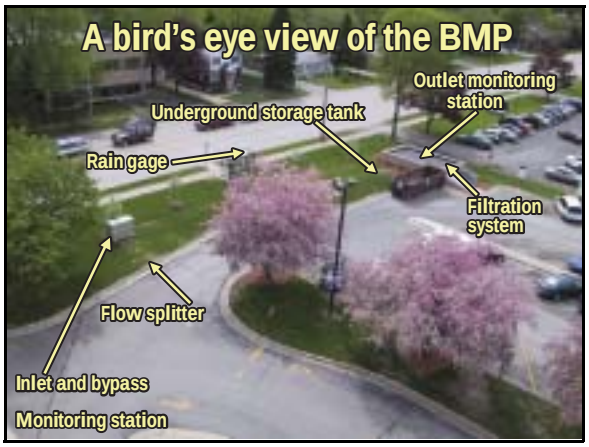
URBAN NONPOINT TEAM

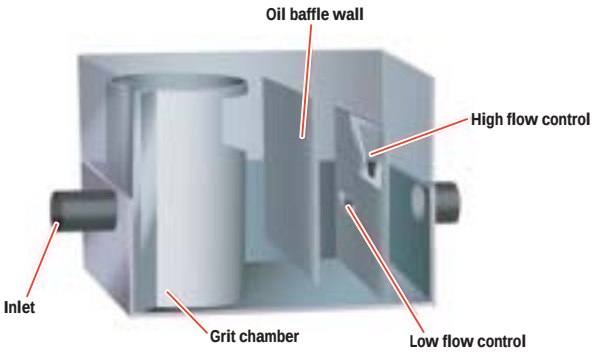
Mission

The urban monitoring Self-Directed Work Team (SDWT) provides information critical to cooperators to make informed urban water resource decisions. Team objectives are to efficiently manage projects from conception and proposal stage through the operation and management phases, resulting in thoughtful and timely products whether they be data requests, data summaries or final reports. Through these objectives it is our intent to continuously improve site installation, technical approach, data collection coordination, financial management and report production of urban studies. We will strive to maintain a positive cooperator relationship and to enhance the skills and growth of individual team members.

Team Members

William R. Selbig, Hydrologist
Robert J. Waschbusch, Hydrologist
David W. Owens, Hydraulic Engineer
Steven R. Corsi, Hydrologist
Troy D. Rutter, Hydrologic Technician
Judy A. Horwatich, Hydraulic Engineer
Joel A. Brieske, Hydrologic Technician





Vortechs^{TM} System by Vortechnics.

PROJECTS

VERIFICATION OF TREATMENT PERFORMANCE OF THE VORTECHNICS AND STORMWATER MANAGEMENT FILTER

COOPERATOR:

Wisconsin Department of Transportation

PROJECT CHIEFS:

Judy A. Horwatich
David W. Owens

LOCATION:

City of Milwaukee

PROJECT NUMBER:

WI 17207

PERIOD OF PROJECT:

October 2000 to September 2003

PROBLEM

The Wisconsin Department of Transportation (WDOT) is required to improve the quality of runoff from roadways under their control as part of the National Pollution Discharge Elimination System (NPDES) and an agreement with the Wisconsin Department of Natural Resources (WDNR). In addition, future state and federal regulations will prescribe new performance standards for nonpoint runoff management and calculation requirements for total maximum daily loads (TMDLs) of contaminants discharging in watershed basins.

OBJECTIVES

The objectives of this project are to: (1) determine the effectiveness of a Vortechnics Stormwater Treatment System and a Stormwater Management Storm Filter System in removing pollutants from highway runoff water, (2) compare the measured removal efficiencies with manufacturers' estimates, (3) characterize the variability in freeway runoff quality, (4) characterize pollutant loading in freeway runoff, and (5) determine the practical application of the treatment devices (for example, installation, operation, and maintenance costs).

APPROACH

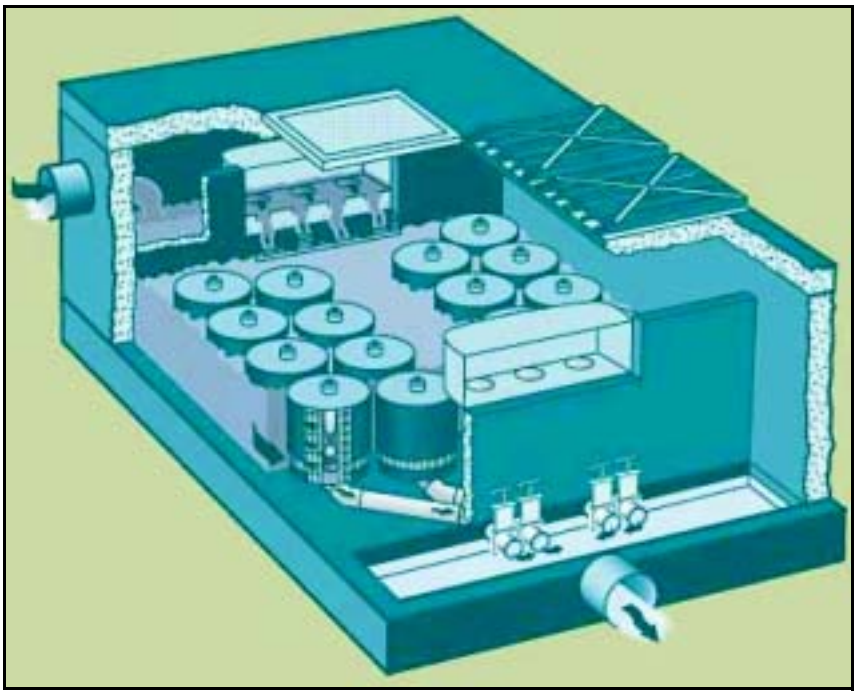
Discharge and event mean concentration (EMC) data will be collected at the BMP inlets and outlets for 15 consecutive large (more than 0.15 inches of precipitation) runoff events. These samples will be analyzed for total phosphorus, suspended and dissolved solids, zinc, copper, and chloride. Other samples from small (less than 0.15 inches of precipitation) events occurring between the larger events will be analyzed only for suspended solids. The data will be used to calculate individual event water-quality loads entering and exiting the BMPs. The calculated loads will be used to determine the removal efficiencies of the two treatment systems for the test period and to determine if there are any efficiency patterns related to event size.

PROGRESS (July 2001 to June 2002)

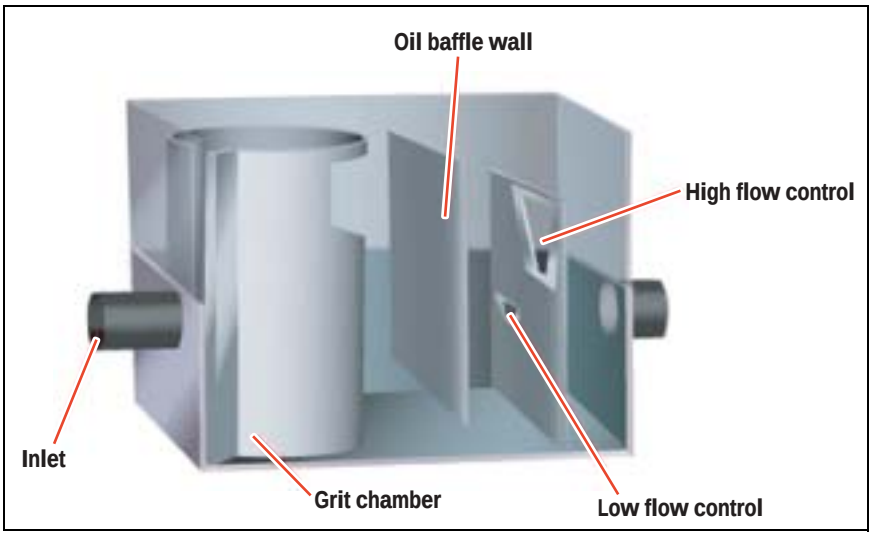
The project proposal has been completed and monitoring equipment has been installed. Treatment systems have been installed.

PLANS (July 2002 to June 2003)

It is expected that sampling will be initiated in May 2002 and should be concluded by October 2002. This schedule depends on timely delivery and setup of the treatment devices. A data report will be written describing the BMPs, the monitoring system, and a summary of the data collected.



Stormfilter™ by Stormwater Management Inc.



Vortechs™ System by Vortechnics

VERIFICATION OF A PRESSURIZED STORMWATER FILTRATION SYSTEM AT ST. MARY'S HOSPITAL

COOPERATORS:

Wisconsin Department of Natural Resources;
National Science Foundation

PROJECT CHIEFS:

Judy A. Horwatich
Steven R. Corsi

LOCATION:

Green Bay

PROJECT NUMBER:

WI 17208

PERIOD OF PROJECT:

September 2000–Continuing

PROBLEM

Urban stormwater is degrading Wisconsin waters. Cost-effective treatment technologies are needed to reduce adverse impacts that urban stormwater runoff can have on surface-water quality. A variety of advanced technologies have emerged in recent years that can help communities achieve compliance with new regulations. The EPA's Environmental Technology Verification (ETV) Program established a cooperative agreement with the National Standards Foundation (NSF) International to verify the treatment capabilities of the proprietary treatment devices.

The Wisconsin Department of Natural Resources and the USGS will conduct a study of a pressurized stormwater filtration system as an ETV program. The system has been installed at St. Mary's Hospital in Green Bay and is being used to treat runoff from its parking lot and rooftops. Stormwater is captured and pumped through a two-phase filter system and discharged into a city storm sewer. Backflush water is discharged into a sanitary sewer.

OBJECTIVE

The project objective is to determine the efficiency of the pressurized filtration system in extracting sediment, nutrients, and zinc from stormwater runoff.

APPROACH

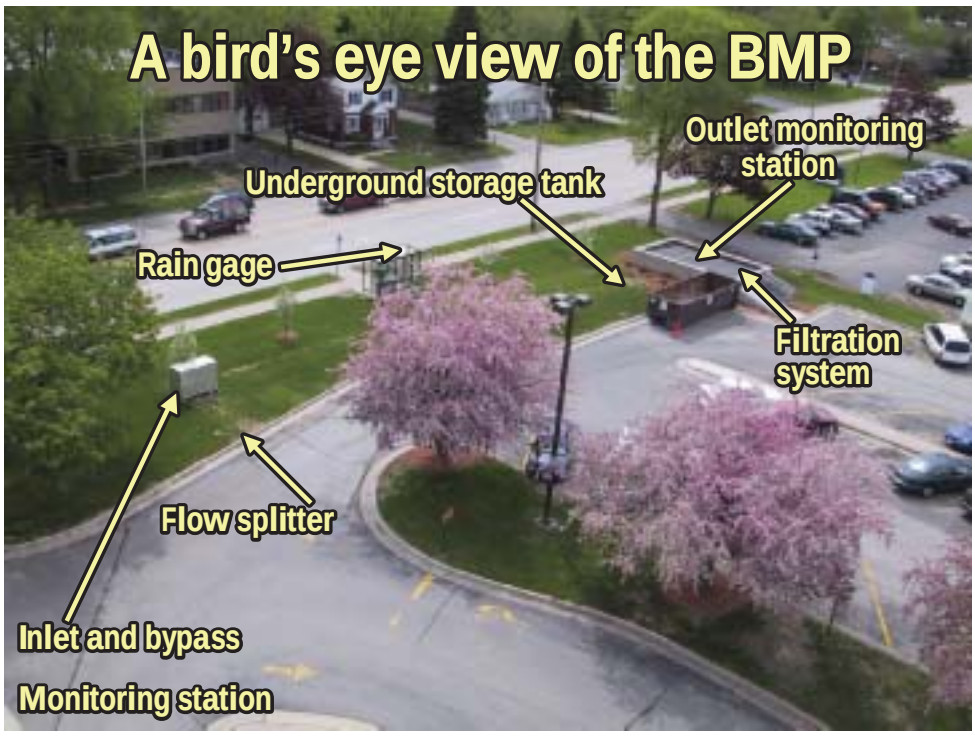
To accomplish the above objective, the following approach will be used: (1) install flow-monitoring and water-quality sampling equipment at the inflow, outflow, and bypass of the system, (2) continuously monitor rainfall and flow, and collect water-quality samples for 15 runoff events in 2001, (3) analyze samples for sediment, total and dissolved phosphorus, Kjeldahl N, NO_2-NO_3 N, and zinc, (4) compute loads for inflow, filtered outflow, and bypass for the above constituents, (5) compute a mass balance on flow and water-quality loads for all events, and (6) publish a technical report on the results of the study.

PROGRESS (September 2000 to June 2001)

All equipment has been installed and is operational. Several test samples have been collected.

PLANS (July 2001 to June 2002)

Plans are to: (1) monitor 9 additional consecutive storms that have more than 0.2 inches of rain, (2) compute the discharge record and water-quality loads for the three monitoring locations, (3) complete a mass balance summary for the monitored storms, and (4) publish the results of the study.



Overview of monitoring and filter systems.

THRESHOLDS OF TOXICITY IN URBAN STREAMS

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

Steven R. Corsi

LOCATION:

Statewide

PROJECT NUMBER:

WI 17216

PERIOD OF PROJECT:

July 2001 to September 2002

PROBLEM

The State of Wisconsin has recently implemented a federally mandated program that requires cities with populations greater than 10,000 to develop stormwater management plans. The intent is to eventually regulate stormwater as a point source of pollution by setting limits on the quantity and quality of runoff entering receiving waters. The critical problem that needs to be addressed is the degree to which toxicants found in urban runoff need to be regulated in order to protect the biological integrity of receiving streams. Fish and invertebrate communities of streams in Wisconsin have been shown to be severely degraded where land surface imperviousness, which is a good surrogate for the level of urban impact, in the watershed is greater that 8–12 percent. Extensive testing over a five-year period on one stream in the metropolitan Milwaukee area with watershed imperviousness greater than 25 percent showed toxicity repeatedly in test organisms exposed to water or stream sediment for more than seven days. This toxicity was not substantially reduced by passing the runoff through a pilot-scale stormwater retention basin similar to those presently used in urban areas. One question that needs to be addressed is whether there is a threshold level of watershed imperviousness below which regulation of toxicants in stormwater runoff is not needed? Another question that needs to be answered is at what field concentration of potential toxicants do we see adverse effects in stream-dwelling organisms? This will permit regulatory effort to be more effectively focused on problem areas and problem chemicals.

The Wisconsin Department of Natural Resources would use this information to identify areas where regulation of toxicants in runoff is necessary to protect, enhance, or restore aquatic communities. Municipalities will need this information to most economically and effectively comply with these impending regulations.

OBJECTIVE

The purpose of this study is to examine the relation of watershed imperviousness in urban river systems to measures of toxicity in aquatic organisms. Specific objectives include: (1) determine the chronic toxicity of urban river systems to *P. promelas* in 30-day tests using

in-situ caged fish tests, and (2) support an effect by University of Wisconsin–Stevens Point (UWSP) and University of Wisconsin– Milwaukee (UWM) to study acute and chronic toxicity of urban river systems on several organisms as well as short-term effects on reproductive success of *P. promelas,* effects on reflex/predator avoidance behaviors in *P. promelas* offspring, and effects on preference-avoidance behavior and habitat selection in *P. promelas* adults.

APPROACH

The USGS portion of this project will include the caged-fish study and support of the UWSP-UWM monitoring efforts by providing an adequate shelter for testing, water level for determination of stream status, and coordination of shelter transport between sites.

In-stream fathead minnow exposures will involve the following details: (1) in-stream fathead minnow exposures will consist of a number of test chambers (3 or 4 at a time) and one control chamber placed at different locations longitudinally on the stream, (2) tests will ideally coincide with other toxicity monitoring by UWSP-UWM, (3) chambers consist of 4 cartridges with 5 adult minnows (3 months old) per cartridge, (4) the ideal stream will flow from 0.0 percent urban impact to a high urban impact and changes will be placed at several places longitudinally along the stream. The control chamber will be defined as the chamber at the location with 0.0 percent urban impact. Exact placement of chambers will be dependent on the depth and flow conditions of each individual stream, (5) if suitable conditions do not exist for placement of chambers in some portions of the stream, nearby streams with appropriate urban impact will be considered as well, and (6) site visits will be made by UWSP personnel each day to check on the condition of the minnows. During each site visit, dissolved oxygen, conductivity, and water temperature will be recorded in the stream and in each cartridge.

Support of the UWSP-UWM effort will include the following: (1) the monitoring shelter will consist of a rented construction trailer that will be used by UWSP, UWM, and paid for from the USGS budget, (2) the site will be located near a stream gage or other source to provide electrical connections, and (3) the trailer rental agency will transport the monitoring station between sites.

PROGRESS (July 2001 to June 2002)

The sites have been selected and procurement at the shelter is ongoing.

PLANS (July 2002 to June 2003)

Four to five sites will be monitored during the 2002 summer and another four to five sites during the 2003 summer.

CALIBRATION OF THE SOURCE LOADING AND MANAGEMENT MODEL (SLAMM)

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

Judy A. Horwatich

LOCATION:

Statewide

PROJECT NUMBER:

WI 17219

PERIOD OF PROJECT:

July 2001–Continuing

PROBLEM

Wisconsin municipalities are using urban runoff models to help them prepare stormwater management plans. Planners and engineers use the models to identify the most important sources of pollutants and quantify the benefits of different management alternatives. The Source Loading and Management Model (SLAMM) is one of the models recommended for stormwater planning by the WDNR.

All watershed models should be calibrated before they are applied. Large errors in flow and pollutant concentrations can result if the model is not adjusted as much as possible to the places it will be used. In most cases the municipalities will not have the resources to collect the necessary flow and pollutant concentration data. Fortunately, enough stormwater data has been collected to adjust SLAMM for use by municipalities in Wisconsin.

OBJECTIVE

The objective of the project is to calibrate and verify the SLAMM model with the stormwater flow and pollutant concentration data available from urban studies conducted in Wisconsin.

APPROACH

Flow and pollutant concentrations are available from eight stormwater projects conducted by the Wisconsin USGS. Source-area concentrations were collected for four of the projects. The USGS collected flow and concentration data at the end of the pipe for all the projects. Land use and development characteristics, such as percent-connected imperviousness, were determined for each study area. All the above information is needed to calibrate and verify SLAMM.

There are three steps to calibrate SLAMM. First, the predicted runoff volumes should be adjusted to match the values observed at the end of the pipe. After the appropriate rainfall file is created, the runoff volumes are predicted for each rainfall event. To determine what adjustments are needed to the model's rsv (runoff coefficients) file, plots are made to describe the bias and variance between the predicted and observed values. Runoff coefficients in the rsv files are increased or decreased to minimize the bias and variance. Multiple model runs must be made until the rsv values produce the best results possible for all eight sites.

Second, the predicted particle solids loads should be adjusted to match, as much as possible, the observed particle solids loads at all eight sites. The two steps in adjusting the predicted particle solids loads are: (1) entering the average source area particle solids concentrations into the model's particulate solids concentration files, and (2) modifying std (street delivery) file until the predicted and observed end of the pipe particulate loads are reasonably close for all eight sites.

All remaining pollutants are calibrated in the last step. Normalized particulate concentrations are determined for phosphorus, zinc, copper, and PAHs. The geometric mean for each source is entered into the model's ppd file. Then the geometric mean of the dissolved concentrations for each source area is entered into the ppd file. Large differences in predicted and measured loads could justify some adjustment to the measured values in the ppd files. Again the files would have to be adjusted so the predicted values match as best as possible for all eight study sites.

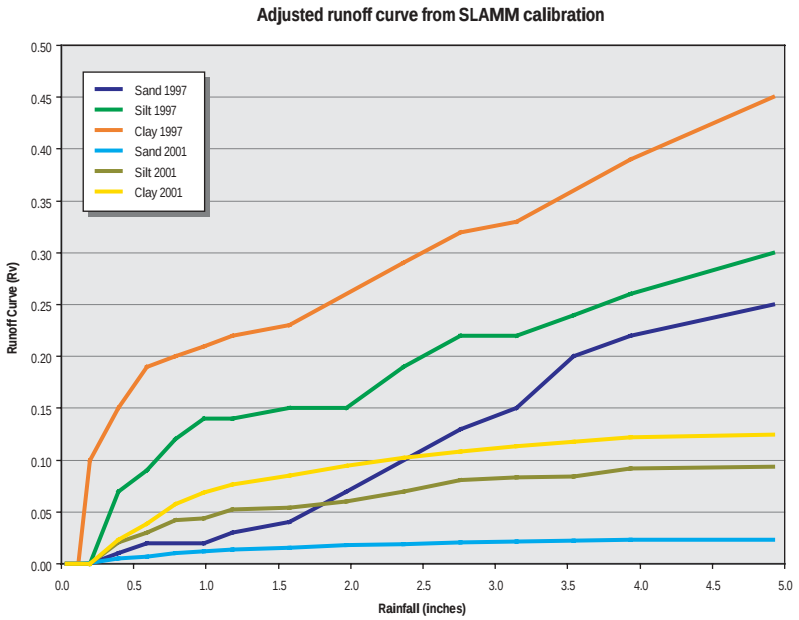
All the files created by the calibration will be placed on the USGS web page. A link will be made from the WDNR web page to the USGS web page.

PROGRESS (July 2001 to June 2002)

Flow, pollutant concentration, and land use data has been compiled. Calibration of the runoff volume is also completed. Plots have been prepared describing the bias and variance between the predicted and measured values. Calibration of the particulate solids loads is almost completed. Files are available on the USGS web page.

PLANS (July 2002 to June 2003)

Calibration work will be completed for the particulate solids, phosphorus, zinc, copper, and PAHs. At the end of this year we plan to compile the data from three more stormwater studies and verify SLAMM. We will calibrate the rsv file for pervious areas based on a lawn runoff study. An Open-File Report will be published explaining calibration of the model.



Comparing SLAMM curve number before and after calibrations.

EVALUATING IMPROVED STREET SWEEPING FOR ENHANCING WATER QUALITY IN HIGHWAY RUNOFF IN MILWAUKEE

COOPERATOR:

Wisconsin Department of Transportation

PROJECT CHIEF:

Robert J. Waschbusch

LOCATION:

Milwaukee County

PROJECT NUMBER:

WI 17231

PERIOD OF PROJECT:

October 1998 to September 2002

PROBLEM

The Wisconsin Department of Transportation (WDOT) is required to control the quality of runoff from roadways under their control as part of the National Pollutant Discharge Elimination System (NPDES). One way to control roadway runoff quality is to use street sweeping to remove pollutants before they are entrained in runoff. This option may be more cost effective than structural BMPs since WDOT already conducts street sweeping and would only need to increase the frequency of sweeping and use an improved sweeper.

OBJECTIVES

The primary objective of the investigation is to determine if water-quality benefits are realized by improved street sweeping and, if so, to what degree. Secondary objectives are to: (1) develop accumulation curves for solids deposited on freeways in the greater Milwaukee area, (2) use solids accumulation curves and water-quality data to calibrate the SIMPTM model, (3) characterize the variability in freeway runoff quality; and (4) characterize pollutant loading with and without the street-sweeping program.

APPROACH

This study used a paired-basin approach, shoulders in the test basin were swept once a week with an Enviro-whirl street sweeper and the control basin was never swept. Regression relations will be determined between the test and control basins for both sweeping and non-sweeping periods. If the slope and intercept of the regression relationships are significantly different between the sweeping and non-sweeping periods, the difference will be attributed to street sweeping.

Baseline periods, where no sweeping occurs in either the test or control basin, will be used to define concentration relations for runoff events between the basins. These relations will then be compared to concentration relations found between the basins during sweeping periods. Sweeping periods will have the test basin swept at a rate of once per week and the control basin unswept. The sweeping and non-sweeping schedule was selected to provide an equal number of sweep-

ing versus non-sweeping samples from frontal, convective and winter runoff events.

PROGRESS (July 2001 to March 2002)

Monitoring for the project was completed at the end of September 2000. Preliminary data analysis has been performed on the runoff concentration data and the results presented at the Fox-Wolf 2000 stormwater conference in Green Bay in February 2001. Data and analysis results were delivered to the WDOT for publication in a WDOT research project report. In addition, a U.S. Geological Survey Open-File Report is being prepared. The Open-File Report has gone through editorial and technical review and is currently being prepared for publication.

PLANS (March 2002 to July 2003)

U.S. Geological Survey Open-File Report will be finalized and published. The WDOT research project report will be published approximately August 1, 2002. Results of the project were presented to the WDOT Technical Oversight Committee.

EVALUATION OF THE EFFECTIVENESS OF LOW-IMPACT DEVELOPMENT PRACTICES

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

William R. Selbig

LOCATION:

Cross Plains

PROJECT NUMBER:

WI 17233

PERIOD OF PROJECT:

July 1998 to September 2005

PROBLEM

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

Low-impact development is designed to reduce the volume and improve the quality of runoff while attempting to preserve the natural hydrology of the site. Low impact practices include the reduction of impervious surfaces and installation of infiltration devices, such as rain gardens.

OBJECTIVE

To evaluate the effectiveness of low-impact practices for reducing runoff quantity and improving runoff water quality.

APPROACH

Test and control sites have been selected in Cross Plains, Wisconsin. The control site, which was developed from 1988 to 1991, used traditional urban design practices such as storm sewers, curbs and gutters, and a wet detention basin. The second site began development in May 1999 and is implementing low impact development practices. Both sites are finger valleys that are approximately a quarter mile apart.

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

Comparisons will be made between the BMPs based on unit-area runoff and unit-area loads. Furthermore, the data collected during the 7-year period will

document the changes in water quality and quantity during the construction cycle (from platting to site closeout).

PROGRESS (July 2001 to June 2002)

Continued monitoring and sampling at both sites. Additional equipment was installed at three detention pond inlets and the detention pond outlet to measure runoff velocity and discharge. These sites are also equipped to capture water-quality samples. Soil reflectometers and thermocouples were installed near the center of the infiltration basin to continuously measure soil moisture levels at various depths. Also, soil cores were taken at various locations within the infiltration basin to better understand the performance of the practice.

PLANS (July 2002 to June 2003)

Continue to monitor and sample both sites. Additional infiltration tests will be performed not only on the infiltration practice but also on outlying pervious surfaces to comprehensively understand expected infiltration rates and track any decreases over time. Two flumes will be installed to measure volume of water that enters the infiltration basin from the north end. A piezometer will be installed near the detention pond invert to measure fluctuations in storage previous to and during runoff events.

A detention pond designed for stormwater treatment in the Cedar Hills residential development, Cross Plains, Wisconsin.

IMPACTS OF RESIDENTIAL CONSTRUCTION ON STREAMWATER QUALITY

COOPERATOR:

Dane County Land Conservation Department

PROJECT CHIEF:

William R. Selbig

LOCATION:

Cross Plains

PROJECT NUMBER:

WI 17235

PERIOD OF PROJECT:

April 1999 to September 2003

PROBLEM

Population in Dane County, Wisconsin, is growing at a fast pace. Farmland is being taken out of crop production and being replaced with urban land uses. During this urbanization, large tracts of land are being disturbed to create new subdivisions for residential housing. This disturbance can have a negative impact on in-stream water quality and quantity such as sedimentation and higher temperature. Quantification of these changes needs to be documented to reduce future in-stream impacts.

OBJECTIVE

The main objective of this project is to determine the "in-stream" impacts of residential urbanization on a small stream in Cross Plains, Wisconsin. Additional objectives include: (1) comparing the sediment load estimated by the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to monitored data, and (2) determining the changes in hydrology of the site by quantifying variation in peak flows as related to changes in drainage basin surface characteristics caused by the construction activities.

APPROACH

Discharge, and associated solids concentrations and loads will be measured both upstream and downstream of a 72-acre site that will be converted from agricultural to residential land use. Water-quantity, water-quality, and land-use data will be collected at a site located immediately upstream of the residential development and at an existing USGS gaging station (Brewery Creek at Cross Plains, 05406470) located immediately downstream of the development. Monitoring will be done prior to construction, during construction, and after construction. Water-quality analyses include total suspended solids, total solids, and particle-size distribution. Before and after event mean concentrations from the upstream and downstream sites will be statistically compared.

PROGRESS (July 2001 to June 2002)

Runoff from several summer storm events and winter snowmelt events were sampled for water quality during the year as the development enters its active construction phase. An additional component was added to the study that examines the potential changes in stream geomorphology that may be a result of activities from nearby development.

PLANS (July 2002 to June 2003)

Continue monitoring and photo documentation during the active construction phase of the project. Data will be compiled and analyzed in the spring of 2003.

Early phases of residential construction activity.

EVALUATION OF STREET SWEEPING AS A WATER-QUALITY MANAGEMENT TOOL IN RESIDENTIAL BASINS IN MADISON

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

William R. Selbig

LOCATION:

Dane County

PROJECT NUMBER:

WI 17237

PERIOD OF PROJECT:

May 2001 to September 2005

PROBLEM

The City of Madison is required to control the quality of stormwater runoff as part of the National Pollution Discharge Elimination System (NPDES). Previous studies have indicated that runoff from street surfaces is a major contributor of pollution in the city (Waschbusch and others, 1999). One way to control roadway runoff is to use street sweeping to remove pollutants before they are entrained in runoff. This option may be preferable to structural Best Management Practices (BMPs) since structural BMPs can be expensive and often require land. In addition, the City already conducts street sweeping and may only need to modify their sweeping practices.

OBJECTIVE

The primary objective of this project is to determine if the dirt load on residential streets is reduced by various street sweeping scenarios and if so to what degree. Water-quality samples will be collected from three basins to determine if water quality benefits are realized by the street sweeping program and to what extent. The water-quality sampling results from these basins and the street dirt load data will be used to estimate the benefits that may be achieved using other street sweeping programs.

Secondary objectives are: (1) characterize street dirt loadings with and without the street sweeping program from residential streets, and (2) characterize the water quality in street runoff from residential watersheds.

APPROACH

This study will use a paired basins approach, meaning that data will be collected from four basins and then compared to each other. One basin will be the “control” basin and will have minimal sweeping. The other three basins (the “test” basins), will have different sweeping regimens implemented. Two basins will utilize two different street sweepers provided by Elgin Inc. and will be swept once per week. The remaining basins will be swept on the same schedule as other areas of Madison, approximately one time per month, and will be completed using existing equipment. Data from the test basins will be compared to data from the control basin.

The USGS will collect vacuum samples once a week from four study basins for the duration of the study. These samples will be collected using equipment and methods similar to that described in Pitt (1979) and Waschbusch and others (1999). During sweeping periods, samples will be collected immediately before street sweeping occurs and immediately after. Street dirt data will be used to determine the pick-up efficiency of the street sweepers and the rate of dirt build-up on and wash off from the streets. The USGS will dry, sieve, and weigh the vacuum samples. The samples will be sieved into particle size fractions ranging from <63 μm. to >2,000 μm in an effort to further characterize street dirt. The sieved dirt data will be used to see if there is a difference in the collection efficiency between new Elgin, Inc., sweepers and sweepers currently used by the City.

In addition to the street dirt sampling, the control basin and the basins utilizing Elgin street sweepers will have water-quality samples collected and compared. The three basins will be equipped with dataloggers, flow measurement devices or structures, phones, modems, ISCO samplers, and raingages. AC power will be necessary for battery chargers, refrigerated samplers, heating tapes on sampler intakes, and area-velocity meters.

Sweeping periods will have the test basins swept at a rate of once per week and the control basin unswept except at the beginning of an equilibration period. The City of Madison will be responsible for getting the streets swept on schedule. On days when it is raining or snowing, the street sweeping will be delayed for a day or two until the streets are dry. The sweeping schedule has been selected to provide an equal number of sweeping versus non-sweeping samples from spring, summer, and fall runoff events.

PROGRESS (July 2001 to June 2002)

Four residential basins were selected in southwest Madison. The control and two test basins were outfitted with water quantity and quality monitoring equipment at the outfall. Several runoff samples were collected and analyzed throughout the year. In addition to water-quality samples, vacuum samples were collected weekly at all four basins to characterize street dirt loadings during a non-sweeping year.

PLANS (July 2002 to June 2003)

Continue to monitor water quantity and quality at the control and test basins. Vacuum samples will be collected weekly at each basin beginning in April and will continue until late fall.

Highway street sweeping in Milwaukee, Wisconsin.

EDUCATIONAL BMP EVALUATION PROGRAM FOR TWO BASINS IN THE CITY OF MILWAUKEE

COOPERATOR:

City of Milwaukee Public Works Department

PROJECT CHIEF:

Peter E. Hughes

LOCATION:

City of Milwaukee

PROJECT NUMBER:

WI 17241

PERIOD OF PROJECT:

December 2001 to June 2003

PROBLEM

The City of Milwaukee, as part of their Wisconsin Pollutant Discharge Elimination System (NPDES) Municipal Storm Water Permit is required to monitor representative outfalls to characterize the quality of stormwater discharges from their separated storm sewer system.

OBJECTIVE

The primary objective of this study is to assist the City of Milwaukee in setting up a stormwater runoff monitoring program, on two small urbanized basins, to fulfill the requirements of their NPDES permit. Baseline and storm event samples will be collected, samples submitted for laboratory analyses, and constituent loads will be computed. The City will use the data to determine the effectiveness of an intensive information and education campaign, aimed at residential residents and city employees who work and live in the area, for improving the water-quality of the streams.

APPROACH

The USGS will work with the City of Milwaukee to upgrade two automated sampling sites, one on Lyons Creek and one for a storm sewer at 18th and Ramsey Street, to include a velocity sensor and a data-logger. The data-loggers will be programmed to activate water-quality samplers to collect a flow-proportional sample for analyses solids, nutrients, and selected organic constituents. Data will be transmitted to computers at both the USGS and the City and will be used to compute stormwater and baseline water quality loads. There will be a total of 30 event samples collected at each site and 15 base flow samples collected at the Lyons Creek site.

PROGRESS (December 2001 to June 2002)

The additional monitoring equipment has been procured and installed and sampling of baseline and storm events has begun. Data is being entered into the USGS Watstore system and the USGS is working with the City to maintain and operate the two sites.

PLANS (July 2002 to June 2003)

Complete collection of the storm and baseflow samples. Analyze the water-quality data and compute the loads for the two sites. Work with the City to summarize the data for presentation to the Wisconsin Department of Natural Resources. A data report will be prepared which will summarize the storm event loads, flow and rainfall data collected for this project.

MONITORING AND EVALUATION OF THE IMPACTS OF AIRCRAFT AND RUNWAY DEICERS ON THE KINNICKINNIC RIVER SURFACE-WATER RESOURCES

COOPERATOR:

County of Milwaukee

PROJECT CHIEF:

Steven R. Corsi

LOCATION:

Milwaukee

PROJECT NUMBER:

WI 20400

PERIOD OF PROJECT:

November 1996–Continuing

PROBLEM

Milwaukee County is involved in an effort to reduce runoff of deicing chemicals from General Mitchell International Airport (GMIA) to Wilson Park Creek. Ethylene and propylene glycol-based deicers are used during cold weather periods to deice aircraft, runways, and other paved areas used by aircraft. Glycol concentrations in stream samples collected during deicing events throughout the winters between 1996 and 2001 ranged from less than detection limits to 39,000 mg/L in GMIA outfalls (well above toxicity limits).

OBJECTIVE

The overall goals of the project are to evaluate changes in water quality in Wilson Park Creek due to implementation of deicer management at GMIA and fulfill obligations stated in the Wisconsin Department of Natural Resources (WDNR) stormwater permit for GMIA. Specific objectives are as follows: (1) Monitor surface water at four sites in the Wilson Park Creek watershed for water quality and flow during dry weather and runoff conditions. This monitoring is to be conducted before and after implementation of deicer management, and (2) determine changes in water quality and toxicity levels in Wilson Park Creek due to implementation of deicer management. This monitoring should quantify a suite of water-quality parameters that are of interest as stated in the WPDES permit issued to GMIA by WDNR.

APPROACH

Flow is measured and samples are collected at one site upstream from airport runoff and three sites downstream. Assessments of water quality will be made on a yearly basis. After two years of post-management monitoring, comparisons between pre- and post-management data will be made to determine if changes in water quality have occurred.

PROGRESS (July 2001 to June 2002)

An extensive runoff monitoring program has been in place since November 1996. The first two winters represent conditions before deicer management was implemented.The 1998–2001 winter represent data

with partial deicer management. The 2000–2002 winter represents fully implemented deicer management conditions. Nine sites were monitored the first year, and four sites are currently being monitored. Flow, dissolved oxygen, water temperature, and rainfall are being monitored continuously. Water-quality constituents are sampled selectively during deicer application events, baseflow, and one summer rainfall event per year. Glycol, biochemical oxygen demand, selected nutrients, and selected metals analyses are being conducted. Microtox and bioassay analyses are being conducted for toxicity assessment. In situ fathead minnow assays were conducted upstream and downstream from airport runoff. Two journal articles were written summarizing the first two years of dissolved oxygen, water chemistry, and toxicity data. Snow banks within the airport have been monitored for three years to determine the quantity of deicer stored within the snowbanks.

PLANS (July 2002 to June 2003)

At least one more year of monitoring is planned during post implementation conditions. After monitoring of post-implementation runoff, statistical analyses will be conducted to determine the effectiveness of the deicer management practice. A direct comparison of pre- to post-implementation data will be done using paired-watershed and upstream-downstream analyses between sites.

Two reports have been written and were published in June 2001. Two more papers are currently being written discussing the effects of deicer additives and at least two additional reports will be published. One will discuss the results of snowbank monitoring, and the other will analyze the effectiveness of deicer management practices at GMIA.

Aircraft undergoing deicing at General Mitchell International Airport, Milwaukee, Wisconsin.

SOURCES OF CRYPTOSPORIDIUM IN WATERSHEDS

COOPERATOR:

Wisconsin State Laboratory of Hygiene

PROJECT CHIEF:

Steven R. Corsi
Robert J. Waschbusch

LOCATION:

Southeast Wisconsin

PROJECT NUMBER:

WI 21600

PERIOD OF PROJECT:

October 1999 to April 2002

PROBLEM

For the past 75 years, the water supply industry has enjoyed an excellent track record of providing safe, potable water to the public. As a result, the industry has achieved a high level of consumer confidence in tap water. This success has been possible through an emphasis on continuous improvement in both water-treatment technology and source-water protection. Despite this effort, recent well-publicized waterborne disease outbreaks of cryptosporidiosis involving large numbers of ill people and some deaths have been attributed to possible treatment deficiencies linked with source-water contamination. Recent studies have suggested that the Milwaukee outbreak of 1993 was caused by a "human only" genotype which would point to poorly treated human waste as a possible source of the outbreak. It is extremely important that both the wastewater industry and the drinking water industry have the best information available to respond to both waterborne disease issues and legislative issues in an effective manner. Understanding the occurrence and variability of cryptosporidium in source water is critical to the production of a safe drinking water supply. Essential to this understanding is the ability to characterize potential sources of cryptosporidium and predict their response to hydrologic and climatologic events.

OBJECTIVE

The goals of this research study are to define the relative magnitude and contributions of cryptosporidium from major sources defined by land use and wastewater discharges on an annual basis, to characterize contributions of each source by factors such as hydrograph timing, climatic effects, and seasonal variations, and to compare and integrate the resulting data with existing data on cryptosporidium.

APPROACH

Two subwatersheds were selected for monitoring the entire project duration. One of these basins is primarily agricultural land use and the other is primarily urban land use. In addition to these two subwatersheds, three wastewater treatment plant discharges representing different treatment technologies and/or flow levels and one combined sewer overflow (CSO) were moni-

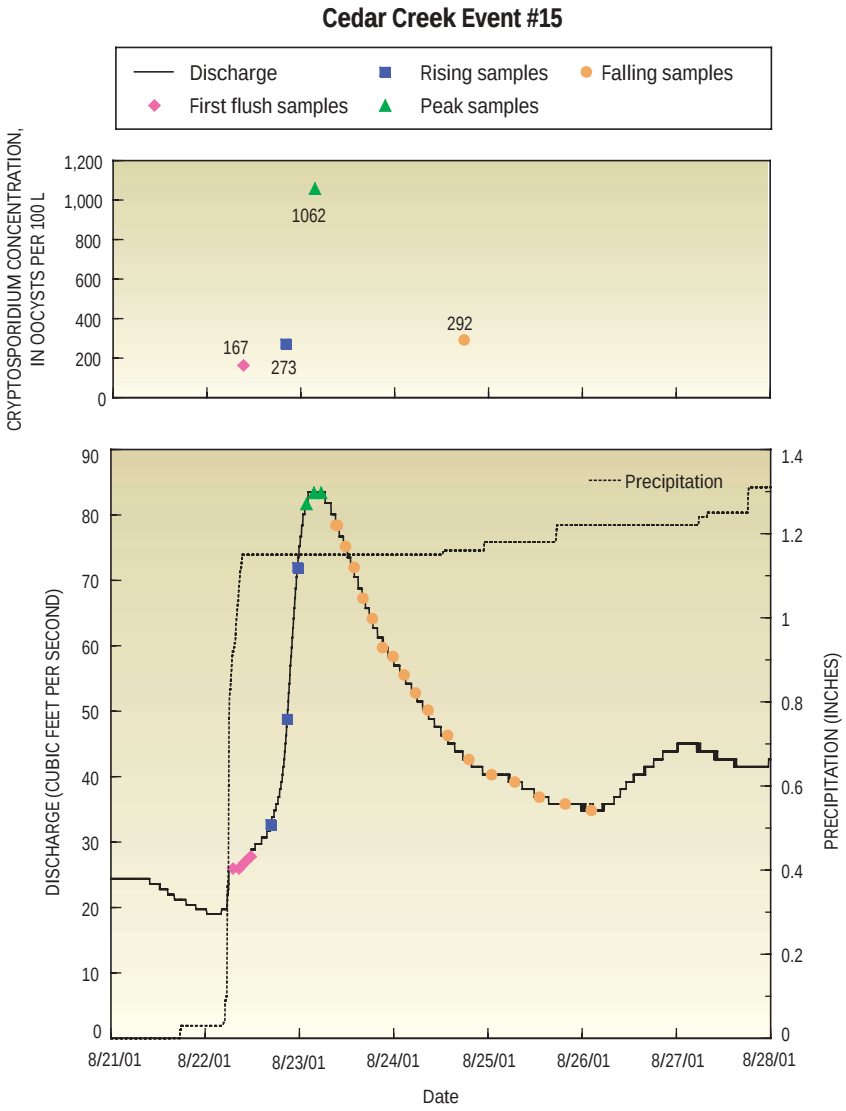
tored for approximately six months each. Both fixed interval and weather event samples were collected from all sites. The sample results will be used to determine cryptosporidium magnitude and variability. These data will be used along with flow data to calculate event and annual loads at the sites. Other data were also collected including precipitation, water temperature, dissolved oxygen, turbidity, conductance and also land-use data in a GIS system. The data and tools resulting from this project will enable managers to better understand and deal with the sources of cryptosporidium in their watersheds.

PROGRESS (July 2000 to June 2001)

Sampling is complete at all sites. The initial phase of data reduction is complete.

PLANS (July 2001 to June 2002)

Data analysis will be finalized and final reports will be written.



Graph showing precipitation and resultant hydrograph at the Cedar Creek monitoring site. The points on the hydrograph indicate where cryptosporidium subsamples were collected. Subsamples with the same type of points were composited into a single sample for cryptosporidium analysis, the results of which are indicated at the upper portion of the figure.

OCCURRENCE AND VARIABILITY OF PATHOGENS IN WISCONSIN'S URBAN STREAMS

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEFS:

Robert J. Waschbusch
Steven R. Corsi

LOCATIONS:

Milwaukee area and Superior area

PROJECT NUMBER:

WI 22300

PERIOD OF PROJECT:

March 2001 to December 2003

PROBLEM

Water-borne pathogens are a great concern to water-quality managers because of the potential impact on human health, aquatic life, and recreational use. Nowhere have pathogens been more in the public eye than Milwaukee, Wisconsin, where a 1993 Cryptosporidium outbreak was blamed for the death of over 100 people. In addition, recent Milwaukee beach closures have brought renewed concerns before an anxious public over area-wide sanitary and stormwater management. The origins of pathogenic organisms can be many and difficult to delineate. Obviously, sanitary sewer and combined sewer overflows can be a major source of pathogens originating from human fecal material. Sanitary sewer overflow (SSO) or bypassing is a technique used by sanitation utilities to relieve possible backup and surcharging problems during wet-weather periods. In 1999 alone, 120 bypasses were reported by municipalities in Wisconsin (WDNR report) and 87 of these were associated with storm events. They are not confined to just the large metropolitan areas. They occur in cities and villages of all sizes and in all geographic regions of the State. Though not as prevalent as SSOs on a statewide basis, combined sewers and their associated overflows (CSO) may also be important localized sources of pathogens. A third important source of pathogens is runoff water from storm sewers and diffuse inputs. Past research has shown microbial densities in stormwater runoff to be similar to those found in diluted raw sewage. Sources of these organisms include livestock, beavers, pets, and waterfowl. The documented presence of pathogenic organisms, such as Giardia, Cryptosporidium, Salmonellae, Pseudomonas aeruginosa in storm sewers with no sanitary sewer connections, suggests that diffuse or nonpoint sources of these microorganisms may be an overlooked water-quality issue.

OBJECTIVE

The overall goal of this project is to provide a greater understanding of the occurrence of pathogenic organisms in urban streams. Specific objectives include: (1) determine concentrations of pathogenic indicators and specific pathogens in urban streams of

different sizes, land uses, and point source inputs, (2) determine ambient concentrations of total suspended solids, BOD, total phosphorus, and chloride, (3) collect 13 rounds of samples at each site—9 event samples and 4 baseflow samples, (4) explore the resulting data in an attempt to develop relations between watershed size, major land use, hydrologic and meteorological conditions, and water-quality parameters identified above, and (5) determine sources and relative contributions of *E. coli* bacteria to urban streams by use of strain identification and typing.

APPROACH

The USGS will operate two continuous monitoring stations—one at the mouth of the Milwaukee River in Milwaukee and one further up in the Milwaukee River watershed on Cedar Creek at Grafton. The Wisconsin Department of Natural Resources (WDNR) will collect samples at numerous streams in the Milwaukee area. The focus of this study will be a synoptic survey of 12 stream sites in the Milwaukee metropolitan area and 2 in the Superior area. Milwaukee sites will be selected to spatially cover the watershed draining to the Milwaukee Harbor. All sites will be selected to represent a range of water-course size, land use (residential, industrial, open space), and point- source input locations (CSO, SSO, and stormwater discharges). A total of 14 stream sites will be chosen, with some streams having more than one site to examine downstream longitudinal changes. The sampling goal will be to collect a total of 13 grab samples at each site (flow composite samples at the USGS sites), 9 during periods of high flow, and 4 during base-flow conditions. Sampling will be spaced to address seasonal differences, and will occur over a period of 1-1/2 years. Recent advances in genetic strain identification will be used in conjunction with the sampling effort to attempt to identify the sources of *E. coli*. An analysis of this data will provide an assessment of the potential risks from the pathogenic presence.

PROGRESS (March 2001 to June 2002)

Sites have been operating since spring 2001, and the first six rounds of samples have been collected.

PLANS (July 2002 to June 2003)

Two more rounds of baseflow samples and five more rounds of event samples will be collected. Sampling will continue through September. Data analysis and final reporting will be conducted in the following fall and winter period.

COLLECTION OF REAL-TIME AND PATHOGEN DATA AT RECREATIONAL BEACHES IN MADISON

COOPERATOR:

City of Madison

PROJECT CHIEFS:

Robert J. Waschbusch
Steven R. Corsi

LOCATION:

Madison

PROJECT NUMBER:

WI 22800

PERIOD OF PROJECT:

January 2002 to September 2004

PROBLEM

The City of Madison, Wisconsin contains three recreational lakes with over 20 miles of shoreline within the city limits. For over 50 years, the Madison Department of Public Health (MDPH) has conducted weekly microbiological testing of the thirteen beaches surrounding these lakes. Historically, fecal coliform and other indicator testing has been performed, with the recent addition of nonpathogenic *E.coli*. The MDPH has developed beach-closing criteria based on testing results, combined with physical observations of conditions at the beach site. Traditionally the decision to close a beach has been communicated via posting of signs at the beach site as well as press releases. Since 1999, the MDPH has also posted a rating system on their web page to communicate beach conditions.

Although the MDPH has developed beach-closing criteria based on microbial indicators, there is a concern that the criteria may not reflect the actual risk to swimmers since the occurrence of pathogenic microorganisms during periods of high indicator levels has never been determined. The historic records demonstrate that bacterial indicator levels may vary significantly from one beach to another with no apparent explanation for the differences. This variation confounds the beach closing decision-making process. There is a need to gather data to bring clarity through data based decision making to this process.

OBJECTIVE

The overall objective of this project is to develop a method of estimating the likelihood of occurrence of waterborne pathogens. Project deliverable will include: (1) a systematic characterization of the correlations between traditional indicator microorganisms and origins of fecal contaminants (human vs. animal sources), (2) evaluation and implementation of a new sensitive analytical method for detecting *E.coli* 0157:H7 in recreational waters, (3) a data-driven decision process (model) based on actual risk of pathogen occurrence linked with indicator testing data to determine beach closing parameters, and (4) an enhanced ability to provide real-time, user friendly, state-of-the-art water quality information to the public, which will include public education regarding recreational water quality issues.

APPROACH

Three beaches in Madison will be selected for monitoring, each on a different Madison lake. One will be located near a strormwater runoff outfall, one will be on a small shallow lake with high user counts and one will be on a large lake with low user counts. Weather monitoring, automatic water quality monitoring and sampling equipment will be installed at each beach. Several water quality and weather variables such as water temperature, precipitation, turbidity, rainfall, windspeed, and direction and wave height will be continually monitored. City of Madison beach personnel will record swimmer and waterfowl counts, and note any diaper/fecal accidents. Indicator organism and pathogen samples will be collected 3 days a week during the swimming season (approximately Memorial Day to Labor Day) for 2 years. The automatic water quality samplers will be used to collect indicator organism and pathogen samples from six events at each beach each summer. These events may be defined as rainfall runoff events, high turbidity periods, periods of high user counts, periods of high waterfowl count, wind/wave events or other types of events. Monitoring results from the first summer will likely be used to focus event-sampling efforts the second summer. The continuously monitored water quality and weather data and indicator organism results will be used to develop a probability based tool for beach closures on likelihood of pathogen occurrence.

PROGRESS (July 2001 to March 2002)

The three beaches to be monitored have been selected and much of the monitoring equipment has been purchased.

PLANS (March 2002 to July 2002)

The monitoring equipment will be installed, beach personnel will be trained in bather and waterfowl count collection methods. The monitoring program will begin in June 2002.

REPORTS

Annual progress reports will be submitted to the U.S. Environmental Protection Agency. A final report will be produced that details the study beaches, study methods, and data collected. The report will also present results of statistical analysis and the predictive model developed.