1997 Project Abstract
For the Period Ending June 30, 1999
This project was supported by Environment and Natural Resources Trust Fund (M.S.116P)

Title:	Metropolitan Area Groundwater Model to Predict Contaminant Movement
Project Manager:	Andrew Streitz
Organization:	Minnesota Pollution Control Agency
Address:	Environmental Outcomes Division 520 Lafayette Road St. Paul MN 55155 andrew.streitz@pca.state.mn.us
Website:	www.pca.state.mn.us/water/groundwater/metromodel.html
Legal Citation:	ML 1997, Chp. 216, Sec. 15, Subd. 10 (b).
Appropriation Amount:	$300,000

A. Statement of Objectives

1. To build a regional groundwater flow model encompassing the Twin Cities seven-county Metropolitan area. To assemble supporting databases, and build the hydrogeologic conceptual model.

2. To coordinate the development of the Metro Model and its supporting databases so that it was accepted and used by the environmental and groundwater modeling community.

B. Overall Project Results

1. The Metro Model has become a common starting point among local groundwater scientists for local scale model construction. The Metro Model has provided the regional boundary conditions so that end-users can insert local detail, and thereby create a more robust site-specific model in a shorter time than was previously possible.

   Geologic and hydrogeologic databases have been assembled and developed by project team members to support the Metro Model. The databases and maps have been distributed through CD-ROM and Internet to government scientists and private consultants.

2. Acceptance of the Metro Model has been advanced through close cooperation between the project team and government and private sector scientists. Consensus among this group of groundwater professionals has been crucial for

providing guidance for the development of the conceptual model, supporting databases, and the model itself.

C. Project Results Use and Dissemination

1. Examples of the use of the Metro Model include three recent Requests-for-Proposals issued by the Ramsey County Soil & Water Conservation District and the Minnesota Department of Health for the construction of regional models to be applied to problems of wellhead protection and groundwater management. All three stipulated extensive use of the Metro Model and its supporting databases as a necessary starting point for the consultants winning the contracts.

2. The MPCA has applied the Metro Model to Superfund and tank leak sites. Both the Reilly Tar & Chemical Superfund site, and the McKee/Convoy Tank leak site were modeled using the Metro Model as a starting point. Agency Hydrologists worked with project staff and a consultant hired by the project to add local detail. The Metro Model was modified easily for both sites. Reports available.

3. Three abstracts have been submitted to the Midwest Groundwater Conference by Metro Model staff concerning: the application of the Metro Model at remediation sites, the use of spatial statistics to clean-up databases, and the importance of surface water/groundwater discharge measurements to calibrate groundwater models. A fourth abstract was submitted by a hydrologist at the MPCA on his experience using the Metro Model at a Superfund remediation site. The conference is in October and more information is available at the Department of Natural Resource, Division of Waters webpage.

4. Metro Model databases, maps and model elements have been distributed by CD-ROM and Internet to over 40 groundwater modelers and interested parties.

Date of Report: July 1, 1999
LCMR Final Workprogram Update Report

Date of Next Status Report: NA
Date of Workprogram Approval:
Project Completion Date: June 30, 1999

LCMR Work Program 1997

I. Project Title: Metropolitan Area Groundwater Model to Predict Contaminant Movement

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Total Biennial Project Budget:

$LCMR:	$300,000
- $LCMR Amount Spent:	$294,000
= $LCMR Balance:	$6,000

A. Legal Citation: ML 1997, Chp. 216, Sec. 15, Subd. 10 (b).
Metropolitan Area Groundwater Model to Predict Contaminant Movement
$300,000

Appropriation Language: This appropriation is from the trust fund to the pollution control agency for the second biennium to improve and refine the metropolitan groundwater model to improve contaminant tracking, cleanup evaluation, and overall protection of groundwater resources.

B. Status of Match Requirement:

II. Project Summary and Results:

In the 1995 LCMR project, the MPCA compiled the Geographic Information Systems (GIS) layers and constructed the model for steady-state (time-averaged) conditions, using the Multi-Layer Analytic Element Model (MLAEM) computer program. The model continues to be developed with guidance from a large advisory group of interested groundwater scientists from other governmental units and the private sector who have volunteered many hours of their time. Now, at the end of the 1997 LCMR project, the MPCA has tested, calibrated, refined, and applied the model to evaluate existing contamination sites.

For the 1997 LCMR project, MPCA staff, in cooperation with staff from the University of Minnesota (UM), enhanced the regional model of groundwater movement in the Twin Cities Metropolitan Area. We:
1) refined areas within the model where more detail was needed and also available from local studies, including models developed by outside users who applied the Metro Model to their own locales,
2) continued to make the model and its GIS databases more easily accessible to public and private sector users, assisted them in using it, and actively involved the advisory workgroup and all users in shaping the model to meet more needs,
3) applied the enhanced model to evaluate additional contaminant movement and cleanup problems. We applied the new capabilities in the software along with improvements in the model to simulate, with increased reliability, behavior of groundwater at actual contamination sites. Results were continuously examined by the advisory workgroup for their accuracy and usefulness in other, non-MPCA applications.

This work completes the LCMR development phase of the steady-state model. The MPCA and other agencies, with extensive input from the advisory workgroup, will work with the legislature to identify appropriate ways to update, administer, and support the model into FY 2000. The MPCA has decided to incorporate Metro Model staff costs into the overall Agency budget.

III. Progress Summary:

A. Result 1 Refinement of the Metro Model

1. Groundwater simulations now exist for all five layers and all three hydrologic provinces. Single layer versions of the most important aquifer in the Twin Cities area, Layer 3, are now available. This has increased the Metro Model's value in the groundwater community, especially among users with more limited computer resources. Project staff will continue working on the Metro Model after the conclusion of the LCMR phase of the project under Agency budget support.

2. Our Agreement with the University of Minnesota, Minneapolis campus, Department of Civil Engineering was successfully completed. The University had two main tasks: 1) to compare the leakage calibration in the northwest province of the model with the leakage theory that has been developed by Otto Strack, and 2) to refine layers 3, 4, and 5 of the existing model. A final report is on file at the Minnesota Pollution Control Agency.

3. The Metro Model team worked closely with regional and local modeling projects, including:

a. Ramsey County released a Request for Proposal (RFP) identifying the Metro Model as a required starting point for the consultant selected for the project.

b. Hennepin County- cooperated on groundwater models and observation well networks.

c. Washington County- the Metro Model team provided guidance as the county contracted with the Minnesota Geological Survey for a study of the glacial drift. This information was then incorporated into the Metro Model.

d. Minnesota Dept. of Health issued a RFP that recommended the Metro Model as a source of supporting databases, the conceptual model , and model elements.

e. Minnesota Department of Natural Resources requested technical help for the investigation of groundwater at Savage Fen in the city of Savage.

f. Metro Model staff serve on advisory workgroups for three counties, and three state agencies.

B. Result 2 Public Outreach of Metro Model and its Supporting Databases

1. The project team has built a library of supporting databases which have been distributed to government scientists and private consultants via CD-ROM.

a. Included are geologic interpretations, groundwater contours, digital maps and other GIS files. These databases are becoming a standard in the groundwater community.

b. A copy was sent to Linda Bruemmer, of the LCMR staff in February 1999.

c. The Internet will eventually become the main distribution tool.

2. The team has met with interested parties both inside and outside of state government to demonstrate model operation, to distribute files and train users. Over 100 requests for data and/or modeling help have been responded to.

a. This has promoted greater contacts between groundwater modelers, private consultants, and government scientists and regulators.

b. The shared experiences and groundwater modeling techniques increase the probability that different models will share important elements. This will reduce misunderstandings between parties.

3. The Metro Model Web site can be found at:
http://www.pca.state.mn.us/water/groundwater/metromodel.html

C. Result 3 Site-Specific Applications of the Metro Model

1. The project team has developed local-scale models for superfund and leaking underground storage tank sites. Reports available upon request.

a. Reilly Tar & Chemical Superfund site, St. Louis Park.

b. McKee/Convoy tank site, Eagan.

c. Working with Agency technical staff, the Metro Model was easily adapted for these local areas.

2. The project team has begun to schedule work with Agency staff from over 10 sites encompassing many different remediation programs. This next phase of the project will start in FY 2000.

2. The project team has provided technical support to other state agencies, including:

a. Minnesota Dept. of Health, and their Wellhead Protection area groundwater models.

b. The Science Museum of Minnesota (SMM) and their St. Croix Watershed Research Station used the Metro Model and supporting databases on their 1997 LCMR project, Watershed Science: Integrated Research And Education Program (13b). ("Funding for this project approved by the Minnesota Legislature, ML 1997, Chapeter 216, Sec. 15, Subd. 13(b) as recommended by the Legislative Commission on Minnesota Resources from the Minnesota Future Resources Fund.")

3. The project team has provided technical support to private consultants in the areas of:

a. Databases, GIS, and model elements.

b. Use of the modeling software.

IV. Outline of Project Results:

Result 1 Refinement of the Metro Model

Refine areas within the model where more detail is needed and available from local studies, including models developed by outside users who apply the Metro Model to their own locales. Particular attention will be given to county-wide models and the growing number of small-scale wellhead protection area (WHP) models. Additionally, the model will be updated to reflect new information and model interpretations, as they become available. This process will include model calibration and validation.

Budget: $150,000 Balance: $2,000

Completion Date:

-Incorporation of Dakota County model datasets	March 1998
-Incorporation of Existing WHP models	July 1998
-Incorporation of Washington County model datasets	January 1999

Result 2 Public Outreach of Metro Model and its Supporting Databases

Make the Metro Model and its GIS databases easily accessible to public and private sector users, assist them in using it, and actively involve the advisory workgroup and all users in shaping the Metro Model to meet all reasonable technical requirements. This will include the construction and maintenance of an Internet Web page, making GIS coverages, database files, and reports available to all interested parties over the Internet.

Budget: $60,000 Balance: $2,000

Completion Date:

-Prepare Model Databases for Dissemination	January 1998
-Unveil Metro Model Web Page	June 1998
-Complete and Maintain the Web Page	March 1999

Result 3 Site-Specific Applications of the Metro Model

Apply the enhanced model to evaluate additional contaminant movement and cleanup problems. Software enhancements and model improvements will provide more representative simulations of groundwater behavior at actual contamination sites. Using the new tools, we will evaluate how contaminants are contained in response to remediation controls, or are spreading due to other high-volume pumping in the area or other factors. The advisory workgroup will continue to meet to evaluate modeling results for their accuracy and usefulness in other, non-MPCA applications.

Budget: $90,000 Balance: $2,000

Completion Date:

-Complete local-scale analyses of selected contaminant sites selected by the MPCA	January 1998
-Complete local-scale analyses of selected contaminant sites as recommended by the advisory workgroup (in the public sector)	June 1999

V. Dissemination

The Metro Model Project team met regularly with an advisory workgroup made up of public and private sector scientists and groundwater modelers. Further, the team sends out regular project updates to the larger hydrogeologic community to keep them informed of the project's progress. GIS coverages, database files, and project reports will be disseminated on the Internet Web for easy access by all interested parties.

VI. Context

A. Significance: The MPCA and other State and local governments are faced with complex groundwater management problems. The Metropolitan Council has estimated that approximately 230 billion gallons of groundwater are contaminated in the Twin Cities Metropolitan Area, including 16 percent of the most commonly used groundwater resource, the Prairie du Chien/Jordan aquifer. The Metro Model has developed into a flexible, versatile tool, in combination with local investigations, to evaluate movement of contaminated groundwater within and among aquifers in the seven-county area.

The Metro Model is an innovative, proactive tool for managing groundwater in a major urban area. The Model provides a useful regional framework for evaluating potential water quality threats to public water supplies. Though outside the MPCA's scope, the model has also been used to evaluate the impacts of anticipated increased pumping on Metropolitan Area groundwater resources, as urbanization pressures increase, and to help ensure sustainable development of groundwater so that it is not depleted faster than it is replenished.

B. Time: This workplan completes the development phase of the steady-state (time averaged) model, substantially adding to the applications developed during the initial FY 1996 - 1997 LCMR project. The MPCA worked with other state agencies to identify appropriate non-LCMR mechanisms to support development of the capability to model needed time-variable features and expansion of the model outside the seven-county area, as well as the ongoing administration and continuous improvement of the model after the 1998 - 1999 biennium.

C. Budget Context:

	July 95 - June 97 Prior expenditures on this project	July 97 - June 99 Proposed exp. on this project	July 99 - June 2001 Anticipated future exp. on this project
1. LCMR	$250,000	$300,000	$0
2. Other State	$200,000	$101,000	$300,000*
3. Non State	$66,000	$0	$0
4. Cash	$0	$0	$0
Total	$516,000	$401,000	$300,000

Budget:

Personnel**: Salary and Fringe over 2 years	$191,050
0.8 Research Scientist 3	
0.5 Hydrologist 3	
0.5 Student	
Rent	$3,900
Printing	$0
Contracts	
University of Minnesota	$60,000
Kelton Barr Consulting	$20,000
Attorney General's Office	$500
Instate Training & Travel	$1000
Out of State Training & Travel	$2000
Supplies & Communications	$1,800
Equipment: Computer, Software & Network Access	$19,750
Total	$300,000

*The MPCA will incorporate Metro Model salary costs into the overall agency budget starting with FY 2000.

**Classified MPCA employee Andrew Streitz (Hydrologist 3) was 50% supported with LCMR project funds and 50% supported with other funding, mainly or all the Solid Waste Fund, for FYs 1998 and 1999. As a member of Program Development's Ground Water Unit, he has been working on ground water modeling for the last five years, supported by MPCA Agency funds. Groundwater modeling issues for the overall program have been refocused into the metropolitan groundwater model because the skills and knowledge gained in developing the Metro Model will enhance the modeling capabilities of the Agency groundwater program in the future.

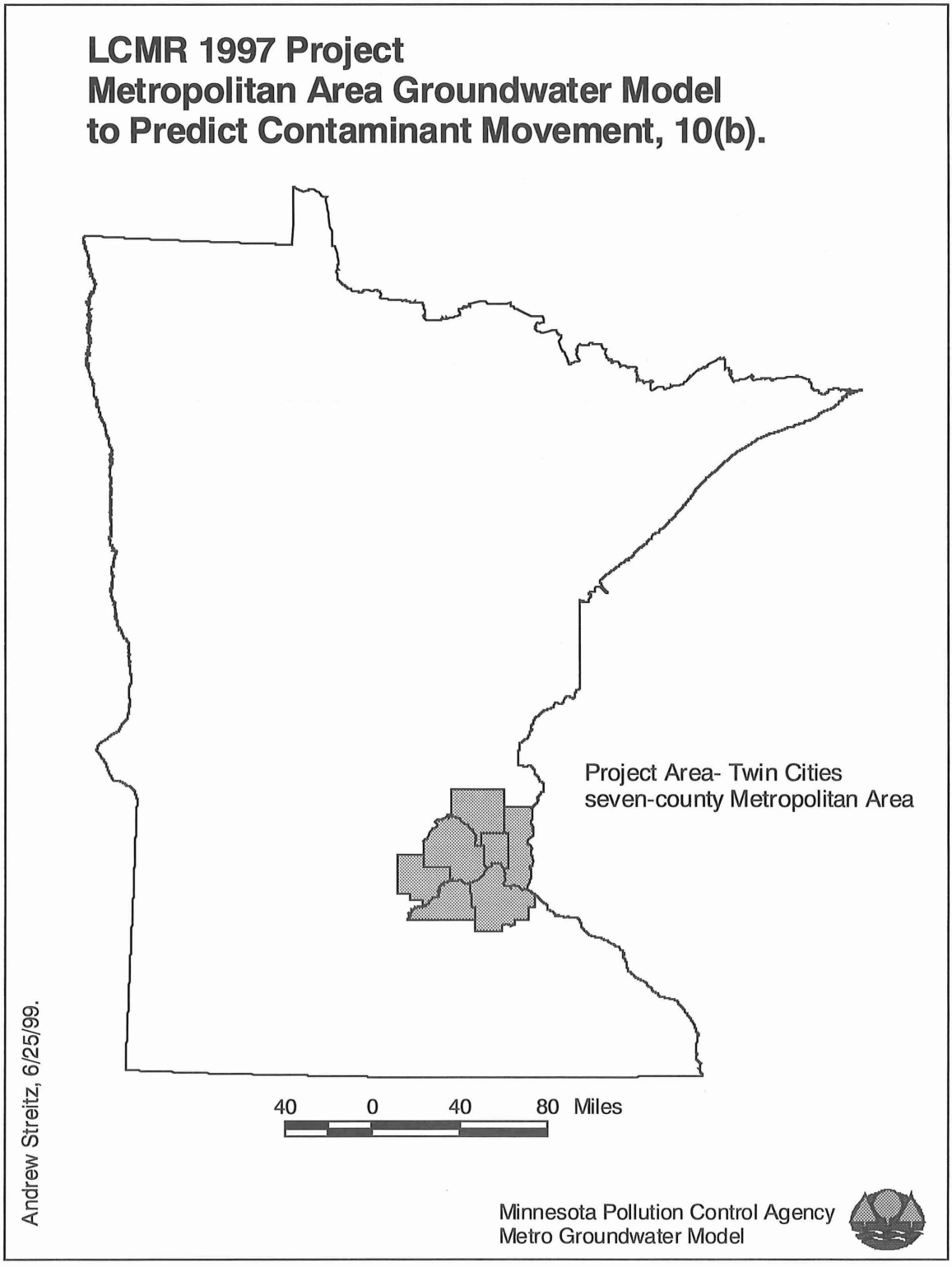
Unclassified MPCA employee John Seaberg (Research Scientist 3) drew 80% of his salary from the LCMR funding, with the remainder coming from State Superfund. John accomplished selected Agency goals through the use of the Metro Model on specific contamination sites within the metropolitan area.

VII. Cooperation
NA

VIII. Location
Map showing Model project area attached.

IX. Reporting Requirements:
Workprogram progress reports were submitted on April 30, 1998, and February 15, 1999. This is the final workprogram report and is submitted to discharge the duties of the appropriation.

X. Research projects:


LCMR 1997 Project
Metropolitan Area Groundwater Model
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Project Area- Twin Cities
seven-county Metropolitan Area
40 0 40 80 Miles
Andrew Streitz, 6/25/99.
Minnesota Pollution Control Agency
Metro Groundwater Model