

## **2019 Project Abstract**

For the Period Ending June 30, 2022

**PROJECT TITLE:** County Geologic Atlases - Part B (Groundwater Atlas)

**PROJECT MANAGER:** Paul Putzier

**AFFILIATION:** Minnesota Department of Natural Resources

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**FUNDING SOURCE:** Environment and Natural Resources Trust Fund

**LEGAL CITATION:** M.L. 2019, First Special Session, Chapter 4, Article 2, Subd. 03o

**APPROPRIATION AMOUNT:** \$2,400,000

**AMOUNT SPENT:** \$2,400,000

**AMOUNT REMAINING:** \$0.00

### **Sound bite of Project Outcomes and Results**

The Groundwater Atlas provides foundational, science-based, information for use and management of Minnesota groundwaters. The atlas is valuable to government, industry, and for research. The grant supported work on nineteen atlases and publication of county groundwater atlases (County Atlas Part B) for Brown, Hennepin, Kanabec, Meeker, Morrison, Redwood, and Winona counties.

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

The Groundwater Atlas provides foundational, science-based, information for use and management of Minnesota groundwaters. The atlas is valuable to government, industry, and research. During the period of the grant, county groundwater atlases (County Atlas Part B) were published for Brown, Hennepin, Kanabec, Meeker, Morrison, Redwood, and Winona counties. Mapping activities also continued through the end of the grant in Aitkin, Becker, Cass, Dodge, Houston, Hubbard, Isanti, Kandiyohi, Nobles, Olmsted, Rock, and Wadena, with publication of completed groundwater atlases for Becker, Cass, Dodge, Houston, Hubbard, Isanti, and Wadena expected in 2023.

The following related reports were also published:

- The Karst Landscape Unit Map for Winona and Houston counties.
- Minnesota Groundwater Provinces 2021. This document is one of the most widely used reference documents from the Atlas Program.
- Groundwater Atlas Users Guide.

Groundwater sampling is a key element in the completion of an atlas. Sampling efforts necessarily slowed during the pandemic. However, groundwater sampling was completed in Dodge, Kandiyohi, Nobles, Olmstead, Rock, and Steele counties. Letter reports with all sampling results were provided to well owners for all wells sampled as part of this grant.

DNR Groundwater Atlas staff completed field work for the geophysical investigation of Pennington County as part of the atlas process. DNR Groundwater Atlas staff also completed planning for the geophysical investigations in fall 2022 of Douglas, Grant, Polk, and Red Lake counties.

As part of the atlas development process, DNR staff conduct reviews of draft County Geologic Atlases (Part A) prepared by the MGS. During the grant this included DNR reviews for Aitkin, Becker, Cass, Dakota, Lac qui Parle, Lake, Otter Tail, Steele and St. Louis.

Dissemination and outreach activities continued throughout the grant period including presentations, news releases, GovDelivery list serve (6,000 recipients) notifications, and virtual meetings with county staff and county boards, seminars, and presentations.

**Project Results Use and Dissemination**

Dissemination activities focused on notification of sampling activities and publication of atlases through news releases and GovDelivery (6,000 recipient list serve), participation in seminars, presentations, and educational/technical field trips to a diverse set of stakeholders and resources managers including county SWCDs, county boards, the Clean Water Council, BWRS, MPCA, the Legislative Conference of Minnesota Counties, LCCMR events, and others. Dissemination also included workshops with counties, publication of summary articles, updated website and many personal contacts with users of the atlas. Atlas staff also worked closely with university staff to incorporate atlas materials in the classroom and to collaborate on projects.

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# Environment and Natural Resources Trust Fund (ENRTF)

## M.L. 2019 ENRTF Work Plan – FINAL REPORT

### (Main Document)

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**Today's Date:** August 15, 2022

**Final Report**

**Date of Work Plan Approval:** June 21, 2019

**Project Completion Date:** June 30, 2022

**Does this submission include an amendment request?** No

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**PROJECT TITLE:** County Geologic Atlases - Part B (Groundwater Atlas)

**Project Manager:** Paul Putzier

**Organization:** Minnesota Department of Natural Resources

**College/Department/Division:** Ecological and Water Resources Division

**Mailing Address:** Box 25, 500 Lafayette Rd N.

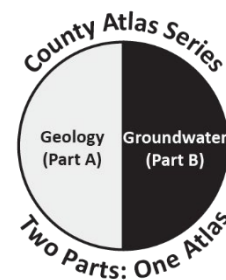
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**Location:** Statewide, with focus on these counties: Becker, Brown, Cass, Dodge, Hubbard, Isanti, Kanabec, Olmsted, Redwood, Wadena, and Washington.

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**Total Project Budget:** \$2,400,000

**Amount Spent:** \$2,400,000.00

**Balance:** \$0.00

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**Legal Citation:** M.L. 2019, First Special Session, Chapter 4, Article 2, Subd. 03o

**Appropriation Language:** \$2,400,000 the first year is from the trust fund to the commissioner of natural resources to continue producing County Geologic Atlases to inform management of surface water and groundwater resources for drinking water and other purposes. This appropriation is for Part B, which uses the geologic formations mapped in Part A of the County Geologic Atlases to characterize the potential water yields of aquifers and the aquifers' sensitivity to contamination.

#### I. PROJECT STATEMENT

The County Geologic Atlas (CGA) Program provides "Information Infrastructure", at the county scale, including a report and series of accompanying maps, figures and tables that describe the location and size of an area's aquifers and groundwater resources and other important information like direction of groundwater flow, sensitivity to pollution, age and chemistry of groundwater and connections to surface water resources. Information provided in an atlas is used in water, zoning and development planning and environmental protection efforts. Each county atlas (or report) is used by a wide variety of local, state and federal government

agencies and by private citizens, companies and organizations. The complete atlas for each county is prepared in two parts:

- Part A – First, the geology of a county is mapped by the Minnesota Geological Survey (MGS).
- Part B – Next, the hydrogeology (groundwater) is mapped by the Department of Natural Resources (DNR).

This project supports continuing development of the groundwater atlases by the DNR for counties across the state. The groundwater atlas defines aquifer boundaries and helps identify the interconnection of aquifers, their sensitivity to pollution, and their connection to the land surface and surface water resources. Delineation and mapping of aquifers, recharge areas, and karst systems (sinkholes, caves) is an essential step to inform management for water supply planning, protecting water supplies, public health, ecological systems and the groundwater resource. Counties with a complete atlas (Part A & Part B) enjoy strong economic benefits especially with respect to water resource use and management. Some of the many typical applications and uses of the atlas are noted by the following selected resource managers:

Jim de Lambert, Senior Hydrogeologist, Carlson McCain, Inc: “As a consulting hydrogeologist ...I can safely say that the State of Minnesota has an excellent hydrogeological data base compared the other states that I am familiar with. For most projects the initial information sources include the County Geologic Atlas. For Minnesota well siting projects, the County Atlas Series will be my first source of information to help define the project area and to give the area broad hydrogeologic context. This assists in identifying potential target aquifer(s). If an agricultural producer is considering irrigation on one or more parcels, the county atlas can be used to quickly identify potential aquifers. If a public water supplier is considering a new source, the atlas may be used to guide the search and develop specific search areas for more detailed exploration activities. If the supplier is a Rural Water System, there is often considerable flexibility with well field location and this type of county and regional information can be invaluable.”

Heather Cunningham, Zoning and Environmental Services Administrator, Carlton County: “I would say that I use the atlas on a monthly basis. In the last 6 months, I have used it for the review of an Environmental Assessment Worksheet (EAW), pollution sensitivity for a proposed mixed use development, groundwater contamination at our closed landfill, and in working with a lake association.”

Kristi Anderson, Hydrogeologist, Northwest AqwaTek Solutions: “The majority of what I do is working with the agricultural community for crop irrigation systems; I typically look to the County Geologic Atlas (CGA)....as the starting point for my work.”

Joe Hudak, Assistant Engineering Geologist, Minnesota Department of Transportation: “We typically use the county atlases for subsurface information prior to conducting any geophysical fieldwork or drill rig borings/CPT soundings. Most of our investigations involve gathering geotechnical information for various transportation related foundations, such as bridges/structures/embankments over poor soils etc. We also use them (CGA) for areas where karst terrain may be present, areas with shallow water tables and for writing EAW reports for upcoming projects.”

Martin Larsen, Olmsted County Feedlot Technician, Landowner & Farmer, Olmsted County: “The County Geologic Atlas is an important tool for the Olmsted Soil and Water Conservation District. It is used for animal feedlot permitting and nutrient management planning to locate sinkholes, depth to bedrock and first encountered bedrock. The springshed maps included in some groundwater atlases are utilized for local education and outreach. The maps of surface and groundwater interaction are shared with landowners and producers to encourage implementation of manure application setbacks and other best management practices for protection of groundwater resources.”

Each Part B county atlas project includes some or all of the following work components: assembly of data layers (from Part A Atlas); development of conceptual hydrogeologic models; development of flow direction maps of the water table and deeper aquifers; groundwater sample collection for analysis and interpretation of water age and chemistry data (including arsenic and chlorides); geophysics field data collection and analysis; construction of hydrogeologic cross sections; construction of maps of pollution sensitivity; preparation and publication of the final atlas report, training of local atlas users, and dissemination of information. Depending on the geologic or hydrologic setting of a specific county, other data or field data may also be assembled or collected. The karst landscape of southeast Minnesota is an example where additional data may be collected to further define the hydrogeologic system and could include defining additional related karst features and karst system analysis (including dye traces and karst system maps).

This project will provide approximately 18 – 24 months of funding to complete, continue, or initiate groundwater atlas projects for the following counties: Becker, Brown, Cass, Dodge, Hubbard, Isanti, Kanabec, Olmsted, Redwood, Wadena, and Washington.

Counties with a complete atlas (Part A & Part B) enjoy strong economic benefits especially with respect to water resource use and management. This project includes the assembly of atlas groundwater maps and data into geospatial (GIS) data layers. These online assembled data layers, maps and electronic tools make the information more accessible for local, county and state decision makers, scientists and citizens.

## **II. OVERALL PROJECT STATUS UPDATES**

**First Update:** March 15, 2020 (July 1, 2019 through January 11, 2020)

This first update is for activities and costs completed from July 1, 2019 through January 10, 2020. County Groundwater Atlases (County Atlas Part B) were published for Meeker, Morrison and Redwood counties. Completed work also included preparing for and completing groundwater sample collection from Dodge and Olmsted counties in the fall of 2019, laboratory analysis of samples collected in the spring of 2019 for Hennepin and Hubbard counties, planning for atlas workshops, outreach/dissemination activities, and continued mapping activities in Becker, Brown, Cass, Dodge, Hennepin, Hubbard, Isanti, Kanabec, Olmsted, and Wadena.

**Second Update:** September 15, 2020 (January 12, 2020 through June 30, 2020)

This second update is for activities and costs completed from January 11, 2020 through June 30, 2020. In mid-March 2020 the Minnesota Stay Safe at Home order was issued, directly impacting the programs plans to collect groundwater samples from two counties in May and June. All fieldwork was delayed until appropriate procedures addressing the pandemic could be addressed and approved. Because of the shortened field season, and limitations adopted for fieldwork to reduce the risk due to coronavirus, plans changed to attempt to complete sampling in three counties (instead of four) in the 2020 season. Those three counties are Kandiyohi, Rock and Nobles. An attempt will be made to complete groundwater sampling in those three counties between August and October 2020.

County Groundwater Atlases (County Atlas Part B) were published for Brown, Kanabec and Washington counties. Planning for atlas workshops, outreach/dissemination activities, and continued mapping activities in Becker, Cass, Dodge, Hennepin, Hubbard, Isanti, Kandiyohi, Nobles, Olmsted, Rock and Wadena.

**Third Update:** March 15, 2021 (July 1, 2020 through January 19, 2021)

This update is for activities and costs completed from July 1, 2020 through January 19, 2021. In mid-March 2020 the Minnesota Stay Safe at Home order was issued, directly impacting the programs plans to collect groundwater samples in the first half of 2020. All fieldwork was delayed until appropriate procedures addressing the pandemic could be approved. Because of the shortened field season, and limitations adopted for fieldwork to reduce the risk due to coronavirus, plans were changed to complete sampling in three counties

(instead of four) in the 2020 season. Those three counties were Kandiyohi, Rock and Nobles. Groundwater samples were collected in those three counties between August and October 2020. Additional sampling is planned to complete work in Rock & Nobles counties in spring of 2021.

No groundwater atlases (County Atlas Part B) were published during the reporting period. Three atlases were published during the prior six month reporting period. During this reporting period, planning continued for atlas workshops, outreach/dissemination activities, and mapping activities continued in Becker, Cass, Dodge, Hennepin, Hubbard, Isanti, Kandiyohi, Nobles, Olmsted, Rock and Wadena.

**Fourth Update:** September 15, 2021 (January 20, 2021 through June 30, 2021)

This update is for activities and costs from approximately January 20, 2021 through June 30, 2021. The Minnesota Stay Safe at Home order was still in place for much of the period, continuing to affect the programs plans to collect groundwater samples in the first half of 2021 and conduct workshops. Fieldwork was delayed until appropriate procedures addressing the pandemic were approved.

Groundwater sampling in Rock and Nobles counties, which started in 2020, was completed during the reporting period. We also sent out a second mailing for Rock and Nobles Counties to find additional well owners willing to participate in the groundwater sampling.

The following reports were published during the period:

- The Winona Groundwater Atlases (County Atlas Part B).
- The Karst Landscape Unit Map for Winona and Houston counties was published. The KLUM is a supplement to the groundwater atlas for some counties in the karst geologic regions of southeast Minnesota.
- Minnesota Groundwater Provinces 2021. This document is derived from County Atlases (Geologic and Groundwater), and is one of the most widely used reference documents from the Atlas Program.
- Groundwater Atlas Users Guide. This document instructs how to use the atlas in simple, understandable language.

As part of the process to produce a groundwater atlas, DNR seeks external reviews of draft atlases. We typically provide the draft atlas to up to eight external reviewers including the MGS, the United States Geological Survey, the Minnesota Department of Health, local SWCDs, and county staff.

When DNR has received and qualified the groundwater chemistry results from private wells collected for the atlas, we send the results to well owners with a letter of explanation. During the reporting period, we sent well owner reports for Kandiyohi, Rock, and Nobles Counties.

As part of the atlas development process, DNR staff conduct reviews of draft Geologic Atlases (Part A) prepared by the MGS. During the review period this included reviews of MGS Part A documents for St. Louis and Lake counties.

During this reporting period, planning continued for atlas workshops, and mapping activities continued in Becker, Cass, Dodge, Hennepin, Hubbard, Isanti, Kandiyohi, Nobles, Olmsted, Rock and Wadena.

Dissemination and outreach activities continued including news releases, GovDelivery list serve notifications, and virtual meetings with county staff and county boards. More details are in the dissemination section below.

**Fifth Update:** March 15, 2022 (July 1, 2021 through February 28, 2022)

This update is for activities and costs from approximately July 1, 2021 through February 28, 2022. Elements of the Minnesota Stay Safe at Home order was still in place for much of the period, continuing to affect the program plans to collect groundwater samples in the second half of 2021 and conduct workshops with county

staff. Planning has started for an in-person workshop for the Hennepin and Cass County Groundwater Atlases in Spring 2022.

Comprehensive groundwater sampling in Steele County was completed during the reporting period, and sampling for C-14 was completed in several counties.

The Hennepin County Groundwater Atlases (County Atlas Part B) was published during the period.

DNR Groundwater Atlas staff completed field work for the geophysical investigation of Pennington County as part of the atlas process.

As part of the process to produce a groundwater atlas, DNR seeks external reviews of draft atlases. We typically provide the draft atlas to up to eight external reviewers including non-atlas DNR staff, the MGS, the United States Geological Survey, the Minnesota Department of Health, local SWCDs, and county staff.

When DNR has receives and qualifies the groundwater chemistry results from private wells collected for the atlas, we send the results to well owners with a letter of explanation. During the reporting period, we sent well owner reports for the second round of sampling for Rock, and Nobles counties. We sent well owner reports for Steele County in February 2022.

As part of the atlas development process, DNR staff conduct reviews of draft Geologic Atlases (Part A) prepared by the MGS. During the review period this included reviews of MGS Part A documents for St. Louis and Lake, Aitkin, Steele, Dakota, Otter Tail and Lac Qui Parle.

During this reporting period, planning continued for atlas workshops, and mapping activities continued in Becker, Cass, Dodge, Hennepin, Hubbard, Isanti, Kandiyohi, Nobles, Olmsted, Rock and Wadena.

Dissemination and outreach activities continued including presentations, news releases, GovDelivery list serve (6,000 recipients) notifications, and virtual meetings with county staff and county boards. More details are in the dissemination section below.

### **Amendment Request**

Because of delays in our work and inaction associated with the recent legislative sessions due to Covid, we have not spent what we expected in the non-personnel categories such as laboratory and travel expenses. Many of our contracts for analytical laboratory work, and other non-labor expenses are tied to the biennium, and are not easily transferable to FY22. In addition, we have the new funding from ML2020 that is meant to cover some of the delayed work in the same counties. After notifying LCCMR staff with the September 2021 update (email September 15, 2021) about the need for an amendment, DNR began to direct personnel work alone to the ML2019 project, and we began using the ML2020 appropriation for 're-contracted' FY2022 expenses like lab work, travel and supplies.

This amendment request is to move the remaining balances from each non-personnel budget categories into the personnel budget. The categories, amounts transferred to personnel and the amended budgets are:

- Professional/Technical/Service Contracts reduced by \$220,772 to new budget of \$257,228
- Equipment/Tools/Supplies reduced by \$26,502 to new budget of \$25,498
- Printing reduced by \$42,123 to new budget of \$33,877
- Travel reduced by \$11,137 to new budget of \$43,689
- Other Atlas Production reduced by \$4,937 to new budget of \$1,063

As the Budget Spreadsheet for this update indicates, each of these expense budgets will have a zero balance and the personnel budget will be increased by \$305,471 to a revised budget of \$1,923,471. The Direct & Necessary budget will remain unchanged.

### **Final Report: August 15, 2022**

This final update is for activities and costs from approximately February 28, 2022 through June 30, 2022.

Planning has started for an in-person workshops for the Hennepin and Cass County groundwater atlases.

Comprehensive groundwater sample planning took place for Aitkin County, with plans to complete sampling in July 2022. Planning also continued for groundwater sampling for C-14 in four counties.

No new County groundwater atlases (County Atlas Part B) were published during the period. Technical difficulties related to data files delayed the planned publication of Cass, Becker and Isanti. The expectation is for publication in 2022.

DNR Groundwater Atlas staff completed planning for the geophysical investigations of Red Lake, Polk, Douglas and Grant as part of the atlas process.

When DNR has received and qualified the groundwater chemistry results from private wells collected for the atlas, we send the results to well owners with a letter of explanation. During the reporting period, we sent well owner reports for the second round of sampling for Rock, and Nobles counties. We sent well owner reports for Steele County in February 2022.

As part of the atlas development process, DNR staff conduct reviews of draft County Geologic Atlases (Part A) prepared by the MGS. During the review period this included reviews of MGS Part A documents for Aitkin, Dakota, Otter Tail and Lac Qui Parle, Lake, Steele and St. Louis.

During this reporting period, planning continued for atlas workshops, and mapping and reporting activities continued in Aitkin, Becker, Cass, Dodge, Hennepin, Hubbard, Isanti, Kanabec, Kandiyohi, Nobles, Olmsted, Rock, Steele, Wadena and Winona.

Dissemination and outreach activities continued including presentations, news releases, GovDelivery list serve (6,000 recipients) notifications, and virtual meetings with county staff and county boards. More details are in the dissemination section below.

### **Overall Project Outcomes and Results**

The groundwater atlas provides foundational, science-based, information for use and management of Minnesota groundwaters. The atlas is valuable to government, industry, and research. During the period of the grant, county groundwater atlases (County Atlas Part B) were published for Brown, Hennepin, Kanabec, Meeker, Morrison, Redwood, and Winona counties. Mapping activities also continued through the end of the grant in Aitkin, Becker, Cass, Dodge, Houston, Hubbard, Isanti, Kandiyohi, Nobles, Olmsted, Rock and Wadena, with publication of completed groundwater atlases for Becker, Cass, Dodge, Houston, Hubbard, Isanti and Wadena expected in 2023.

The following related reports were also published:

- The Karst Landscape Unit Map for Winona and Houston counties.
- Minnesota Groundwater Provinces 2021. This document is one of the most widely used reference documents from the Atlas Program.
- Groundwater Atlas Users Guide.



Groundwater sampling is a key element in the completion of an atlas. Sampling efforts necessarily slowed during the pandemic. However, groundwater sampling was completed in Dodge, Kandiyohi, Nobles, Olmstead, Rock, and Steele counties. Letter reports with all sampling results were provided to well owners for all wells sampled as part of this grant.

DNR Groundwater Atlas staff completed field work for the geophysical investigation of Pennington County as part of the atlas process. DNR Groundwater Atlas staff also completed planning for the geophysical investigations in fall 2022 of Douglas, Grant, Polk, and Red Lake counties.

As part of the atlas development process, DNR staff conduct reviews of draft County Geologic Atlases (Part A) prepared by the MGS. During the grant this included DNR reviews for Aitkin, Becker, Cass, Dakota, Lac qui Parle, Lake, Otter Tail, Steele and St. Louis.

Dissemination and outreach activities continued throughout the grant period including presentations, news releases, GovDelivery list serve (6,000 recipients) notifications, and virtual meetings with county staff and county boards, seminars, and presentations.

### III. PROJECT ACTIVITIES AND OUTCOMES

#### **ACTIVITY 1 Title: County Geologic Atlas Part B (Groundwater Atlas)**

**Description:** Building on the Part A atlases prepared by the MGS, this project will provide approximately 24 months of funding to complete, continue, or initiate groundwater atlas projects for the following counties: Becker, Brown, Cass, Dodge, Hennepin, Hubbard, Isanti, Kanabec, Olmsted, Redwood, Wadena, and Washington. The goal is to complete Activity 1 work in approximately two years.

DNR will obtain the MGS GIS files, evaluate and modify those GIS files to reflect county groundwater resources, plan for and collect groundwater samples, compile field water chemistry, analyze groundwater samples for natural chemistry and age-dating isotopes at specialized analytical laboratories, and assemble the aquifer characteristics data.

Following collection and evaluation of all the data, a final groundwater atlas report will be prepared, which includes a detailed description of the groundwater resources in the county, groundwater maps, groundwater cross sections, and interpretations of pollution sensitivity of aquifers in the county. As data are finalized and new reports are completed, the project will continue to add and assemble GIS and other data onto statewide data layers to be available online to everyone who needs the information.

Project design and data collection for counties in southeast Minnesota may include specialty karst system mapping and field studies in support of the completed or in-progress Part B report. As part of this engagement, County Geologic Atlas staff will provide support, training and consultation to local resources managers in understanding special features and concerns related to the karst geology in southeast Minnesota as established in the CGAs.

Following completion of each groundwater atlas, DNR will disseminate the information (see Dissemination section below) and be available to assist stakeholders in the application and use of the atlas.

#### **ACTIVITY 1 ENRTF BUDGET: \$2,400,000**

<b>Outcome</b>	<b>Completion Date</b>
1a. Publish completed Part B reports (up to four counties per year).	June 30, 2022
1b. Continue ongoing work on Part B projects (up to eight counties).	June 30, 2022
1c. As new projects are completed, continue to add data to compiled GIS data layers.	June 30, 2022
1d. Start new Part B projects (up to four per year).	June 30, 2022

**First Update: March 15, 2020**

Progress was made for each outcome, including publication of completed groundwater atlases for Meeker, Morrison and Redwood counties, ongoing work on atlases for fourteen additional counties, including starting work on Rock, Nobles and Kandiyohi counties.

**Second Update: September 15, 2020**

For Outcome 1a during the six-month reporting period, County groundwater atlases (County Atlas Part B) were published for Brown, Washington and Kanabec counties.

For Outcome 1b, planning for atlas workshops (Brown, Redwood, Morrison and Meeker counties), outreach and dissemination activities, and continued mapping activities in Becker, Cass, Dodge, Hennepin, Hubbard, Isanti, Kandiyohi, Nobles, Olmsted, Rock and Wadena.

For Outcome 1c, GIS activity continued, adding final data layers for completed atlases to be served out to the public.

For Outcome 1d, in mid-March 2020 the Minnesota Stay Safe at Home order was issued, directly impacting the programs plans to collect groundwater samples from two counties in May and June. All fieldwork was delayed until appropriate procedures addressing the pandemic could be addressed and approved. Because to the shortened field season, and limitations adopted for fieldwork to reduce risk of spread of coronavirus, plans changed to attempt to complete sampling in three counties (instead of four). Those three counties are Kandiyohi, Rock and Nobles. An attempt will be made to sample groundwater from the three counties between August and October 2020.

In addition, the following actions in support of the atlas were completed:

- MHAs: created water table elevation and depth to water table data for eight (8) recently completed counties, and provided water table points, created final rasters for the maps and began process of updating pollution sensitivity of near-surface materials for next eight counties.
- Files and metadata for regions prone to surface karst feature development (Publication GW-01) were updated and sent to Minnesota IT (MNIT), the agency technology service provider, GIS team for posting to GDRS and Geospatial Commons for wide access.
- New statewide soils data were obtained and prepared for use on pollution sensitivity of near-surface materials; completed Wadena, Cass, Isanti, Hennepin, Houston, Winona calculations for inclusion in underway atlases.
- Continued work on the Groundwater Atlas Users Guide to assist resources managers in the application and use of the atlas.

**Third Update: March 15, 2021**

For Outcome 1a during the six-month reporting period, no county groundwater atlases (County Atlas Part B) were published.

The Atlas Program published GW-05, titled "Tritium Age Classification: Revised Method for Minnesota". This important document is a collaboration between DNR and the Minnesota Department of Health updating the understanding and use of tritium as a tracer in groundwater systems in Minnesota. Tritium is a key parameter in the analysis for the County groundwater atlas process.

For Outcome 1b, planning moved to holding virtual atlas workshops (Brown, Redwood, Morrison and Meeker counties), outreach and dissemination activities, and continued mapping activities in Becker, Cass, Dodge, Hennepin, Hubbard, Isanti, Kandiyohi, Nobles, Olmsted, Rock and Wadena.

For Outcome 1c, GIS activity continued, adding final data layers for completed atlases to be served out to the public.

For Outcome 1d, in mid-March 2020 the Minnesota Stay Safe at Home order was issued, directly impacting the programs plans to collect groundwater samples counties in May and June. All fieldwork was delayed until appropriate procedures addressing the pandemic could be approved. Because to the shortened field season, and limitations adopted for fieldwork to reduce risk of spread of coronavirus, plans changed to complete sampling in three counties (instead of four). Those three counties were Kandiyohi, Rock and Nobles. Groundwater samples were collected in those three counties between August and October 2020.

In addition, the following actions in support of the atlas were completed:

- Groundwater sampling is a key point of contact/dissemination for the program. Staff completed sampling in three counties, which includes hundreds of contacts – email, calls and in-person.
- As part of the groundwater sampling for the atlas, letters are sent to over 1000 well owners in each county scheduled for sampling which explain the program, acknowledge the ENRTF funding, and provide some additional background.
- Work was started to update the “2021 Minnesota Groundwater Provinces” document, which is derived from groundwater atlas work, and one of the most widely used general reports from the Atlas Program.
- Created final rasters (GIS) for the maps and began process of updating pollution sensitivity of near-surface materials for the next eight counties.
- Work continues on the Karst Landscape Unit Map for county atlases in southeastern counties.
- Continued work on the Groundwater Atlas Users Guide to assist resources managers in the application and use of the atlas. A draft of the User Guide was circulated to external (non-DNR) professionals and atlas end-users (SWCD, etc.) asking for their review and comments to improve the guide before final publication in 2021.
- DNR made additional contacts with well owners in Hubbard, Hennepin and Dodge counties for Carbon-14 sampling.
- Collected C-14 samples for Dodge, Hennepin, Hubbard and Olmsted Counties.
- Completed a review of the draft MGS Ottertail Part A to begin planning for the start of the Part B groundwater atlas.

#### **Fourth Update: September 15, 2021**

For Outcome 1a during the six-month reporting period, the following reports were published:

- The Winona Groundwater Atlases (County Atlas Part B).
- The Karst Landscape Unit Maps (KLUM) for Winona and Houston counties.
- Minnesota Groundwater Provinces 2021.
- Groundwater Atlas Users Guide.

For Outcome 1b, planning moved to holding virtual atlas workshops, outreach and dissemination activities, and continued mapping activities in Becker, Cass, Dodge, Hennepin, Hubbard, Isanti, Kandiyohi, Nobles, Olmsted, Rock and Wadena.

For Outcome 1c, GIS activity continued, adding final data layers for completed atlases to be served out to the public.

For Outcome 1d, the Minnesota Stay Safe at Home order remained in place, continuing to affect the programs plans to collect groundwater samples. With the shortened field season, and limitations adopted for fieldwork to reduce the risk due to coronavirus, we completed groundwater sampling in Rock and Nobles counties. The sampling had started during the prior reporting period. Work also started preparing for sampling in Steele County.

In addition, as part of the atlas development process, DNR staff conduct reviews of draft Geologic Atlases (Part A) prepared by the MGS. During the review period this included MGS Part A documents for St. Louis and Lake counties. DNR Atlas staff also created basemap files for MGS for Freeborn, Lyon, Murray, Koochiching, and Stevens counties as a start for the Part A atlas.

#### **Fifth Update: March 15, 2022**

For Outcome 1a during the reporting period, the following report was published: The Hennepin County Groundwater Atlas (Part B).

For Outcome 1b, planning moved to holding virtual atlas workshops, outreach and dissemination activities, and continued mapping activities in Becker, Cass, Dodge, Hennepin, Hubbard, Isanti, Kandiyohi, Nobles, Olmsted, Rock and Wadena.

For Outcome 1c, GIS activity continued, adding final data layers for completed atlases to be served out to the public.

For Outcome 1d, elements of the limited Minnesota Stay Safe at Home order remained in place, continuing to affect the programs plans to collect groundwater samples. With the shortened field season, and limitations adopted for fieldwork to reduce the risk due to coronavirus, the second round of groundwater sampling was completed in Rock and Nobles counties. The sampling had started during the prior reporting period. Comprehensive groundwater sampling was completed in Steele County, and follow-up sampling for C-14 was completed in several counties.

A geophysical investigation was completed in Pennington County as part of the county atlas development.

In addition, as part of the atlas development process, DNR staff conduct reviews of draft Geologic Atlases (Part A) prepared by the MGS. During the review period this included reviews of MGS Part A documents for St. Louis and Lake, Aitkin, Steele, Dakota, Otter Tail and Lac Qui Parle.

#### **Final Report: August 15, 2022 (III. PROJECT ACTIVITIES AND OUTCOMES)**

For Outcome 1a: During the reporting period, no new groundwater atlases were published.

For Outcome 1b: Mapping activities continued through the end of the grant in Aitkin, Becker, Cass, Dodge, Houston, Hubbard, Isanti, Kandiyohi, Nobles, Olmsted, Rock and Wadena, with publication of completed groundwater atlases for Becker, Cass, Dodge, Houston, Hubbard, Isanti and Wadena expected in 2023 with the support of an additional ENRTF grant.

For Outcome 1c: No new groundwater atlases were published, consequently no new GIS files were served out to the public during this reporting period.

For Outcome 1d: Elements of the limited Minnesota Stay Safe at Home order remained in place, continuing to affect the programs plans. No groundwater sampling took place in new counties in the reporting period.

As part of the atlas development process, DNR staff conduct reviews of draft County Geologic Atlases (Part A) prepared by the MGS. During the review period this included reviews of MGS Part A documents for Aitkin, Dakota, Otter Tail and Lac Qui Parle, Lake, Steele and St. Louis.

#### **Final Report Summary – Activities and Outcomes**

For Outcome 1a: During the period of the grant, county groundwater atlases (County Atlas Part B) were published for Brown, Hennepin, Kanabec, Meeker, Morrison, Redwood, and Winona counties. This met the goals for the activity under this grant.

For Outcome 1b: Mapping activities continued through the end of the grant in Becker, Cass, Dodge, Houston, Hubbard, Isanti, Kandiyohi, Nobles, Olmsted, Rock and Wadena, with publication of completed groundwater atlases for Becker, Cass, Dodge, Houston, Hubbard, Isanti and Wadena expected in 2023 with the support of an additional ENRTF grant. This met the goals for the activity under this grant.

For Outcome 1c: During the period of the grant, groundwater atlas GIS files for the flowing counties were published online: Brown, Hennepin, Kanabec, Meeker, Morrison, Redwood, and Winona counties. All GIS files were posted, meeting the goals for this activity.

For Outcome 1d: Elements of the limited Minnesota Stay Safe at Home order remained in place, continuing to affect the programs plans. Groundwater sampling was completed in Dodge, Kandiyohi, Nobles, Olmsted, Rock, and Steele counties. The plan was to complete groundwater sampling in a least two additional counties before the end of the grant, but due to the pandemic, we had to shift from field work to work we could do under the stay at home order for about one year.

The pandemic also limited the number of counties where geophysical investigations could be completed. The plan was to complete geophysical surveys in a least two additional counties before the end of the grant, but due to the pandemic, we had to shift from field work to work we could do under the stay at home order for about one year. DNR Groundwater Atlas staff completed field work for the geophysical investigation of Pennington County as part of the atlas process. Additionally, using this grant, DNR Groundwater Atlas staff completed planning for the geophysical investigations of Douglas, Grant, Polk and Red Lake as part of the atlas process.

#### **IV. DISSEMINATION:**

**Description:** At the completion of a groundwater atlas, DNR provides notification to LCCMR staff and to approximately 6,000 email recipients (listserv: <http://www.dnr.state.mn.us/emailupdates>) who have signed up to receive such notifications. DNR also uses official news releases that are picked up by media outlets across the state. Additional dissemination outlets include articles or updates in newsletters for organizations such as the Legislative Water Commission, the Minnesota Ground Water Association, internal DNR agency news releases, and presentations at conferences across Minnesota.

Each completed County groundwater atlas is printed in paper format (approximately 300 copies) and distributed to the county, libraries, state agencies, and other organizations. County representatives are provided with up to 100 paper (hard) copies of the final atlas to distribute to local stakeholders. Project data, including water chemistry data and GIS data are available on the DNR web site. Water chemistry data are also incorporated into an interagency Equis database that can be used by all state government entities. Printed copies are available for sale at the MGS. PDF versions of the complete report are posted to the DNR web site:

[https://www.dnr.state.mn.us/waters/groundwater\\_section/mapping/status.html](https://www.dnr.state.mn.us/waters/groundwater_section/mapping/status.html).

Following the publication of each Part B atlas, a local workshop is held to introduce the report contents and train users in its application. County representatives host the workshop, inviting interested parties. Real-life exercises based on the specific groundwater resources of the county are used to walk stakeholders through the use of the

comprehensive information provided in the CGA for their county. Following dissemination and the local workshop, DNR staff are available to answer questions and assist in the continued application and use of the atlas.

The Minnesota Environment and Natural Resources Trust Fund (ENRTF) will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the [ENRTF Acknowledgement Guidelines](#).

**First Update:** March 15, 2020

The following is a list of selected atlas dissemination activities for the reporting period July 1, 2019 through January 10, 2020:

- June – Minnesota Groundwater Association Newsletter article summarizing the Washington County Groundwater Atlas was published.
- July - News Release notification of sampling as part of the groundwater atlas planned for Dodge County.
- July - GovDelivery notification (6,000 recipients) of sampling as part of the groundwater atlas planned for Hennepin, Dodge and Olmsted counties.
- July 2 – Representatives of MGS and DNR met with staff of Lyon County to them to the Atlas Program.
- GovDelivery notification of completion and availability of the Dodge County Geologic Atlas (Part A).
- July 18 – Atlas staff from DNR and MGS participated in the Washington County – PFAS Field Trip introducing stakeholders to geology and groundwater issues in the county.
- August 21 – Representatives of MGS and DNR met with staff of the Association of Minnesota Counties to discuss the Atlas Program goals and benefits to counties.
- September 10 – Representatives of MGS and DNR presented to the Roseau & Lake of the Woods County Commissioners & staff of the county’s SWCDs.
- September 15-16 Representatives of MGS and DNR staff participated in the Clean Water Council Biennial Field Trip to SE Minnesota.
- September 24 – Atlas GovDelivery notification of completion and availability of the Meeker County Groundwater Atlas.
- October 3 – Media News Release notification that Meeker County Groundwater Atlas is published and available.
- October 15 – Representatives of MGS and DNR atlas staff participated in LCCMR strategic planning dinner in Rochester.
- October 16 – Representatives of MGS and DNR atlas staff participated in the LCCMR Field Tour, SE Minnesota.
- October 16 – Representatives of MGS and DNR atlas staff participated in LCCMR strategic planning lunch in Minneapolis.
- October 18 – Representatives of MGS and DNR atlas staff participated in the Whitewater State Park Centennial Field Trip, using the atlas to present on geology and groundwater of the area.
- December 5 – News Release Redwood County Groundwater Atlas is published and available.
- January 7, 2020 – Representatives of MGS and DNR Atlas Programs presented to the Swift County Commissioners & staff.

## **Second Update: September 15, 2020**

Dissemination activities slowed as a result of the March Minnesota Stay Safe at Home order. However, the team continued to engage as much as possible and connect with our stakeholders across Minnesota. The following is a list of selected atlas dissemination activities for the reporting period January 2020 through June 30, 2020:

- Work with Matt Berens, University of Minnesota on collaborative sampling plans for neonicotinoids in groundwater in 2020.
- Provided atlas GIS layer files for Native Plant Communities and Rare Species for modeling purposes in the Bonanza Valley Groundwater Management Area.
- GovDelivery notification of completion and availability of the Morrison County Groundwater Atlas.
- Media News Release notification that Morrison County Groundwater Atlas is published and available.
- Minnesota Groundwater Association Newsletter article summarizing the Morrison County Groundwater Atlas.
- Provided input to the Legislative Water Commission on developing water balances over areas larger than county scale, including groundwater modeling methodology that leverages county atlas series data with the goal of enhancing groundwater sustainability. Provided comments on specific legislative language.
- Representatives of MGS and DNR staff met with Scott County Staff to discuss a completing a groundwater atlas.
- Atlas staff met with Tribal Liaison Brad Harrington to discuss Atlas Program and fieldwork in tribal areas.
- Presentation to the Lyon County Board of Commissioners with MGS.
- Presentation to the Legislative Conference of the Association of Minnesota Counties.
- Presentation to Lyon County Board of County Commissioners.
- Contact from Mille Lacs County about moving forward with atlas.
- Meeker County Atlas Workshop held with local resource managers attending. The workshop was hosted by the county.
- Seminar Presentation to Winona State Geoscience Center: "Dyeing in the Driftless".
- Atlas staff participated in High School Geo Mapping – Science Olympiad.
- Brown County Board of Commissioners presentation canceled due to Covid19.
- GovDelivery notification on behalf of MGS to 6,000 emails on the completion of the Geologic Atlas (Part A) for Olmsted County.
- Brown & Redwood County CGA Workshop canceled due to Covid19.
- News Release, GovDelivery, MGWA article noting the publication of groundwater atlases for Brown and Redwood counties.
- Geologic Mapping Forum Atlas presentation (MGS/DNR) – Canceled due to Covid19.
- University of Minnesota Water Resources Graduate Class (John Nieber) presentation on the Atlas Program with MGS canceled due to Covid19
- Water Festival Groundwater Model presentation by atlas staff canceled due to Covid19.
- MN Minerals Education Workshop Winona, canceled due to Covid19.
- News Release, GovDelivery, and MGWA article published noting the publication of Groundwater Atlas for Kanabec County.
- Collaborated with several stakeholders to develop a video demonstrating Groundwater Movement in SE MN and an educational tool, using information from the Atlas Program.

### **Third Update:** March 15, 2021

Dissemination activities continued to be restricted as a result of the continuing Minnesota Stay Safe at Home order. However, the team continued to engage as much as possible and connect with our stakeholders across Minnesota.

The following is a list of selected atlas dissemination activities for the reporting period July 2020 through December 2020:

- The Atlas Program published GW-05, titled “Tritium Age Classification: Revised Method for Minnesota”. This important document is a collaboration between DNR and the Minnesota Department of Health updating the understanding and use of tritium as a tracer in groundwater systems in Minnesota.
- BWSR presentations – DNR was invited by BWSR to make two presentations on the Atlas Program to large Webinar audiences on October 28, 2020 and December 10, 2020.
- Conversations with Dodge County (Dean Schrandt) about status of the groundwater atlas, and use for county zoning updates based on aquifer pollution sensitivity. Dean Schrandt also provided DNR with some GIS data that they put together for their groundwater work.
- Met local Kandiyohi media at a well sampling site to demonstrate and describe the Atlas Program.
- DNR made a technical presentation to staff of MGS on Dec. 2. Included detailed discussion of how to best link the Part A and Part B atlas work.
- Work continued with Dr. Matt Berens, University of Minnesota, on collaborative sampling plans for neonicotinoids in groundwater in 2020/2021.
- Continued input to the Legislative Water Commission on various ideas/legislation developing water balances over areas larger than county scale, including groundwater modeling methodology that leverages county atlas series data with the goal of enhancing groundwater sustainability.
- Continued planning underway for an online presentation to the Brown County Board of Commissioners on the county groundwater atlas which was previously canceled due to Covid19.
- Planning continued for Brown & Redwood County CGA online workshops. The workshops had to be canceled due to Covid19.
- DNR and MGS presentation to the University of Minnesota Water Resources Graduate Class (John Nieber) on the Atlas Program.
- Collaborated with several stakeholders to develop a series of videos demonstrating Groundwater Movement in Southeast Minnesota. The videos are partially based on work of the Atlas Program and provide a powerful educational tool.
- Groundwater sampling is a key point of contact/dissemination for the program. Staff completed sampling in three counties, which includes hundreds of contacts – email, calls and in-person meetings.
- As part of the groundwater sampling for the atlas, letters are sent to over 1000 well owners in each county scheduled for sampling which explain the program, acknowledge the ENRTF funding, and provide some background.
- DNR made additional contacts with well owners in Hubbard, Hennepin and Dodge counties for Carbon-14 sampling.

### **Fourth Update:** September 15, 2021

Dissemination activities continued to be restricted because of the continuing Minnesota Stay Safe at Home order. However, the team continued to engage as much as possible and connect with our stakeholders across Minnesota.



The following is a list of selected atlas dissemination activities for the reporting period January 2021 through June 2021:

- Copies of the Winona County Groundwater Atlas were sent to the DNR library, Legislative Reference Library, and the Minnesota Legislative Water Commission.
- The organization Freshwater published “Banking groundwater: Managed Aquifer Recharge”. The publication contained thirty references to Washington and Clay county atlases.
- Atlas staff held conversations with stakeholders from Wright County to answer follow up questions related to our completed atlas.
- DNR and MGS staff made a presentation on the Atlas Program to the Koochiching County Board on February 23.
- Presentation to the Traverse County Board of Commissioners with MGS (March 5).
- Presentation to the staff of Stevens County in preparation for a presentation to the county board (March 11).
- Presentation to the Stevens County Board of Commissioners with MGS (March 16).
- March 18 discussion between Dodge county zoning and environmental staff and Atlas staff about how to be proactive in managing sensitive aquifers in the county. They are planning to use the Pollution Sensitivity analysis from the atlas to develop zoning for a new “Aquifer Protection District”.
- Presentation about groundwater and the Atlas Program to visitors at Beaver Creek State park.
- Atlas staff participated in a discussion with staff from Washington County, MPCA, local SWCDs, the city of Woodbury and consultants related to karst groundwater and issues of construction integrity, based on the results of the Washington County Groundwater Atlas.
- Atlas staff participated in an all-day meeting on March 24 with the SE Minnesota State Interagency Working Group. Atlas staff presented the results of the recently published Winona Groundwater atlas and the Karst Landscape Units document.
- Washington County groundwater and GIS data was provided to Dr. Lisa Lamb, University for St. Thomas for use in collaborative project with the city of Woodbury and for class project work.
- Contact with Brian Martinson of Association of Minnesota Counties to provide updates.
- Atlas program supported the publication of a paper by the University of Minnesota on Neonicotinoids in the Journal of Environmental Toxicology.
- Atlas staff participated in a call with staff from the MGS, Roseau and Lake of the Wood SWCDs to begin planning the atlas work there.
- Contact with Sam Steffl Drilling to discuss use of groundwater atlas in drilling work.
- Contact with Mahnommen County (Aaron Neubert) to discuss a presentation to the county board.
- May 18 Zoom call with Stacey Stark, University of Minnesota - Duluth, and her team to present more information about the Atlas Program. UMD uses the atlas in work with counties across the state. See more on this below.
- May 28 – GovDelivery notification of publication of four Atlas Program products: Groundwater Atlas of Winona County; Groundwater Atlas Users Guide; Minnesota Groundwater Provinces 2021; Karst Landscape Units of Houston and Winona counties.
- June 10 – GovDelivery notification of the publication of Rock & Nobles Geologic Atlases (Part A), and information on the completion of the groundwater atlas for these counties.

Also during the reporting period, the Atlas Program received several emails from our customers detailing some of the creative and valuable ways the atlases are used. The Atlas Program takes advantage of these opportunities to ask how we can improve the atlas products and find out more about how the atlas is used.

Below is a selection of those communications, highlighting stakeholders from the **academic and research** communities in particular:

**Stacey Stark**, Associate Director, Research Computing, Office of the Vice President for Research  
University of Minnesota Duluth

*"We are using the groundwater atlas to make some very simple maps to support content in county Hazard Mitigation Plans, a plan required by FEMA to access certain federal mitigation program funds (\$\$). We facilitate the update of these plans for almost half of all counties."*

*"If not for the groundwater atlas, we would not have access to the information about the groundwater sensitivity and would likely leave this out of the plan. The availability of these public data allow us to include the information in a plan produced for an audience that may not be aware of the groundwater atlas resource. The county's groundwater resources may not be on the radar of Emergency Management or many of the other stakeholders in this plan. One of our goals is to outline potential hazards to the county and assemble resources for them to address mitigation actions to these hazards. So perhaps the most valuable thing that comes out of our use of the data is to potentially get it in the hands of others who may use it in the future for planning and education. Thank you for this valuable resource!"*

**Lisa Lamb**, Professor, Earth, Environment, & Society, University of St. Thomas

*"At the University of St. Thomas, we are completing a community service project with the City of Woodbury, helping examine their Stormwater Management Plan, it's specifications and impact on groundwater. Specifically, we are examining dry ponds to see if and how they are working and hoping to find patterns that might exist between ones that are working well and those that are not working. As part of that, students are using the County Atlas to understand the geology and groundwater characteristics, in conjunction with land use, age of pond construction, and more. The students learn GIS basics using downloadable GIS layers from the atlas, and then examine the characteristics near their 'adopted' dry ponds. At the University of St. Thomas the atlas provides real life data to help educate future natural resource professionals."*

**Peter K. Kang**, Ph.D., Assistant Professor, Department of Earth & Environmental Studies, University of Minnesota Twin Cities

*"I continue to be impressed by the MGS and DNR atlas products. The comprehensive geologic and hydrogeologic products support cutting-edge research projects that lead to better management of Minnesota's water resources. My research group develops predictive models for groundwater systems, and the County Atlas provides critical information for those models. Recently, our team studied the feasibility of aquifer storage and recovery in four Minnesota study areas. Thanks to the County Atlas, my research team was able to successfully estimate the amount of water that can be safely stored in groundwater systems. Also, the Atlas is an excellent resource for groundwater related courses that I teach at the University of Minnesota. Examples of future research projects that will benefit from the Atlas include: Predicting contaminant fate and transport in groundwater systems (e.g., fate and transport of nitrate in groundwater systems); Groundwater-surface water interaction; Managed aquifer recharge; Hydrogeologic characterization and modeling for groundwater management."*

**John Linc Stine**, Executive Director of Freshwater

*"Hi, I just checked out the 2021 update to the Minnesota Groundwater Provinces map (an Atlas program by-product). I have loved using this tool to help frame the understanding of Minnesota's watersheds, landscapes and drinking water sources. I appreciate that you've stuck with keeping it up-to-date with the most current*

*mapping. I'm sure others had a hand in the update, so please let anyone else know that your work is used in my presentations, referenced and appreciated. Well done and keep up the great work!"*

#### **Fifth Update:** March 15, 2022

The following is a list of selected dissemination activities for the reporting period July 1 2021 through February 28, 2022:

- July 28. Morrison Groundwater Atlas - Virtual Workshop with the county staff and stakeholders. We received this acknowledgement from Shannon Wettstein, District Manager, Morrison SWCD, *"Geological Atlas Team, Thank you again for your time yesterday and ALL of the work you have put into this project. The comments I heard from those in attendance was very positive and I personally found the information super interesting. All of you are such professionals, the state is lucky to have you work for them!"*
- August 5. News release of publication of Winona County Groundwater Atlas.
- August 26. MPCA Water Issues Seminar – Atlas staff presentation on the recently published, *2021 Groundwater Provinces*.
- August 16. News release of well sampling planned in Steele County for groundwater atlas.
- August 10. Daily Planet – Publication of the Groundwater Atlas of Winona County announced.
- September. Groundwater Atlas Team at the State Fair Information Booth.
- September 12 – 13. Groundwater Atlas team members participated in the Clean Water Council Southwest Minnesota Field trip/workshop. Paul Gardner, Administrator, Clean Water Council, passed along this note: *"Thanks so much for your help with our field tour! The feedback from Council members has been very positive, especially about how state agencies provide key expertise to help improve water quality."*
- Fall 2021. Collaboration with Gustavus College. A student participated in the work of the Atlas team, including observing groundwater sampling in Steele County. Professor Laura Triplett said, *"I am the surficial geologist at Gustavus. I teach our hydrogeology course, advise most water-related student research projects, do my own water-focused research and also coincidentally am the instructor for this year's senior research seminar. I am thrilled to make this connection with you! I use the Groundwater Atlas all the time, of course, when teaching and advising about hydrogeology, so I'm excited to get to know you and your team."*
- October 14. MPCA Water Issues Seminar – Groundwater Atlas team members presented on the Tritium Age Classification: Revised Method for Minnesota.
- Oct. 19. Atlas staff presented at Assisi Heights in Rochester on "Karst Hydrology & the Environment" for a group engaged in groundwater and environmental issues. The team received very positive feedback from the organizer and participants.
- October 7. Presentation by Atlas staff for the Natural Resources Research Institute (NRRI) in Duluth on the Groundwater Atlas program. Many at NRRI conducting research regarding groundwater and surface water flow/interactions and others at the institute generate extensive geospatial datasets.
- October 15. Presentation for the Natural Resources Research Institute (NRRI) in Duluth on the springshed mapping and the MGTD.
- Fall 2021. Atlas staff received a call from Eric Miller of the Nicollet County SWCD. He's working on an assessment report for the NRCS, National Water Quality Initiative Program, focusing on the Rogers Creek watershed – St Peter wellhead area. He was looking for GIS clips of published atlas cross sections to show the aquifers discussed in the atlas. He had picked up the atlas at the training session after the Nicollet-Sibley workshop several years ago.

- Fall 2021. The Atlas team received email from MDA with a question about the Minnesota Regions Prone to Surface Karst Feature Development layer in the GDRS/QuickLayers/Geospatial Commons. Kim Kaiser of MDA explained, *“We used Karst as an input to our Fall Nitrogen Fertilizer Restriction Map, it is one of several layers representing areas of Vulnerable Groundwater. We are just wondering if there have been refinements in the last few years and if any future changes are anticipated. Lastly, I was asked to verify that this layer is related to the Near Surface Pollution Sensitivity layers.”*
- November 2. American Institute of Professional Geologist (AIPG) luncheon seminar on the 2021 *Groundwater Provenance* developed from the Groundwater Atlases.
- December 10. Presentation by Atlas staff to Metroblooms organization on the Hennepin County Groundwater Atlas.
- December 28. GovDelivery notification (6,000 recipients) of the publication of the Hennepin County Groundwater Atlas.
- Copies of the Hennepin County Groundwater Atlas were sent to the DNR library, Legislative Reference Library, and the Minnesota Legislative Water Commission.
- January 27, 2022. MPCA 2022 Water and Watersheds Meeting in January.
- February 3. News Release announcing the publication of the Hennepin County Groundwater Atlas.
- February 2021. The Atlas program received feedback from John Clark & Ali Elhassan of the Metropolitan Council Environmental program, stating, *“The Minnesota County Atlases are essential for our water supply planning work in the Twin Cities metro. The Atlases provide the foundational data and information for many of our projects including the Metropolitan Area groundwater models and help to link drinking water sustainability with local land use planning and regional development. Groundwater resources extend far beyond the local political boundaries where they are used and managed requiring collaboration between local utilities, businesses, regulators, resource managers, planners, and others to address challenges. The Atlases provide the context for those partnerships and allow us to develop technical tools and information to ensure the present and future sustainability of drinking water resources and supply systems. The Atlases are indispensable resources that help to improve drinking water quality and quantity and benefit the people of Minnesota.”*

#### **Final Update: August 15, 2022**

- News Release notification of sampling as part of the Aitkin County Groundwater Atlas.
- Presentation to DNR Field Hydrologists Forum and Clean Water Hydrologist Meetings.
- “Springs of the Twin Cities” tour based on atlas information.
- Groundwater Atlas website updates
- Presentation to Clean Water Council
- SEMN Meeting – alternative cropping system in karst terrain.
- Conversations with Blue Earth county environmental staff – atlas GIS files/use.

#### **Final Report Dissemination Summary**

Dissemination activities focused on notification of sampling activities and publication of atlases through news releases and GovDelivery (6,000 recipient list serve), participation in seminars, presentations, and educational/technical field trips to a diverse set of stakeholders and resources managers including county SWCDs, county boards, the Clean Water Council, BWRS, MPCA, the Legislative Conference of Minnesota Counties, LCCMR events, and others. Dissemination also included workshops with counties, publication of summary articles, updated [website](#) and many personal contacts with users of the atlas. Atlas staff also worked closely with university staff to incorporate atlas materials in the classroom and to collaborate on projects.

The following is a list of *selected* atlas dissemination activities for the grant period:

- Minnesota Groundwater Association Newsletter articles were published summarizing the county groundwater atlases published.
- News Release notification of sampling as part of the groundwater atlas planned for each county.
- GovDelivery notification (6,000 recipients) of sampling as part of the groundwater atlas planned for counties.
- Representatives of MGS and DNR met with staff of many county boards, staff and SWCDs to introduce them to the Atlas Program.
- GovDelivery notification of completion and availability of county geologic atlases (Part A) as they were published.
- Atlas team host and participate in many field trips.
- Representatives of MGS and DNR met with staff of the Association of Minnesota Counties to discuss the Atlas Program goals and benefits to counties.
- Representatives of MGS and DNR staff participated in the Clean Water Council Biennial Field Trip to SE Minnesota.
- Representatives of MGS and DNR atlas staff participated in LCCMR strategic planning dinner in Rochester.
- Representatives of MGS and DNR atlas staff participated in the LCCMR Field Tour, SE Minnesota.
- Representatives of MGS and DNR atlas staff participated in LCCMR strategic planning lunch in Minneapolis.
- Atlas staff worked with Matt Berens, University of Minnesota on collaborative sampling plans for neonicotinoids in groundwater in 2020.
- Provided atlas GIS layer files for modeling purposes in the GWMA's.
- Atlas staff met with Tribal Liaison Brad Harrington to discuss Atlas Program and fieldwork in tribal areas.
- Presentation to the Legislative Conference of the Association of Minnesota Counties.
- County Groundwater Atlas Workshops were held with local resource managers attending. The workshops were hosted by the counties.
- Atlas members gave seminar presentations in many venues.
- Atlas staff participated in High School Geo Mapping – Science Olympiad.
- The Atlas Program published GW-05, titled “Tritium Age Classification: Revised Method for Minnesota”.
- BWSR presentations – DNR was invited by BWSR to make two presentations on the Atlas Program to large Webinar audiences.
- Work continued with Dr. Matt Berens, University of Minnesota, on collaborative sampling plans for neonicotinoids in groundwater in 2020/2021.
- DNR and MGS presentation to the University of Minnesota Water Resources Graduate Class (John Nieber) on the Atlas Program.
- Collaborated with several stakeholders to develop a series of videos demonstrating Groundwater Movement in Southeast Minnesota.
- As part of the groundwater sampling for the atlas, letters are sent to over 1000 well owners in each county scheduled for sampling which explain the program, acknowledge the ENRTF funding, and provide some background.
- DNR made additional contacts with well owners in counties for Carbon-14 sampling.

- Copies of all recently published county groundwater atlases were sent to the DNR library, Legislative Reference Library, and the Minnesota Legislative Water Commission.
- Presentation about groundwater and the Atlas Program to visitors at Beaver Creek State Park.
- Atlas staff participated in an all-day meeting with the SE Minnesota State Interagency Working Group. Atlas staff presented the results of the recently published Winona
- Atlas program supported the publication of a paper by the University of Minnesota on Neonicotinoids in the Journal of Environmental Toxicology.
- GovDelivery notification of publication of four Atlas Program products: Groundwater Atlas of Winona County; Groundwater Atlas Users Guide; Minnesota Groundwater Provinces 2021; Karst Landscape Units of Houston and Winona counties.
- Morrison Groundwater Atlas - Virtual Workshop with the county staff and stakeholders.
- MPCA Water Issues Seminar – Atlas staff presentation on the recently published, *2021 Groundwater Provinces*.
- September. Groundwater Atlas Team at the State Fair Information Booth.
- Groundwater Atlas team members participated in the Clean Water Council Southwest Minnesota Field trip/workshop.
- Collaboration with Gustavus College.
- MPCA Water Issues Seminar – Groundwater Atlas team members presented on the Tritium Age Classification: Revised Method for Minnesota.
- Atlas staff presented at Assisi Heights in Rochester on “Karst Hydrology & the Environment” for a group engaged in groundwater and environmental issues.
- Two presentations by Atlas staff for the Natural Resources Research Institute (NRRI) in Duluth on the Groundwater Atlas program.
- American Institute of Professional Geologist (AIPG) luncheon seminar on the *2021 Groundwater Provinces* developed from the groundwater atlases.
- Presentation by Atlas staff to Metroblooms organization on the Hennepin County Groundwater Atlas.

## V. ADDITIONAL BUDGET INFORMATION:

### A. Personnel and Capital Expenditures

#### Explanation of Capital Expenditures Greater Than \$5,000:

#### Explanation of Use of Classified Staff:

#### Total Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation:

Enter Total Estimated Personnel Hours for entire duration of project: 18,200	Divide total personnel hours by 2,080 hours in 1 yr. = TOTAL FTE: 8.75
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#### Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:

Enter Total Estimated Contract Personnel Hours for entire duration of project: N/A	Divide total contract hours by 2,080 hours in 1 yr. = TOTAL FTE: 0
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## **VI. PROJECT PARTNERS:**

### **A. Partners outside of project manager's organization receiving ENRTF funding**

### **B. Partners outside of project manager's organization NOT receiving ENRTF funding**

## **VII. LONG-TERM- IMPLEMENTATION AND FUNDING:**

The County Atlas Program is the primary vehicle to provide comprehensive geologic and groundwater system mapping and associated databases at appropriate scales statewide. The goal is to complete an atlas for all 87 counties. Counties with a complete atlas (Part A & Part B) enjoy strong economic benefits especially with respect to water resource use and management. Once the atlas is completed for a county, updates (GIS, web access, etc.), if needed, could be funded by a combination of the individual counties in conjunction with DNR general funds, and other funds as become available.

The MGS receives funding from DNR and leverages federal dollars from the National Cooperative Geologic Mapping Program of the USGS. The MGS competes annually for these federal cost-share dollars. MGS Part A atlas development is funded by ENRTF and Clean Water Fund through direct appropriation. DNR is a cooperator and funding partner with the MGS. The groundwater atlases are supported by a combination of state general fund, Clean Water Fund and ENRTF appropriations to DNR. Springshed mapping and research to investigate and understand groundwater flow in the complex geologic systems in southeast Minnesota has been supported by ENRTF; the results of that work will be utilized in the completion of atlases in southeast Minnesota.

## **VIII. REPORTING REQUIREMENTS:**

- Project status update reports will be submitted March 15 and September 15 each year of the project.
- A final report and associated products will be submitted between June 30, 2022 and August 15, 2022.

## **IX. SEE ADDITIONAL WORK PLAN COMPONENTS:**

- A. Budget Spreadsheet**
- B. Visual Component or Map**
- C. Parcel List Spreadsheet**
- D. Acquisition, Easements, and Restoration Requirements**
- E. Research Addendum**

Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR)."



**Attachment A****Environment and Natural Resources Trust Fund****M.L. 2019 Budget Spreadsheet - FINAL****Legal Citation:** M.L. 2019, First Special Session, Chapter 4, Article 2, Subd. 03o**Project Manager:** Paul Putzier**Project Title:** County Geologic Atlas - Part B (Groundwater Atlas)**Organization:** Minnesota Department of Natural Resources**Project Budget:** \$2,400,000**Project Length and Completion Date:** Three Years, June 30, 2022**Today's Date:** August 15, 2022

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET		Revised Budget 4/5/2022	Amount Spent	Balance
<b>BUDGET ITEM</b>				
<b>Personnel (Wages and Benefits): All Positions are for two years.</b>		\$ 1,923,471	\$ 1,923,471	\$0
Hydrologist Supervisor (classified): \$126,000 (75% salary, 25% benefits); 0.5 FTE 2 Yrs.				
Res Sci 3 (classified): \$126,000 (75% salary, 25% benefits); 1 FTE 2 Yrs.				
Hydrologist 3 (classified): \$119,000 (75% salary, 25% benefits); 0.75 FTE 2 Yrs.				
Hydrologist 3 (classified): \$106,000 (75% salary, 25% benefits); 1 FTE 2 Yrs.				
Hydrologist 2 (unclassified or classified): \$88,000 (75% salary, 25% benefits); 2 FTE (Randy/Vanessa) 2				
Hydrologist 1 (classified or unclassified): \$70,000 (75% salary, 25% benefits); 2 FTE 2 Yrs.				
Information Officer 2 (classified or unclassified): \$71,000 (75% salary, 25% benefits); 0.75 FTE (Ruth) 2				
Research Analyst Sn-GIS (classified or unclassified): \$74,000 (75% salary, 25% benefits); 0.75 FTE (Holly)				
<b>Professional/Technical/Service Contracts:</b> Contracts: Laboratory analysis of approximately 110 water samples per county (Approx. 880 total) for primary analysis.		\$ 257,228	\$ 257,228	\$0
Lab budget for existing state contracts with MN Department of Agriculture (\$40,000/county)				
University of MN (\$6,500/county)				
University of Waterloo (\$13,250/county)				
<b>Equipment/Tools/Supplies</b>				
Water sampling and measurement tools and field analytical meters and equipment (est \$15,000 for replacement Trimble, Hack water quality meters, Rugged Pro field probes and titrate system). Supplies, including expendable water sampling supplies (Approx. 880 samples total. \$38/sample: high volumn mico filters; valves and tubing for each well sampled, titration supplies (est \$34,000). Shipping costs for water samples to laboratories (est \$3,000).		\$ 25,498	\$ 25,498	\$0
<b>Printing</b>				
<i>Each Atlas Part B includes printing (off-set and digital) of approximatley 300 copies:</i>		\$ 33,877	\$ 33,877	\$0
<i>1) One 40-60 page bound report with up to 40 color figures, maps and tables</i>				
<i>2) Three to four, full color map plates that are each approximatley 24-inches by 36-inches in size. Some Atlases require a second, figures only, bound report. Printing costs also includes preparing 1,000 post cards for each county mailed to citizens to obtain permission for water well sampling. Total anticipated per county printing costs estimated to be \$9,500. Printing costs for eight (8) county atlas estimated to be \$76,000.</i>				
<b>Travel expenses in Minnesota</b>				
In-state vehicle mileage (est \$28,128) and travel expenses (est \$26,698), primarily for water sample and field data collection.		\$ 43,689	\$ 43,689	\$0
<b>Other</b>				
Atlas Production: Upgrades for GIS and report publication specialty software (ex. Avenza Map Publisher) for three DNR Atlas production staff (est \$3,000). Specialty software training for DNR Atlas production staff, such as Adobe InDesign, Map Publisher, ArchGIS (est \$3,000).		\$ 1,063	\$ 1,063	\$0
Direct & Necessary: *Direct and Necessary expenses: People Support (~\$25,856), Safety Support (~\$5,356), Financial Support (~\$23,093), Communication Support (~\$1,251), IT Support (~\$58,559), and Planning Support (~\$1,059) necessary to accomplish funded programs/projects.		\$ 115,174	\$ 115,174	\$0
<b>COLUMN TOTAL</b>		\$ 2,400,000	\$ 2,400,000	\$0
*Direct and Necessary expenses include Department Support Services (Human Resources, IT Support, Safety, Financial Support, Communications Support, and Planning Support). Department Support Services are described in the agency Service Level Agreement and billed internally to divisions based on rate that have been developed for each area of service. These services are directly related to and necessary for the appropriation. Department leadership services (Commissioner's Office and Regional Directors) are not assessed. Those elements of individual projects that put little or no demand on support services such as large single-source contracts, large land acquisitions, and funds that are passed through to other entities are not assessed Direct and Necessary costs for those activities.				
<b>OTHER FUNDS CONTRIBUTED TO THE PROJECT</b>		<b>Status (secured or pending)</b>	<b>Budget</b>	<b>Spent</b>
<b>Non-State:</b> N/A				
<b>State:</b>			\$ 1,200,000	\$ 1,200,000
				\$ -



General Fund staff support, estimated \$1,200,000 for 2-year period for completion of Part B atlases in base program. Est. spent.				
<b>In kind:</b>		\$ 16,000	\$ 12,000	\$ 4,000
County/local government assistance to arrange water sampling access and sponsor local training workshop. Est. spent.				
<b>PAST AND CURRENT ENTRF APPROPRIATIONS</b>	<b>Amount legally obligated but not yet spent</b>	<b>Budget</b>	<b>Spent</b>	<b>Balance</b>
<b>Current appropriation:</b> N/A				
M.L. 2019, First Special Session, Chapter 4, Article 2, Subd. 03o		\$ 2,400,000	\$ 2,400,000	\$0
M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 03c		\$ 1,125,000	\$ 151,062	\$ 973,938
M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 03c		\$ 1,875,000	\$ 6,678	\$ 1,868,322
<b>Past appropriations:</b> County Geologic Alas Appropriations spent prior to July 1, 2019		\$ 5,715,000	\$ 5,715,000	\$ -
M.L. 1991 ENTRF to DNR \$600,000				
M.L. 1993 ENTRF to DNR \$425,000				
M.L. 2009 ENTRF Ch 143 Sec 2 Subd 3 to DNR \$890,000 (CGA portion)				
M.L. 2011, First Special Session, Chp. 2, Art. 3, Sec. 2, Subd. 03b2, \$600,000				
M.L. 2013, Chp. 52, Sec. 2, Subd. 03c, \$1,200,000				
M.L. 2015, Chp. 76, Sec. 2, Subd. 3b, \$2,000,000				

