~~January 1, 1993~~ June 30, 1993

LCMR ~~Status Report~~ Final Report, 1993

I. South Central Minnesota Surface Water Resources Atlases and Data Base - Water 79

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A. M.L. 91 Ch. 254, Article 1, Sec. 14 Subd. 4(b)
Appropriation $300,000
Balance ~~99,897~~ ~~$-0-~~

South Central Minnesota Surface Water Resource Atlases and Data Base: This appropriation is from the Minnesota environment and natural resources trust fund to the commissioner of natural resources for a grant to Mankato State University for development of surface hydrology atlases and data base in both hard and electronic format for the 13 counties of south central Minnesota.

B. Compatible Data: During the biennium ending June 30, 1993, the data collected by projects funded under this section that have common value for natural resource planning and management must conform to information architecture as defined in guidelines and standards adopted by the Information Policy Office. In addition, the data must be provided to and integrated with the Minnesota Land Management Information Center's geographic data bases with the integration costs borne by the activity receiving funding under this section.

C. Match Requirement: $000 NA
Funds Raised to Date: $91,000 - ~~Resolutions~~ From 13 counties

II. Narrative

The present system of water management in Minnesota separates surface and groundwater. This program will map surface water resources on the same county based 7 1/2 minute mosaic maps developed for our geologic atlases, allowing for direct overlay and thus holistic interpretation, planning and management. Both maps and data bases from which the maps are derived will be in electronic and hard copy format.

III. Objectives

A. Data gathering and hard and/or electronic copy map production for surface hydrology of 13 south central Minnesota counties.

A.1. Narrative: The surface water resources mapping objective will produce surface hydrology atlases on the same mapping base used for our geologic atlases. This will allow the surface hydrology maps to be directly compared with subsurface geologic - hydrogeologic maps for the purposes of holistic interpretation, planning and management.

A.2. Procedures: Existing data will be gathered to produce the following maps:

1. General Land Survey Maps, including original wetlands.
2. Present Surface Hydrology including lakes, wetlands, rivers & floodplains, drainage ditches and drainage areas of each of the above. Also included will be a Blue Earth County pilot attempt at locating water and erosion control structures. Quantitative geomorphic

analysis will be done including minor basin order, bifurcation ratios, lake morphometry and erosion control structure pilot analyses.
3. Weather station locations, rainfall gauge locations and data plots.
4. Point Source Pollution Maps including dumps, sanitary landfills, underground storage tanks, NPDES permits, extraction permits, storm sewers and sanitary sewer outlets (from EPA work and waste distribution (haulers and recyclers).
5. Incorporation of the new LCMR land-use maps, when available.
6. Population data from 1990 census and change in population.
7. Overlay of county soil maps when compatible.
8. Cancer, epidemiology maps, joint effort with regional medical center, develop pilot methodology.

Maps 1, 2, 4 and 5 will also be done on a township level (220 townships) to provide more detail.

A.3. Budget

	LCMR Funds	Matching Funds
a. Amount Budgeted	$200,000	$60,000
Balance ~~1/1/93~~ 6/30/93	~~$66,598~~ ~~$-0-~~	

A.4. Timeline for Products/Tasks

	July91	Jan92	June92	Jan93	June93
For maps 1, 3 and 6					
Gather data	**********	**********			
Generate maps		**********	**********		
	July91	Jan92	June92	Jan93	June93
Compose text			**********		
Print maps					********
For maps 2-4					
Gather data	**********	**********			
Run quantitative analysis on data		**********	**********		
Generate maps		**********	**********		
Compose text			**********		
Print maps					********
For maps 5 and 7					
Gather electronic and hard copy data	**********	**********			
Generate maps		**********	**********		
Compose Text		**********	**********		
Print Maps					********
For map 8					
Gather information	**********	**********			
Generate maps		**********	**********		
Generate text			**********		
Print maps					*******
Assemble and bind atlases					*******

A.5. Status: Final report due June 30, 1993.

Map information contained on General Land Survey maps (original wetlands) has been transferred onto a USGS 7.5 minute quadrangle map base for ~~10~~ all of the 13 counties. Weather station rainfall gauge locations have been received ~~for 8 of~~ from the 13 counties and their locations plotted onto USGS 7.5 minute quadrangle maps for digitizing. National Wetlands Inventory maps (NWI) classification system categories have been grouped and the Cowardin Classification scheme simplified to better fit our needs.

County ditch and tile maps have been collected from ~~11 of~~ all 13 counties and the map information transferred onto USGS 7.5 minute quadrangle maps. Minor watershed boundary lines have been adjusted to fit the county ditch and tile drainage systems for ~~8 of the~~ all 13 counties. Ditchshed and lakeshed boundary lines have also been delineated for ~~8 of the~~ all 13 counties.

County ditch and tile lines, minor watersheds, ditchsheds, and lakesheds have been digitized into a Sun workstation using AutoCAD. Information contained on ~~24~~ USGS 7.5 minute quadrangle maps has thus far been digitized ~~for the Blue Earth, LeSueur, Des Moines and Little Sioux River basins~~ for 9 counties and the remaining 4 will be completed in July.

Preparation of county atlas maps and atlas design ~~has begun for 4 of the 13 counties~~ will go to the printer on the following schedule:

Blue Earth, Jackson, LeSueur and Martin Counties July 1; Brown, Cottonwood, Nicollet, Sibley and Watonwan Counties in August; and Faribault, Freeborn, Steele and Waseca Counties in September.

A.6. Benefits: This objective will provide a regional surface water hydrology hard copy map database that will be built directly upon our geologic atlases base allowing holistic water resources interpretation, planning and management. This objective will provide a map database for digitizing into an electronic format discussed in Objective B.

B. Design of data base for south central Minnesota surface water data, collection of existing electronic data and transfer of hard copy data to electronic format which will be compatible with our regional geologic atlases and database.

B.1. Narrative: Design and develop a centralized regional database and user interface for new and existing surface water data which will be compatible with LMIC and our regional geologic atlases and database.

B.2. Procedures:

1. Collect and evaluate all current electronic data
2. Evaluate hard copy data
3. Design database
4. Populate database with electronic and hard copy data
5. Test database and evaluate performance
6. Make necessary adjustments to database
7. Design user interface
8. Test user interface
9. Adjust user interface as needed
10. Digitization of maps from Objective A.

B.3. Budget

	LCMR Funds	Matching Funds
a. Amount Budgeted:	$100,000	$31,000
Balance ~~1/1/93~~ 6/30/93	~~$33,299~~ ~~$-0-~~	

B.4. Timeline

	July91	Jan92	June92	Jan93	June93
Collection: Evaluation of Data	**********				
Database Design	**********	**********			
Digitization of Maps	**********	**********	**********	**********	**********
Populate Database	**********	**********			
Database Testing			**********	**********	
Evaluate & Adjust Database			**********	**********	
Design, Test, Evaluate & Adjust User Interface			**********	**********	**********

B.5. Status: The goal of the database is to provide a coherent, accessible, and broad-based collection of data on the lakes of Southern Minnesota. The system ~~under~~ development accomplishes these ends as follows:

- •Coherency: The data is organized into a single relational database system with accuracy and integrity as primary goals.
- •Accessibility: The system provides a consistent user interface which conforms to IBM (CUA) design standards, and to Water Resources Center standards for multiple paths to the data (for example, through Query/400, SQL, and standalone applications.)
- •Broad-based: The system contains a wide variety of data collected from multiple sources.

The large size of the system necessitated certain design goals: modularity, the division of the system into more manageable, smaller modules, and the integration of data from a number of different sources, all of which may have followed conflicting design standards. These goals were accomplished by considering the system as a single, large database divided into modules representing the various data sources or studies. Each of these studies was linked to a specific set of lakes, all of which could be held in some central file. ~~So far,~~ Two ~~of these~~ major modules have been integrated into the system, representing data from the Water Resources Center's study of 53 Southern Minnesota lakes, and the Minnesota Department of Administration's SWIM database of lakes in Minnesota. These broad modules are further divided into "submodules", or areas, each of which may consist of one or more data sets.

In addition, both of the currently implemented modules have data on lake location, lakeshore development, and a bibliography of hard copy information on file in the Water Resources Center (a unique feature of the database which allows researchers to obtain source information such as photographs and newspaper articles regarding a lake). A further design goal is that of pedigree. Considering the overlapping areas above, such as lakeshore development, it is important, for verification purposes, to know the source of such data. In files, then, where there is overlap between modules, a 'pedigree' was assigned to each record indicating the source of the data. The pedigree is simply a 3-letter code which represents a specific researcher or agency.

The system has been implemented on the Mankato State AS/400, using Synon/2E application generator, SQL, and C/400 (for data conversion). Beyond the ready availability of the software and hardware, the AS/400 and Synon provided an ideal environment. The AS/400 greatly facilitated the import and management of data, and Synon provided a consistent, CUA compliant user interface and minimized implementation time.

The transfer of data was one of the most significant tasks in the implementation of the system, especially in the case of data from the Water Resources Center. This data was transferred to a networked PC from a Unisys 2200 (where it resided in a Mapper database) using TCP/IP FTP, and then via PC/Support to the As/400, where C programs were written to convert the various reports into a usable form. Both PC/Support and C/400 using embedded SQL were great helps in this task. Once the data was transferred to the Synon data files, a set of

functions for display, update and printing were developed in Synon. Synon allowed functions to be prototyped before generation.

~~There are several areas in which development on the database is ongoing:~~
•Additional modules: several recently-completed or nearly-completed studies ~~will be~~ are being added to the database ~~before the end of the biennium~~, broadening the scope of the data considerably.
•Documentation: A complete user manual ~~will be developed before the end of the biennium~~ is in final stages of development and will be used for August workshops on the lakes database.
•Predefined queries: a library of Query Definitions ~~will be~~ has been developed for a set of standard reports on the data.

B.6. Benefits: This objective will provide comprehensive and easy to use south central Minnesota surface water data at a regional site. Data will be available in map and report format. All data will be compatible with LMIC as either an electronic ASCII file or an ARC digitized file. Further, all data and maps will be compatible with the south central Minnesota geologic atlases and data base, both in hard and electronic format.

IV. Evaluation

The program can be evaluated in the short term by the use counties make of both the prepared hard and electronic copy. Especially important will be the counties' ability to integrate combined ground water and surface water data and maps to solve water resources problems and assist management decisions. The long term evaluation of the project's success will be the continued updating and adding of new parameters to this holistic base by the region and individual counties.

V. Context: Related Current and Previous Work

A. At present, surface water and ground water data are treated as separate. Further water resources problems are delineated as either surface water or ground water. We lack the tools to properly integrate solutions to problems which involve both.

B. Although we have tools for interpretation, planning and management of ground water and surface water by themselves, we lack tools to deal holistically with both. This project will provide for this need.

C. Holistic water resource management involving the integration of resources, governmental levels, and data had its origin in Minnesota with 110B. LCMR was the funding source which made the 110B process a success. The lack of usable, available, and integrated data to apply to local water issues was a major finding of the 110B process. This program is intended to provide a solution for south central Minnesota and a model for the rest of the state. It is anticipated that funding beyond the FY92-93 biennium will be sought from LCMR.

D. Pilot County Groundwater Mapping
and Information System /$340,000

E. Biennial Budget System Program Title and Budget: Not available at this time.

VI. Qualifications

1. Program Manager:

Professor Henry W. Quade
Director, Mankato State University Water Resources Center
Ph.D. - Indiana University - Limnology, Ecology
M.S. - University of Minnesota - Zoology, Ecology, Limnology
B.S. - University of Wisconsin - Zoology, Ecology, Limnology

Dr. Quade has had numerous local, state and federal publications, grants, research presentations and committee roles in a wide range of water resources areas during the past twenty years as the limnology professor at Mankato State University. Areas include work on lakes, rivers, wetlands, ground water, agricultural drainage and water resources policy. Related to this program he has done extensive work in quantitative surface water geomorphology of river - drainage - wetland systems and published agricultural drainage atlases on four of the counties.

2. Major Cooperators/Principal Investigators:

A) David Kormann, B.S. Computer Science, working on M.S. Computer Science

Mr. Kormann is a staff member for Mankato State University's Information Sciences Institute and functions as our computer coordinator and database administrator.
~~Ms. Menk is no longer with the MSU Water Resources Center. Her duties are being covered as a match by MSU (Computer Science Department).~~

B) John Rongstad, Cartographer/G.I.S., WRC Staff

B.S. - Mankato State University - Geography
Completing Master's Degree in Geography/Cartography

Mr. Rongstad has been chief cartographer for the Water Resources Center since July, 1989. He was co-director on the 89-91 LCMR grant for geologic and hydrogeologic mapping project

Two G.I.S. specialists (ArcINFO) have been hired and are on staff for the project.

~~C) Dr. David Pence, M.D.~~
~~Dr. Pence is the head of the Immanuel - St. Joseph's Hospital Regional Cancer Treatment Center and head of the hospital radiation oncology department.~~

C.) Cis Berg, G.I.S./Lake Management, WRC Staff

B.S. - Mankato State University - Biology
Completing Master's Degree in Biology/Limnology

Ms. Berg has been involved in a multitude of lake management projects in Southern Minnesota and has worked on the 89-91 LCMR grant for geologic and hydrogeologic mapping project.

VII. Reporting Requirements

Semiannual status reports will be submitted not later than Jan. 1, 1992, July 1, 1992, Jan. 1, 1993 and a final status report by June 30, 1993.