

Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-575

Proposal Title: Airborne Geophysical Reconnaissance of Groundwater Resources, Northwestern Minnesota

Project Manager Information

Name: Aaron Hirsch Organization: U of MN - MN Geological Survey Office Telephone: (612) 626-4028 Email: ahirsch@umn.edu

Project Basic Information

Project Summary: Conduct reconnaissance airborne electromagnetic (AEM) surveys to determine how to improve mapping of the limited known aquifers in northwest Minnesota, which are experiencing increased groundwater use.

ENRTF Funds Requested: \$686,000

Proposed Project Completion: March 31, 2029

LCCMR Funding Category: Water (B)

Project Location

What is the best scale for describing where your work will take place? Region(s): NW

What is the best scale to describe the area impacted by your work? Region(s): NW

When will the work impact occur?

During the Project and In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Expansion of agricultural and animal production in northwestern Minnesota has resulted in increased groundwater use. Northwest Minnesota has relatively scarce groundwater availability, with most identifiable aquifers limited to small and widely scattered surface and near-surface sand bodies. This part of the state typically receives less rainfall than elsewhere, with that pattern expected to continue, highlighting the need to identify additional groundwater resources. Because the groundwater system is quite complex, we need high resolution subsurface information to better understand the resource. Data currently used to map buried aquifers are limited to individual boreholes – primarily water wells of variable depths. In the absence of a systematic exploratory drilling program, data are not readily available at regularly spaced intervals to "fill in" between existing well locations, in large part because of the significant cost, time commitment, and uncertainty in hitting groundwater resources. This results in large gaps in our understanding of existing aquifers as well as the potential failure to locate additional aquifers which limits utilization of the groundwater system.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

To help fill the gaps in our understanding of groundwater resources, we will perform regional helicopter-based airborne electromagnetic (AEM) surveys across select areas of northwest Minnesota (see figure) with special attention to rural water districts. AEM equipment generates an electromagnetic (EM) field and records the subsurface response. Measurements differentiate between resistive aquifer-bearing sediment and conductive aquitards. This innovative technique fills the gap between existing boreholes where we do have information and extends coverage deeper underground, with 100s of miles of data collected over a short period of time resulting in significant savings over drilling and other methods. AEM surveys, for groundwater resource studies, have been completed throughout the United States and regionally in neighboring states (e.g., North Dakota), but not in Minnesota.

The design of this survey has two goals. 1) Perform AEM over areas of known but poorly characterized groundwater resources, and 2) ground truth and constrain data uncertainty using existing borehole data. This geophysical survey will aid groundwater resource discovery, groundwater sustainability, and geological mapping in northwestern MN, resulting in better targeting of existing aquifers. It is expected that processes developed from this AEM survey will be applicable to other parts of Minnesota.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

The interpreted geophysical data will be presented to local governmental entities and users at townhall-style meetings in the areas where AEM was flown, and at roundtable discussions with regional stakeholders and state agencies, all to aid in the preservation and conservation of the current and future groundwater supply in the region. The data will be used to better map known existing aquifers, identify potential new resources, and determine where and to what extent AEM can be used in future studies to conserve and protect our groundwater resources. The results from this investigation will spur additional AEM groundwater studies in Minnesota.

Activities and Milestones

Activity 1: Acquisition of airborne electromagnetic surveys in western MN

Activity Budget: \$497,700

Activity Description:

In this activity, the AEM geophysical survey will be conducted by an independent contractor. Initially, we will work with the contractor to finalize the contract, streamline the survey design, and schedule the acquisition. Depending on the contractor's availability and the weather, the contractor may not be able to start until the Spring after funding is received. The PI will acquire ground-based EM measurements at select locations in-line with the finalized survey design. Prior to data collection, the contractor will mobilize to the site area where we will hold a community engagement-style townhall for local stakeholders to learn more about the project, ask questions, and see the geophysical equipment. During survey acquisition, the helicopter traverses the survey line with a large electromagnetic coil loop suspended below (see figure). The coil generates an electromagnetic field and records the response of the subsurface material to that field. The survey is designed to acquire data over areas where the subsurface has been mapped from boreholes/wells as well as areas with little or no subsurface data; this includes areas within Polk, Red Lake, Pennington, Marshall, Kittson, and Roseau counties. After survey completion, the contractor will deliver a final report including maps and data.

Activity Milestones:

Description	Approximate Completion Date
Contract negotiations	August 31, 2026
Finalize survey design and AEM system verification, and ground-based EM survey	October 31, 2026
Mobilization of the AEM survey	April 30, 2027
Collection of AEM survey in northwest Minnesota	May 31, 2027
Receipt of final data products from contractor	July 31, 2027

Activity 2: Airborne electromagnetic data processing and ground-truthing program

Activity Budget: \$105,750

Activity Description:

After survey completion, AEM data must be fully processed and inverted to a pseudo geologic cross-section before it can be used to interpret groundwater resources. Processing will be completed by the Minnesota Geological Survey (MGS) geophysicist with training from an expert from the United States Geological Survey. The data quality of each survey point will be assessed, with irregularities and noise filtered or removed. At specific borehole locations within the survey area where the types of unconsolidated sediment are known, we will use a downhole probe to measure conductivity in the borehole for comparison to the AEM data collected at that location. This will be used to ground truth, aid in data processing, and constrain final processing. Final processing of the data will result in a continuous series of gridded 2D conductivity models along each survey line.

Activity Milestones:

Description	Approximate Completion Date
AEM data processing training with the United States Geological Survey	September 30, 2027
Borehole measurements of conductivity for ground truthing	November 30, 2027
Full data processing complete and final inversion of the EM data using ground truth data	February 28, 2028

Activity 3: Geologic interpretation of AEM geophysical data

Activity Budget: \$82,550

Activity Description:

As the data is processed, including the data products from the contractor, we will begin interpretation for groundwater resources. In collaboration with the MGS geologists and guidance from the USGS, we will interpret conductivity models as they relate to conductive fine-grained silts and clays versus resistive water-bearing sands and gravels (aquifers) using existing borehole data and MGS subsurface geologic expertise. From the interpretation, we will be able to determine the minimum aquifer thicknesses resolvable with this geophysical method, within which geological environments AEM works best, and feasibility of this method to more focused AEM groundwater studies in western Minnesota. The raw, processed, and interpreted data will be published as an MGS report and journal article/s with data housed online as part of the MGS Geophysical Portal. We will present the results in townhall style meetings to communities in the respective regions of the AEM surveys. Additionally, we will convene collaborative meetings with regional stakeholders to discuss the results as they relate to groundwater resources. Communicating these results to the public will support the resiliency and sustainability of the groundwater resources in northwest Minnesota.

Activity Milestones:

Description	Approximate Completion Date
Interpretation and resolution estimates of AEM survey data	May 31, 2028
Communication of results to affected communities	September 30, 2028
Publication of AEM survey results as MGS report	November 30, 2028
Data and reports published on the MGS Geophysical Portal	January 31, 2029
Submission of AEM survey results for journal publication	March 31, 2029

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?

This project will produce airborne electromagnetic (AEM) information necessary to aid in aquifer identification in parts of northwestern Minnesota and demonstrate the capabilities of this method for groundwater resource discovery. We will actively work with local and regional governmental units to determine if AEM could be beneficial to their groundwater conservation efforts. The results from this AEM reconnaissance will result in follow-up AEM studies in western MN targeting areas of greatest need, significant newly identified aquifer AEM anomalies, and additional AEM studies in other regions of MN to further preserve and delineate groundwater resources.

Project Manager and Organization Qualifications

Project Manager Name: Aaron Hirsch

Job Title: Geophysicist

Provide description of the project manager's qualifications to manage the proposed project.

PI Hirsch has been the geophysicist for the Minnesota Geological Survey (MGS) at the University of Minnesota-Twin Cities for the past 3.5 years where he has worked on geophysical projects across the state. Hirsch previously received his MA from Boston University in geophysics and a PhD at the University of Rhode Island's Graduate school of Oceanography with a focus in marine geology and geophysics before he was a postdoctoral fellow at the University of Minnesota. Prior to obtaining his advanced degrees, Hirsch worked at the University of Nevada Las Vegas performing various field geophysics programs and in the Geophysical Operations group within the ExxonMobil Exploration company (EMEC) where he designed, managed, and provided quality control to seismic operations across the globe.

PI Hirsch has a strong background in computational geophysics and project management of geophysical field programs. Hirsch designed and managed multiple large geophysical surveys while at EMEC and is currently in charge of multiple geophysics related programs at MGS. At MGS, Hirsch is co-author of over fifteen completed and ongoing county geological atlases and PI on two United States Geological Survey funded programs. Additionally, Hirsch has processed and interpreted multiple geophysical datasets at MGS and during his MA and PhD.

This project has a strong multi-disciplinary team. Dr. Anthony (Tony) Runkel is Lead Geologist of the MGS and has regional expertise in groundwater. Dr. Robert (Bob) Tipping is Director of the MGS with expertise in geologic modeling and groundwater. The geology staff at MGS have a combined 50+ years of experience mapping the sand and gravel aquifers in Minnesota.

Organization: U of MN - MN Geological Survey

Organization Description:

The Minnesota Geological Survey (MGS) was established in 1872 by the State of Minnesota as part of the University of Minnesota. The MGS, with approximately 30 staff, is the geological mapping agency for the State of Minnesota and the research and service arm of the N.H. Winchell School of Earth and Environmental Sciences department in the College of Science and Engineering. The MGS serves the people of Minnesota by providing systematic geoscience information to support stewardship of water, land, and mineral resources. MGS geologic mapping and research supports informed land use management and decision-making that protects and wisely allocates resources, and the MGS works closely with university, government, industry, and community partners to ensure we respond to the diverse needs of Minnesota.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineli gible	% Bene fits	# FTE	Class ified Staff?	\$ Amount
Personnel								
Project Investigator / Geophysicist		The lead researcher with overall responsibility of the grant; in charge of project management, liason with contractors, processing of all data sets, and interpretation.			32.3%	0.4		\$43,600
Tony Runkel		Lead Geologist; will provide general subsurface and groundwater expertise.			36.3%	0.02		\$3,250
Quaternary geologist		Will provide Quaternary geology expertise to data interpretation.			32.3%	0.17		\$11,000
Precambrian geologist		Provide Precambrian geology expertise to data interpretation			32.3%	0.06		\$6,000
Paleozoic geologist		Provide Paleozoic expertise to data interpretation			32.3%	0.04		\$5,000
GIS Staff		Support the creation and publishing of the AEM data			32.3%	0.08		\$8,750
Borehole geophysics staff		Support the collection of the borehole geophysics ground truth program			32.3%	0.04		\$4,000
MGS Director		Support assessment of AEM aquifer characterization			36.3%	0.02		\$3,500
Field Technician		Support the collection of ground-based geophysical data			32.3%	0.04		\$1,900
							Sub Total	\$87,000
Contracts and Services								
United States Geological Survey	Subaward	AEM training and consultation in data processing, field QA/QC, and interpretation				0.1		\$34,000
Aqua Geo Frameworks	Service Contract	Provide airborne electromagnetic (AEM) expertise for the survey design, field QA/QC, data processing, and interpretation.				0.4		\$46,000
SkyTEM	Service Contract	Collect and minimally process the airborne electromagnetic (AEM) data including producing final reports and maps				0.25		\$450,000
							Sub Total	\$530,000

Equipment, Tools, and Supplies							
						Sub Total	-
Capital Expenditures							
		Geophysical software - Geoscene3D	Software will be used for data visualization and interpretation	Х			\$17,500
		Aarhus Workbench EM processing software	Software required for airborne electromagnetic (AEM) data processing and data QC	х			\$25,000
						Sub Total	\$42,500
Acquisitions and Stewardship							
						Sub Total	-
Travel In Minnesota							
	Miles/ Meals/ Lodging	2 trips each for 4 days travel; \$440 lodging (\$110x4); \$272 per diem (\$68x4); \$256 vehicle (\$64x4); \$169 mileage (\$0.26/mile at 650 round trip to Thief River Falls)	Travel to survey area for mobilization and initial community engagement				\$2,300
	Miles/ Meals/ Lodging	17 days of borehole geophysics; \$1870 lodging (\$110x17); \$1156 per diem (\$68x17); \$1275 borehole van (\$75x17); \$444 mileage (.37/mile at 1200 miles in NW)	Use of the Minnesota Geological Survey borehole geophysics van to collect measurements for AEM ground truthing				\$4,800
	Miles/ Meals/ Lodging	4 days travel to region; \$440 lodging (\$110x4); \$272 per diem (\$68x4); \$256 vehicle (\$64x4); \$338 mileage (\$0.26/mile at 1300 round trip with two trips to Thief River Falls)	Travel to northwest Minnesota to communicate results to public				\$1,400
						Sub Total	\$8,500
Travel Outside Minnesota							
						Sub Total	-
Printing and Publication							

	Publication	Publication of results in national scientific journal	Communicate results of the AEM survey to the scientific community			\$5,000
	Printing	Mobilization community engagement printing	Print material and posters for the mobilization community engagement			\$250
	Printing	End of project community engagement printing	Printing of materials and posters to present the interpreted results to communities			\$250
					Sub Total	\$5,500
Other Expenses						
		Rental and shipping of borehole geophysical equipment	Rent borehole geophysics downhole probe to measure conductivity as part of the ground truthing program			\$5,000
		Rental and shipping of ground-based electromagnetic equipment	Geophysical equipment will be used to quality control the airborne EM data collection			\$7,500
					Sub Total	\$12,500
					Grand Total	\$686,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Capital Expenditures		Geophysical software - Geoscene3D	Speciallized computer software required for the completion of this project. This is not listed as a generally ineligible expense. Additional Explanation : Software is specialized for 3D geological modeling and AEM data interpretation. Software license is a 1 year license and is not transferable.
Capital Expenditures		Aarhus Workbench EM processing software	Speciallized computer software required for the completion of this project. This is not listed as a generally ineligible expense. Additional Explanation : Software is specialized for EM data processing. Software license is for a single year and is not transferable

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub	-
			Total	
Non-State				
In-Kind	United States Geological Survey (USGS)	These funds will be used by the USGS personnel working on this project	Potential	\$6,000
		to cover expenses that are generally inelligible		
			Non State	\$6,000
			Sub Total	
			Funds	\$6,000
			Total	

Total Project Cost: \$692,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component File: c55601b6-dc0.pdf

Alternate Text for Visual Component

Cartoon diagram of the helicopter airborne electromagnetic (AEM) method and the proposed location of the AEM survey....

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
Letter of support from Red Lake Soil Water Conservation	<u>b4bc2e97-04b.pdf</u>
District	
Letter of support from West Polk Soil Water Conservation	40ad9f85-e0c.pdf
District	
Letter of support from Polk County Environmental Services	44b74f98-5a7.pdf
USGS letter of support	42d247d3-d86.pdf
UMN SPA Letter	<u>16611d82-7a4.pdf</u>

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Do you understand that travel expenses are only approved if they follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I understand the UMN Policy on travel applies.

Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?

No

- Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10? N/A
- Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF? N/A
- Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing \$10,000 or more or large-scale stream or wetland restoration?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care, treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this proposal:

Tony Runkel and Bob Tipping, Minnesota Geological Survey

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

Yes, I understand