SURFACE WATER TEAM

Mission

The surface-water Self-Directed Work Team encompasses a variety of projects that involve monitoring or modeling of the quantity and/or quality of surface-water runoff. The products of these efforts provide critical information to local, state, national and international managers necessary for making decisions regarding laws and regulations, urban development planning and remediation activities. The surface-water team objectives are to: (1) efficiently manage projects from the conception and proposal stage on through management and operation, resulting in informative products, and (2) maintain a sufficient amount of funding and challenging work for the entire team. Through these objectives, it is our intent to continuously evolve with and develop new data collection and analysis techniques, be proficient and respected modelers, plan for future projects, enhance the skills and growth of individual team members, and maintain a positive relationship with our cooperators.

Acoustic Doppler Current Profiler (ADCP) used to measure discharge.

U.S. Geological Survey sampling PCBs on the Fox River at Green Bay, Wisconsin.

Team Members

William R. Krug, Hydrologist/Engineering
Randy J. Hunt, Research Hydrologist/Geology
Jeffrey J. Steuer, Hydrologist/Engineering
David J. Gracyzk, Hydrologist/Forestry
Gerald L. Goddard, Hydrologic Technician
Halward L. Hanson, Hydrologic Technician
David E. Housner, Hydrologic Technician
Judy A. Horwatich, Hydraulic Engineer
Mark A. Corsentino, Student Trainee (Civil Engineering)
Timothy L. Hanson, Hydrologic Technician
Andrew J. Mumpy, Hydrologic Technician

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AMPHIBIAN MALFORMATIONS AND WATER QUALITY

COOPERATORS:

U.S. Geological Survey
Biological Resources Discipline;
Upper Mississippi Environmental
Science Center

PROJECT CHIEF:

John F. Elder

LOCATION:

Southern Minnesota

PROJECT NUMBER:

WI 00102

PERIOD OF PROJECT:

October 2000 to September 2002

PROBLEM

Since 1995, amphibian malformations have been reported in 43 states and two Canadian provinces. Malformations have been found in 38 species of frogs and 19 species of toads, with as much as 60 percent of individuals affected in some local populations. Malformations range from relatively minor abnormalities, such as missing toes or feet, to more debilitating problems, including missing, deformed or extra front or rear limbs, deformed mandibles, missing eyes, or internal abnormalities. This problem is a threat to the survival of affected amphibian species, some of which are already declining. In addition, the conditions that lead to changes in amphibian development may pose a threat of a much broader nature, extending across many types of aquatic ecosystems around the world.

Studies of amphibian malformations during the past decade have focused primarily on the morphology, physiology, and pathology of malformations. These studies have provided valuable documentation of the occurrence of malformations, and the debilitating effects on the animals. However, the root causes of the problem are not yet known, despite considerable research into a variety of possible etiologies.

Changes in water quality or hydrologic characteristics seem likely to be associated with amphibian malformations because of extensive exposure of the animals to natural waters and the fact that amphibians breathe at least partly through their skin. However, no research to date has specifically and unambiguously implicated any particular environmental factor as a cause of amphibian malformations. In fact, malformations are almost certainly not attributable to a single cause; they are much more likely to be associated with mixed factors in complex interaction with each other. This project provides water quality data in parallel with amphibian surveys to determine if certain water quality peculiarities exist in ecosystems where amphibian malformations are relatively common. Information about the physical, chemical, and ecological characteristics of these ecosystems may lead to identification of some key factors or recent environmental changes that might be associated with developmental changes in the affected amphibian species.

OBJECTIVE

To identify and describe any association between amphibian malformations and water quality in pond habitats of southeastern Minnesota. Because the study area is rural-agricultural, emphasis in water-quality analysis is on occurrence of organic compounds that are commonly applied on agricultural fields and might therefore be likely to occur at elevated concentrations in pond waters.

APPROACH

This study is conducted at rural ponds in Winona and Houston Counties in southeastern Minnesota. The ponds range from less than one acre to a few acres in size. Ponds whose watersheds are fully or partially agricultural fields are matched with similar-size ponds that receive drainage form natural areas. Amphibian collections, for examination of malformations, are accompanied by water sampling for analysis of pesticides and pesticide metabolites. Results for agricultural and natural ponds are compared to assess possible links between occurrence of any compounds or group of compounds and occurrence of amphibian malformations.

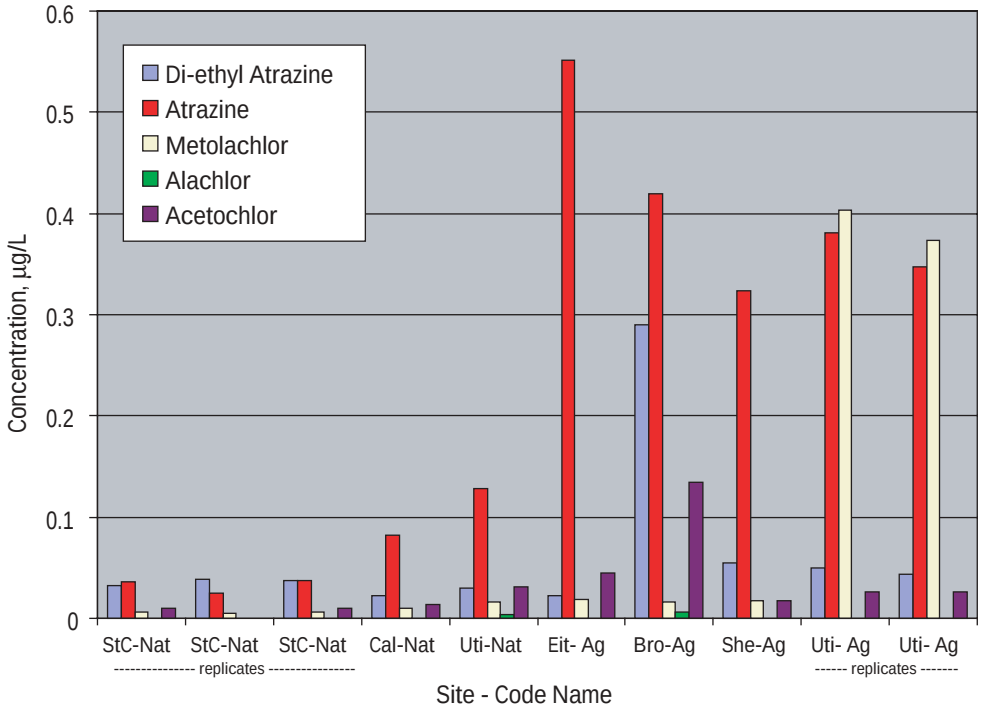
PROGRESS (July 2001 to June 2002)

At all ponds, water samples were collected in spring 2001, and amphibians were collected and examined for malformations. Water samples were chilled and sent immediately to the National Water Quality Laboratory in Lakewood, Colorado for analysis of pesticides and pesticides metabolites. Results showed clear differences between agricultural and natural ponds with respect to occurrence of certain pesticides and pesticide metabolites. Concentrations of atrazine in all agricultural ponds were in excess of 0.3 micrograms per liter, but near or less than 0.1 micrograms per liter in all natural ponds. Some of the agricultural ponds also had elevated concentrations of di-ethyl atrazine, metalochlor, and acetochlor. Very few malformations were found in any of the ponds, however, and no relation could be established between their occurrence and the concentrations of pesticides in the pond water.

PLANS (July 2002 to September 2002)

Analysis, interpretation, and presentation of data and results from 2001 study. Comparisons of results with other studies. Meet with scientists investigating similar problems in other areas of the country. Additional sampling is not currently planned, although project team is prepared for further data collection upon reports of increased frequency of observations of amphibian malformations.

Pesticides detected in water of SE Minnesota Ponds, June 11–13 2001. Amphibians from same ponds were examined for malformations. Ponds in agricultural watersheds (Ag) compared with ponds in natural areas (Nat).



PROJECT COLLABORATION WITH THE BIOLOGICAL RESOURCES DISCIPLINE AT LA CROSSE

COOPERATOR:

Biological Resources Discipline, La Crosse, Wisconsin

PROJECT CHIEF:

Jeffrey J. Steuer

LOCATION:

La Crosse County

PROJECT NUMBER:

WI 00103

PERIOD OF PROJECT:

October 2000 to September 2002

PROBLEM

The Mississippi River is one of the world's major river systems in size, habitat diversity, and biological productivity. The Biological Resources Discipline (BRD) Environmental Science Center in La Crosse, Wisconsin, provides scientific understanding, information, and technologies needed to support sound management of biological resources on the Upper Mississippi River. There is a need to bring the BRD expertise into the Wisconsin District (WRD) projects and in return provide hydrologic expertise and experience into the BRD investigations. This project will increase collaboration between the two disciplines.

OBJECTIVE

The purpose of the project is to enhance BRD and WRD collaboration in investigations such as nitrogen budgets and the resulting biological impacts; urbanization effects on backwater area biota; mercury, PCB, cadmium, and pesticide impacts in zebra mussels; sedimentation patterns and the resulting effects on mussels, paddlefish, and navigation; and hydrologic assistance in assessing trends in the Upper Mississippi River long-term monitoring program.

APPROACH

From October 2000 through September 2001 one WRD hydrologist worked in the La Crosse BRD office on a half-time basis. This physical relocation of the hydrologist established communication and enhanced collaboration for the inter-discipline personnel. The WRD hydrologist continues to work with the mussel landscape team on a quarter time basis while located in the Middleton Office.

PROGRESS (July 2001 to June 2002)

Much of the present day effort provides the mussel landscape team with hydrologic and hydraulic expertise in the effort to understand why endangered mussel species form their beds in specific locations. These hydraulic efforts have included: conducting bottom roughness and shear calculations in selected Mississippi River pools and an accompanying comparison to historical mussel data; assisting with evaluation of an electronic

method (RoxAnn) to inventory mussel beds and bottom substrate; and utilizing acoustic Doppler profiles to determine bottom roughness and shear velocity.

An example of newly developing collaborative effort is the Halfway Creek study. Halfway Creek Marsh is situated within the lower reach of Halfway Creek and Sand Lake Coulee Creek watersheds (combined watershed area 28,000 acres) and has an outlet that drains to the Mississippi River Pool. Initial project design will utilize four automated sites to monitor water, sediment, and nutrient fluxes into and out of the natural and constructed sections of Halfway Creek Wetland. Ultimately the project may evolve into a study of specific nutrient processes that will assist the U.S. Environmental Protection Agency in Total Maximum Daily Load calculations and further understanding in the Mississippi River and Hypoxia problem.

PLANS (July 2002 to September 2002)

The Middleton WRD hydrologist will continue to work on the mussel landscape team on a quarter time basis. The project is expected to continue beyond September 2002.

REGIONAL FLOOD-FREQUENCY STUDY FOR URBAN AND RURAL STREAMS IN WISCONSIN

COOPERATORS:

City of Fond du Lac;
Wisconsin Department of Transportation

PROJECT CHIEF:

William R. Krug

LOCATION:

Statewide

PROJECT NUMBER:

WI 10900

PERIOD OF PROJECT:

July 1985–Continuing

PROBLEM

Flood-frequency estimates are required at many sites for bridge and culvert design, as well as for flood-plain management and flood-insurance studies. Most sites at which such estimates are required do not have records of flood peaks.

OBJECTIVE

Objectives are to: (1) operate a State-wide network of crest gages to obtain ongoing information on flood peaks, (2) develop improved regression equations for the State of Wisconsin, and (3) analyze and improve the network of crest-stage gages to obtain better data for developing improved regression equations.

APPROACH

A network of approximately 90 crest-stage gages will be maintained to gather flood peak information, especially on streams with small drainage areas. The information on annual flood peaks will be used to compute flood-frequency at these sites. Periodically, the expanded information on flood frequency at streams throughout the state will be used to compute regional flood- frequency equations to estimate flood frequency at ungaged sites.

PROGRESS (July 2001 to June 2002)

Annual flood peaks were computed and published in the annual data report for 85 crest-stage stations, including 19 of the new stations. Significant effort has been made in measuring flood discharges at crest gages, especially at the newly installed gages, and improving ratings at crest gages. Flood frequency has been recalculated using data through water year 2000.

PLANS (July 2002 to June 2003)

The crest-stage-gage network will be monitored throughout the year. More new gages will have ratings developed for them as measurements and surveys are available. Significant effort will be made to improve ratings at all the gages. Work will continue on recalculating regression equations for computing flood frequency—leading to publication of a new report.

REPORTS

Krug, W.R., 1996, Simulation of temporal changes in rainfall-runoff characteristics, Coon Creek Basin, Wisconsin: Journal of the American Water Resources Association, v. 32, no. 4, p. 745–752.

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

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

Conger, D.H., 1981, Techniques for estimating magnitude and frequency of floods for Wisconsin streams: U.S. Geological Survey Water-Resources Investigations Open-File Report 80–1214, 116 p., 2 pls.

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

FOX RIVER REMEDIATION

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

Jeffrey J. Steuer

LOCATIONS:

Outagamie County
Brown County

PROJECT NUMBER:

WI 14500

PERIOD OF PROJECT:

August 1998 to September 2003

PROBLEM

Several Fox River bottom sediment deposits have been considered for pilot-scale remediation based upon high PCB concentrations. The pilot remediation project at deposit "N" (Kimberly) began in November 1998 and, in August 1999, pre-dredge sampling commenced at the Sediment Management Unit (SMU) 56_57 (Green Bay). There was a need, as part of the Fox River Remediation Assessment Team (FRRAT) efforts, to monitor and collect environmental data before, during, and after the remediation operation. Most recently, the Wisconsin Department of Natural Resources and the U.S. Environmental Protection Agency have a 7-year plan to remediate PCBs from the bottom sediments in the Fox River. The plan calls for a pre-remediation assessment of PCB transport followed with a 40-year monitoring program upon completion of the remediation program. There is a need to monitor and collect environmental data before, during, and after this full-scale remediation operation.

OBJECTIVE

During the pilot-scale remediation efforts, monitoring and sampling will be conducted to meet the project Quality Assurance Project Plan objectives. The objectives are to: (1) evaluate baseline conditions prior to dredging activities, (2) evaluate short-term impacts, including PCB mass fluxes during dredge activities, and (3) evaluate conditions following the completion of dredge-related activities. Objectives for the full-scale remediation have yet to be finalized.

APPROACH

Pilot-Scale remediation at Deposit "N"—The baseline investigation consisted of water-column samples collected at four upstream locations and four downstream locations prior to the commencement of dredging. Bottom sediment samples were collected from a minimum of 30 locations in Deposit N and an intermediate zone located between the sediment deposit and the silt-containment barrier.

Evaluation of short-term impact at Deposit "N" includes water-column sampling at four upstream and four downstream locations, dredge slurry samples and continuous-flow monitoring, composite samples of all on-shore processing locations, composite samples of processed solids for landfill disposal, samples of filter media, and treated carriage water samples.

Evaluation of long-term impact included collecting sediment core samples from the same locations as the pre-dredge sample sites, and an intermediate zone characterization using visual reconnaissance and sampling.

Pilot-Scale remediation at SMU 56_57—The baseline investigation consisted of water-column samples collected at four upstream locations and five downstream locations prior to the commencement of dredging.

Evaluation of short-term impact SMU 56_57 included water-column sampling at four upstream and five downstream locations, dredge slurry samples with continuous-flow monitoring and composite samples of processed and treated carriage water samples.

PROGRESS (July 2001 to June 2002)

Deposit "N"—Pre- and post-dredge cores have been collected and processed at 30 locations along with the intermediate zone. Over 90 PCB samples, 800 TSS samples, and over 6,400 water-quality measurements have been collected at the water-column sites. Shoreside (remediation process) samples and slurry flow data have been collected for 29 continuous days. The USGS mercury lab has completed the bottom sediment and remediation process sample analyses. The data analyses is complete and the final report has been written evaluating the water-column transport and the shore-side processes.

SMU 56_57—Over 90 PCB samples, 800 TSS samples, and over 6,400 water-quality measurements have been collected at the water-column sites. Assistance was provided in the slurry sampling and five 80-liter effluent samples were processed. The data analyses is complete and the final report has been written evaluating the water-column transport and the overall PCB fluxes.

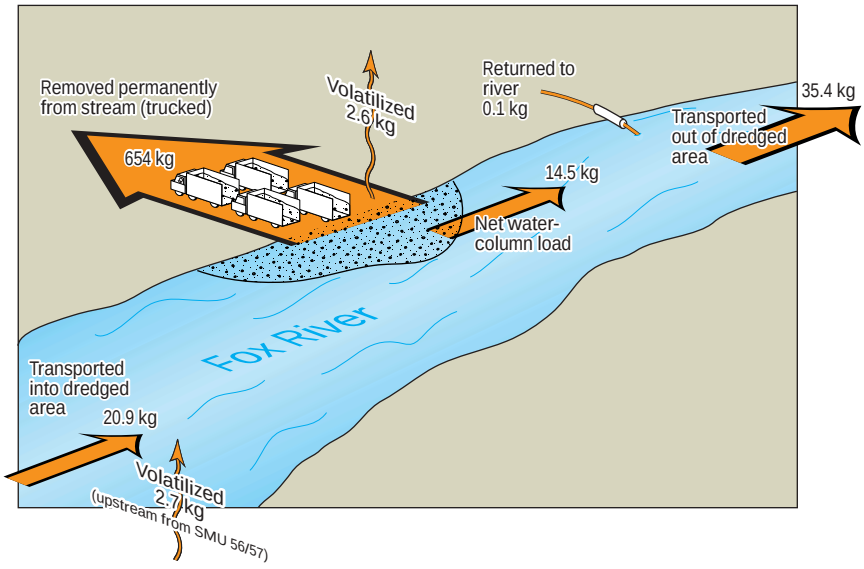
PLANS (July 2002 to June 2003)

The USGS will participate in determining the sampling scope and monitoring design in support of the full scale remediation effort. The low level (80-liter; limits of detection of approximately 0.01 ng/L) water-column PCB samples along with ancillary data will be collected beginning in June 2002.

REPORTS

Fox River Remediation Advisory Team, 2000, Evaluation of the effectiveness of remediation dredging: The Fox River Deposit N Demonstration Project November 1998–January 1999: Water Resources Institute Special Report 00–01.

Steuer, J.J., 2000, A mass-balance approach for assessing PCB movement during remediation of a PCB-contaminated deposit on the Fox River, Wisconsin: U.S. Geological Survey Water-Resources Investigations Report 00–4245, 8 p.



Pathways of polychlorinated biphenyl (PCB) mass (Aroclor 1242) during the September 1–December 15, 1999 remediation at SMU 56/57. Amounts are in kilograms.

BRIDGE SCOUR ON BALSAM ROAD BRIDGE

COOPERATOR:

Marathon County Highway Department

PROJECT CHIEF:

Peter E. Hughes

LOCATION:

Marathon County

PROJECT NUMBER:

WI 17230

PERIOD OF PROJECT:

May 1998–Continuing

PROBLEM

Bridge scour has become a topic of nationwide interest in recent years but has not been identified as a serious problem for many bridges in Wisconsin. The Balsam Road bridge over the Big Eau Pleine River in Marathon County is one bridge, however, which has already been severely scoured with pier footings and pilings exposed. The scour hole is concentrated around the bridge location, beginning at approximately 200 feet upstream to approximately 200 feet downstream. An engineering assessment indicates that the 100-year return period discharge could undermine the east abutment and piers 1 and 2 and scour close to pile tip elevations on Pier 3 and the west abutment.

OBJECTIVE

The objective of this study is to install acoustic transducers to continuously monitor the scour depth on the upstream and downstream sides of the piers at the east side of the bridge. Discharge data from the streamflow gage at Stratford will be used to provide a high flow alert to the USGS and the Marathon County Highway offices to allow closure of the bridge if scour depths increase to dangerous levels.

APPROACH

Acoustic transducers will be attached to the upstream and downstream faces of the most eastern pier on the Balsam Road bridge. The scour depth data will be recorded on a datalogger and telemetered to the USGS office in Middleton, Wisconsin. This information will be automatically uploaded to the World Wide Web home page for the USGS Wisconsin District (http://wi.water.usgs.gov). A voice modem will be installed at the Big Eau Pleine River streamflow gage at Stratford and will be programmed to provide an alert to the Marathon County Highway Department and USGS offices that a flood event is occurring. This alert will provide the opportunity to closely monitor the scour depths to determine whether the bridge should be closed due to hazardous conditions.

PROGRESS (July 2001 to June 2002)

Scour depth was monitored through September 2001. Data were available on the World Wide Web.

PLANS (July 2002 to June 2003)

Project has been terminated.

DANE COUNTY SURFACE WATER MODEL

COOPERATOR:

Dane County Regional Planning Commission

PROJECT CHIEF:

William R. Krug

LOCATION:

Dane County

PROJECT NUMBER:

WI 18901

PERIOD OF PROJECT:

April 2001 to March 2002

PROBLEM

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

OBJECTIVE

Evaluate alternative operation plans for the lake system (Lakes Mendota, Monona, and Waubesa), in order to control flooding on the lake system, while sustaining downstream flows and provide adequate lake levels for recreation.

APPROACH

The model used in preparing the report, "Simulation of the Effects of Operating Lakes Mendota, Monona, and Waubesa, South-Central Wisconsin, as Multipurpose Reservoirs to Maintain Dry-Weather Flow" by William Krug (1999), will be modified to reflect current conditions.

Net inflow to be used in the model will be computed from the measured outflow, observed changes in lake stages, and the record of past diversions. Outflow has been measured since September 1930 on the Yahara River near McFarland, Wisconsin. Daily lake stage for most periods of the same years has been measured on Lakes Monona and Mendota. Records of sewage diversion are available from the Madison Metropolitan Sewerage District.

The model will be used to evaluate the effects of various possible alternatives.

PROGRESS (July 2001 to June 2002)

The model has been adapted to include the latest rating curve for the channel below Lake Waubesa. The input/output formats are being revised to accommodate the additional years of record since the last study.

PLANS

The final report will be reviewed and published.

TRANSPORT OF PCBs AT TWO SITES ON CEDAR CREEK

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

Jeffrey J. Steuer

LOCATION:

Ozaukee County

PROJECT NUMBER:

WI 19100

PERIOD OF PROJECT:

April 2000 to September 2002

PROBLEM

High concentrations of polychlorinated biphenyls (PCBs) have been found in the Cedar Creek bed sediments, water column, and fish tissues. Partial remediation of Cedar Creek (Ruck Impoundment) was completed in 1994. PCB transport trends are needed to assist in future management decisions.

OBJECTIVE

The objective is to determine PCB loading changes at Columbia Avenue (downstream of the Ruck Impoundment) and Highland Road.

APPROACH

From August 1994 to August 1995, 24 PCB samples were collected at Columbia Avenue and Highland Road. Total suspended solids, chlorophyll *a*, and discharge data were used in conjunction with the PCB data to establish PCB concentration regression relations.

From December 2000 through October 2001, 24 additional 80-liter PCB samples (along with supporting constituents) will be collected at the two Cedar Creek sites. Utilizing these data, residuals from the 1994–95 regression relations will be examined to determine if PCB concentrations have statistically changed over time.

PROGRESS (July 2001 to June 2002)

Field equipment blanks have been collected; equipment, cleaning and processing procedures have been found to be acceptable. The 24 PCB samples and related constituents have been collected. Laboratory results have been received for 20 of the samples. Immediately downstream of the remediated Ruck Impoundment, several of the samples had no detected congeners in either the dissolved or particulate fractions. Downstream of the Highland Impoundment, total PCB (congener summation) concentrations have ranged from 0.44 to 23.6 ng/L.

PLANS (July 2002 to June 2003)

In conjunction with the WDNR, this office will conduct data analyses such as comparing previous and current regression residuals in addition to a neural network analysis.

LINCOLN CREEK PCBs

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

Peter E. Hughes

LOCATION:

City of Milwaukee

PROJECT NUMBER:

WI 19101

PERIOD OF PROJECT:

June 2001 to June 2003

PROBLEM

The Wisconsin Department of Natural Resources is evaluating alternatives for removing PCB contaminated sediments from the Estabrook Impoundment on the Milwaukee River. Lincoln Creek empties into this impoundment and it is important to identify if there are continuing sources of PCBs coming from Lincoln Creek drainages.

OBJECTIVE

The primary objective of this study is to collect water-column samples during runoff events to quantify the PCB load being transported in Lincoln Creek.

APPROACH

The USGS will establish a gaging station on Lincoln Creek at 27th Street and install equipment to automatically collect water samples during runoff events. A total of 19 event composite samples will be collected and processed for analysis by the Wisconsin State Laboratory of Hygiene for particulate and dissolved PCBs. A total of 110 discrete suspended solids samples will also be analyzed. Streamflow will be continuously monitored and used to compute the PCB and suspended solids loads transported during runoff events.

PROGRESS (June 2001 to June 2002)

The gaging equipment has been installed and is operational. Sampling of runoff events has started.

PLANS (July 2002 to June 2003)

Complete collection of the storm samples and submit samples to the lab. Prepare a summary of the data for WDNR. A data report will be prepared which will summarize the storm event loads and flow data collected for this project.

TRANSPORT OF PCBs AT THREE SITES ON PINE CREEK AND MANITOWOC RIVER (HAYTON MILLPOND)

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

Jeffrey J. Steuer

LOCATION:

Calumet County

PROJECT NUMBER:

WI 19102

PERIOD OF PROJECT:

April 1994 to September 2002

PROBLEM

High concentrations of polychlorinated biphenyls (PCBs) have been found in the Hayton Millpond and Pine Creek bed sediments, water column, and fish tissues. PCB transport trends are needed to assist in future management and remediation decisions.

OBJECTIVE

The objective is to determine PCB loading changes at the Hayton Millpond outlet along with PCB loading in reaches of Pine Creek.

APPROACH

From August 1994 to August 1995, 24 PCB samples were collected at the Hayton Millpond outlet. Total suspended solids, precipitation, chlorophyll *a*, and discharge data were used in conjunction with the PCB data to establish PCB concentration regression relations.

From August 2001 through June 2002, five additional 80-liter PCB samples (along with supporting constituents) will be collected at the Millpond outlet along with 10 PCB samples on Pine Creek. Utilizing these data, residuals from the 1993–95 regression relations will be examined to determine if PCB concentrations have statistically changed over time.

PROGRESS (July 2001 to June 2002)

Field equipment blanks have been collected; equipment, cleaning, and processing procedures have been found to be acceptable. Ten PCB samples and their related constituents have been collected. Laboratory results have been received for three of the samples. Relative loading between the sites may be similar to that observed seven years ago. During August 2001, one of the Pine Creek sites (Quarry Road) had a total PCB (congener summation) concentration of 730 ng/L.

PLANS (July 2002 to September 2003)

Data analysis will be completed.

MITIGATION OF FUTURE NORTH FORK URBANIZATION IMPACTS ON THE PHEASANT BRANCH HYDROLOGIC SYSTEM

COOPERATORS:

City of Middleton;
Wisconsin Department of Natural Resources

PROJECT CHIEFS:

Jeffrey J. Steuer
Randy J. Hunt

LOCATION:

Dane County

PROJECT NUMBER:

WI 20202, 20203, 20204

PERIOD OF PROJECT:

July 1996 to January 2004

PROBLEM

As Middleton and its surroundings continue to develop, the Pheasant Branch North Fork Basin is expected to undergo significant urbanization. For the downstream city of Middleton, headwater urbanization can mean increased flood peaks, increased water volume, and increased pollutant loads. It may also adversely effect down-gradient ecosystems such as Pheasant Branch Marsh and reduce ground-water recharge. Previous work has often not included the transient interaction between surface and ground water. The proposed work will combine ground- and surface-water modeling in the analysis of the Pheasant Branch system.

OBJECTIVE

Objectives are to: (1) locate potential sites for runoff controls and/or enhanced infiltration to ensure future flood peaks do not exceed the present condition flood peaks, (2) quantify the flood peak and ground-water recharge differences resulting from a fully-urbanized condition with and without treatment or runoff controls, (3) use the ground-water model to assess North Fork basin urbanization impacts on Pheasant Branch Marsh, and (4) construct a ground-water model able to address future needs such as siting future water supply.

APPROACH

The overall approach will combine ground- and surface-water models to locate an effective combination of stormwater treatment or control sites within the North Fork basin which may be developed to produce minimal effects on the Pheasant Branch hydrologic system. The surface-water component will build upon the simulations detailed in “Effects of urbanization on streamflow, sediment loads, and channel morphology in Pheasant Branch Basin near Middleton, Wisconsin” (Krug and Goddard, 1985, WRIR 85–4068). To achieve the objectives of this project, the model will contain a spatial resolution to simulate 1 to 4 developments per square mile (approximately 40 model sub-areas). Significant development has occurred in the South Fork basin since 1981. Two of the areas simulated as not generating runoff in 1981 have developed and presently drain to the South Fork. It will be necessary to update the South Fork basin model to ensure that shifting of the North Fork hydrograph peak (due to runoff controls) will not produce an enhanced peak downstream of the

confluence (Krug and Goddard, pages 16, 17). The new model efforts will calibrate to recently collected Pheasant Branch discharge and precipitation data collected at Highway 12.

The ground-water component will use a model constructed at a smaller scale than the recently developed Dane County model (Krohelski and others, 2000) to have the appropriate resolution for the stormwater control alternatives. Similar to Krohelski and others (2000), the model will be constructed using MODFLOW (McDonald and Harbaugh, 1988). Recharge results from the surface-water model will be input into the ground-water-flow model to assess the effects of management alternatives on ground-water recharge distribution and magnitude. The model will also calculate the changes in ground-water-derived baseflow in the system for the different alternatives and assess the effectiveness of recharge enhancement scenarios.

In February 2000, the project was expanded when the models were accepted as part of an Environmental Protection Agency (EPA)/National Science Foundation (NSF) research grant. The expanded research will be coordinated by the WDNR and University of Wisconsin–Madison. To further that effort, the surface-water model will be modified to incorporate research findings. The ground-water model will be refined to include additional geologic data and hydrologic features near the Pheasant Branch Marsh.

PROGRESS (July 2001 to June 2002)

The calibrated PRMS model was updated and verified for the period October 1998 through October 2000—an interval which included the largest recorded peak flow on Pheasant Branch Creek. Recurrence interval hydrographs for the South Fork Channel were provided to a private consultant in support of the City of Middleton.

Measurements have been made in the Creek to detail individual seepage areas along with several sites that extend downstream to Century Avenue. A flume has been installed downstream of the Frederick Springs area with data displayed on the World Wide Web.

The PRMS model has been nearly converted (90 percent) to the Modular Modeling System to allow inclusion of local infiltration and head flux algorithms.

The Water-Resources Investigation Report, "Use of a watershed modeling approach to assessing the hydrologic effects of urbanization, North Fork Pheasant Branch Basin near Middleton, Wisconsin" and Fact Sheet, "Evaluating the effects of urbanization and land-use planning using ground-water and surface-water models," were published.

Assistance with geophysical logging of a monitoring well near the Springs was given to the Wisconsin Geological and Natural History Survey.

Assistance with drilling of monitoring wells near a study subdivision was given to the Wisconsin Geological and Natural History Survey.

PLANS (July 2002 to June 2003)

The conversion of the PRMS surface-water model to the Modular Modeling System will be completed and modules for the local infiltration and head flux algorithms will be written.

Support will be given to the larger Pheasant Branch project conducted by the Wisconsin Department of Natural Resources, the University of Wisconsin–Madison, and the Wisconsin Geological and Natural History Survey. The work includes well installation and instrumentation in a study subdivision and chemical and isotope analyses for water samples collected during the study.

REPORTS

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MODELING THE EFFECTS OF THE CRANDON MINE USING THE HSPF WATERSHED MODEL

COOPERATOR:

U.S. Environmental Protection Agency

PROJECT CHIEF:

Jana S. Stewart

LOCATION:

Forest County

PROJECT NUMBER:

WI 20500

PERIOD OF PROJECT:

January 1997 to September 2002

PROBLEM

The Nicolet Minerals Company has proposed construction of a zinc and copper mine near Crandon, Wisconsin. Before any operations can begin, an environmental impact assessment must be written and approved. At present, it is uncertain what specific effects the mine will have on the hydrology and water quality of the streams and lakes in the area.

OBJECTIVE

The objectives of this project are to: (1) assemble hydrologic, meteorologic, and land-use information for the area near the proposed mine, (2) develop a watershed model for the Swamp Creek basin, and (3) use the model to determine what potential impacts the mine will have on the hydrology of Swamp Creek and nearby lakes.

APPROACH

Available hydrologic, meteorologic and land-use information will be obtained from the U.S. Geological Survey databases, the Nicolet Minerals Company, the Mole Lake Tribe, the Wisconsin state climatologist, the National Climatic Data Center, and the Wisconsin Department of Natural Resources. These data will be used to develop a watershed model for the Swamp Creek Basin using the Hydrologic Simulation Program Fortran (HSPF) watershed model. The model will be calibrated using a subset of data available for Swamp Creek and verified using an independent subset of the data. The model will be adjusted to simulate mine construction, operation, and closure. The output of the model will be used to quantify the effects of the mining operations on the water levels of streams and lakes in the area.

PROGRESS (July 2001 to June 2002)

Model scenarios are in progress and a report being written.

PLANS (July 2002 to September 2002)

The calibrated HSPF model will be adjusted to quantify the effects of the mine construction, operation, and closure on the water levels of streams and lakes in the area. The report will be finalized and final GIS layers will be documented. Meetings will be conducted to present final results.

GEOGRAPHIC INFORMATION SYSTEM (GIS) DATABASE DEVELOPMENT AND SUPPORT OF MODFLOW AND HSPF MODELING EFFORTS RELATED TO THE PROPOSED CRANDON MINE

COOPERATOR:

U.S. Army Corps of Engineers

PROJECT CHIEF:

Jana S. Stewart

LOCATION:

Forest County

PROJECT NUMBER:

WI 20501

PERIOD OF PROJECT:

October 1998 to September 2002

PROBLEM

A number of modeling efforts are underway to evaluate potential changes to surface- and ground-water resources in the vicinity of the proposed Crandon mine. The United States Army Corps of Engineers (USACE) will be evaluating these potential effects using the MODFLOW model with modeling work and an environmental impact statement (EIS) being completed by third party contractors. The U.S. Environmental Protection Agency (USEPA) is working with the U.S. Geological Survey (USGS) and Aqua Terra Consultants, Inc., to develop a HSPF computer model for the simulation of the surface-water budget in the vicinity of the proposed mine. Although the objectives and scope of the two models differ, there is overlap between the areal extent of the models and the thematic data layers required for input, analysis, interpretation and evaluation. Data acquisition and development, GIS analyses and map displays prepared for one modeling effort need to be coordinated and shared for both modeling efforts and for impact assessment.

OBJECTIVE

The objectives of this project are to (1) coordinate GIS data acquisition and related communication in support of modeling and impact assessment, as directed by the U.S. Army Corp of Engineers (USACE), (2) conduct GIS analyses and provide displays related to the USACE third party MODFLOW modeling contractor effort, as needed and as directed by the USACE and USACE-Waterways Experiment Station, and (3) review GIS analyses and displays related to third party Environmental Impact Statement contractor effort, as needed and directed by the USACE.

APPROACH

Spatial data layers will be acquired and developed as needed to assist in both surface- and ground-water modeling efforts and in support of impact assessment. Map figures and spatial data layers will be prepared using ARC/INFO and ArcView GIS software. Existing spatial data layers will be acquired from outside

resources, including Wisconsin Department of Natural Resources, Great Lakes Indian Fish and Wildlife Commission, and Nicolet Minerals Company, if available. Other data layers will be developed and analyses conducted as needed.

PROGRESS (July 2001 to June 2002)

The original scope of work for this project was rewritten as a result of the USACE FEMWATER modeling effort being dropped in place of a third party contractor MODFLOW modeling effort. Spatial data layers were acquired and map figures prepared as needed by the USACE, and the EIS contractors. A list of available data layers was prepared for the USACE and the EIS contractor.

PLANS (July 2002 to September 2002)

Spatial data layers will be acquired, GIS analyses conducted, and map figures prepared, as needed by the USACE or the MODFLOW or EIS contractors. Review of GIS analyses and map figures will be conducted as requested by the USACE.

THE EFFECT OF NEAR-SHORE DEVELOPMENT ON CONSTITUENT LOADING TO LAKES IN NORTHERN WISCONSIN

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEFS:

David J. Graczyk
Randy J. Hunt

LOCATION:

Vilas and Forest Counties

PROJECT NUMBER:

WI 21800

PERIOD OF PROJECT:

October 1999 to September 2003

PROBLEM

Additions of nutrients, pesticides, and sediment from near-shore developments to lakes may seriously degrade lake-water quality. Shoreline-zoning regulations such as required setbacks, cutting restrictions, and buffers between the lake and development have been developed in the hope that these requirements can mitigate the effects of sediment and nutrient runoff.

Previous studies have estimated the amount of these loadings from the lake watershed but few studies have determined the processes and pathways in which these constituents are delivered to the lake at a site-specific scale (for example, one-acre parcel). The effectiveness of buffers or cutting restrictions on reducing the amount of chemical constituent loads and sediment has yet to be demonstrated.

OBJECTIVE

The objectives of the study are to: (1) estimate the quantity of surface-water runoff and ground water that flows into a lake from developed and undeveloped lands, and (2) determine the quality of surface-water runoff and ground water that flows into a lake from developed and undeveloped lands.

APPROACH

Effects of shoreline development on water and nutrient loading will be assessed using a paired approach. The comparison will focus on developed and undeveloped sites on four lakes in Vilas and Forest Counties in northern Wisconsin. Developed sites may include runoff from lawns, driveways, sidewalks, and roofs; undeveloped sites consist of mostly immature woods having woody and non-woody vegetation and relatively undisturbed ground. Both surface-water runoff and ground-water components will be characterized where appropriate.

Sites were divided into those where the lakes have ground-water inflow and those that do not. Those that had ground-water inflow will be instrumented to characterize the ground- and surface-water components. Sites with ground-water flow away from the lake will be instrumented to characterize surface-water components only. Each site will be surveyed and a detailed map will be prepared to determine the areas that contribute to surface runoff.

A tipping bucket rain gage will be installed at each site. Precipitation will be measured during the non-freezing portion of the year. Precipitation from a nearby National Weather Service gage will be used during freezing periods.

Surface-water runoff will be measured by using two types of monitors depending on the site. An automatic collection monitor will be installed at four sites. A passive collection monitor will be installed at two sites. The quality of surface water will be determined from analyses of the runoff collected by both automated and non-automated systems.

Ground-water flow will be monitored by the installation of piezometer nests. The nests will be distributed along the topographic gradient. The most down-gradient nest will be installed adjacent to the lakeshore. The quality of ground water will be determined from a subset of water table wells and piezometers located at the nest sites. In addition, the quality of ground water that discharges to the lake will be characterized using seepage meters and pore-water diffusion equilibrators. All surface- and ground-water samples will be analyzed for total dissolved phosphorus, total phosphorus, ammonia nitrogen, nitrate and nitrite nitrogen, and total Kjeldahl nitrogen. Approximately 7 surface-water samples per site will be collected, and 5–10 ground-water samples will be collected. The Wisconsin State Laboratory of Hygiene will analyze all samples.

PROGRESS (July 2001 to June 2002)

Samples were collected and analyzed at selected ground-water wells and at the surface-water data-collection sites. There were 76 samples collected at the four lawn sites and 67 samples collected at the seven woods sites. The median surface runoff in inches from the woods catchments was an order of magnitude less than the median surface runoff from the lawn catchments. All surface-water samples from the lawn and the woods were composited; the median woods concentration for ammonia nitrogen, Kjeldahl nitrogen, total phosphorus, and dissolved total phosphorus was greater than the median lawn concentrations. The only median lawn concentration that was greater than woods median concentration was nitrate plus nitrite nitrogen. A non-parametric Wilcoxon rank-sum test determined that composite lawn median concentrations were statistically significantly different from the woods median concentrations. Although concentrations for most constituents were greater in the woods samples, the loads from the woods were lower than the lawns because of greater runoff volumes generated from the lawn catchments. There was a strong pattern of the lawn yields exceeding the woods median yields (within and between sites). This is due to more runoff from the lawns than from the woods sites. The ground-water system is an important ground-water pathway for nutrient transport. The ground-water yields from lawns are approximately three to four times greater contributors of nitrate plus nitrite and total phosphorus to the ground-water system than the woods site.

PLANS (July 2002 to June 2003)

A final report is being prepared that will summarize all surface-water and ground-water data. The report will also summarize all loadings and yields to the lake from the different land uses. Final report will be published. The next data-collection phase will begin. Data-collection sites will be found and a buffer demonstration project will begin. This project will focus on the hydrology and determine how water moves across a lawn and then to a buffer and if this water eventually makes it to the lake. The study will use a rainfall simulator and inert tracers to determine how and the volumes of water that flow through the buffer.