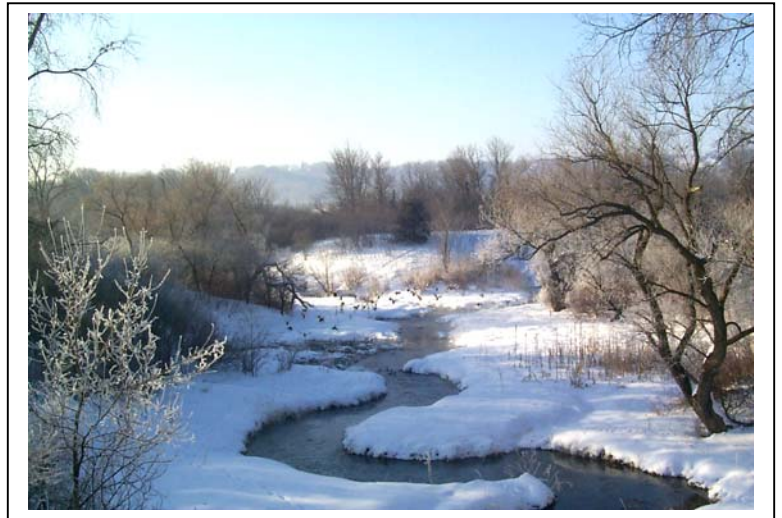
Another example of monitoring lessons learned can be seen in this picture of the Minnesota River at Judson. During ice-out conditions in the spring of 2003, the pump and the 8-foot log to which it was attached were completely lifted out of the water and deposited on the shore.



When equipment fails, automated collection of flow-weighted composites is usually no longer possible. The sampling protocols must switch to weekly grab samples until the situation is restored. Grab samples are labor intensive and do not characterize runoff events as well as composite samples. Until repairs are made, however, there is little alternative. In the case of the displaced pump in the Minnesota River at Judson, repairs could not be completed until the water level receded enough so the equipment could be recovered, repaired, and remounted.

- **Use Heat Tape if You Can:**

Minnesota winters are conducive to the formation of ice in streams and rivers. Heavy ice can easily destroy in-stream sensors, bubbler lines, transducers, sample intake lines, and temperature probes. To avoid this, monitoring stations should be equipped with heavy commercial braided heat tape that runs through the same buried conduit that houses the sample lines and signal wires for other in-stream probes. The heat tape terminates in the stream, and creates a small area where ice conditions cannot be sustained.



By using heat tape, all probes can remain installed in the stream throughout the year, and the sample intake lines are not compromised by ice. Continuous heat in the conduit cannot be sustained using only DC batteries as the power source. Rather, heat tape requires access to a constant AC power supply, which has been provided at most WOMP and Mankato Area monitoring stations.

The in-stream probes at WOMP and Mankato Area monitoring stations remain in place during the winter. Therefore, stream flows can be captured during the first large snowmelt event, and composite samples can be obtained during this critical time period. These data are very important for accurate quantification of annual or seasonal pollutant loads. Monitoring stations powered only by heavy-duty marine batteries are typically unable to capture the spring snowmelt event, since the in-stream transducers and sample lines must be removed each fall to avoid ice damage.

This equipment cannot be reinstalled until well after the spring snowmelt event is over, the ice is gone, and the water stage has returned to a level where it is safe to re-enter the stream to reinstall them.

- **Power Supply Can be Fickle:**

Even though the WOMP stations are all served by commercial AC power supply, this source of energy can become unstable, particularly during electrical storms. The dataloggers and samplers all have battery backup, but these deplete fairly rapidly without restoration of AC power to recharge them. Sometimes something as simple as a ground fault interrupter being tripped by a power surge can cause the trickling recharge system to fail. Field staff, being surprised to see no display in the LCD of the sampler, may initially conclude that the sampler itself has failed when actually the culprit is the AC power supply. The lesson learned is as follows: One should always suspect power supply problems first before examining or replacing the equipment.

- **Pests:**

Pests cause sampling problems. Many of the monitoring shelters have become home to some type of pest, which, if persistent enough, can cause problems. At the Le Sueur River station, a huge infestation of army ants in the refrigerated sampler caused delays in sample collection. At other locations, mice gain access to the shelters during winter through openings in the exterior vent fans or utility conduits. Once inside, they like to warm themselves on the heat tape inside the same conduit that houses the sample lines and instrument wires. The best solutions are to use flypaper materials and baits to trap insects such as ants. Keep hornet sprays available to deter wasps from using the shelter masts or the rain gage as supports for their nests. Mice can be managed with poisons, but use pipe sealer to close off the ends of the conduit inside the shelter. Also, cover the vent fan openings to the outside before winter begins.



- **Bridges Don't Last Forever:**

Bridges often provide good locations for monitoring stations, as they afford safe, convenient access above the high-water mark. When long-term monitoring sites are constructed, it is hoped that the bridges by which they are stationed will be stable and safe. However, all bridges have a life span, and the Nicollet County Road 23 Bridge over the Minnesota River at Judson, MN was removed and replaced with a new bridge in 2004. This meant that the monitoring station at Judson had to be moved to a new location in 2003, entailing a year of talking with county officials, drawing up plans, thinking about possible new station locations, and starting over when plans don't fit the county engineer's ideas. When placing a monitoring station on or near a bridge, it is important to take into consideration the age and condition of the bridge, so the costly problem of moving a long-term station can be avoided if at all possible.

- **Daily Data Downloading:**

The Campbell datalogger software has the capability to automatically download stored data on a schedule, independent of whether or not the station operator is present at the computer. A daily data download can always be conducted manually, but experience has found that the use of the automatic download feature is more efficient. Statistics displayed after each download can quickly alert the data owner if a potential problem exists at the station.

- **Program Coordination is Essential:**

Regular, on-going coordination and oversight of the local partners supporting the Watershed Outlet Monitoring Program (WOMP) is essential to a successful program. A program with this many monitoring stations and partners must have oversight to ensure that the standardized monitoring and data management protocols are being followed; otherwise, each cooperator can quickly diverge into their own way of doing things. If this tendency to diverge were allowed to occur unchecked or unnoticed, then the integrity of the monitoring data would ultimately become compromised. Additionally, since rainfall often occurs late at night, on weekends, or on holidays, the availability of a WOMP Coordinator assures that the stations are still being managed remotely even during off-duty hours. Opportunities to check the status of the stations, activate the automatic samplers, and capture event-generated composite samples are not missed simply because they occur when no one is at the office. WOMP coordination also figures prominently when local cooperators are unable to address equipment failure or a need for station maintenance.

- **Data Management is as Important as Monitoring:**

After WOMP stations started appearing on the landscape near the outlets of Metro Area watersheds, several local governments determined that they too wanted to have continuous stream monitoring become part of their own watershed management programs. The Watershed Outlet Monitoring Program (WOMP) has done a good job demonstrating how to build stations, install instruments, and conduct fieldwork. But what many of the local governments may not fully consider when designing their own monitoring network is that they must also plan to organize and manage the huge volume of data that each station generates. Both flow data and water quality data must be properly collected, managed, checked, edited, stored, and retrieved.

- **Report Your Monitoring Results:**

Each year, MCES staff produce an annual stream monitoring report that presents the results of monitoring conducted at all Metro and Mankato Area sites. For each monitoring station, the report provides a watershed land use map, an annual hydrograph with rainfall and sampling information, a summary of water chemistry information, annual loading information for suspended solids and nutrients, and macroinvertebrate monitoring results and metrics. In addition, MCES, MDA, MPCA, and the Minnesota State University-Mankato Water Resources Center staff jointly prepare an annual “State of the Minnesota River: Summary of Surface Water Quality Monitoring” report that presents the results of monitoring conducted by numerous agencies at sites throughout the Minnesota River Basin. These reporting tasks have been made easier by establishing consistent data file formats and data checking procedures that are common to all stations across the network.

During the 2004-2005 biennium, MCES staff conducted all of the data checking for the monitoring stations described in this biennial report. Beginning in January 2005, the Water Resources Center at Minnesota State University-Mankato assumed responsibility for both the monitoring and data checking work for the six stations in the Mankato Area.

Metropolitan Council Environmental Services 2003 Stream Monitoring Report



Prepared by:

Cassandra Champion, Leigh Harrod, Karen Jensen, Kent Johnson,
Heather Offerman, and Tim Pattock

Environmental Quality Assurance Department
January, 2005



<http://www.metrocouncil.org/environment/RiversLakes/Streams/StreamResults.htm>

Budget

Combined Programs: Costs for the 2004 – 2005 Biennium

Cost accounting for both the “Metropolitan Area Watershed Outlet Monitoring Program (WOMP)” and the “Minnesota River Watershed Monitoring Program” has been continuously tracked by MCES program staff, the Metropolitan Council’s internal accounting department, and the MSU-Mankato Water Resources Center. The \$500,000 grant from the MPCA for the 2004 – 2005 biennium is being disbursed to MCES and the MSU-Mankato Water Resources Center as specified by the MPCA/MCES grant contract, the MPCA/MCES grant contract amendment, and the MPCA/MSU-Mankato grant contract. First and second installments of \$12,303.36 and \$237,696.64, respectively, were received by MCES in December 2003, and a third installment of \$123,300 was received by MCES in November 2004. A first installment of \$69,030 was received by the MSU-Mankato Water Resources Center in early 2005. The remaining \$57,670 is being withheld by the MPCA until MCES and MSU-Mankato submit this 2004-2005 biennial progress report in August 2005. As indicated in the work plans accompanying the grant agreements, the estimated budget for the Metropolitan Area Watershed Outlet Monitoring Program during the 2004-2005 biennium was \$323,000, while the estimated budget for the Minnesota River Watershed Monitoring Program was \$177,000. The expenditures in Table 7 below reflect the actual costs for both programs during the period from July 1, 2003 through June 30, 2005.

Table 7. Program Expenditures from July 1, 2003 through June 30, 2005

Program	WOMP \$323,000 MCES	MN River \$100,300 MCES	MN River \$76,700 MSU-Mankato	Total \$500,000
Staff Labor	138,522.71	36,426.98	8,998.11	183,947.80
WOMP Grants and Contracted Services	52,165.89	198.94	0.00	52,364.83
Materials and Supplies and Office Expenses	4,447.41	875.32	550.95	5,873.68
Monitoring Equipment	0.00	0.00	629.91	629.91
Monitoring Maintenance	0.00	0.00	185.01	185.01
Monitoring Utilities	13,927.49	4,858.37	726.20	19,512.06
Laboratory Expenses	46,317.60	25,068.40	15,701.26	87,087.26
Professional Development and Travel Expenses	1,034.17	745.00	192.75	1,971.92
Miscellaneous	1,027.86	0.00	424.75	1,452.61
Agency Indirect Costs	0.00	0.00	933.28	933.28
TOTAL	257,443.13	68,173.01	28,342.22	353,958.36
Surplus	65,556.87	32,126.99	48,357.78	146,041.64

The accounting figures in Table 7, although based upon information provided by the Metropolitan Council's accounting department and the MSU-Mankato Water Resources Center, should be regarded as preliminary. For more detailed accounting information on these two programs, please contact Mary Elverum (651-602-1084) in the Metropolitan Council's accounting department or Diane Ovrebo (507-389-5492) at the MSU-Mankato Water Resources Center.

Table 7 indicates that, as of June 30, 2005, a surplus existed in the approximate amount of \$146,041.64. The MPCA/MCES and MPCA/MSU-Mankato grant contracts allow the continuing expenditure of this remaining balance through June 30, 2006, to support both monitoring programs. As per the terms of the grant contracts, MCES has \$97,683.86 remaining to spend on the Metropolitan Area Watershed Outlet Monitoring Program, and MSU-Mankato Water Resources Center has \$48,357.78 remaining to spend on the Minnesota River Watershed Monitoring Program.

Goals for the 2006 – 2007 Biennium

The first biennium (1998-1999) of the Interagency Water Monitoring Initiative focused on implementation of the two MCES water monitoring programs. Monitoring stations were built, personnel were hired, and contracts with cooperators were established. Both monitoring programs were in a start-up phase.

The second biennium (2000-2001) reflected the emphasis placed upon coordination and operation of what is now a sizeable monitoring network.

During the third biennium (2002-2003), program managers and participants had the benefit of being fully operational, as well as the advantage of experience. New tools and activities were initiated for both MCES monitoring programs, including an increased emphasis on data analysis and reporting. Three key reports were prepared to document stream and river conditions during the 2000-2001 period: “State of the Minnesota River: Summary of Surface Water Quality Monitoring 2000”, “State of the Minnesota River: Summary of Surface Water Quality Monitoring 2001”, and the “Metropolitan Council Environmental Services 2001 Stream Monitoring Report”. These monitoring, data analysis, and reporting enhancements reach beyond the standard monitoring tasks outlined in the MCES program work plans. Implementation of these goals in the third biennium not only enhanced the monitoring programs, but also increased public awareness of the importance of these programs for characterizing the quality of Minnesota’s water environment.

During the fourth biennium (2004-2005), monitoring work continued at the 14 Metro and Mankato Area monitoring stations, with 2005 marking the seventh consecutive year of water data collection at these locations. This developing long-term record is proving essential for documenting trends in water quality concentrations and pollutant loads, evaluating water quality differences between streams, relating water quality to land use practices, prioritizing water quality improvement work, and evaluating water quality improvements as best management practices are applied to both point and nonpoint sources of pollution. Water monitoring data are playing an essential role in the identification of water quality impairments and the development of TMDL plans (MPCA) and target pollutant loads (MCES) to address these impairments. As such, reporting and assessment of monitoring data remained a key focus during the 2004-2005 biennium. Four key reports were prepared to document stream and river conditions during the 2002-2003 period: the “State of the Minnesota River: Summary of Surface Water Quality Monitoring 2002” report, the “State of the Minnesota River: Summary of Surface Water Quality Monitoring 2003” report, the “Metropolitan Council Environmental Services 2002 Stream Monitoring Report”, and the “Metropolitan Council Environmental Services 2003 Stream Monitoring Report”. Another primary emphasis during the 2004-2005 biennium was transitioning the “Minnesota River Watershed Monitoring Program” to its new home in the Water Resources Center at Minnesota State University-Mankato. This was successfully accomplished in January 2005.

In August 2005, the Minnesota Pollution Control Agency appropriated an additional \$500,000 to the Metropolitan Council and Minnesota State University-Mankato, for continuation of the “Metropolitan Area Watershed Outlet Monitoring Program” and the “Minnesota River Watershed Monitoring Program”, respectively, during the 2006-2007 biennium. MCES and MSU-Mankato staff are currently preparing program work plans and budgets for the 2005-2007 biennium, and MPCA staff have initiated the process for establishing grant agreements with both partners for the 2006-2007 funding.

During the fifth biennium (2006-2007), new tools and activities will continue to be implemented for the MCES and MSU-Mankato monitoring programs as opportunities arise. As the monitoring network ages, increasing investments will be needed for maintenance of monitoring station infrastructure and equipment. Also, increasing emphasis will be placed on presentation and assessment of the monitoring data. With long-term datasets now available for both programs, water quality problems and issues can be identified, and the monitoring information can be translated to watershed activities and actions that foster water quality protection and improvement.

Monitoring Enhancements

Some of the monitoring enhancements anticipated during the 2006-2007 biennium include:

- Surveying the elevation reference points at all monitoring stations, so that stages can be converted to mean sea level.
- Continuing to enlist MCES staff and the Metropolitan Area Volunteer Stream Monitoring Partnership for collection of macroinvertebrate data in WOMP watersheds, thereby providing valuable biological data to complement physical and chemical data.
- Implementing the use of PDAs² for the electronic collection of field data.
- Increasing the use of transparency tubes and Hach kits in the field.
- Thoroughly reviewing, assessing, and interpreting the data from both programs to characterize water quality conditions and impacts.
- Providing recommendations, where appropriate, for watershed best management practices that will protect and improve water quality.
- Partnering with professors at Minnesota State University-Mankato to create opportunities for graduate students to work with Water Resources Center and MDA staff. Through educational partnerships, students can conduct further research on the physical, chemical, and biological dynamics of these river systems. This information can then be used by program staff for assessment purposes.
- Creating additional “State of the Minnesota River” and “MCES Stream Monitoring” reports and enhancing the visibility and accessibility of monitoring data to the public and policy makers.

² PDA = Personal Digital Assistant. Because field notes currently are hand-written on paper, it is both labor intensive and difficult to transcribe field measurements and comments into a database so they can be viewed electronically when the data are displayed or manipulated. PDAs will automate the process of writing field notes in a digital format common to all monitoring stations in the MCES network.

Public Education Efforts

Some of the public education efforts anticipated during the 2006-2007 biennium include:

- Updating and enhancing information about the MCES and MSU-Mankato monitoring programs on the Metropolitan Council and Minnesota River Basin Data Center websites.³
- Conducting field day education activities.
- Continuing and expanding partnerships with local groups and agencies.
- Participating in external hydrologic and watershed studies.
- Presenting program data and information at local and state conferences, promoting the use of program data by outside agencies, and ensuring easy access to the data through the MCES Environmental Information Management System (EIMS) and Minnesota River Basin Data Center.
- Hosting future conferences addressing water quality issues in the Minnesota River Basin, via the Water Resources Center at Minnesota State University-Mankato.

Recommendations for Continued Monitoring

³ See www.metrocouncil.org/environment/RiversLakes and <http://mrbdc.mnsu.edu>.

The funding provided to MCES and MSU-Mankato since 1998 by the Minnesota Legislature, as a part of the Interagency Water Monitoring Initiative, has been valuable for filling stream monitoring gaps in the Metropolitan Area, and for establishing an important monitoring presence in the Minnesota River Basin. The expanded monitoring work has provided insightful information on the condition of Minnesota waters, as well as current land use impacts on water quality. Since these land use impacts are largely a reflection of non-point sources of pollution that are heavily influenced by precipitation and runoff, long-term monitoring is critical for characterizing water quality conditions that occur as a result of considerable climatological variation from year to year. Long-term monitoring also provides crucial information for determining if changes in land use with application of best management practices are indeed achieving protection and improvement of water quality conditions, as desired.

A continuation of the “Metropolitan Area Watershed Outlet Monitoring Program” during the 2006-2007 biennium and beyond will help support the Metropolitan Council’s legislative mandate to develop management objectives and target pollution loads for watersheds in the Metropolitan Area. Long-term water quality monitoring information is needed for assessing current watershed and water quality conditions, developing target pollutant loads, and measuring progress toward achievement of target loads, as best management practices (BMPs) are implemented in these watersheds.

A continuation of the “Minnesota River Watershed Monitoring Program” during the 2006-2007 biennium and beyond will help achieve “fishable and swimmable conditions” in the Minnesota River, as mandated by the Federal Clean Water Act and Minnesota State Rules. Fish consumption advisories based on mercury and PCB (polychlorinated biphenyl) currently exist for the Minnesota River throughout the Metropolitan Area, as well as in outstate areas. Violations of water quality standards for dissolved oxygen, turbidity, and bacteria are also evident in the Minnesota River, while high levels of phosphorus and nitrogen pose water quality problems as well. Long-term water quality monitoring information is needed for assessing current watershed and water quality conditions, identifying the water quality pollutants and sources contributing to exceedances of water quality standards/criteria and impairment of designated uses in the Minnesota River Basin, establishing target pollutant loads and load allocations through TMDL plans, and measuring progress toward achievement of “fishable and swimmable conditions” in the Minnesota River, as best management practices (BMPs) are implemented in watersheds throughout the Minnesota River Basin.

MCES and MSU-Mankato greatly appreciate the support of the Minnesota Legislature and the Minnesota Pollution Control Agency for implementation and on-going maintenance of these important monitoring programs. An additional significant benefit of these monitoring programs is the establishment of partnerships with local, state, and federal governmental agencies and the public, since a collaborative effort is needed to protect and improve Minnesota’s waters.

For more information about the MCES “Metropolitan Area Watershed Outlet Monitoring Program”, please contact:

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Environmental Monitoring and Assessment
Metropolitan Council Environmental Services
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St. Paul, MN 55101
Phone: 651-602-8117
E-mail: kent.johnson@metc.state.mn.us

For more information about the MSU-Mankato “Minnesota River Watershed Monitoring Program”, please contact:

Shannon Fisher, PhD.
Director and Assistant Professor of Biology
Water Resources Center
Minnesota State University-Mankato
184 Trafton Science Center South
Mankato, MN 56001
Phone: 507-389-5492
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Appendix A

MCES Watershed Outlet Monitoring Program Sites and Cooperators (2004 – 2005 Biennium)

MCES Watershed Outlet Monitoring Program Sites and Cooperators (2004 – 2005 Biennium)

Grant funding provided to MCES by the Minnesota Legislature, via the MPCA, as a part of the “Interagency Water Monitoring Initiative”

Monitoring Cooperators

Bassett Creek	Bassett Creek Watershed Management Organization Minneapolis Park and Recreation Board
Cannon River	Dakota County Soil and Water Conservation District (SWCD)
Crow River	Wright County Soil and Water Conservation District (SWCD)
Eagle Creek	Lower Minnesota River Watershed District
Minnehaha Creek	Minneapolis Park and Recreation Board
Riley Creek	Riley-Purgatory-Bluff Creek Watershed District
Valley Creek	Valley Branch Watershed District and Science Museum of Minnesota
Willow Creek	Black Dog Watershed Management Organization (2003-2004) Lower Minnesota River Watershed District (2004-2005)

Addresses and Contact Information

Bassett Creek

Station Location: 100 Irving Avenue South, Minneapolis, MN
Cooperator 1: Minneapolis Park and Recreation Board
Contact: Sara Aplikowski, Minneapolis Park and Recreation Board
ph: 612-313-7784 fax: 612-370-4831 e-mail: saplikowski@minneapolisparcs.org
Cooperator 2: Bassett Creek Watershed Management Organization
Contact: Chris Bonick, Barr Engineering
ph: 952-832-2780

Cannon River

Station Location: 14951 264th Street Path, Welch, MN
Cooperator: Dakota County SWCD
Contact: Laura Jester, Dakota County SWCD
4100 220th Street West #102, Farmington, MN 55024-8087
ph: 651-480-7784 fax: 651-480-7775 e-mail: lora.jester@co.dakota.mn.us

Crow River

Station Location: 8200 MN Highway 55, Rockford, MN
Cooperator: Wright County SWCD
Contact: Kerry Saxton, Wright County SWCD
ph: 763-682-1933 fax: 763-682-1970 e-mail: kerry.saxton@mn.nacdnet.net

Eagle Creek

Station Location: 8451 West 126th Street, Savage, MN
Cooperator 1: Lower Minnesota River Watershed District
Field Services: Scott County SWCD
Contact: Leigh Harrod, MCES
ph: 651-602-8085 e-mail: leigh.harrod@metc.state.mn.us

Minnehaha Creek

Station Location: 4712 32nd Avenue South, Minneapolis, MN
Cooperator: Minneapolis Park and Recreation Board
Contact: Sara Aplikowski, Minneapolis Park and Recreation Board
ph: 612-313-7784 fax: 612-370-4831 e-mail: saplikowski@minneapolisparcs.org

Riley Creek

Station Location: 15995 Flying Cloud Drive, Eden Prairie, MN
Cooperator: Riley-Purgatory-Bluff Creek Watershed District
Field Services: Barr Engineering Co., Inc.
Contact: Hal Runke, Barr Engineering
ph: 952-832-2804 fax: 952-832-2601 e-mail: hrunke@barr.com

Valley Creek

Station Location: 15800 Putnam Boulevard South, Afton, MN
Cooperator 1: Valley Branch Watershed District
Cooperator 2: Science Museum of Minnesota
Field Services: St. Croix Watershed Research Station
Contact: Jim Almendinger
ph: 651-433-5953, ext.19 fax: 651-433-5924 e-mail: dinger@sci.mus.mn.us

Willow Creek

Station Location: 2900 West MN Highway 13, Burnsville, MN
Cooperator: Lower Minnesota River Watershed District
Field Services: Dakota County SWCD
Contact: Leigh Harrod, MCES
ph: 651-602-8085 e-mail: leigh.harrod@metc.state.mn.us

Appendix B

“Mercury and PCB Inputs to the Minnesota River Monitoring Program”

Publications Providing the Results of Mercury Monitoring Conducted During the 1998-1999, 2000-2001, and 2002-2003 Bienniums

- Balogh, S.J., Nollet, Y., and Offerman, H.J. 2005. A comparison of total mercury and methylmercury export from various Minnesota watersheds. *Science of the Total Environment* 340: 261-270.
- Balogh, S.J., Huang, Y., Offerman, H.J., Meyer, M.L., and Johnson, D.K. 2003. Methylmercury in rivers draining cultivated watersheds. *Science of the Total Environment*, 304: 305-313.
- Balogh, S.J., Huang, Y., Offerman, H.J., Meyer, M.L., and Johnson, D.K. 2002. Episodes of elevated methylmercury concentrations in prairie streams. *Environmental Science & Technology* 36: 1665-1670.
- Balogh, S.J., Meyer, M.L., and Johnson, D.K. 1998. Transport of mercury in three contrasting river basins. *Environmental Science & Technology* 32: 456-462.
- Balogh, S., Meyer, M., and Johnson, D.K. 1998. Diffuse and point source mercury inputs to the Upper Mississippi, Minnesota, and St. Croix Rivers. *Science of the Total Environment* 213: 109-113.
- Balogh, S.J., Meyer, M.L., and Johnson, D.K. 1997. Mercury and suspended sediment loadings in the Lower Minnesota River. *Environmental Science & Technology* 31: 198-202.