METROPOLITAN COUNCIL ENVIRONMENTAL SERVICES
2003 STREAM MONITORING REPORT

Chapter 1: Introduction

Background: MCES Stream Monitoring Program

Storm water runoff in both urban and rural areas carries non-point source pollutants from diverse and widely scattered sources to Twin Cities Metropolitan Area (TCMA) streams and rivers. To determine the extent of non-point source pollutant loading from tributaries to the Mississippi, Minnesota, and St. Croix Rivers, to provide the information necessary for development of target pollutant loads for these tributary watersheds, and to evaluate the effectiveness of watershed best management practices for reducing non-point source pollution and improving water quality in streams and rivers, Metropolitan Council Environmental Services (MCES) and local partners are currently monitoring at 30 stations on 28 streams in the TCMA and in the vicinity of Mankato, MN. These streams are monitored during significant runoff events, such as snowmelt and heavy rainfalls, and during baseflow conditions, to help determine the sources and extent of non-point sources of pollution.

The MCES Stream Monitoring Program was initiated in the late 1980's. At that time, it was recognized that point source pollution controls alone would be insufficient to attain the water quality goals of the Federal Clean Water Act, as amended through 1987, in the Lower Minnesota River. During the 1988-1992 period, MCES built and began operating seven automated water quality monitoring stations on six major tributary streams in the Lower Minnesota River Basin within the TCMA. The purpose of these seven stations was to assess the nature and extent of non-point source pollution loading to the Lower Minnesota River via monitoring of stream flow and water quality conditions.

As concern about non-point source pollution impacts grew, MCES began expanding its stream monitoring program to the Mississippi and St. Croix River Basins as well. Several reasons have driven a rapid growth of the program since the mid 1990's. First, the Metropolitan Council is mandated by state law (MN Statute 473.157) to establish target pollutant loads for TCMA watersheds. Second, the collection of surface water quality information is relevant to the Metropolitan Council's regional planning and modeling efforts. Finally, the stream monitoring program presents an opportunity for MCES to stimulate and support water quality monitoring efforts at a local level, thereby promoting local resource stewardship and decision making. All of these objectives are important components of the Council's regional planning mission. In support of this multi-faceted mission, long-term stream monitoring data are critical for understanding non-point source pollutant impacts on water quality at the watershed level, and for documenting water quality improvements as non-point source best management practices (BMPs) are implemented in TCMA watersheds.

During the 1995-2000 period, MCES and local partners built and began operating 14 new stations in the TCMA. Of these 14 stations, several are no longer operational or are currently being operated by other governmental units, leaving nine stations that are now being operated by

MCES and partners. During the 1998-2000 period, with state funding received from the Minnesota Legislature via a grant from the Minnesota Pollution Control Agency (MPCA), eight new stations were built in the TCMA and four new stations were built in the Middle Minnesota River Basin near Mankato, MN. The eight TCMA stations are operated cooperatively by MCES and local partners, while the four Middle Minnesota River Basin stations are operated cooperatively by MCES and the Minnesota Department of Agriculture (MDA).

Since 1999, MCES and Scott County have been partners in a paired watershed study that is being conducted within the Sand Creek Watershed. The effectiveness of agricultural BMPs for sediment and nutrient management are being evaluated through a comparison of annual pollutant concentrations and loads delivered from side-by-side Sand Creek subwatersheds draining to West Raven Stream and Scott County Ditch 10. Agricultural BMPs (nutrient management and conservation tillage) are being applied to the Scott County Ditch 10 subwatershed, while the West Raven Stream subwatershed is serving as the control. MCES established automated water quality monitoring stations on West Raven Stream and Scott County Ditch 10 in 1998, and monitoring began at both sites in 1999. Schuler Environmental Engineering operated both monitoring stations during the 1999-2002 period, through a contract with MCES. Operation of both stations was transferred to the Scott County Soil and Water Conservation District in 2003, with ongoing MCES technical and laboratory services support. The monitoring data from both stations will be used to determine if agricultural BMPs are resulting in water quality improvement. The 2003 monitoring data from both stations are included in this report.

A complete record of all MCES stream monitoring stations and their years of operation is available on the MCES website: http://www.metrocouncil.org/environment/RiversLakes. Also available on the website is detailed information about MCES river, lake, and wastewater treatment plant monitoring programs.

<u>2003 Stream Monitoring Data</u>

This report presents the 2003 annual monitoring data from 30 MCES stream monitoring stations. The 2003 hydrologic, water chemistry, and biological data and information for each of the 30 stations are presented in Chapter 2.

Table 1 presents an alphabetical listing of all current MCES stream monitoring stations by major river basin (Mississippi, Minnesota, and St. Croix). Maps depicting monitoring station locations in the TCMA and in the vicinity of Mankato, MN (Middle Minnesota River Basin) are presented as Figures 1 and 2, respectively.

2003 Precipitation

Annual 2003 statewide total precipitation data and departure-from-normal precipitation data, obtained from the Minnesota State Climatology office, are presented in Figures 3 and 4, respectively. According to the State Climatology Office, 2003 precipitation totals in the TCMA ranged from 20-24 inches in the southern and southwestern portions of the region, to 24-28 inches in the central, northern, and southeastern portions of the region, to 28-32 inches in the northeastern portion of the region (Figure 3). Generally, most of the TCMA received 20-28 inches of precipitation. The seven counties within the TCMA experienced a two- to ten-inch decrease in precipitation compared to the normal level (Figure 4). This precipitation deficit was less pronounced in the northern part of the TCMA and more pronounced in the southern part.

A drier precipitation pattern was also evident in the vicinity of Mankato, MN, where 2003 precipitation totals ranged from 20-24 inches (Figure 3). Total precipitation amounts in the Mankato area were six to ten inches below the normal level (Figure 4).

Compared to 2002, 2003 was a much drier year in the TCMA, with 8-20 inches less precipitation. In the Mankato area, 2003 was a slightly drier year, with 4 inches less precipitation. The seasonal distribution of precipitation was somewhat different in 2003 than in 2002. While the spring of 2002 exhibited very little snowmelt and runoff, the spring of 2003 was characterized by slight to moderate levels of snowmelt and runoff. While wet conditions prevailed throughout the summer and fall of 2002, most of the precipitation in 2003 was recorded prior to the end of July. Starting in early August, the remainder of the year was largely characterized by drought conditions and low stream flows.

Annual precipitation patterns in the TCMA and Mankato area during the 2001-2003 period are summarized and compared below.

			TCMA	**Mankato**
Total Annual Precipitation:				
	2001		24-40 inches	28-36 inches
	2002		36-40 inches	24-28 inches
	2003		20-32 inches	20-24 inches
Precipitation Departure from Normal:				
	2001		-4 to +6 inches	-2 to +6 inches
	2002		+6 to +10 inches	-2 to -4 inches
	2003		-2 to -10 inches	-6 to -10 inches
Precipitation Occurrence:				
	2001	Snowmelt	Heavy	Heavy
		Rainfall	April to mid-July	April to mid-July
	2002	Snowmelt	Very Little	Very Little
		Rainfall	April-October	April-October
	2003	Snowmelt	Slight-Moderate	Slight-Moderate
		Rainfall	April-July	April-July

Table 1. MCES Stream Monitoring Stations

Major Basin	Monitoring Station (Station Code)	Page Number
Mississippi River		
	Bassett Creek (BS)	11
	Battle Creek (BA)	19
	Beltline Interceptor (BT)	29
	Cannon River (CN)	33
	Crow River (CW)	43
	Crow River, South Fork (CWS)	53
	Fish Creek (FC)	63
	Minnehaha Creek (MH)	73
	Rum River (RUM)	83
	Vermillion River (VR)	91
Minnesota River		
Middle Minnesota River Basin	Beauford Ditch (BD)	101
(Near Mankato, MN)	Blue Earth River (BU)	109
	Le Sueur River (LE)	119
	Little Cobb River (LC)	129
Minnesota River		
Lower Minnesota River Basin	Bevens Creek, Lower (LBE)	137
(Twin Cities Metropolitan Area)	Bevens Creek, Upper (UBE)	147
	Bluff Creek (BL)	155
	Carver Creek (CA)	165
	Credit River (CR)	173
	Eagle Creek (EA)	183
	Nine Mile Creek (NM)	193
	Riley Creek (RI)	203
	Sand Creek (SA)	213
	Scott County Ditch 10 (SCD10)	223
	West Raven Stream (WR)	231
	Willow Creek (WI)	239
St. Croix River		
	Browns Creek (BR)	247
	Carnelian-Marine Outlet (CM)	257
	Silver Creek (SI)	265
	Valley Creek (VA)	275

Chapter 2: Stream Monitoring Station Information and 2003 Results

Organization of the 2003 stream monitoring data in Chapter 2 of this report is alphabetical by station name, within the three major river basins: Mississippi, Minnesota, and St. Croix. Information about each monitoring station is presented in the following format (x = Station Code, as indicated in Table 1):

Table 1.x: Monitoring Station Information
Figure 1.x: Monitoring Station Location and Watershed Characteristics
Figure 2.x: 2003 Hydrograph, Precipitation, and Sampling Information
Table 2.x: 2003 Water Chemistry Information
Table 3.x: 2003 Annual Loading Information for Suspended Solids and Nutrients
Figure 3.x: 2003 Hydrograph with Total Suspended Solids and Nitrate Nitrogen Concentrations
Figure 4.x: 2003 Hydrograph with Total and Dissolved Phosphorus Concentrations
Table 4.x: Comparison of 2001-2003 Hydrology and Water Chemistry
Table 5.x: 2003 Macroinvertebrate Monitoring Results and Metrics

Monitoring Station Information

General information about each stream monitoring station (location and drainage area, station operator, MCES contact information, watershed district or watershed management organization, a station overview, and 2003 monitoring year information) is presented in Table 1.x. A map depicting each monitoring station location, stream course, watershed boundary, and land use characteristics within the watershed is presented as Figure 1.x.

Monitoring Equipment, Methods, and Results

The following information on MCES stream monitoring equipment and methods is a generalized summary that is applicable to all stations. Some subtle variations exist between stations with regard to the equipment and methods used for monitoring. For detailed information about equipment and methods at a particular monitoring station, please refer to the stream monitoring section of the MCES website: http://www.metrocouncil.org/environment/RiversLakes. A detailed "MCES Quality Assurance Program Plan for Stream Monitoring" is also available in the stream monitoring section of the website.

Flow Monitoring

Each automated monitoring station continuously records 15-minute data on water level (stage) and flow, along with temperature and conductivity. A rating curve is maintained during ice-free conditions. When winter ice cover creates very difficult conditions for accurate flow and rating curve measurements, winter flows are estimated. The annual 2003 stream hydrograph, based upon daily average flows, is presented in Figure 2.x.

Precipitation Monitoring

Most stations collect continuous precipitation data via a tipping-bucket rain gauge. Daily and annual precipitation information for 2003 is also presented in Figure 2.x. For those stations without a rain gauge, the 2003 precipitation information has been obtained from another gauge in the same watershed or in an adjoining watershed.

Water Chemistry Monitoring

Water chemistry samples are collected during baseflow and runoff conditions. Baseflow conditions are typically represented by monthly grab samples. Runoff conditions are typically represented by flow-weighted composite samples collected during all runoff events in the open-water season (March-November), including the spring snowmelt period. Figure 2.x portrays all water chemistry samples obtained during baseflow and runoff conditions throughout the monitoring year, in conjunction with the annual hydrograph.

All water chemistry samples are analyzed by the MCES Laboratory. The water quality variables analyzed by the laboratory include: total chloride, hardness, total metals (Cd, Cr, Cu, Ni, Pb, Zn), total Kjeldahl nitrogen, nitrate-nitrogen, total and dissolved phosphorus, total and volatile suspended solids, and turbidity. Transparency tube measurements are obtained in the field. Summary statistics for concentrations of these water chemistry variables in 2003 were calculated using SPSS and are presented in Table 2.x. Concentrations of total suspended solids and nitrate nitrogen in relation to the 2003 hydrograph are presented in Figure 3.x. Concentrations of total and dissolved phosphorus in relation to the 2003 hydrograph are presented in Figure 4.x. All 2003 water chemistry data for each monitoring station are presented in Appendix 1, which is available by request or via the MCES website.

Annual 2003 loading information for selected water chemistry variables (total suspended solids, total and dissolved phosphorus, and nitrate-nitrogen) was calculated using FLUX and is presented in Table 3.x.

A year-to-year comparison of select hydrologic and water chemistry data for the 2001-2003 period is presented in Table 4.x.

Biological Monitoring

Macroinvertebrate samples are collected once or twice annually (spring and/or fall) at all wadeable stations, using the multi-habitat method. Macroinvertebrate monitoring results and metrics for 2003 are presented in Table 5.x.

Glossary of Stream Monitoring Terms

A glossary of key stream monitoring terms that appear throughout this report is presented at the end of the report.