2008 Project Abstract

For the Period Ending June 30, 2011

PROJECT TITLE: South-Central MN Groundwater Monitoring and County Geologic Atlases
PROJECT MANAGER: Dale Setterholm
AFFILIATION: Regents of the University of Minnesota; Dept: Minnesota Geological Survey
MAILING ADDRESS: Regents: 450 McNamara Center 200 Oak Street SE Minneapolis MN 55455; Geological Survey: 2642 University Ave. W. St. Paul MN 55114
CITY/STATE/ZIP:
PHONE: 612-627-4780
E-MAIL: sette001@umn.edu
WEBSITE: http://www.geo.umn.edu/mgs/
FUNDING SOURCE: Environment and Natural Resources Trust Fund

LEGAL CITATION: ML 2008, Chap.367, Sec.2, Subd.4(h).

Appropriation Language: \$1,600,000 is from the trust fund for collection and interpretation of subsurface geological information and acceleration of the county geologic atlas program. \$706,000 of this appropriation is to the Board of Regents of the University of Minnesota for the Geological Survey to begin county geologic atlases in three counties. \$894,000 of this appropriation is to the commissioner of natural resources to investigate the physical and recharge characteristics of the Mt. Simon aquifer. This appropriation represents a continuing effort to complete the county geologic atlases throughout the state. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

#### **APPROPRIATION AMOUNT: \$706,000**

#### **Overall Project Outcome and Results**

County geologic atlases are created to support water and mineral resource management. An atlas provides maps and associated databases at scales appropriate for land use planning and water management decisions. An atlas greatly improves our ability to monitor the resource, to predict the effects of pumping, and to respond effectively to contamination. This project created atlases for Blue Earth, Nicollet, and Sibley counties in paper, digital, and web-accessible formats. They will be published as MGS C-24, C-25, and C-26, and workshops will be held to train users.

Geologic maps describe the distribution of earth materials. The materials determine where water can enter the ground (become ground water), where it can be taken from the ground (aquifers), and how aquifers connect to rivers, lakes, and wetlands. Each geologic atlas contains the below parts.

Database map: shows the location of all well records, borings, scientific drilling, natural exposures, and geophysical measurements used to support all the maps in the atlas. The data itself is also provided.

Surficial Geology map: this map shows the earth materials immediately beneath the soil zone, and describes their composition and ability to convey water. The surface described by this map is the interface between human activities and ground water. Its character determines to a great degree the sensitivity of ground water to contamination.

Glacial Stratigraphy and Sand Distribution Model: A series of maps show the location, depth, and thickness of sand or gravel bodies (aquifers) in glacial materials. This map is useful in finding a water source, determining pumping effects, and in understanding the results of water monitoring.

Bedrock Geology map, bedrock topography map: These maps describe the location and type of bedrock present, and its ability to host and transmit groundwater. Where a sequence of sedimentary rocks are present the contacts between layers are mapped as digital surfaces and this enables numerical simulations of the ground water system that can predict the effects of pumping before wells are drilled.

Through this project, MGS also provided support to the DNR Mt. Simon monitoring well project by examining and describing samples, conducting downhole geophysical surveys, and providing interpretations of the geologic units penetrated by these wells.

#### **Project Results Use and Dissemination**

Geologic atlases are created to support informed decision-making. They are applied to wellhead protection, water appropriation decisions, well field design, onsite water treatment designs, facility siting, monitoring, and remediation of contamination. The atlases are printed for those who don't use computers and for use in the field. They are also provided in several digital formats for electronic use including geographic information systems. When the atlases are complete we hold workshops in the county to explain the products and their uses.

# Environment and Natural Resources Trust Fund 2008 Work Program Final Report, and Trust Fund 2009 Work Program

**Date of Report:** 7/19/11 Work Program Date of Next Status Report: 6/30/11 M.L. 2008 M.L. 2009 Date of Work program Approval: June 10, 2008 June 16, 2009 **Project Completion Date:** June, 30 2011 June 30, 2012 I. PROJECT TITLE: South-Central MN Groundwater Monitoring and County Geologic Atlases; and County Geologic Atlas Acceleration **Project Manager**: Dale Setterholm Affiliation: Regents of the University of Minnesota; Dept: Minnesota Geological Survey Mailing Address: Regents: 450 McNamara Center 200 Oak Street SE City / State / Zip : Minneapolis MN 55455 Geological Survey: 2642 University Ave. W. City / State / Zip : St. Paul MN 55114

Telephone Number: 612-627-4780 E-mail Address: sette001@umn.edu FAX Number: 612-627-4778 Web Page address: http://www.geo.umn.edu/mgs/

Location: Nicollet, Blue Earth, Sibley Counties; Anoka and Wright Counties

	M.L. 2008	M.L. 2009	Total
Total Trust Fund Project Budget:	\$1,600,000	\$2,695,000	\$4,295,000
DNR Total	\$894,000	\$1,875,000	\$2,769,000
MGS Total	\$706,000	\$820,000	\$1,526,000
MGS Trust Fund Appropriation	\$706,000	\$820,000	\$1,526,000
Minus Amount Spent:	\$706,000	\$653,995	\$1,359,995
MGS Equal Balance:	\$0	\$166,005	\$166,005

# Legal Citation:

ML 2008, Chap.367, Sec.2, Subd.4(h).

**Appropriation Language:** \$1,600,000 is from the trust fund for collection and interpretation of subsurface geological information and acceleration of the county geologic atlas program. \$706,000 of this appropriation is to the Board of Regents of the University of Minnesota for the Geological Survey to begin county geologic atlases in three counties. \$894,000 of this appropriation is to the commissioner of natural resources to investigate the physical and recharge characteristics of the Mt. Simon aquifer. This appropriation represents a continuing effort to complete the county geologic atlases throughout the state. This appropriation is available until June 30, 2011, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

# Legal Citation: ML 2009, Chap.143, Sec.2, Subd.3(b)

**Appropriation Language:** \$2,695,000 is from the trust fund for collection and interpretation of subsurface geological information and acceleration of the county geologic atlas program. \$820,000 of this appropriation is to the Board of Regents of the University of Minnesota for the geological survey to continue and to initiate the production of county geologic atlases. \$1,875,000 of this appropriation is to the commissioner of natural resources to investigate the physical and recharge characteristics of the Mt. Simon aquifer. This appropriation represents a continuing effort to complete the county geologic atlases throughout the state. This appropriation is available until June 30, 2012, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

# II. FINAL PROJECT SUMMARY FOR 2008 PROJECT, AND PROJECT SUMMARY AND RESULTS FOR 2009 PROJECT:

#### <u>M.L. 2008</u>

### **Overall Project Outcome and Results**

County geologic atlases are created to support water and mineral resource management. An atlas provides maps and associated databases at scales appropriate for land use planning and water management decisions. An atlas greatly improves our ability to monitor the resource, to predict the effects of pumping, and to respond effectively to contamination. This project created atlases for Blue Earth, Nicollet, and Sibley counties in paper, digital, and web-accessible formats. They will be published as MGS C-24, C-25, and C-26, and workshops will be held to train users.

Geologic maps describe the distribution of earth materials. The materials determine where water can enter the ground (become ground water), where it can be taken from the ground (aquifers), and how aquifers connect to rivers, lakes, and wetlands. Each geologic atlas contains the below parts.

Database map: shows the location of all well records, borings, scientific drilling, natural exposures, and geophysical measurements used to support all the maps in the atlas. The data itself is also provided.

Surficial Geology map: this map shows the earth materials immediately beneath the soil zone, and describes their composition and ability to convey water. The surface described by this map is the interface between human activities and ground water. Its character determines to a great degree the sensitivity of ground water to contamination.

Glacial Stratigraphy and Sand Distribution Model: A series of maps show the location, depth, and thickness of sand or gravel bodies (aquifers) in glacial materials. This map is useful in finding a water source, determining pumping effects, and in understanding the results of water monitoring.

Bedrock Geology map, bedrock topography map: These maps describe the location and type of bedrock present, and its ability to host and transmit groundwater. Where a sequence of sedimentary rocks are present the contacts between layers are mapped as digital surfaces and this enables numerical simulations of the ground water system that can predict the effects of pumping before wells are drilled.

Through this project, MGS also provided support to the DNR Mt. Simon monitoring well project by examining and describing samples, conducting downhole geophysical surveys, and providing interpretations of the geologic units penetrated by these wells.

# **Project Results Use and Dissemination**

Geologic atlases are created to support informed decision-making. They are applied to wellhead protection, water appropriation decisions, well field design, onsite water treatment designs, facility siting, monitoring, and remediation of contamination. The atlases are printed for those who don't use computers and for use in the field. They are also provided in several digital formats for electronic use including geographic information systems. When the atlases are complete we hold workshops in the county to explain the products and their uses.

#### M.L. 2009

The 2009 project will initiate Part A County Geologic Atlases by the Minnesota Geological Survey for Anoka County and Wright County.

These projects will create both short and long-term benefits for the people and natural resources of the region. The information generated by these projects will be immediately useful to water management scientists, planners, drillers, consultants, industrial users, and municipal officials for understanding and assessing local ground water conditions for protection and wise use.

# III. A. PROGRESS SUMMARY AS OF 12/01/09:

#### <u>M.L. 2009</u>

MGS staff have supplied the staff of Anoka and Wright counties with maps and copies of all well construction records that need accurate locations. Those staff were trained and MGS has monitored their progress for quality control. Both counties report 90% completion on the nearly 10,000 wells for each county, and both expect to complete their work by the end of 2009. Anoka County will submit paper maps with well locations to be digitized at MGS. Wright County will submit a GIS file of digital locations. This project is also supporting the final production and printing of the Benton and Chisago geologic atlases. Many of the map products have been through review and are in editing. The subsurface products are last in line and have been interrupted by the drilling program for the ML 2008 project. All products are expected to go to printing in January, 2010.

# III. B. PROGRESS SUMMARY AS OF 6/30/10:

### M.L. 2009

The staff at Wright and Anoka counties have established accurate locations for nearly all of the 9,500 previously unlocated well records. Anoka County is working to resolve conflicting location data for a small number of wells, and when added to the wells previously located by MGS, the database will contain nearly 26,000 wells. Interpretation of the well records will continue as mapping progresses. Wright County has completed their locating effort, and MGS is troubleshooting any location conflicts. Bedrock interpretations have been done, but changes will be made as the mapping progresses. Interpretation of Quaternary materials is about half done.

This project also supported the final production and printing of the Benton and Chisago geologic atlases. The atlases have been printed and a DVD of digital versions completed for each county. These have been delivered to the counties and to LCCMR. A workshop will be held in each county in the fall or early winter to familiarize users with the products.

#### Amendment Request (8/10/10)

The wages and benefits, and cost of printing these publications exceeded the result budget by \$32,944. This is caused by the long time gap between budgeting of this work and when it actually took place. The cost of printing is determined by a bidding process and cannot be estimated more accurately ahead of time. The result is two modern geologic atlases at a cost to LCCMR of \$491,944, or \$245,972 each. Over the last 20 years atlas costs have averaged \$314,180 per county, so we are pleased with this result. To balance the budget we have reduced wages and benefits for Result 3B by \$32,994 which covers the overage in Result 5 and an overage of \$50 to repair the flowmeter in Result 3B. This is a relatively small change to the funds available for Result 3B and we do not anticipate it will have a significant impact on our progress.

Amendment Approved (8/10/10)

# III. C. PROGRESS SUMMARY AS OF 12/31/10:

#### <u>M.L. 2009</u>

The Anoka County Geologic Atlas is about 50% complete, congruent with the halfway point of the grant period. The CWI database for the county now contains more than 24,000 wells including nearly 10,000 wells for which the county established locations. Geologic interpretations of these well records are also complete. Both the surficial geologic map and the bedrock geologic map were accepted as STATEMAP projects which brought in \$68,525 in additional funds. The surficial geologic map is about 60% complete and the bedrock map slightly closer to completion. Both will be ready for submission to the USGS by July 1. Progress on the subsurface Quaternary mapping includes the completion of 4 rotary sonic core

holes, and 15 Giddings probe holes. Examination and analysis of the samples is underway.

The Wright County Geologic Atlas is also about 50% complete, as expected. The CWI database now has more than 10,000 well records with digital locations. There was a problem with the county locations on some wells and MGS is re-locating about 500 wells to remedy this problem. The surficial geologic map has contacts drawn, soils classified, and a peat layer is under construction. The Quaternary subsurface effort includes 6 rotary sonic core holes just completed and description and analysis of the core is underway. We have also developed a new GIS routine that uses the CWI data to quickly predict the distribution of aquifer materials and create a model to guide the geologists as they map. Preliminary versions of the bedrock geology and topography are complete and and structure contours are done for the major unconformities. These will be revised as necessary when the final locations of the 500 wells are established.

## Amendment Request (1/19/11)

The current budget for the 2008 grant has just over \$29,000 remaining for result 3, and over \$58,000 remaining for result 4. Our costs on result 4 have been lower than expected due to changes in the number of holes DNR drilled, and changes in the construction of those wells that precluded some of the downhole logging we planned. We still have some work to do on that activity, but it won't spend down the remaining \$58,000 completely. On the other hand, the remaining funds in result 3 are insufficient to complete the mapping we intend to do. This is not unexpected, as the budget was \$630,200 and we took on 3 CGAs (typically costing more than \$300,000 each). We have garnered additional support from the USGS STATEMAP program and this, along with some efficiency and technology, has allowed us to nearly complete these atlases. If we could apply any funds not needed for result 4 to completing the tasks in result 3 I expect we can get very close to completing those atlases with the exception of printing costs. I would likely utilize funds from the 2010 grant to pay for printing. Each of my grants recognizes the uncertainties at the time of application (which counties, how many wells, drilling costs, etc.) and promises progress, not completion. Each grant also allows for application of funds to unfinished work from previous grants. I am requesting permission to utilize funds from the result 4 budget toward result 3 activities as needed. I also request permission to transfer funds among categories (ex: wages and benefits, travel, supplies) as necessary to best utilize the remaining funds to fulfill the project goals. It is not possible to predict these transfers accurately, but they will likely mostly move funds from excess travel or supply funds to other categories, and mostly from result 4 to result 3.

Amendment Approved (1/20/11)

# III. D. PROGRESS SUMMARY AS OF 7/19/11:

Final Progress Summary M.L. 2008

The databases (well construction records, borings, outcrop descriptions) and corresponding maps are complete. The maps of the bedrock geology, bedrock topography, depth-to-bedrock, and bedrock structure are also complete. The maps of the surficial geology are in completed form, but may be revised to match the subsurface glacial geology products. All of these maps have been editing and are ready for printing. The products that describe the subsurface glacial geology of Blue Earth and Nicollet counties are the only products not completed. The closelyspaced cross-sections are complete, and the GIS staff will use these to create the digital surfaces that define the sand bodies (aquifers). We expect this work to be complete in this guarter. Then printing of all the maps and creation of a DVD with all the products and data will take place and be followed by workshops to introduce the products and train users. These activities will be financed with funds from the M.L. 2010 grant. The \$630,200 available for this activity is significantly less than the \$1,050,000 we would expect three atlases to require (estimated at \$350,000 each). However, we expect to complete these atlases at significantly less than that amount. We have been aided by USGS STATEMAP cost-sharing of some project elements in the amount of \$88.356.

#### <u>M.L. 2009</u>

The Anoka County Geologic Atlas has progressed as scheduled. Both the bedrock geologic map and the surficial geologic map were cost-shared by the USGS STATEMAP program (\$68,525) and this allowed them to be completed recently. Work is now focused on the subsurface glacial geology products that explain the glacial history of the area and map potential aquifers. That mapping has been accepted for cost-sharing by the Great Lakes Geologic Mapping Coalition, and it will be completed by the end of June 2012.

The County Well Index database for the Wright County Geologic Atlas has needed some extra attention due to some location errors introduced by county staff. MGS staff have corrected these errors and we are adding new instructions to the manual we use to train county staff for this work. The surficial geologic map is in draft stage as is the bedrock geologic map. The latter will be completed now that the database has been finalized. Work has been initiated on the subsurface Quaternary products. We still expect this project to finish in about 12 months.

## IV. OUTLINE OF PROJECT RESULTS:

**Result 1:** Groundwater level monitoring guidance document (to be completed by DNR, separate work program)

**Result 2:** Test drilling, monitoring well installation, sampling, laboratory analysis, water level measurement (to be completed by DNR, separate work program)

#### Result 3: Initiate County Geologic Atlases

#### <u>M.L. 2008</u>

Initiate Part A County Geologic Atlases for Blue Earth, Nicollet, and Sibley Counties. Note: all components listed below may not be completed within the time frame and budget of this project, but substantial progress in all three counties is anticipated.

## <u>M.L. 2009</u>

Initiate Part A County Geologic Atlases for Anoka County and Wright County. Note: all components listed below may not be completed within the time frame and budget of this project, but substantial progress in both counties is anticipated.

#### Description:

- create geologic maps, illustrations, and databases in print and GIS formats.
- location, boundaries, size, and hydrologic characteristics of aquifers and the materials that confine them in these counties.
- these maps are essential information in efforts to protect and wisely allocate ground water and they support these related activities and programs:
  - ground water monitoring, wellhead protection, ground water allocation, well construction, wellfield design, facility siting, permitting, application of agricultural best management practices, remediation, and management of ground water dependent surface water features (springs, fens, lakes, rivers).
- products:
  - maps of bedrock geology, surficial geology, subsurface Quaternary geology, bedrock topography, and thickness of glacial deposits
  - database of well construction records to support the mapping, describe water use, and to help resolve well problems; scientific test drilling as necessary

# Summary Budget Information for Result 3:

-	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	\$630,200	\$728,056	\$1,358,256
Amount Spent:	\$657,088	\$562,051	\$1,219,139
Balance:	\$-26,888	\$166,005	\$139,117

Deliverable	<b>Completion Date</b>	Budget	Status
1. M.L. 2008: CWI databases for 3	6/30/09	\$19,040	complete
counties			
2. M.L. 2008: geologic maps	6/30/11	\$610,600	underway
3. M.L. 2009: CWI databases for 2	6/30/10	\$ 18,000	complete
counties			
4. M.L. 2009: geologic maps	6/30/12	\$728,056	underway

Completion Date: M.L. 2008: 6/30/11; M.L. 2009: 6/30/12

**M. L. 2008 Result 3 Status as of 12/1/08:** Efforts are focused on collection and compilation of new and existing data, especially establishing accurate, digital locations for water wells so that the information they contain can be used to support geologic maps. We are also examining, describing, and interpreting drill cuttings and other existing samples.

**M. L. 2008 Result 3 Status as of 6/30/09:** CWI databases are complete and field and laboratory studies to collect, generate, and compile geologic data are underway. Mapping based on landform analysis and CWI data are also well underway. Progress is on schedule.

**M. L. 2008 Result 3 Status as of 12/01/09:** CWI databases are up to date, field studies are nearly complete, and laboratory analyses are about half done. This winter the surficial and bedrock maps will be drafted, a drilling program completed, and the subsurface analysis will be initiated.

**M. L. 2009 Result 3 Status as of 12/1/09:** Both Wright and Anoka county staff have established locations for about 90% of the wells that need accurate locations. MGS provided training, materials, and quality control monitoring. The flowmeter repair was accomplished at expected cost, and the acquisition of the truck and Giddings soil probe is underway. The truck has been purchased (not yet billed) and the soil probe will be mounted in the next two weeks (billed and paid).

**M.L. 2008 Result 3 Status as of 6/30/10:** \_CWI databases are effectively complete. The bedrock geologic maps are complete (Sibley and Nicollet) or in review (Blue Earth). The surficial geologic map is complete for Sibley County, and final field work underway in Blue Earth county. Compilation of the Nicollet and Blue Earth surficial maps should be complete mid-winter. Mapping of the subsurface geology of the Quaternary units is underway. It may be complete by the end of this grant. Editing and printing are likely to take place after this grant has expired.

**M.L. 2009 Result 3 Status as of 6/30/10:** With databases nearly complete, field work, laboratory work, and mapping are underway. Shallow drilling to support the surficial mapping has begun and will continue this field season. The bedrock mapper has examined existing drill cuttings and geophysical boring logs and is currently interpreting the drillers logs in CWI. Map compilation will follow. The new Giddings drilling machine and truck were purchased and are operable. The borehole camera purchase will take place in the next 2 to 4 weeks.

**M.L. 2008 Result 3 Status as of 12/31/10:** The database, surficial geology, and bedrock geology products have passed review and are in editing and pre-print stages. The mapping of subsurface Quaternary aquifers is underway and on schedule for completion by the end of the grant period.

**M.L. 2009 Result 3 Status as of 12/31/10:** The Anoka and Wright CGAs are about 50% complete. The CWI databases including geologic interpretations are complete except for relocation of about 500 wells. The Anoka surficial and bedrock maps were accepted as STATEMAP projects which brought in \$68,525 in additional funds. The surficial and bedrock geologic map are about 60% complete in both counties. Progress on the subsurface Quaternary mapping includes the completion of rotary sonic core holes, and Giddings probe holes. Examination and analysis of the samples is underway. The borehole camera has been purchased and deployed.

**M.L. 2008 Final Report Summary:** The database products are complete. The surficial geology maps are complete, but may be revised to be fully compatible with the subsurface products. The bedrock products (geologic map, topographic map, structure contours, digital surfaces) are complete. The subsurface Quaternary products are complete for Sibley and Nicollet counties, and nearly complete in Blue Earth County. In that county the closely-spaced cross-sections are just being finalized and digital surfaces and maps will be derived from them. Finally, the map package will be printed, a DVD of all files prepared, both delivered to the counties, and then a workshop held to introduce the products and train users. These last activities will be financed by the M.L. 2010 grant to MGS as stated in its work program.

**M.L. 2009 Result 3 Status as of 6/30/11:** For Anoka County: The database is complete. The surficial and bedrock maps are complete. The subsurface Quaternary products (sand body aquifer models, stratigraphic column, cross-sections) are underway and will be cost-shared by the Great Lakes Geologic Mapping Coalition (\$36,736). For Wright County: The database is complete. Draft versions of the surficial and bedrock geologic maps are complete, and may be revised as additional data and products are obtained. The subsurface Quaternary products (sand body aquifer models, stratigraphic column, cross-sections) are underway.

## Result Status as of 12/1/11:

#### Result Status as of 6/30/12:

#### M.L. 2009 Final Report Summary:

#### **Result 4:** MGS support for DNR Drilling Program

**Description:** MGS will process, examine, interpret, and archive samples from the DNR test drilling. MGS will also conduct downhole geophysical logging of selected test holes to observe aquifer properties.

#### Summary Budget Information for Result 4:

,	5	M.L. 2008	M.L. 2009	Total
	Trust Fund Budget:	\$75,800	\$0	\$75,800
	Amount Spent:	\$48,912	\$0	\$48,912
	Balance:	\$26,888	\$0	\$26,888

Deliverable	Completion Date	Budget	<u>Status</u>
1. report to DNR	6/30/11	\$75,800	complete

Completion Date: M.L. 2008: 6/30/10

**Result 4 Status as of 12/1/08:** MGS provided DNR with geophysical logs in the vicinity of their new drilling to facilitate siting the holes, and interpreting the samples

and new geophysical surveys. We also provided downhole logging of 2 of the 3 holes drilled so far. MGS has processed and archived the samples delivered by DNR and also conducted textural analysis of one of the two sample sets delivered. We have conducted downhole logging of 8 "holes of opportunity" in the project area to support mapping. We failed to differentiate the cost of these activities from the cost of activities under result 3 so far, however the activity in this area has been minimal. We will recover this data and include it in our next report.

**Result 4 Status as of 6/30/09:** The MGS sediment lab has received 12 sets of drill cuttings from DNR which have been processed, described, and archived. Textural analyses have been performed on some of these holes. MGS has conducted downhole geophysical surveys at 14 DNR drill sites, traveling 2,635 miles. A natural gamma survey is conducted at every site, and depending on the drill hole condition other surveys such as SP, resistivity, multitool, and caliper have been conducted. Some holes are logged with the drill rods in place to establish how to construct the well to observe the Mt. Simon aquifer, and then logged again after the well is constructed to get improved data without interference from the drilling tools.

**Result 4 Status as of 12/1/09:** MGS staff traveled to 4 more DNR drill sites and conducted downhole geophysical surveys. Drill cuttings were collected and returned to the MGS lab for description and storage. Interim reported to DNR has provided them with the information necessary to construct observation wells. Some holes were logged through the drill rods and will be relogged in the well casing at some time.

**Result 4 Status as of 6/30/10:** MGS examined the drill cuttings and geophysical logs from 15 DNR drill holes to interpret the stratigraphic intervals intersected by these holes. The cost estimate for this work was based on an expectation that 9 rotasonic holes and 25 reverse-circulation holes would need support. The construction of the 15 holes drilled also greatly reduced the opportunity for flow-logging. These changes in scope have reduced the associated effort and costs considerably. We still anticipate conducting some flow-logging later this season, but not of a scope that would utilize all the remaining funds. These funds could be utilized to support the work of Result 3 and bring us closer to finishing the atlases, or could be applied to support of more drilling by DNR this year.

#### Amendment Request (8/10/10)

In this amendment we have decreased the budget for supplies because DNR did not do any rotasonic coring and no core boxes were necessary. We increased the travel budget as some of the holes required more than one trip, and DNR relied on MGS for more logging than anticipated. The net effect on the budget for this result is zero.

Amendment Approved (8/10/10)

**Result 4 Status as of 12/31/10:** MGS received 11 new cutting sets from the DNR observation well drilling program (phase 2, drilled in the north and west suburbs) since July 1, 2010. Student workers have processed 10 of these sets and the most

recent set is on the shelf drying. It will be processed in the next few weeks. We also performed downhole logging on most of these holes. Five of the Phase 1 holes, in Watonwan and Martin counties were flow-logged in November, 2010. A report of the results of the flow-logging is currently in preparation, and is expected to be completed by March, 2011.

**Final Report Summary:** MGS received 12 new cuttings sets from the second phase of DNR drilling. These have been processed and some have been described and interpreted. MGS delivered a report of descriptions and interpretations to DNR on 9/10/10. This report, Cuttings Summary for the Minnesota Department of Natural Resources South-Central Drilling Program by Alan R. Knaeble, Gary N. Meyer, and John H. Mossler, is MGS Open-file Report 10-06 and can be accessed at <a href="http://mgssun6.mngs.umn.edu/pub4/ofr10\_06/Scentral%20drilling%20rpt10\_06.pdf">http://mgssun6.mngs.umn.edu/pub4/ofr10\_06/Scentral%20drilling%20rpt10\_06.pdf</a> . The report on flow-logging is in draft form and will be delivered to DNR in the next month or two. This report will have findings worthy of publication, and MGS may publish this report, or incorporate these results into a more comprehensive report later.

**Result 5:** Production and Printing of the Benton and Chisago County Geologic Atlases

# **Description:**

- Take the geologic maps and databases from 2007 work program through the technical review, editing, production, and printing phases
- products:
  - printed maps of bedrock geology, surficial geology, subsurface Quaternary geology, bedrock topography, and thickness of glacial deposits
  - A CD or DVD package of digital versions of the products in several formats appropriate for the varying technology levels of users

#### Summary Budget Information for Result 5:

_	M.L. 2008	M.L. 2009	Total
Trust Fund Budget:	\$0	\$91,944	\$91,944
Amount Spent:	\$0	\$91,944	\$91,944
Balance:	\$0	\$0	\$0

Deliverable	<b>Completion Date</b>	Budget	Status
1. printed maps and DVD	6/30/10	\$91,944	complete

Completion Date: M.L. 2009: 6/30/10

**Result 5 Status as of 12/1/09:** Most of the map products have been reviewed and are in the editing and production stage. The subsurface products are not yet

complete and will be delayed slightly by the drilling program for M.L. 2009. All products are expected to go to the printer by the end of January.

**Result 5 Status as of 6/30/10:** The Benton and Chisago County Geologic Atlases have been completed and delivered to the counties and to the LCCMR. The counties each received 1,000 copies of the printed atlases, and a DVD containing all the digital files and associated databases.

**Final Report Summary:** The Benton and Chisago County Geologic Atlases have been completed and delivered to the counties and to the LCCMR. The counties each received 1,000 copies of the printed atlases, and a DVD containing all the digital files and associated databases.

# V. TOTAL TRUST FUND PROJECT BUDGET:

<u>M.L. 2008</u>	
<b>Personnel:</b> approx. 6 fte from approx. 15 staff	\$510,412
<b>Contracts:</b> rotasonic test drilling; approx. 10 holes, 3-4 per county	\$125,000
Equipment/Tools/Supplies	\$ 18,060
(core boxes \$5100, lab/field supplies \$9500 (sample bags/envelopes, bea chemicals, repairs), drill parts \$1100, photocopy/scan/plotter \$500, field m lab analyses \$1500)	kers, aps \$350,
Acquisition, including Easements:	\$ 0
Travel:	\$52,528
Other:	\$ 0
2008 TRUST FUND PROJECT BUDGET:	\$706,000
Explanation of Capital Expenditures Greater Than \$3,500:	none
<u>M.L. 2009</u>	
<b>Personnel:</b> approx. 6 fte from approx. 15 staff	\$570,216
Contracts: drilling (approx. 6 or 7 holes \$75,000) printing \$22,000	\$ 97,101
Equipment/Tools/Supplies	\$ 98,883
(\$86,000 capital equip below; \$3500 core box, lab/field supplies \$7000, copy/scan/plot \$400, field maps \$300, lab analyses \$1600)	
Travel:	\$ 54,000
Other:	\$ 0
2009 TRUST FUND PROJECT BUDGET:	\$820,200

# Explanation of Capital Expenditures Greater Than \$3,500:

Soil Probe and carrier truck:

\$62,000

The Minnesota Geological Survey relies primarily on water well records for subsurface geologic data. This is augmented by 1 to 3 rotasonic test borings approximately 250 feet deep, and 100 to 200 shallow borings less than 25 feet deep. The shallow borings are drilled with a truck mounted auger owned by MGS. This

project will purchase a new auger and truck to augment our current equipment. The acceleration of the program requires a second set of equipment.

Repair of a downhole flow meter tool:

\$9,000

\$15,000

MGS lowers several types of measuring probes into water wells or test borings to record physical properties of the surrounding earth materials, or the water in the borehole and adjacent aquifers. Our flowmeter probe was damaged during previous use and these funds will repair it for use on this project and future atlases.

Downhole Video Camera and Recorder

A downhole video camera provides us with the ability to see geologic strata in uncased intervals of wells or test borings. This is useful in interpreting the geology, and also in assessing the suitability of the hole for deploying the downhole flow meter or other tools. Seeing the conditions in advance will help us avoid tool loss or damage in holes with obstructions or problematic construction.

#### VI. **OTHER FUNDS & PARTNERS:**

#### Α. **Project Partners:**

M.L. 2008

Minnesota Geolgical Survey, total from 2008 appropriation Nicollet County (well location verification) Blue Earth County (well location verification) Sibley County (well location verification)

\$706,000 in-kind contribution in-kind contribution in-kind contribution

# M.L. 2009

Minnesota Geolgical Survey, total from 2009 appropriation	\$820,200
Anoka County (well location verification)	in-kind contribution
Wright County (well location verification)	in-kind contribution

#### Β. Project Impact and Long-Term Strategy:

County Geologic Atlases provide information essential to sustainable management of water resources. Atlases are completed or underway for 25 of Minnesota's 87 counties. The products also support and enhance the activities of other agencies such as ground water monitoring, wellhead protection, ground water allocation, well construction, wellfield design, facility siting, permitting, application of agricultural best management practices, remediation, and management of ground water dependent surface water features (springs, fens, lakes, rivers).

#### С. Other Funds Proposed to be Spent during the Project Period:

M.L. 2008

The USGS STATEMAP Program has granted MGS \$88,356 toward completion of the surficial geologic map of Sibley County and the bedrock geologic maps of Nicollet and Sibley counties. These grants were leveraged by using the LCCMR grant as a match.

# <u>M.L. 2009</u>

Proposals will be made for similar matches to selected products of the 2009 appropriation. Update: The USGS Statemap Program accepted the Anoka surficial and bedrock maps as projects and will contribute \$68,525 in additional funds.

**D. Spending History:** LCMR provided funds for the Mankato State University, Water Resource Center to create and publish geologic atlases in the project area covered by the 2008 work plan.

# VII. DISSEMINATION:

Geologic maps and databases prepared by the Minnesota Geological Survey will be available in GIS and other electronic formats on the MGS website, and in print.

# VIII. REPORTING REQUIREMENTS:

Periodic work program progress reports will be submitted not later than 12/1/08, 7/1/09, 12/1/09, 7/1/10, 12/1/10, 6/30/11, 12/1/11, 6/30/12 A final work program report and associated products will be submitted between June 30 and August 1, 2009 and again between June 30 and August 1,2010 as requested by the LCCMR

# IX. RESEARCH PROJECTS:

Attachment A: Budget Detail for 2008 Projects	-									
Project Title: South-Central Minnesota County Ge	eological Atlases									
Project Manager Name: Dale Setterholm, MGS										
Trust Fund Appropriation: \$ 706,000										
	Result 3 (MGS)	Revised Result 3	Amount Spent	Balance	Result 4 (MGS)	Revised Result 4	Amount Spent	Balance	TOTAL	TOTAL
2008 Trust Fund Budget	Budget:	Budget 8/9/10	(6/30/2011)	(6/30/2011)	Budget:	Budget 8/9/10	(6/30/2011)	(6/30/2011)	BUDGET	BALANCE
	Port A County				MGS support for					
	Coologic Atlasos:				NIGS Support for					
	Blue Forth Nicellet				DINK DIIIIIII					
	Dive Lartin, Nicoliet,									
	Counties									
BUDGET ITEM	Counties			0				0		
				Ŭ				0		
PERSONNEL: wages and benefits	<del>\$440,450</del>	\$449,336	\$498,264	-\$48,928	<del>\$69,962</del>	\$69,962	\$44,977	\$24,985	\$519,298	-\$23,943
Contracts									\$0	\$C
Other contracts rotosonic drilling (Result 3)	\$125,000	\$116,114	\$116,114	\$0	<del>\$0</del>	\$0		\$0	\$116,114	\$C
Printing	<del>\$0</del>	\$0	\$0	\$0	<del>\$0</del>	\$0		\$0	\$0	\$0
Supplies (xeroxing, maps and publications, kraft	<del>\$12,750</del>	\$22,750	\$16,751	\$5,999	<del>\$5,310</del>	\$1,500	\$191	\$1,309	\$24,250	\$7,307
envelopes, sample bags, sieves, banding for core										
samples)										
Travel expenses in Minnesota	<del>\$52,000</del>	\$42,000	\$25,959	\$16,041	<del>\$528</del>	\$4,338	\$3,743	\$595	\$46,338	\$16,636
COLUMN TOTAL	\$630,200	\$630,200	\$657,088	-\$26,888	\$75,800	\$75,800	\$48,912	\$26,888	\$706,000	\$0

# Status of County Geologic Atlases

