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 during the 1998-1999 biennium. Since the Metropolitan Council funding was provided via the Minnesota Pollution Control Agency (MPCA) budget, the MPCA executed a grant agreement with the Metropolitan Council in April, 1998, to transfer the funding. In 1998, MCES received $517,500 from the MPCA, via terms of the grant agreement. Ten percent of the funding ($57,500) is being withheld by the MPCA until the end of the grant period in December 1999.

New MCES Monitoring Programs

With the $575,000 in funding provided by the Minnesota Legislature, MCES monitoring efforts during the 1998-1999 biennium have focused on the establishment and implementation of two programs: the “Metropolitan Area Watershed Outlet Monitoring Program” ($316,000), and the “Mercury and PCB Inputs to the Minnesota River Monitoring Program” ($259,000). Both projects are being conducted in cooperation with local, state, and federal partners with a shared interest in the monitoring information.

The “Metropolitan Area Watershed Outlet Monitoring Program,” implemented in early 1998, expanded the existing MCES stream monitoring network in the Metropolitan Area. The objective of this program is to collect the water quality data needed to assess current watershed conditions, develop target pollutant loads, and measure progress toward achievement of target loads, as nonpoint source best management practices (BMPs) are implemented in these watersheds. To date, seven new monitoring sites have been established in seven Metro Area watersheds. By the end of March 1999, these seven sites (Cannon River, Crow River, Eagle Creek, Minnehaha Creek, Riley Creek, Valley Creek, and Willow River) were complete, and are fully functional for the 1999 monitoring year. Three additional monitoring sites, at locations yet to be determined, will be established by fall, 1999. The monitoring work for this program is being conducted in cooperation with a number of federal, state, and local units of government in the Metro Area.

The “Mercury and PCB Inputs to the Minnesota River Monitoring Program”, implemented in the fall of 1998, has 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 nonpoint 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 new monitoring sites have been established in the Mankato, MN area. Monitoring sites are located on the Minnesota River at Judson and St. Peter, and within the Blue Earth and LeSueur River watersheds. Although the six monitoring stations are not yet fully complete and functional, some monitoring work began in March 1999. 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) began in the spring of 1998. In February 1998, MCES hired Leigh Harrod as a Senior Environmental Scientist to direct the program, including establishment of ten new stream monitoring stations in Metro Area watersheds. The program's objective is to obtain the water quality data needed to assess current watershed conditions, develop target pollutant loads, and measure progress toward achievement of target loads, as nonpoint source best management practices (BMPs) are implemented in these watersheds.

In 1998, seven new watershed outlet monitoring sites (Cannon River, Crow River, Eagle Creek, Minnehaha Creek, Riley Creek, Valley Creek, and Willow River) were established in seven Metro Area watersheds. By March 1999, these seven sites were fully functional for the 1999 monitoring year. Monitoring activity for these seven new sites began in the spring of 1999. Three additional monitoring sites, at locations yet to be determined, will be established by fall, 1999.

This portion of the biennial report will describe the status of the Metropolitan Area Watershed Outlet Monitoring Program (WOMP) in terms of monitoring activity to date at the seven new monitoring stations, cooperative monitoring partnerships, and data 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 MCES monitoring programs.

Site Descriptions

The MCES "Annual (1998) Progress Report for the Metropolitan Area Watershed Outlet Monitoring Program," provided to the MPCA in June 1998, described the WOMP site locations and listed the local cooperators conducting the monitoring. An updated list of monitoring sites and local cooperators is provided in Appendix A of this report.

Site Construction and Monitoring Equipment

The MCES "Progress Report for the Metropolitan Area Watershed Outlet Monitoring Program", provided to the MPCA in January 1999, described the station monitoring equipment and construction details.

Monitoring Procedures

Conventional Pollutant Monitoring

Since January 1999, all seven WOMP stations have been continuously logging stream flow, temperature and conductivity and reporting 15-minute average values. All sites are equipped with automated samplers, which become operational when a pre-determined stage threshold is met, usually in response to storm-generated runoff. All of the seven new stations captured both water quality samples and continuous discharge data for snowmelt and rainfall runoff events in the spring of 1999. In addition, monthly base flow samples have been obtained at all sites. Five of the seven stations are equipped with rain gages. Table 1 summarizes the number of water samples obtained and conventional pollutant analyses conducted for each WOMP site through June 3, 1999. All laboratory analyses are being conducted by the MCES Laboratory Services Section in St. Paul, MN.

Table 1. Number of Water Samples and Analyses for WOMP Sites (through 6/3/99)

	Cannon River	Crow River	Eagle Creek	Minnehaha Creek	Riley Creek	Valley Creek	Willow Creek
TOTAL SUBMISSIONS	11	8	7	7	10	10	6
Alkalinity	11	7	7	7	10	10	6
5-day CBOD	4	2	1	2	0	0	1
5-day BOD	9	8	7	6	6	10	5
Chloride	0	0	1	0	0	0	0
COD	11	2	7	9	10	10	8
Coliform count	0	1	0	0	0	1	0
Hardness	11	7	7	7	10	10	6
Copper	8	3	2	4	10	1	6
Nickel	8	3	2	4	10	1	6
Lead	8	3	2	4	10	1	6
Zinc	8	3	2	4	10	1	6
Cadmium	8	3	2	4	10	1	6
Chromium	8	3	2	4	10	1	6
Ammonia NH_3	10	6	7	6	9	10	6
Nitrite N	11	7	7	7	10	10	6
Nitrate N	11	7	7	7	10	10	6
Suspended Solids	10	7	7	8	10	10	6
Volatile Solids	10	7	7	8	10	10	6
TKN	11	7	8	8	10	10	6
Total Phosphorus	11	7	8	8	10	10	6
Orthophosphate	10	8	7	8	10	10	5
Total Phosphorus	10	7	6	8	10	10	6
pH	0	0	0	0	10	0	4
Turbidity	11	8	7	7	10	10	6
TOTAL ANALYSES	199	116	113	130	205	142	125

Rating Curve Development

Preliminary rating curves have been developed for all seven WOMP sites. Some of the rating curves are based on historical U.S. Geological Survey (USGS) data or other historical data. Some rating curves have been developed based on field stage measurements and interpolated flow measurements.

All of the rating curves are being continually refined with field measurements. In-stream measurements, such as stage/velocity measurements and dye drips, have been incorporated as appropriate.

Crow and Cannon Rivers

The USGS is providing rating curve measurements for the Crow River WOMP site in Rockford, MN and the Cannon River WOMP site in Welch, MN.

Eagle Creek

The Minnesota Department of Natural Resources (MDNR) is providing in-stream rating curve measurements for the Eagle Creek WOMP site in Savage, MN.

Riley and Willow Creeks

At the Riley Creek WOMP site in Eden Prairie, MN and the Willow Creek WOMP site in Burnsville, MN, the cooperator's technical advisor is Barr Engineering, Inc. At each of these sites, the rating curve was initially based upon a Manning's Equation developed by Barr Engineering. Since activation of these stations, staff from Barr Engineering have made several in-stream measurements to refine the Manning's Equation. Because Willow Creek is flowing in a buried box culvert, rating curve measurements can only be conducted by the dye drip method.

Minnehaha Creek

At the Minnehaha Creek WOMP site in Minneapolis, MN, there was no pre-existing rating curve information upon which to build. Since the summer of 1998, the cooperator and MCES staff have conducted four stage-discharge measurements with an in-stream wading rod and velocity meter, as well as three dye tests to measure the higher flows. The Minnehaha Creek Watershed District, under a consulting contract, also conducted weekly in-stream stage-discharge measurements with a wading rod and flow meter. When these data are received from the watershed district, the refined rating curve data will be retroactively applied to the stage data.

Valley Creek

At the Valley Creek WOMP site in Afton, MN, the cooperator makes regular in-stream measurements with a wading rod and velocity meter.

It is anticipated that the work plan for the next grant period (2000-2001 biennium) will require increased rating curve measurements by the local cooperators, who are developing the rating curves for MCES. To facilitate this effort, MCES has purchased additional Marsh McBirney flow meters to loan to cooperators, and has also built dye drip test kits which have been distributed to cooperators. Training in both procedures has been provided to all cooperators.

Cooperative Monitoring Partnerships

Local Monitoring Partners

With direction and oversight provided by MCES staff, local cooperators are conducting WOMP monitoring. Staff from local watershed districts, soil and water conservation districts, the City of Minneapolis, the Science Museum of Minnesota, and the MDNR are all participating in WOMP, through formal grant agreements with MCES. To achieve greater benefit from the legislative funding, MCES has asked the local cooperators to provide 25% of the construction, equipment, and operating costs for the new WOMP stations, while MCES provides the remaining 75%. The WOMP cost-share agreements were prepared by MCES staff and counsel and distributed to the local cooperators for approval.

Several of the local cooperators have recently expressed an interest in establishing a forum for water resource professionals who are engaged in surface water monitoring activities. The purpose of the "user group" or forum would be to network and exchange stream monitoring information and experiences with others. The forum would also be a good opportunity to further train cooperators in data management, data manipulation, and new monitoring equipment and technology. A letter has recently been sent out to all WOMP cooperators by Pat Conrad of the Ramsey-Washington Metro Watershed District, who has taken the lead on establishing the group. MCES has offered to facilitate this effort by providing meeting space, mailing lists, and other support.

MCES staff have conducted tours of the new WOMP sites for personnel at the MPCA and the Board of Water and Soil Resources (BWSR).

United States Geological Survey (USGS)

The USGS is an invaluable source of historical water stage and flow information, and is providing flow information for the Crow and Cannon River WOMP sites.

Data Reporting

In September 1999, two databases will be provided to the MPCA. Water quality data, currently stored in a MCES Oracle database, will be provided to the MPCA as an Excel spreadsheet. A second database of 15-minute average stage, discharge, temperature, conductivity and rainfall information will be similarly provided in an Excel spreadsheet ("stream flow database"). The storm-generated sampling intervals are also included in the stream flow database.

It is recognized that this initial format for data submittal is an interim solution that may be modified in the future to reflect the internal needs of the MPCA. As this program gains experience, decisions about the desired data format for the MPCA can be incorporated into the final output.

Excel is currently the easiest tool for the WOMP cooperators to use for reporting the data obtained from their respective monitoring stations. All the cooperators have been trained to download data in an identical manner, and a pre-formatted Excel template has been developed for storage of their data. Data from the individual cooperators will be imported into a MCES Oracle database. From Oracle, the data can be exported to the MPCA in a variety of formats, or provided directly in the original Excel templates submitted by the cooperators.

The MPCA has expressed an interest in a data format that is compatible with STORET. In response to that request, the location coordinates for each WOMP station have been captured in UTM_Zone_15, so that an EPA REACH 3 number can be assigned. The REACH numbering system is currently being revised to conform with the National Hydrography Dataset from the U.S. EPA and U.S. Geological Survey (Appendix C).

WOMP monitoring data have already been requested and used by several agencies. The MPCA has utilized WOMP data for two internal projects (the Metro Groundwater Model and the Vermillion River Floodplain Lakes Water Quality Survey). The Metropolitan Mosquito Control District recently requested access to real-time water temperature data at several WOMP sites, for prediction and possible treatment of black fly hatches.

The USGS has expressed an interest in using WOMP data for a new, two-year project funded by Metropolitan Area counties. The goal of the USGS project is to delineate groundwater recharge areas in each Metro Area watershed, based in part upon statistical analysis of base flow in second-order streams. Another USGS proposal would use data from the entire network to update a numerical groundwater model of the Twin Cities. This project would establish interagency cooperation among USGS, MCES, MPCA and the Minnesota Department of Health.

Contact Information

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Mercury and PCB Inputs to the Minnesota River Monitoring Program

Introduction

The Mercury and PCB Inputs to the Minnesota River Program began in the fall of 1998. In September, MCES hired Casandra Osborn as an Environmental Scientist to direct the program, including establishment of a Mankato field office and six new monitoring stations. 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.

A Mankato field office has been established for this program, and six new automonitoring sites are close to completion. Two monitoring sites are located on the Minnesota River at Judson and St. Peter, in the Middle Minnesota River Watershed. One monitoring site is located near the mouth of the Blue Earth River, in the Blue Earth River Watershed. The three remaining monitoring sites are all located in the Le Sueur River Watershed. One site is located near the mouth of the Le Sueur River, and two sites are located on smaller tributaries (Little Cobb River and Little Beauford Ditch) in the Le Sueur River Watershed.

This portion of the biennial report will describe each of the six new monitoring sites and the status of the Mercury and PCB Inputs to the Minnesota River Monitoring Program in terms of site construction and monitoring equipment, monitoring procedures, cooperative monitoring partnerships, and data 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 MCES monitoring programs.

Site Descriptions

The dominant land use in the Middle Minnesota River, Blue Earth River, and Le Sueur River Watersheds is row crop agriculture, primarily corn and soybeans. All of the monitoring stations represent agricultural watersheds and sub-watersheds. This section provides a brief description of each monitoring site, including location.

Little Beauford Ditch

The monitoring site on the Little Beauford Ditch is located about one-half mile north of the town of Beauford on Minnesota Highway 22. The shelter box is mounted on the top of the highway culvert. This monitoring site represents the smallest sub-watershed of all the monitoring sites, with a drainage area of only 7 square miles. The U.S. Geological Survey (USGS) and the Minnesota Pollution Control Agency (MPCA) have previously conducted monitoring at this location. The USGS still collects grab samples at this site.

Little Cobb River

The monitoring site on the Little Cobb River is located at the southwest corner of the County Road 16 bridge. This site represents a drainage area of about 130 square miles. A USGS streamflow gaging station is also located at this site.

Le Sueur River

The monitoring site on the Le Sueur River is located in the Red Jacket Trail County Park, just downstream from the Minnesota Highway 66 bridge. The drainage area represented by this site is about 1,100 square miles. A USGS streamflow gaging station is located about one mile upstream from the monitoring site.

Blue Earth River

The monitoring site on the Blue Earth River is located just downstream from the Rapidan Dam, near County Road 9. The drainage area represented by this site is about 1,550 square miles. A USGS streamflow gaging station is also located at this site.

Minnesota River at Judson

The monitoring site on the Minnesota River at Judson is located at the MDNR boat landing near Nicollet County Road 23. The drainage area represented by this site is about 11,400 square miles, a considerable portion of the entire Minnesota River Basin.

Minnesota River at St. Peter

The monitoring site on the Minnesota River at St. Peter is located behind the Chamber of Commerce Building near the Minnesota Highway 99 bridge. The drainage area represented by this site is about 15,500 square miles, encompassing 11 of the 12 major watersheds in the Minnesota River Basin.

Site Construction and Monitoring Equipment

Metropolitan Council Environmental Services (MCES) trades staff from the Metropolitan Wastewater Treatment Plant (Metro Plant) in St. Paul, MN built the monitoring stations. These six stations are very similar to the recently-established WOMP stations located throughout the Minneapolis/St. Paul Metropolitan Area. Each station, except the Little Beauford Ditch site, is a green fiberglass shelter mounted on a wooden deck. The Little Beauford Ditch site is a large metal box nested in a wooden cradle. Conduit carrying sample lines and analytical probes runs between each shelter and the riverbank. Each shelter has electrical and phone service, which powers the automonitoring equipment and allows remote access to the information being collected. This section describes the construction process for the monitoring sites, the monitoring instruments used at each station, and how the instruments work together to produce a useful database of water quality information.

Site Preparation

Before construction began, landowner permission was obtained for site access and monitoring station location, and all necessary building permits were acquired. At most sites, it was necessary to obtain permission and/or permits from Blue Earth County Department of Roads, Blue Earth County Parks Department, Minnesota Department of Natural Resources (MDNR), and Minnesota Department of Transportation (MNDOT). The site on the Blue Earth River required a land use agreement with a private landowner, and the site on the Minnesota River at St. Peter required permission from the City of St. Peter and the St. Peter Chamber of Commerce. With landowner permission and necessary permits in place, each site was swept to determine the presence and location of underground utilities. After each site had been made safe, construction began.

Platforms and Shelters

At five of the monitoring sites, a walk-in fiberglass shelter, 6' x 8' x 8', houses the monitoring equipment. Machinists from the Metro Plant constructed a wooden platform to support the monitoring shelter. If necessary, a staircase or access ramp was also built. Then the shelter was mounted on the platform. Depending on the configuration of the site, the shelter was lifted up to the platform with a boom truck or pushed and levered into place. Once the shelter was situated, it was bolted onto the platform. At the Little Beauford Ditch monitoring site, a metal box houses the monitoring equipment. The box sits in a wooden cradle attached to the top of the culvert.

Five of the monitoring stations have fiberglass shelters mounted on wooden platforms. Conduit carrying sampling lines and analytical probes from the shelter to the river is buried in a shallow trench. Each shelter has electric and phone utilities. Automonitoring equipment is mounted inside the shelter.

Monitoring Station at Le Sueur River

Sampling Lines and Analytical Probes

Heavy septic tank hose extends from each monitoring shelter to the river, serving as a conduit to house sampling lines and analytical probes. The conduit houses a water sample line, an air bubble line and a conductivity/temperature probe. The sampling lines are wrapped with 120-volt heat tape to prevent freezing. The entire length of conduit is insulated and buried in a shallow trench that extends between the shelter and stream.

Utility Connections

All six stations have telephone and electric utilities. Electricians from the Metro Plant configured the wiring for each shelter and connected the electric and phone services from the nearest transformer or pedestal. The monitoring instruments were mounted inside the shelter and connected to the earth ground. The electricians also installed a switch on the phone line that allows use of the phone line for either conventional calling or as a dedicated modem line.

At Little Beauford Ditch, the utilities are outside of the box and the automonitoring equipment is inside the box.

Availability of electrical power at each site provides a constant and dependable source of power for the monitoring instruments. However, each instrument also has a battery backup in case of power failure, ensuring that important monitoring capabilities and information are not lost during storm events. With electrical power, shelters can be heated during the spring and fall monitoring seasons, allowing monitoring to occur throughout the annual open-water period.

Availability of telephone service at each site allows monitoring staff to remotely access the station via phone modem. With remote access, staff can revise the datalogger program in response to real time conditions, verify that all instruments are functioning properly, determine whether or not the sampler is collecting water, and download the monitoring data.

Automonitoring Equipment

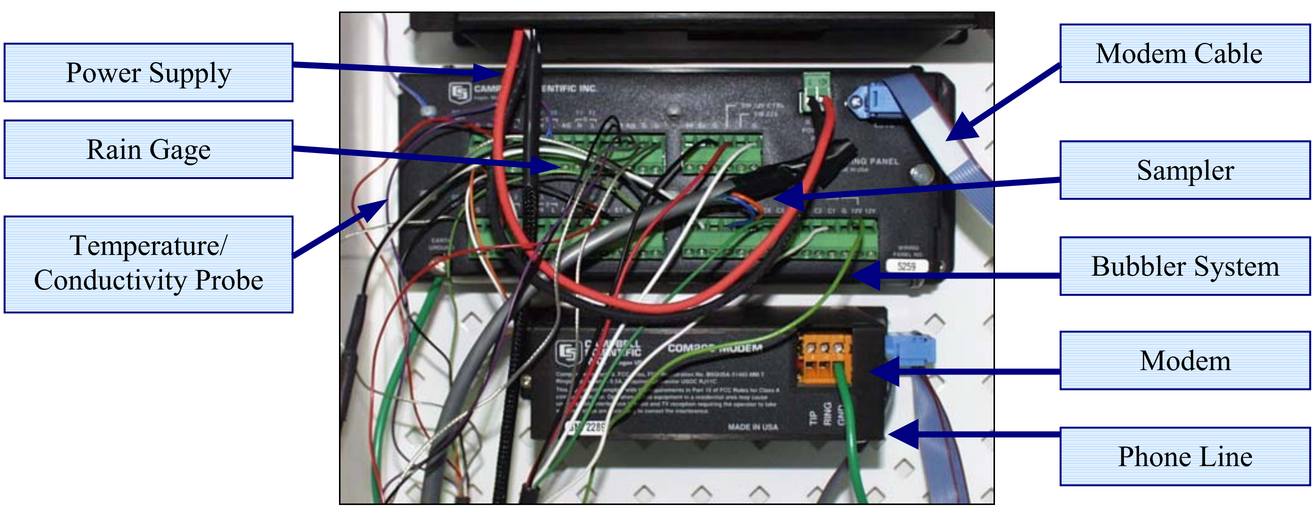
Each station has the same suite of automonitoring equipment. Together, these instruments provide a detailed account of the conditions in the river 24 hours a day. The instruments that monitor continuously include a bubbler system, which measures stage, or water elevation, every 60 seconds, a conductivity/temperature probe, which measures temperature and conductivity every two seconds, and a rain gage, which measures cumulative precipitation during rain events. An automatic sampler collects water samples from the river when pre-determined stage and flow conditions are met. The operation of all these instruments is coordinated by a datalogger, which also stores and outputs the data.

__Campbell Scientific CR10X Datalogger__

The heart of each monitoring station is the Campbell Scientific CR10X datalogger. The datalogger communicates with all of the other instruments and probes, coordinates their activities, and records all the results.

The datalogger can be remotely accessed through phone modem. Through the modem, data can be downloaded, the program can be updated in response to changing conditions or storm events, and decisions can be made about sample collection and site maintenance without leaving the office. The datalogger can be accessed directly through a laptop computer or a keypad.

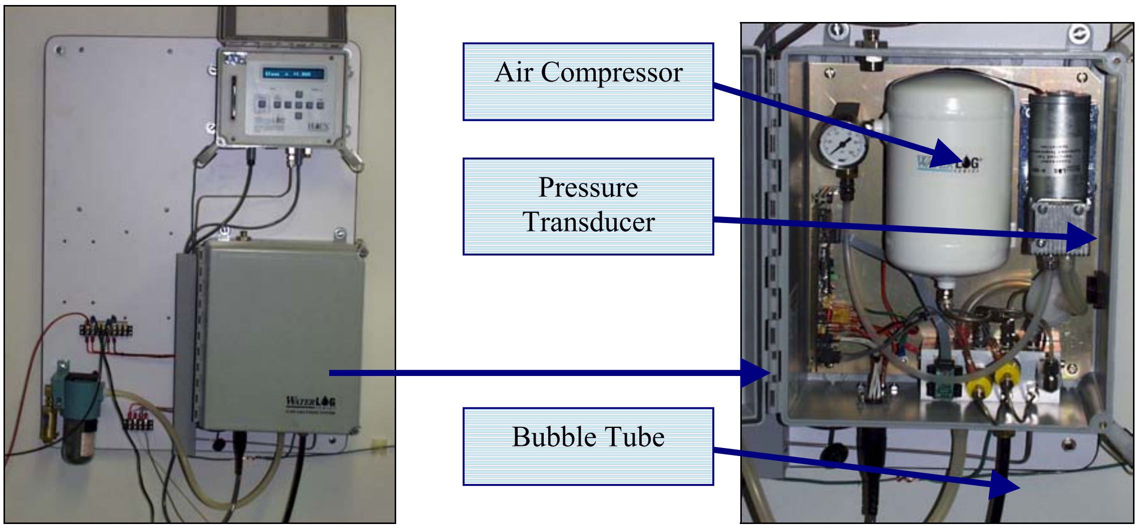
The datalogger program is specific to each site. The datalogger triggers the instruments to take measurements and performs calculations such as flow calculation and unit conversion. The program outputs a line of information every 15 minutes, including date, time, average stage, average flow, average temperature, average conductivity, and cumulativer precipitation. It also triggers the automatic sampler to start and stop sampling according to pre-set stage and flow conditions. The program records a special line of data every time a sample is taken. All of the data can be downloaded as a comma delimited ASCII file.



A Campbell Scientific CR10X datalogger.

Design Analysis Gas Purge Bubbler System

Each monitoring station has a Design Analysis Gas Purge Bubbler System to measure stage, or water elevation. An air compressor and pressure transducer work together to measure stage every 60 seconds. The air compressor forces a small bubble of air through a tube into the stream. The pressure transducer senses the water's resistance against the air bubble in direct proportion to the stage of the stream.



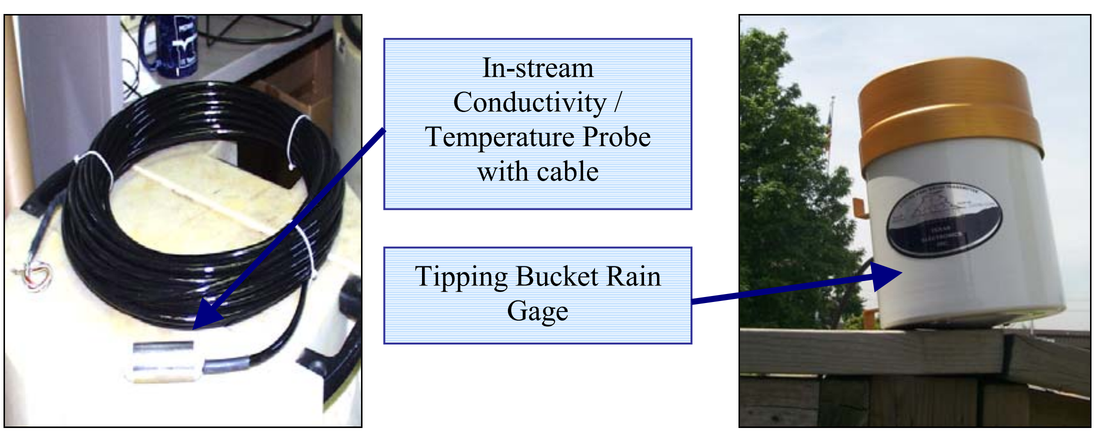
A Design Analysis Gas Purge Bubbler System.

Campbell Scientific 247 Conductivity/Temperature Probe

The conductivity/temperature probe is measures stream temperature and conductivity every two seconds. Readings are averaged on a 15-minute basis and logged into the data logger.

Tipping Bucket Rain Gage

Each monitoring station has a tipping bucket rain gage to measure precipitation. During a rain event, the rain gage records every 0.01-inch of precipitation. These measurements are summed by the datalogger and reported as 15-minute total rainfall.



Sigma 900 Automatic Sampler

Unlike the other instruments at each monitoring station, the Sigma 900 automatic sampler does not function continuously. The sampler is triggered by the datalogger according to pre-determined stage and flow conditions. When the sampler is triggered, it pumps water from the river into sample bottles. The entire hydrograph for each runoff event is sampled and composited by flow volume. Each sample taken represents the same volume of stream flow. All of the samples from one runoff event may be combined, or the hydrograph may be divided into rising and falling limbs to get the best analysis of runoff event loading.

A Sigma 900 Automatic Sampler

Monitoring Procedures

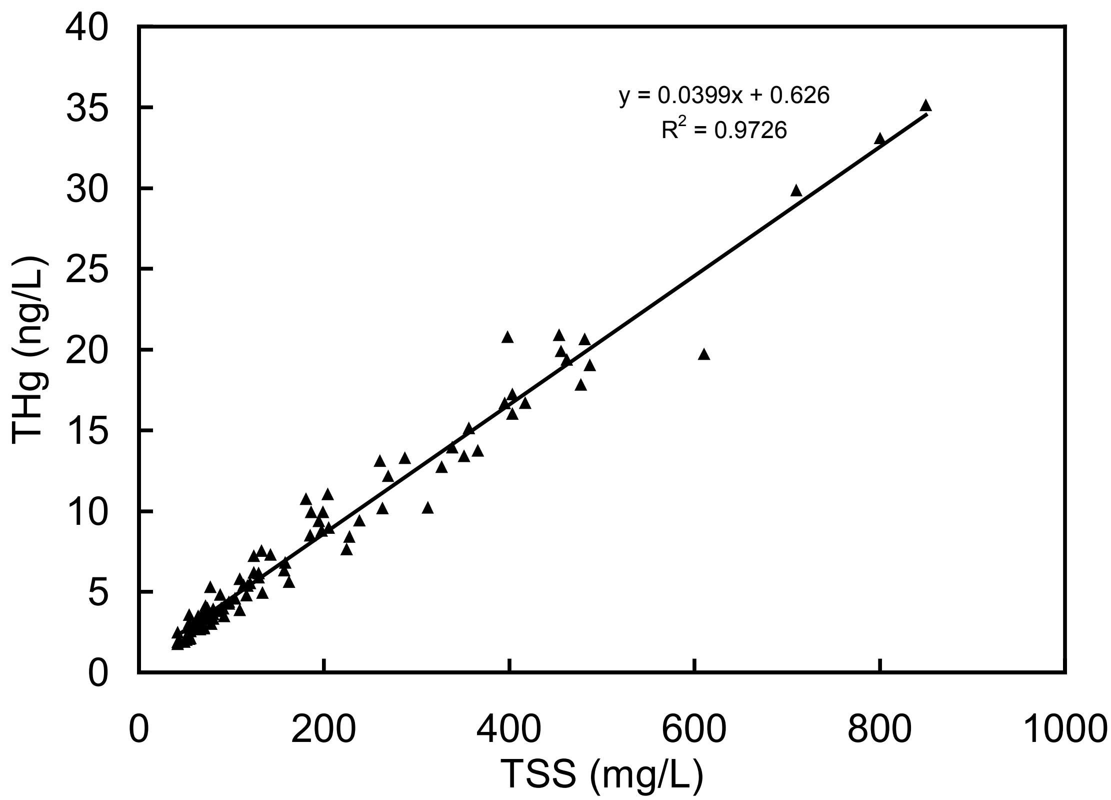
Mercury Monitoring

Mercury monitoring in the Middle Minnesota River, Blue Earth River, and Le Sueur River Watersheds of the Minnesota River Basin began in February 1998. This monitoring, conducted by the Research and Development Section of MCES, is an extension of previous MCES mercury monitoring of the Minnesota, Mississippi, and St. Croix Rivers in the Twin Cities Metropolitan Area. The six monitoring sites on the Minnesota River and its tributaries were each sampled 27 times for mercury and total suspended solids between February and November 1998. Additional Minnesota River monitoring on the same schedule at Jordan and Fort Snelling in the Twin Cities Metropolitan Area allowed comparisons with mercury transport in the Lower Minnesota River Watershed. Mercury monitoring and analytical protocols have been described previously (Balogh, S.J.; Meyer, M.L.; Johnson, D.K. 1997. *Environ. Sci. Technol. 31*, 198-202; and Balogh, S.J.; Meyer, M.L.; Johnson, D.K. 1998. *Environ. Sci. Technol. 32*, 456-462).

To date, the monitoring data show a strong correlation between total mercury (THg) and total suspended solids (TSS) at all sites, suggesting that sources of suspended sediment are also sources of mercury. Figure 1 shows THg vs. TSS data from the mainstem Minnesota River sites in 1998.

Fifteen to twenty samples per year will be collected at each of the eight sites over the next several monitoring seasons to firmly establish the relationship between total mercury and total suspended solids. The goal of the mercury monitoring is to be able to calculate the total mercury load for a runoff event from the total suspended solids loads as measured in the autosamples.

Figure 1. THg vs. TSS at Judson (MI 120), St. Peter (MI 89.7), Jordan (MI 39.4), and Fort Snelling (MI 3.5) Monitoring Sites on the Minnesota River, February through November 1998.



PCB Monitoring

PCB monitoring in the Middle Minnesota River, Blue Earth River, and Le Sueur River Watersheds of the Minnesota River Basin began in March 1998, when Tom Franz was hired by the Research and Development Section of MCES. Prior to this program, PCBs have not been extensively monitored in the Minnesota River. Tom Franz is developing field and laboratory techniques to measure low levels of PCBs in the Minnesota River and characterizing the instrumental and analytical conditions required to accommodate large volume injections for PCB identification and quantification. Also, he has developed an analytical procedure that minimizes labor and solvent use compared to traditional methods. (Appendix B). A number of alternative analytical pathways were evaluated by reproducible recovery of reference standards and low PCB levels in matrix blanks. A few procedural details are still being fine-tuned, including determining formal method detection limits (MDLs) on each matrix used to analyze both the particulate and dissolved phases of PCBs in river water.

To date, 41 samples have been collected, to determine the level of PCBs in the Minnesota River Basin. From the limited number of river samples analyzed to date, the concentration of total PCBs (both dissolved and particulate) ranges from about 1 to 5 ng/L, with 40-70% of the total PCBs associated with suspended particulate material. These concentrations are similar to levels observed in relatively "clean" Lake Michigan tributaries (C. Buelow, Wisconsin State Laboratory of Hygiene, Madison, WI pers. comm.).

PCB Monitoring at the Minnesota River at Judson site. The picture on the left shows the pumping apparatus in the river. The picture on the right shows the filter apparatus and the sample collection bottle.

The PCB monitoring strategy for 1999 and 2000 is to collect approximately eight sets of samples from six sites (Le Sueur River, Little Cobb River, and the Minnesota River at Judson, St. Peter, Jordan, and Ft. Snelling), under conditions that span a wide range of suspended solid concentrations. Additional samples will be collected in series around intense rain events or rain periods, to evaluate PCB loads under various flow and runoff conditions. Thus, approximately 100 PCB samples will be collected each year (corresponding to a total of 200 particulate and dissolved fractions), plus requisite matrix blanks and other quality assurance/quality control samples. Once automatic samplers are established at the monitoring sites (see below), the Blue Earth River site will also be included in the PCB monitoring effort.

Conventional Pollutant Monitoring

The conventional pollutant monitoring program began in September 1998, when Casandra Osborn was hired by the Environmental Monitoring and Assessment Section of MCES to direct the Mercury and PCB Inputs to the Minnesota River Monitoring Program, staff the Mankato field office, and establish the six new monitoring stations in the Minnesota River Basin. During the fall of 1998, monitoring equipment was purchased, monitoring stations were located, and access and construction permits were obtained. The stations were designed according to the configuration of the site, and platforms and shelters were constructed. Some of the sampling lines were installed before the end of the open-water season.

Station construction resumed during the spring of 1999. Monitoring instruments are now installed at all stations, and electrical and phone services have been installed and activated at most sites. Sampling lines have not yet been installed at the two Minnesota River sites (Judson and St. Peter). Unusually high water flows in the Minnesota River have delayed in-stream construction work.

Automonitoring will begin in August 1999 at the four tributary stations (Little Beauford Ditch, Little Cobb River, Le Sueur River, and Blue Earth River), when the stations all have electrical power and phone service, and all of the dataloggers are programmed according to the conditions at each site. The two Minnesota River stations (Judson and St. Peter) will not be equipped for automonitoring until the water level is low enough to permit in-stream construction work for installation of sampling lines. Automonitoring will begin at these stations in late summer. Until that time, grab samples will be obtained more frequently during storm events, as conditions allow.

A weekly grab sampling routine has also been established at all sites. Grab samples characterize water quality under baseflow conditions and supplement automonitoring during runoff events as needed. Grab sampling will continue year round as conditions permit.

Once all of the monitoring stations are operational, data will be collected for continuous stage, or water elevation, flow, temperature, conductivity, and precipitation. Flow-composited samples will be collected automatically during runoff events, and baseflow grab samples will supplement the event-based sampling. Each sample will be analyzed for water transparency, total and volatile suspended solids, alkalinity, hardness, metals, chlorides, nitrogen, phosphorus, chlorophyll-a, total organic carbon (TOC), chemical oxygen demand (COD), and biochemical oxygen demand (BOD). The MCES Laboratory Services Section in St. Paul, MN, will conduct all laboratory analyses.

In the future, continuous dissolved oxygen and turbidity monitoring may be added to the program. And, biological characterization of the monitoring sites, including identification and enumeration of bacteria, periphyton, plankton, and macroinvertebrates, is envisioned.

Rating Curve Development

Preliminary rating curves have been developed for all six monitoring sites. Some of the rating curves are based on historical U.S. Geological Survey (USGS) data or other historical data. Some rating curves have been developed based on field stage measurements and interpolated flow measurements.

All of the rating curves are being continually refined with field measurements. The flow and stage at the two Minnesota River sites are being measured with an Acoustic Doppler Current Profiler (ADCP), which gives a complete picture of the channel geometry and flow velocity across a transect. Other in-stream measurements, such as stage/velocity measurements and dye drips, will be incorporated as appropriate.

Little Beauford Ditch

The preliminary rating curve for the Little Beauford Ditch site is based on data collected by the Minnesota Pollution Control Agency (MPCA) from June to September, 1998. The rating curve will be refined by in-stream field measurements.

Little Cobb River

The preliminary rating curve for the Little Cobb River site was established by the USGS. The rating curve will be refined as new information is made available.

Le Sueur River

The preliminary rating curve for the Le Sueur River site was established by the USGS. Currently, MCES is using the rating curve for the USGS flow gaging station, which is located about one mile upstream from the MCES site. The rating curve for the MCES monitoring site will be refined by correlating stage measurements from the site with USGS flow data, and by field measurements such as dye drips.

Blue Earth River

The preliminary rating curve for the Blue Earth River site is based on the USGS stage-discharge rating table for the site. The rating curve will be refined as new information is made available.

Monitoring with the ADCP at the Minnesota River at Judson.

Minnesota River at Judson

The preliminary rating curve for the Minnesota River at Judson site is based on field stage measurements and calculated flow values. The flow calculation represents the USGS flow at the gaging station in Mankato, which is about 19 miles downstream from the MCES site at Judson, less the sum of the flow values for the Blue Earth and Le Sueur Rivers, which represent the inflow between Judson and Mankato. The preliminary rating curve assumes negligible groundwater inflow. The rating curve will be refined by direct stage and flow measurements taken with the ADCP; and over time, a rating curve specific to the Judson site will be developed.

Minnesota River at St. Peter

The preliminary rating curve for the Minnesota River at St. Peter site is based on field stage measurements and flow values from the USGS gaging station in Mankato, which is about 12 miles upstream. The preliminary rating curve assumes negligible groundwater inflow between Mankato and St. Peter. The rating curve will be refined by direct stage and flow measurement taken with the ADCP; and over time, a rating curve specific to the St. Peter site will be developed.

Cooperative Monitoring Partnerships

Minnesota Department of Agriculture (MDA)

MCES has established an important monitoring partnership with the Minnesota Department of Agriculture (MDA). MCES and MDA have cooperatively established a shared field office in Mankato, and the two agencies are working closely together to develop the Le Sueur River, Blue Earth River, and the Minnesota River at Judson monitoring stations. The MDA will share these three stations for their pesticide monitoring program. Currently, MDA has a grab sampling routine similar to the MCES grab sampling routine. Once the sites are fully operational, the MDA will begin automated sampling for pesticides.

United States Geological Survey (USGS)

The U.S. Geological Survey (USGS) is an invaluable source of historical stage, or water elevation, and flow information. All of the new MCES monitoring stations are located at or near sites which are currently being gaged by the USGS, or which have been gaged by the USGS in the past. This USGS information is the basis for the preliminary rating curves for all six monitoring stations. At two sites, the Little Cobb River and the Blue Earth River, the MCES shelters are located next to the USGS shelters. Because of the close proximity, USGS will be able to draw from the electrical power in the MCES station to power their own equipment, eliminating the need for heavy, awkward marine batteries. In the future, USGS may move their flow monitoring equipment into the MCES shelters.

Minnesota Pollution Control Agency (MPCA)

MCES is supporting a monitoring study being 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. The tube will be used by volunteer citizen monitoring groups to assess water clarity. The MPCA is trying to establish a relationship between the tube, which measures water clarity in centimeters, and turbidity and total suspended solids concentrations. MCES has incorporated transparency tube measurements into the sampling routine, and will contribute all relevant data to the MPCA study.

Local Cooperators

MCES has 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 Reporting

All of the flow and water quality data collected by the dataloggers will be summarized in an Excel database, and will be made accessible to the MPCA and other water resource professionals. The Excel database for each site is organized by month. 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 can be summarized into daily, monthly, and annual averages

All of the sample analysis results from the MCES lab are currently stored in an MCES Oracle database. This information will also be summarized in an Excel spreadsheet and made accessible to the MPCA and other water resource professionals. Methods for calculating annual pollutant loads are under development.

GPS coordinates have been obtained for all six monitoring sites (Appendix C). In the future, all MCES stations will be incorporated into a GIS map for display on the MCES web site. This site will allow water resource professionals and the general public to access information about each site, as well as the data associated with each station. In the future, each monitoring station will be assigned an EPA REACH 3 number so that the data will be compatible with EPA's STORET database and the National Hydrography Dataset.

Contact Information

Questions or comments about this report or the Mercury and PCB Inputs to the Minnesota River Monitoring Program may be directed to:

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Kent Johnson
Manager
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230 East Fifth Street
St. Paul, MN 55101
Phone: 651-602-8117
E-mail: kent.johnson@metc.state.mn.us

Budget

Combined Programs - Costs to Date

Cost accounting for both the Metropolitan Area Watershed Outlet Monitoring Program (WOMP) and the Mercury and PCB Inputs to the Minnesota River Monitoring Program has been continuously tracked by MCES program staff and the Metropolitan Council's internal accounting department. The $575,000 grant from the MPCA was disbursed to MCES in two installments. The first installment of $208,000 was received by MCES in July 1998, after execution of the grant agreement between the MPCA and MCES; and the second installment of $309,500 was received by MCES in September 1998. The remaining $57,500 is being withheld by the MPCA until MCES submits a final grant report in September 1999. As indicated in the work plans accompanying the grant agreement, the estimated budget for the Metropolitan Area Watershed Outlet Monitoring Program during the 1998-1999 biennium was $316,000, while the estimated budget for the Mercury and PCB Inputs to the Minnesota River Monitoring Program was $259,000. The expenditures in Table 2 below reflect the actual costs for both programs during the period from July 1, 1997 through June 30, 1999.

Table 2. Program Expenditures from July 1, 1997 through May 31, 1999

Program	WOMP $316,000	Hg/PCB $259,000	Total $575,000
MCES Staff Labor	$56,095.80	$27,622.20	$83,718.00
Staff Fringe Costs	$22,494.70	$11,714.95	$34,209.65
MCES Trades Labor	$20,642.26	$19,799.25	$40,441.51
Contracted Services	$18,728.62	$6,641.00	$25,369.62
Monitoring Equipment	$101,694.88	$68,290.29	$169,985.17
Materials and Supplies	$12,412.07	$12,392.27	$24,804.34
Monitoring Utilities	$5,585.47	$54.83	$4,791.17
Office Expenses	$166.82	$3,184.00	$3,350.82
Laboratory Expenses	$4,787.93	$8,029.87	$12,817.80
Travel Expenses	$263.59	$41.54	$305.13
Fuel and Vehicle Expense	$20,072.62	$0.00	$20,072.62
Professional Development	$450.26	$0.00	$450.26
Total	$263,395.02	$157,770.20	$421,165.22
SURPLUS (DEFICIT) BALANCE			

The accounting figures in Table 2 indicate that as of May 31, 1999, a surplus exists in the approximate amount of $160,082.53. These figures, although based upon information provided by the Metropolitan Council's accounting department, should be regarded as preliminary. A final, formal cost accounting for the two programs will be included in the final grant report that is due to the MPCA on September 30, 1999.

For more detailed accounting information on these two programs, please contact Mary Elverum (651-602-1084) in the Metropolitan Council's accounting department.

Appendix A

MCES Watershed Outlet Monitoring Program Sites and Cooperators

MCES Watershed Outlet Monitoring Program Sites and Cooperators

Grant Funding provided to the MPCA and MCES by the Minnesota Legislature, through the “Interagency Water Monitoring Initiative”

Monitoring Sites and Cooperators:

1. Bassett Creek, Bassett Creek Watershed District*
2. Cannon River, Goodhue County SWCD and Dakota County SWCD
3. Crow River, Wright County SWCD
4. Eagle Creek, MN DNR
5. Minnehaha Creek, Minneapolis Park and Recreation Board and Minnehaha Creek Watershed District
6. Riley Creek, Riley-Purgatory Watershed District
7. Unnamed creek between Pike’s Lake and Dean’s Lake, Lower Minnesota Watershed District**
8. Valley Creek, St. Croix Watershed Research Station, Science Museum of Minnesota
9. Willow Creek, Black Dog Watershed Management Commission
10. South Washington Watershed District, Cottage Grove outlet (expressed initial interest in program, 5/99) **

* approved and scheduled for construction, summer 1999
** still in approval process, not yet constructed

Addresses and Contact Information

Bassett Creek
Site Location: Bassett Creek at Minneapolis Impound Lot, 2nd Ave N.
Cooperator: Bassett Creek Watershed District
Contact: Len Kremer, P.E., Barr Engineering
ph: 612-832-2764 fax: 612-832-2601
lkremer@barr.com

(This site has just recently been approved by the WMO. The cooperator is in the process of getting permission for access on the site).

Cannon River
Site Location: USGS gaging station in Welch, MN
Cooperators: Dakota and Goodhue County SWCDs
Contact: Brian Watson, Lora Jester Dakota SWCD
ph: 651-891-7777 fax: 651-891-7775
brian.watson@co.dakota.mn.us
Contact: Craig Connelly, Matt Jacobson, Greg Robeson, Goodhue SWCD
ph: 1-651-923-5286 fax: 1-651-923-5288
crc@mn.nrcs.usda.gov

Crow River
Site Location: Hwy. 55 bridge at Rockford, MN
Cooperator: Wright County SWCD
Contact: Kerry Saxton, Wright SWCD
ph: 612-682-1970
kjs@mn.nrcs.usda.gov

Eagle Creek
Site Location: Eagle Creek @ 126th Street Bridge, Savage, MN

Cooperators: MN DNR and the City of Savage
Contact: Greg Kruse, MDNR
ph: 297-2402
greg.kruse@dnr.state.mn.us

Contact: Jeff Sandberg, City of Savage
ph: 612-882-2684
sandberg@ci.savage.mn.us

Minnehaha Creek
Site Location: 32nd Ave and Minnehaha Creek, Minneapolis, MN
Co-cooperators: Minneapolis Park Board and Minnehaha Creek Watershed District
Contact: Jeff Lee, James Johnson, Natalie Brown
Minneapolis Park and Recreation Board
ph: 370-4900 fax: 370-4831
jeffrey.t.lee@ci.minneapolis.mn.us
james.a.johnson@ci.minneapolis.mn.us
natalie.h.brown@ci.minneapolis.mn.us

Contact: Pete Cangeliosi,
Minnehaha Creek Watershed District
ph: 471-6285
pete.cangialosi@minnehahacreek.org

Unnamed Creek in the Lower Minnesota Watershed District;
Site Location: Stream reach between Pike Lake and Dean Lake @ Co. Rd 16, Shakopee, MN
Cooperator: Lower Minnesota Watershed District
Contact: Larry Samstad, Itasca Engineering
327 S. Marschall Rd, Shakopee, MN
ph: 612-445-7993 fax: 612-445-2106

(This site is currently still in the process of gaining landowner approval.)

Riley Creek
Site Location: Riley Creek @ Hwy 212 in Eden Prairie
Cooperator: Riley Creek Watershed District
Contact: Mike Hudec, Hal Runke, Barr Engineering
ph: 612-832-2606 fax: 612-832-2601
mhudec@barr.com

Valley Creek
Site Location: Valley Creek at Putnam Rd, Afton, MN
Cooperator: St. Croix Watershed Research Station, Science Museum of Minnesota
Contact: Jim Almendinger
ph: 651-433-5953, ext.19 fax: 651-433-5924
dinger@sci.mus.mn.us

Willow Creek
Site Location: Cub Foods parking lot at 2900 W. Hwy 13, Burnsville, MN
Cooperator: Black Dog Watershed Management Committee
Contact: Mike Hudec, Hal Runke, Barr Engineering
ph: 612-832-2606 fax: 612-832-2601
mhudec@barr.com

Appendix B

MCES Methodology for PCB Analysis

MCES Methodology for PCB Analysis

Polychlorinated biphenyls (PCBs) are a class of 209 discrete chemical compounds, called congeners, whose biphenyl ring contains from one to 10 chlorine atoms. Approximately 100 congeners are routinely observed in the environment. Monsanto Corp. manufactured PCBs as mixtures of congeners containing various chlorine contents under the `Aroclor' tradename. Current MCES analytical techniques quantify PCBs in terms of Aroclor mixtures as originally produced prior to being banned in 1978. However, environmental weathering of individual congeners has resulted in congener distributions unlike that in the original Aroclor mixtures. Thus, current MCES techniques may overestimate or underestimate PCB concentrations. The goals of this effort are to establish sampling and analytical methods capable of quantifying PCBs on a congener-specific basis in Minnesota River water.

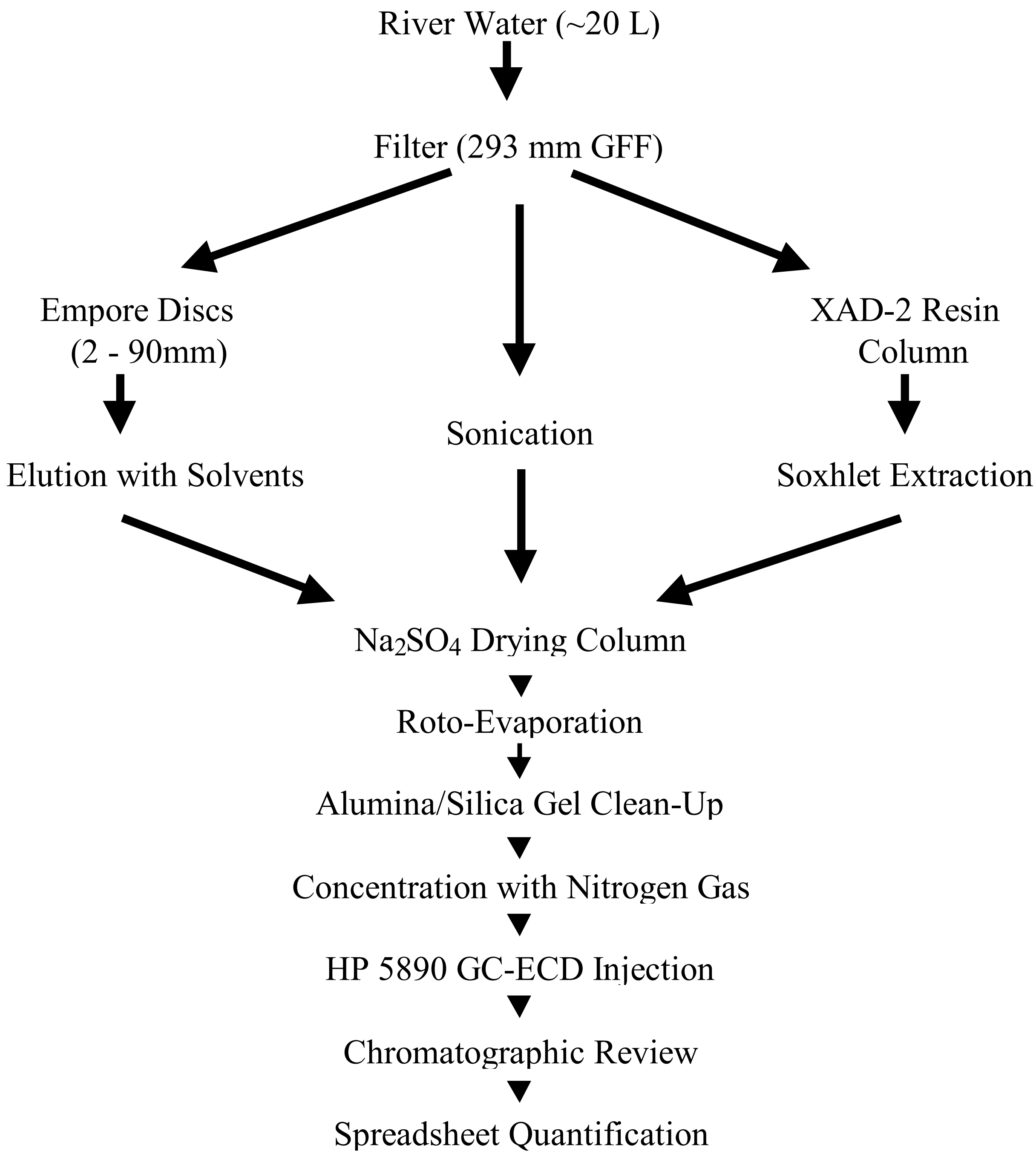
Prior to this program, PCBs have not been extensively monitored in the Minnesota River. However, concentrations are expected to be similar to the mean concentrations observed in Lake Michigan tributaries in 1994-95, ranging from ~2 to 80 ng/L with the particulate fraction accounting for about 60-70% of the total (C. Buelow, Wisconsin State Laboratory of Hygiene, Madison, WI pers. comm.).

For typical analysis of PCBs at trace levels, large volumes (>100 L) of lake or river water are pumped through a filter to collect particulate material, and the filtrate is passed through a column containing some hydrophobic adsorbent such as XAD-2 resin (a polystyrene/divinylbenzene polymer) to isolate the dissolved fraction. This strategy requires many hours on-site to collect each sample, and thus limits the number of samples that can be conveniently collected in a reasonable period of time. In the laboratory, the XAD resin and filter are extracted with solvents, and the extract is concentrated and cleaned to minimize chemical interference. Then, 2 *u*L of the final concentrated extract is injected onto a gas chromatographic instrument (GC) for chemical identification and quantification. This procedure requires significant volumes of solvent to clean equipment and extract samples, and many hours in the laboratory to prepare samples for instrumental analysis. A schematic of the traditional analytical method is shown in Figure 1.

Conversely, the new MCES method (Figure 1) requires only ~20 L of river water that can be "grabbed" from each sampling site and then processed in the laboratory. This has been accomplished by modifying the gas chromatographic instrument to accommodate large volume injections that increase sensitivity by 1 to 2 orders of magnitude. In addition, laboratory procedures have been modified to accommodate these smaller sample volumes, subsequently reducing solvent use and the labor required for each sample.

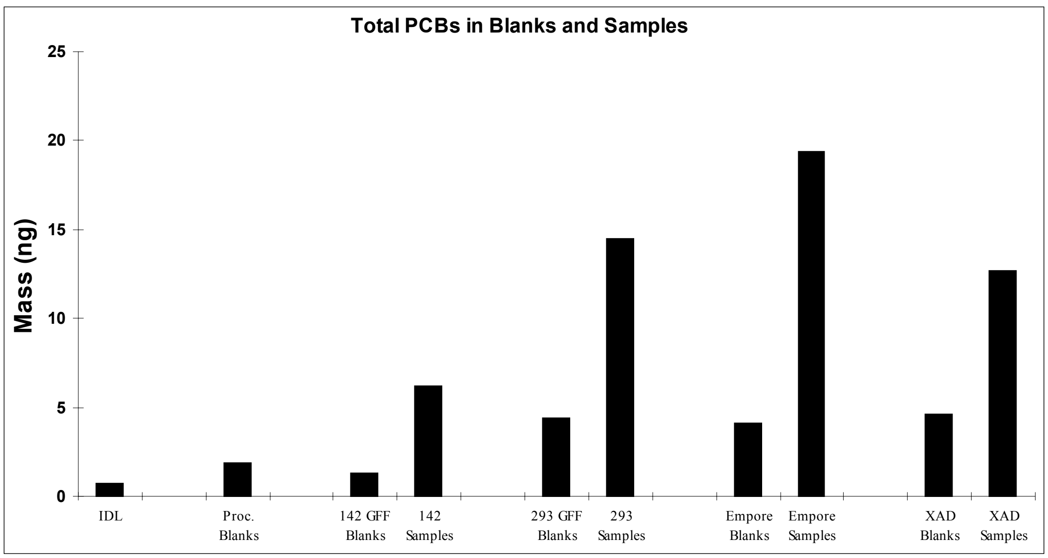
In the field, river water is collected in stainless steel tanks that are pressurized with nitrogen in the laboratory, forcing the water through glass fiber filters (GFFs) to isolate the particulate matter. The filtrate is then passed through Empore™ (3M) discs impregnated with C-18 adsorbent that accumulates dissolved phase PCBs. The glass fiber filters are extracted with solvent in a traditional Soxhlet apparatus, while the Empore discs are simply eluted with solvent. Typical laboratory procedures are applied throughout the remainder of the analysis, prior to large volume injection on a modified HP5890 GC with an electron capture detector. Because Empore discs have not been widely used to monitor PCBs in the aquatic environment, a rigorous evaluation of their performance relative to XAD-2 resin has been incorporated into the method and will continue to be monitored.

Figure 1. MCES Analytical Method for PCBs in River Water



The mass of Σ-PCBs (the sum of all detected and quantified congeners) within solvent, filter, Empore disc and XAD-2 resin blanks ranges from approximately 2 to 6 ng (Figure 2). The mass detected in various river water samples collected to date is also low, ranging from approximately 6 to 20 ng. Thus, rigorous attention to quality assurance and to "clean" laboratory practices will need to be maintained to provide reliable PCB results.

Figure 2. Mass of PCBs in solvent, filter, Empore disks, and XAD blanks and samples.



Appendix C

Location Coordinates for all MCES Automonitoring Stations

Location Coordinates for all MCES Automonitoring Stations

HYDROLOGIC STREAM NAME	STREAM MILE	Topo sheet	MONITOR START	UTM-ZONE15 NORTH	UTM-ZONE15 EAST	COORD SOURCE
Existing MCES Monitoring Network WOMP 1 (300-399)						
VERMILLION RIVER	2.0	HASTINGS	1995	4952424.78	511864.58	trimble
SHINGLE CREEK	0.1	MINNEAPOLIS N.	1995	4987097.18	476864.45	GPS
RICE CREEK	3.7	NEW BRIGHTON	1995	4993377.68	480693.96	GPS
COON CREEK	1.9	COON RAPIDS	1995	4999689.80	476641.50	GPS
FISH CREEK	0.2	ST PAUL EAST	1995	4971586.36	499419.46	GPS
BATTLE CREEK	0.1	ST PAUL EAST	1995	4975987.00	497426.00	GPS
CARNELIAN-MARINE OUTLET	3.0	MARINE ON ST CROIX	1995-'98	4996183.92	516380.15	trimble
SILVER CREEK	0.7	STILLWATER	1998	4992297.55	514733.82	trimble
ELM CREEK	4.9	ANOKA	1995	5000970.90	465692.98	GIS ORTHO
PIONEER CREEK	10.6	ROCKFORD	1995	4983377.13	442692.91	GIS ORTHO
SARAH CREEK	1.8	ROCKFORD	1995	4991505.92	443544.73	GIS ORTHO
BELTLINE INTERCEPTOR	0.5	ST PAUL EAST	1995	4977134.66	496766.21	GPS
SPRINGBROOK	0.5	MINNEAPOLIS N.	1995	4996250.52	478160.82	GPS
LOWER RUM RIVER	0.5	ANOKA	1996	5004707.36	469159.35	GIS ORTHO
BROWNS CREEK	0.3	STILLWATER	1997	4991374.27	515023.98	GPS
WOMP 2 (100-199)						
VALLEY CREEK	1.0	HUDSON	1998	4973627.13	516894.73	trimble
MINNEHAHA CREEK	1.7	ST PAUL WEST	1998	4973800.64	482209.70	trimble
CROW RIVER	23.1	ROCKFORD	1998	4992848.44	442148.66	trimble
CANNON RIVER	11.9	WELCH	1999	4934596.45	521286.20	trimble
EAGLE CREEK	0.8	EDEN PRAIRIE	1999	4958073.03	496484.75	trimble
WILLOW CREEK	1.0	BLOOMINGTON	1999	4958291.02	475069.85	trimble
RILEY CREEK	1.3	EDEN PRAIRIE	1999	4962606.62	462058.41	GIS ORTHO
Existing MCES Monitoring Network NONPOINT (0 - 99)						
RILEY CREEK	1.3	EDEN PRAIRIE	1989	4962761.40	462030.81	trimble
LOWER BEVENS CREEK	2.0	JORDAN WEST	1989	4951134.75	445975.67	trimble
UPPER BEVINS CREEK	5.0	JORDAN WEST	1992	4953706.98	443954.51	trimble
BLUFF CREEK	3.5	SHAKOPEE	1989	4962181.92	457297.41	trimble
CARVER CREEK	1.7	VICTORIA	1989	4955415.85	448533.58	trimble
CREDIT RIVER	0.6	BLOOMINGTON	1988	4958447.65	472830.82	trimble
NINE MILE CREEK	1.8	BLOOMINGTON	1988	4961680.87	476185.24	trimble
SAND CREEK	1.6	JORDAN WEST	1988	4946330.32	449682.39	trimble
MINNESOTA RIVER at JORDAN	39.4	JORDAN WEST	1988	4949030.18	449114.55	trimble
MINNESOTA RIVER (200-299)						
LITTLE BEAUFORD DITCH	0.6	BEAUFORD	1999	4874284.07	423185.52	trimble
LITTLE COBB RIVER	1.6	BEAUFORD	1999	4871866.79	427114.98	trimble
LE SUEUR RIVER	2.3	GOOD THUNDER	1999	4885518.31	415940.56	trimble
BLUE EARTH RIVER	12.0	GOOD THUNDER	1999	4883146.90	411168.25	trimble
MINNESOTA RIVER at JUDSON	120.0	JUDSON	1999	4894885.00	404611.61	trimble
MINNESOTA RIVER at ST PETER	89.7	ST PETER	1999	4908399.82	423950.97	trimble

Code for COORD SOURCE field:
“trimble: = read directly from instrument
“GIS ORTHO” = coordinates read from DOQ
“GPS” = coordinates captured by GPS and corrected