Minnesota Ground Water Association
www.mgwa.org
Newsletter

September 2018
Volume 37, Number 3

Featured:

MGWA President Ellen Considine

Inside:

President's Letter

Ellen J. Considine, P.G., DNR

As kids are going back to school, the recently re-formed Education Committee is considering the many ways it could support groundwater education. We struggled with this topic when I served on the Groundwater Education Gaps White Paper Committee. School curricula are packed, so it hardly seems fair to put more on primary and secondary teachers, yet reaching young students has the potential for greatest impact. Put another way: teaching teachers and students about groundwater gives us the best chance at having future citizens and decision makers who understand groundwater. Educating adults is inherently more challenging because there is not a "common core" for adults. I found the challenges in both primary/secondary and adult education daunting, and by the time the White Paper Committee had drafted the Groundwater Education Gaps White Paper, I did not feel optimistic about lessening the groundwater education gap.

My optimism returned today, when I had the opportunity to see fantastic groundwater education in action today at the Minnesota State Fair. It was Water Day at the DNR building, and water professionals representing all aspects of hydrology were onsite. I was, of course, most interested in a demonstration of a 'sandbox' groundwater flow model, and I was not alone. A crowd of kids and adults stayed through the whole demonstration, paid rapt attention, and asked lots of questions. Some adults even stayed for more than one demonstration. As a groundwater professional, I often forget that not everyone understands what an aquifer is, much less how to protect it. And I am sometimes discouraged that it seems like people don't care anyway. But there at the state fair was a throng of people who could have been eating something fried on a stick or getting spun about at the midway, and instead they chose to learn about groundwater.

For scientists and engineers, educating and communicating with the public often isn't our top priority. We think we don't have time, we dismiss the audience as uninterested, or (as in my case) we are overwhelmed with the task. Yet I saw at the state fair that, when the public is presented with an accessible, approachable opportunity to learn about groundwater, they will take it and (excuse the pun) squeeze every last drop of knowledge out of the experience. I left the state fair today with optimism about the public's hunger for groundwater education, and I am eager to see how the Education Committee addresses the challenge.

MGWA Members Present Results of Drain Tile and Groundwater Recharge Report to the Legislative Water Commission

By Ellen Considine, MGWA President

Jim Stark, Director of the Legislative Water Commission (Commission), invited MGWA to present the findings of White Paper #3 ***Drain Tiles and Groundwater Resources: Understanding the Relations*** to the Commission. A group consisting of Dr. Kristen Blann (an author of the White Paper), Andrew Streitz (liaison to the White Paper Committee), and Ellen Considine (MGWA President) attended the August 21, 2018 meeting of the Commission. We spoke about MGWA's mission and about the findings of the White Paper and answered the Commission's questions.

In particular Kristen's presentation focused on the (1) the apparent widespread and growing use of drain tile in Minnesota, and (2) the lack of information about how drain tile affects or interacts with groundwater recharge. The Commission asked questions about groundwater in general, about the lack of data relating to drain tile, about farming practices, and about government policies that may influence tiling practices.

Overall the experience was a positive one; we were honored to have been invited, and we hope the Commission considers the White Paper's findings. I would encourage members who are interested in the activities of the Commission to observe a meeting or to participate in a Commission stakeholder group.

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Visit www.mgwa.org for MGWA information between newsletters and to conduct membership and conference transactions.

Newsletter Deadlines

Issue	Due to Editor
December '18	11/16/2018
March '19	02/02/2019
June '19	05/03/2019
September '19	08/02/2019

MGWA MEMBER NEWS

Randy Ellingboe Retires as Manager of the Drinking Water Protection Section at MDH

I retired in July as State Drinking Water Administrator and Manager of the Section of Drinking Water Protection in the Minnesota Department of Health, having served in that role since 2008. I thoroughly enjoyed this job for the opportunity to bring public health and water resource protection efforts together through this program. This position allowed me to learn from and collaborate with colleagues in our own Section and Department, as well as many partners in other state, federal, and local water resource programs. I came to a much greater appreciation of the complexities of day-to-day delivery of drinking water to the public, and of the dedication of public water owners and operators, state and federal drinking water staff, Met Council, MGWA and AWWA members, and MN Rural Water Association staff. I am grateful to have made friends and colleagues in earlier work experiences at the MN Dept. of Labor and Industry Plumbing Unit, MPCA in feedlots regulation and nutrient management, and the University of Minnesota Department of Agronomy. Each of these job experiences proved useful as we worked with colleagues to help public water systems protect drinking water from source to tap. I was also given an incredible opportunity to serve as the president of the Association of State Drinking Water Administrators (ASDWA) in 2017. ASDWA gave me the chance to interact with associates from across the country, including at EPA, USGS, state drinking water programs, and organizations like ACWA, ECOS, ASTHO, and GWPC.

In retirement I hope to work more around our hobby farm and our land up north, do more horseback riding, and find time to write and draw. I expect to find opportunities to volunteer and also intend to keep in contact with friends from these work experiences. Our three daughters live out west and my wife Lynn and I enjoy traveling to see them as often as we can. We also hope to see more of the fascinating world we live in.

Hans Neve Promoted to Manager at MPCA

Hans Neve has moved into a new management role at MPCA. Previously Hans was leading the MPCA's vapor intrusion work as well as the ongoing efforts to grow the availability of data and information in a self-service accessible format, the Groundwater Contamination Mapping Project is one example. With the promotion he will be continuing to lead remediation program data access projects but will begin to transition out of vapor intrusion work so he can take on additional duties. The new work includes managing the Closed Landfill Program, the MPCA Emergency Management Team, the Remediation Division Engineering Team and MPCA's Natural Resource Damage Assessment Program.

Jim Pennino Retires from the MPCA

Jim Pennino, a hydrologist with the MPCA's Petroleum Remediation Program, is retiring from the agency in August. Jim's first job as a hydrogeologist was while on active duty in the Army in 1975. The well water for Fort Riley, Kansas, had too much iron. They asked him to see if there was an alternative source of groundwater. Unfortunately, there was no better aquifer for them to tap into. That was 43 years ago including eight years at the Ohio EPA; four years at Leggette, Brashears, and Graham; and 30 years at the MPCA. Some of his best years have been working with the people at the MPCA. Jim said that he was lucky to have worked in the environmental field with many dedicated people and to have been able to do a little science. Gathering and analyzing groundwater chemistry data has always been fun and often his reason for getting up in the morning. He enjoyed a career that allowed him to do that kind of work.

He is a creature of habit and not coming into work after so many years is going to be really different and a little scary. But, he is looking forward to spending more time with his granddaughters and his friend, Irene. He will also remain active advocating for environmental protection.

Paul Stock Retires from the MPCA

Paul Stock retired from the Minnesota Pollution Control Agency (MPCA) on July 25, 2018. Paul grew up on his family's farm east of Mahnomen, MN, and picking rocks in the grain fields led to a fascination with geology. Paul attended the University of Minnesota Morris (UMM) and majored in Geology. After graduating from UMM Paul completed graduate studies in geology at Louisiana State University.

In 1980 Paul began his geology career as a coal exploration and mine development geologist for The North American Coal Corporation. Mining requires understanding and managing groundwater behavior; so Paul began to appreciate the field of Hydrogeology. In 1988, Paul joined Delta Environmental Consultants (now Antea Group); first working out of Charlotte, NC before moving back to Minnesota during 1990, working out of Delta's St. Paul office.

While with Delta, Paul completed Hydrogeology course work at Wright State University. In 1998, Paul began working for the Minnesota Deptartment of Agriculture in the Incident Response Unit where he oversaw investigation and remediation of nutrient and pesticide releases.

In 1999, Paul joined the MPCA where he worked in the Remediation Division out of the MPCA's Detroit Lakes Regional Office. While working for the MPCA, Paul began working with high resolution site characterization tools, including Laser-Induced Fluorescence (LIF), to map the distribution of Light Non-Aqueous Phase Liquids (LNAPL) in the subsurface. Based on what he learned about LNAPL behavior in the subsurface, Paul was invited to join the Interstate Technology Regulatory Council's LNAPL Team. He was appointed Co-Team Leader and was one of the instructors for the 2-Day LNAPL Classroom Training courses that were held across the country, including in Minnesota during 2011.

After retiring Paul plans to spend more time with his family, including his wife, parents, siblings, two sons, and a new granddaughter. Besides spending as much time as possible with their new granddaughter, Paul and Ronda plan to do some traveling; and Paul plans to bring his rock-hammer with in hopes of adding to his rock, mineral, and fossil collection.

2018 MGWA Board

MGWA Primary Objectives

- Promote and encourage scientific and public policy aspects of groundwater as an information provider.
- Protect public health and safety through continuing education for groundwater professionals.
- Establish a common forum for scientists, engineers, planners, educators, attorneys, and other persons concerned with groundwater.
- Educate the general public regarding groundwater resources.
- Disseminate groundwater information.

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Abbreviations and Acronyms

- ASTM – American Society for Testing and Materials
- DNR – Minnesota Department of Natural Resources
- MDA – Minnesota Department of Agriculture
- MDH – Minnesota Department of Health
- MGS – Minnesota Geological Survey
- MPCA – Minnesota Pollution Control Agency
- USEPA or EPA – United States Environmental Protection Agency
- USGS – United States Geological Survey

MGWA NEWS

Second Call for Abstracts

New Deadline: September 30, 2018

Minnesota Ground Water Association Fall Conference

November 15, 2018

University of Minnesota Conference and Continuing Education Center St Paul, MN

The conference is now accepting abstracts for 20-minute oral presentations. Abstracts must be no more than 250 words. The preferred topic is regional groundwater planning, though other topics may be given consideration. Special consideration will be given to abstracts which pertain to groundwater planning "failures" or "near-failures." Abstracts are not required to pertain specifically to Minnesota; case studies from all geographies are welcome.

Successes, Near-misses, and Failures — Regional Groundwater Planning

The MGWA Fall Conference will present examples of successes, near-misses, and failures in regional groundwater planning. Presenters will include scientists, engineers, planners, and others who are thinking about how we use our groundwater resources. We will examine real-world events to learn what can be done better and what worked well.

Although we live in the land of 10,000 lakes, our population is growing and using more groundwater. Because groundwater is largely "invisible", society often does not know the pulse of groundwater as we know the pulse of our rivers and lakes. Consequently, it can be, and sometimes has been, taken for granted as a limitless resource.

When we think about groundwater supply planning, or failure to plan, we often think of dramatic effects in dry climates, like land surface subsidence in the San Joaquin Valley in California. But the importance of groundwater supply planning is becoming evident closer to Minnesota. In Waukesha County, Wisconsin, several hundred feet of groundwater level decline has necessitated pumping groundwater from deeper aquifers that are tainted with naturally occurring radium. Recently, the Des Moines Water Works in Iowa sued three upstream agricultural drainage districts, claiming that the drainage districts had contaminated the Raccoon River, a major water-supply source, with nitrates. And in the Twin Cities metropolitan area, model predictions forecast substantial groundwater level declines in several areas with growing populations over the coming decades.

Adding to the already-complex science of groundwater is the complexity of human nature and our laws. Western states have water rights where the water is allocated according to whoever started using the water first. In Minnesota, everyone has a "riparian right" to enough water to meet their household's needs. For water use exceeding household needs, Minnesotans obtain a water appropriations permit. In Minnesota, first in time does not equal first in right. Instead, in times of shortage water is allocated according to how the water is used: domestic use is first priority and nonessential use is lowest priority. Our riparian water rights system is challenging to administer, especially in the land of 10,000 lakes where the public sees the abundance of water on the land surface. However, our many lakes do not always equate to an abundant, quickly replenished groundwater supply. Likewise, our use of groundwater can cause a public outcry if it affects a popular lake or stream.

As we plan for groundwater use for a growing population with changing needs during a time of climate change, we are faced with a challenge that is new to us but not to others. Speakers from Minnesota and around the world will describe a breadth of groundwater planning experiences that range from technical to administrative and beyond. The speakers will share their successes, near misses, and failures in regional groundwater planning.

Registration

To register, go to the Conference webpage. The early registration deadline is November 2, after which the cost is slightly higher.

Call for Lightning Talks

If you would like to present a short and direct five-minute talk ("lightning talk") pertaining to Minnesota groundwater or the conference theme, please fill out the Lightning Talk Application Form (found on the Conference webpage) and send to Ellen Considine (president@mgwa.org) by November 1st.

Call for Posters

If you would like to present a poster pertaining to Minnesota groundwater or the conference theme, please fill out the Poster Submission Form (found on the Conference webpage) and send to Ellen Considine (president@mgwa.org) by November 1st.

New Division Director for the DNR Ecological and Water Resources

Luke Skinner, Division Director for the DNR Ecological and Water Resources (EWR), accepted the position of Associate Superintendent at Three Rivers Park District. His last day was July 10. His 28 years with the DNR included building the invasive species program and serving as Deputy Director of the Division of Parks and Trails. His new position will allow him to test new waters while continuing to pursue his passion for outdoor recreation, connecting people with the outdoors, and natural resource management.

Steve Colvin (pictured) was appointed as the new Director. Steve has been with DNR for 38 years, including 32 years in Ecological Services which became Ecological Resources, which merged with the Division of Waters to become EWR. He has been Deputy Division Director since 2013 and prior to that he supervised the division's environmental review unit.

While Steve's position was vacant, EWR section managers Jason Moeckel and Ann Pierce served as the acting deputy directors.

Featured Photo

Visitors to the Eco Experience water bar at the state fair are offered a chance to compare and contrast drinking water samples from across the state, and learn about how the State works to keep this water clean.

Clay County Geologic Atlas, Part B

By Jim Berg

Part B of the Clay County Geologic Atlas was recently published by the DNR. Part B covers groundwater conditions and pollution sensitivity. It expands on the Part A geologic atlas previously published by the Minnesota Geological Survey in 2014.

Clay County is located in northwestern Minnesota and is mostly agricultural and rural with small towns. Moorhead (western border) has the largest area of developed land and is the largest user of water. The county lies within the watersheds of the Red River (Upper and Marsh River portions), Wild Rice River, Buffalo River and Otter Tail River. The Red River forms the western border and is the largest river in the region. The western half of the county is part of a glacial lake plain and has little topographic relief and few lakes or wetlands. The eastern part has higher land elevations, a hummocky topography, and numerous lakes and wetlands.

Glacial history

The regional topography and distribution of surficial deposits of Clay County were created as multiple glacial ice lobes advanced into and retreated from the area during the last ice age. Multiple advances of the Wadena lobe from the northeast created thick sediment layers regionally, resulting in high elevations and hummocky topography in the eastern portion of the county. This dominates the west-central part of the state and is commonly referred to as the Alexandria moraine. Each advance deposited layers of sand and gravel, and till (also known as diamicton, a fine-grained glacial deposit of unsorted sand, silt, and clay). These deposits formed the Hewitt Formation.

After the final retreat of the Wadena lobe the source of glacial movement shifted. Several advances of the Des Moines lobe came from the north and northwest and deposited sand and gravel and thick till deposits of the New Ulm, Goose River, and Red Lake Falls formations. These formations overlapped the Alexandria moraine to the east.

In the final phase of the ice age in this region, a great mass of ice in Canada melted and formed a large glacial lake that extended into Minnesota (Lake Agassiz). Sediment from this lake settled into a layer of clay up to 140 feet thick in the western portion of the county, burying and isolating most of the sand and gravel aquifers by a thick layer of impermeable clay.

Groundwater flow

The report includes nine potentiometric surface maps representing the groundwater flow for all the buried sand aquifers. All the potentiometric surface maps show a general pattern of west and northwest flow toward the Red River. Converging groundwater flow patterns due to pumping are apparent in the Moorhead area on maps of five aquifers or aquifer groups.

Groundwater chemistry

To better understand groundwater movement and pollution sensitivity in the county, 89 groundwater samples were collected for this project from wells in a range of aquifers. These samples were analyzed for major cations and anions, trace elements including arsenic and manganese, stable isotopes of hydrogen and oxygen,

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Clay County Geologic Atlas, cont.

and residence time indicators – tritium and carbon-14. The data were combined with water sample data from other agencies and a previous DNR report to produce the figures in the report. Agencies that supplied additional data included the MDH and the MPCA.

Stable isotopes

Stable isotopes of oxygen and hydrogen were used to determine the groundwater and surface-water interactions and to infer the relative ancient atmospheric temperature of the precipitation that is now in aquifers.

The majority of the Clay County samples plot along the meteoric water line (**Figure 1**) which indicates that these samples are from precipitation (rain and snow melt) that infiltrated directly into the subsurface and did not reside for long periods in lakes or other surface-water bodies. This group of direct infiltration samples can be further divided into samples that were from snow and ice melt from the last ice age (glacial), samples from precipitation that fell after the last ice age (post-glacial), and mixtures of those two endpoints (glacial and post-glacial).

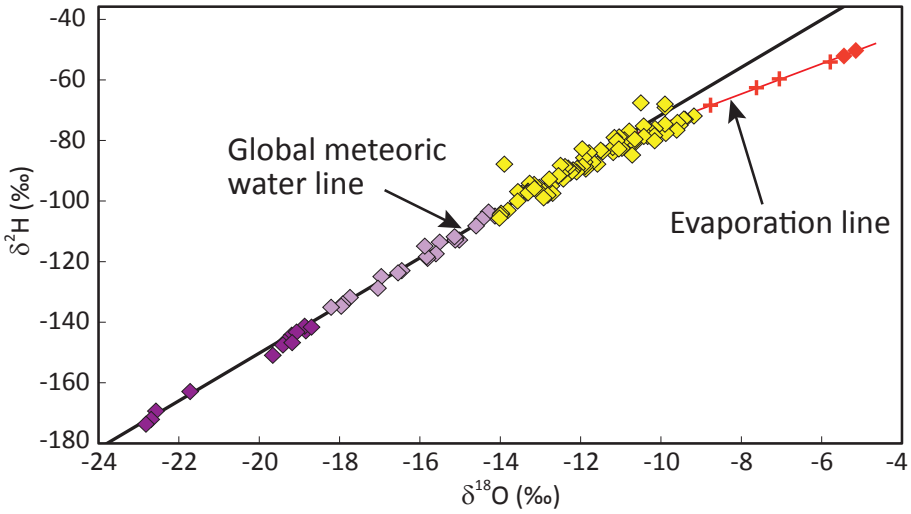

Figure 1. Stable isotope values from water samples are compared to the global meteoric water line. See legend in Figure 2.

The groundwater that were affected by evaporation from surface water plot on the far right of the graph along a trend that has a lower slope than the global meteoric water line. These include four surface-water samples for reference and two groundwater samples from the southeastern part of the county.

The light isotopic sample values plot on the lower left and occur mostly in the western portion of the county (**Figure 2**) beneath the Lake Agassiz clay (Sherack and Brenna formations). This light isotopic signature indicates the precipitation was from a very cold ice-age climate that existed across Minnesota and North America. After the glaciers receded, post-glacial recharge of heavy isotopic water mixed with and replaced these light isotopic waters in all but the most isolated aquifers, such as those beneath the impermeable Lake Agassiz clay. Carbon-14 residence times are shown on Figure 2 for reference.

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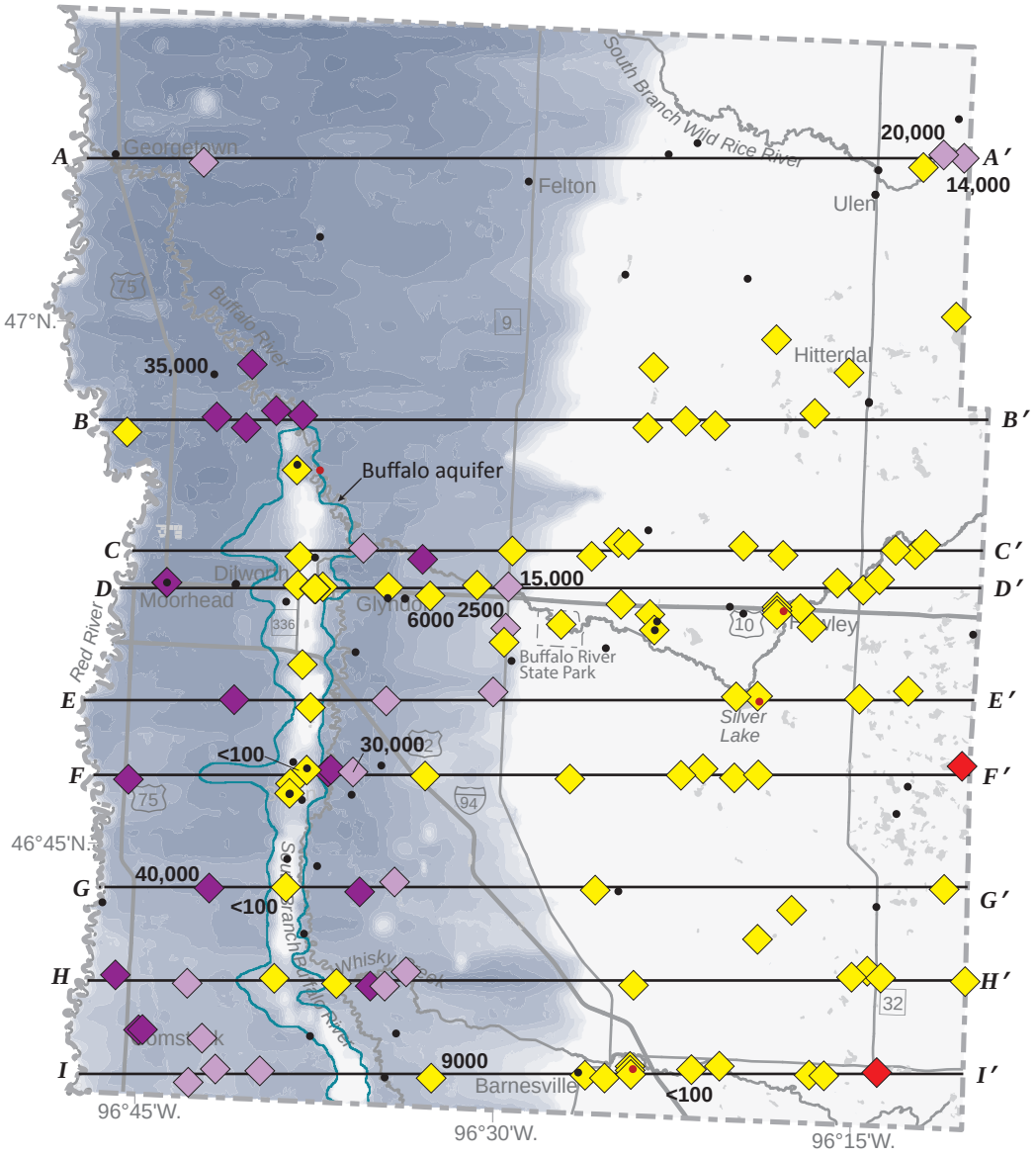

Groundwater source from stable isotope characteristics

- Glacial ice meltwater
- Mixed glacial ice meltwater and post-glacial precipitation
- Mostly post-glacial precipitation
- Evaporative signature
- Evaporative signature, surface water
- No data

Symbols and labels

15,000 Carbon-14 (14C): if shown, estimated groundwater residence time in years.

Lake Agassiz clay thickness

0 feet

138 feet

Figure 2. Groundwater stable isotope characteristics, carbon-14 residence time, and extent of Lake Agassiz clay

Chloride

This anion is an anthropogenic contaminant in the Buffalo aquifer area and at scattered locations in the eastern part of the county (**Figure 3**) mostly in the upper (shallowest) aquifer groups (rlf, gr, and nh). Otherwise, most of the elevated chloride in groundwater samples is from natural sources.

In Clay County, chloride/bromide ratios less than 250 indicate that the chloride is likely from a deep natural source, based on comparisons with other chemical data and published references. Natural sources in the western part of the county could be from chloride that was retained from the inclusion of connate brine deposited with the marine sediments. Flow through the underlying materials (glacial sediments and Cretaceous and Precambrian bedrock) is very slow and flushing of the natural chloride is limited, similar to the relict glacial ice meltwater retained in

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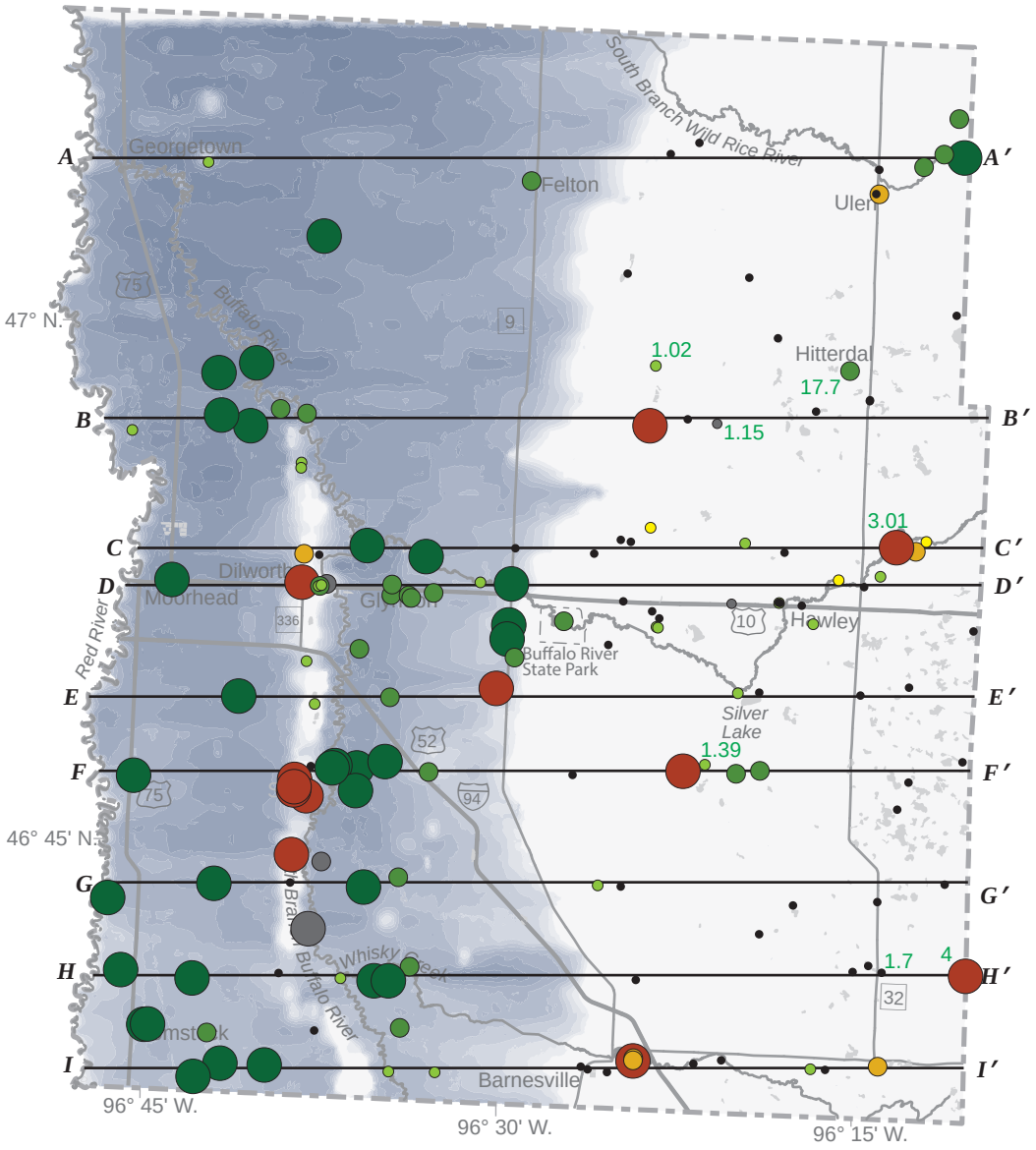

Naturally elevated (Cl/Br<250) chloride in ppm
- Cl ≥5–10
- Cl >10–20
- Cl >20

Anthropogenic (Cl/Br>250) chloride in ppm
- Cl ≥5–10
- Cl >10–20
- Cl >20

Source of chloride unknown chloride in ppm
- Cl ≥5–10
- Cl >10–20
- Cl >20–30

Other

Lake Agassiz clay thickness
- 0 feet
- 138 feet

Symbols and labels

Figure 3. Chloride and elevated nitrate concentrations

aquifers beneath the Lake Agassiz clay. Conversely, the lack of anthropogenic chloride in buried aquifers in the western portion of the county is because of the protective effect of the Lake Agassiz clay.

Arsenic

Of the 133 samples tested for arsenic in Clay County, 117 (88 percent) had values above the reporting limits, indicating a natural water quality problem for the majority of well owners in the county. Detectable arsenic values were found in all sampled aquifers or aquifer groups with one exception. A similar high proportion of elevated arsenic values in Clay County groundwater (74 percent were greater than 2 ppb) have been found in samples collected from 2008 to 2016 in new private wells (MDH, 2018b).

Pollution sensitivity and hydrogeologic cross sections

The report contains two types of pollution sensitivity maps: pollution sensitivity of near surface materials (one map) and buried aquifer or aquifer group sensitivity (11 maps). An example of a buried pollution sensitivity map is shown on **Figure 4** for the Buffalo aquifer, which is pumped by Moorhead Public Service to provide part of the City of Moorhead's water supply. The Buffalo aquifer has a limited extent and shallow glacial outwash deposit with a wide range of pollution sensitivities. Understanding this sensitivity and managing land use above the aquifer is vital for long-term water quality preservation of this critical resource.

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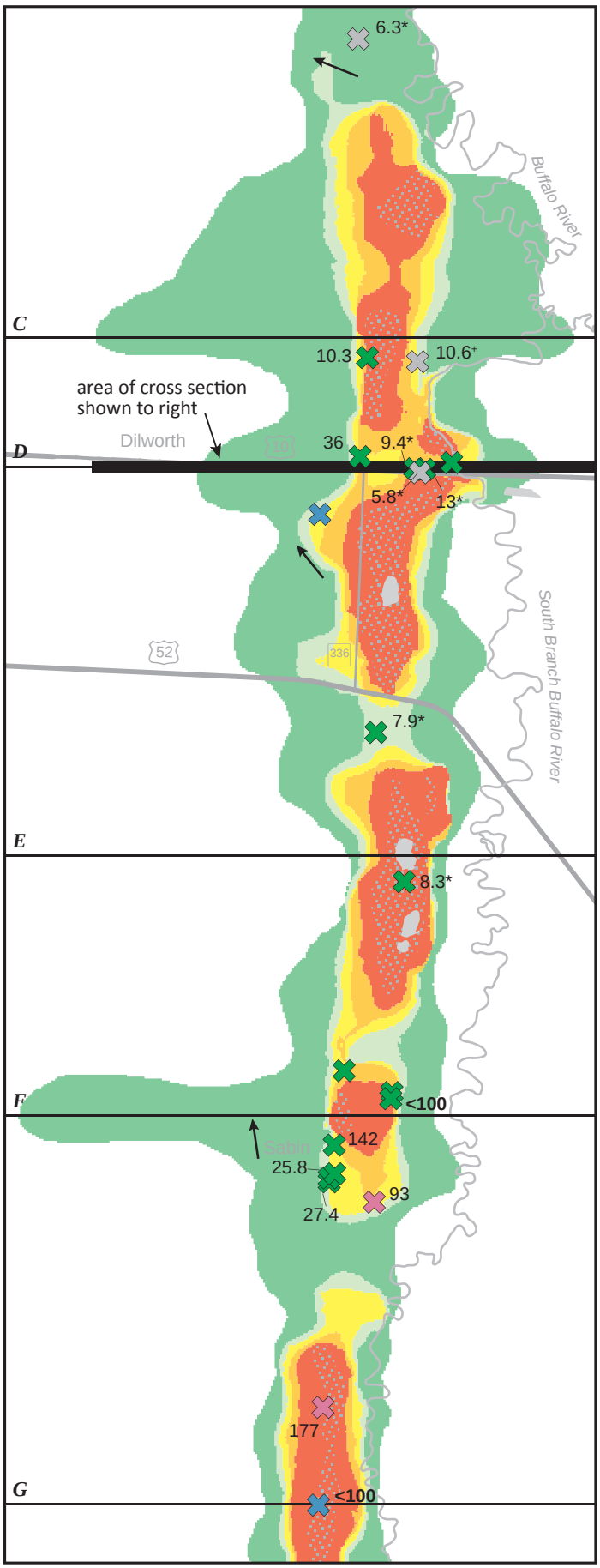


Pollution sensitivity rating

Estimated vertical travel time.

- Very High
- High
- Moderate
- Low
- Very Low

Tritium age

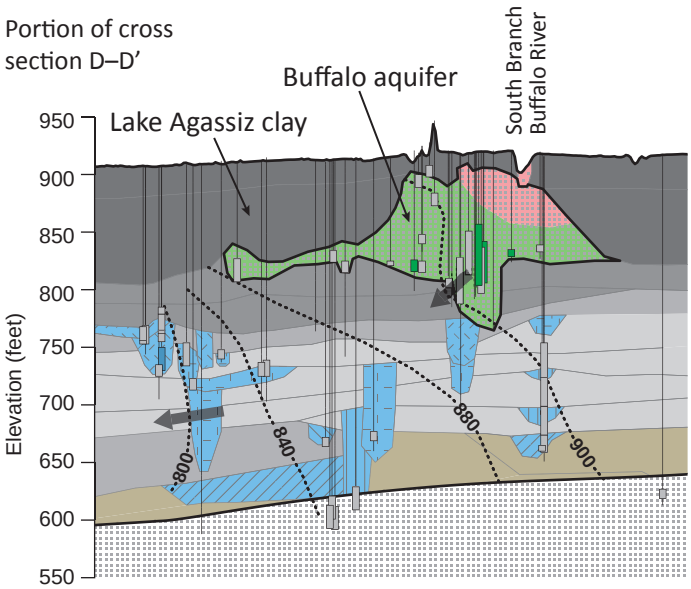
Symbol color indicates tritium age of water sample.

- Recent
- Mixed
- Vintage
- Not sampled for tritium.

Symbols and labels

- 27.4 — Chloride ≥5 ppm. (* naturally elevated, + source unknown)
- <100 — Carbon-14 (^{14}C): if shown, estimated groundwater residence time in years.
- Groundwater flow direction
- Aquifer at surface

Figure 4. Pollution sensitivity of the Buffalo aquifer



Tritium age

- Recent
- Mixed
- Vintage
- Well not sampled for tritium.

Symbols and labels

- General groundwater flow direction
- ····1040···· Approximate equipotential contour

Figure 5. Cross section D-D', western portion showing the Buffalo and underlying aquifers.

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Clay County Geologic Atlas, cont.

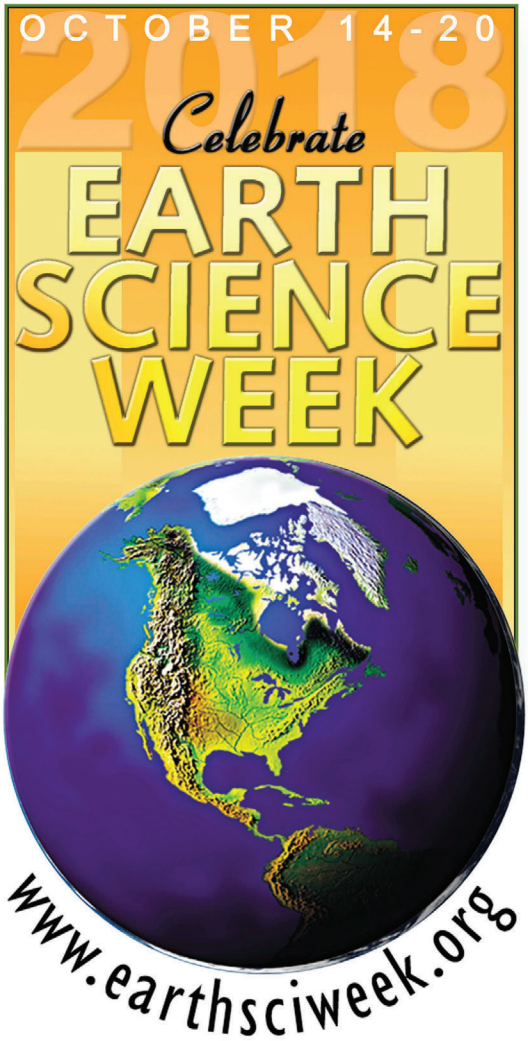
On the cross section view of this area (**Figure 5**) the Buffalo aquifer is shown as a somewhat unusual sand and gravel deposit (colored green and pink for mixed and recent tritium age) partially overlain by glacial lake clay formations (sl – Sherack and bl – Brenna) from glacial lake Agassiz deposition. Beneath the Buffalo aquifer is a complicated stack of older till layers (aquitards) and sand aquifers. These aquifers are typically hydraulically isolated and recharge very slowly. Evidence of this general condition includes vintage tritium ages (tritium values below method detection limit), elevated natural chloride, and light isotopic signatures. The actively recharged Buffalo aquifer stands in stark contrast to these relatively old and isolated aquifers because of the overlying impermeable Lake Agassiz clay.

For more information:

Clay County Geologic Atlas, Part B

DNR County Geologic Atlas program, Part B

For Part A and to purchase paper copies of this atlas: MGS



County Geologic Atlas Mapping in Minnesota's Arrowhead Region, St. Louis and Lake Counties.

Mark Jirsa, Kaleb Wagner, and Jennifer Horton
Minnesota Geological Survey (MGS)

The MGS is beginning year 4 of a 6-year effort to create Part A County Geologic Atlases for St. Louis and Lake counties in Minnesota's "Arrowhead region." The two-county area includes parts of the Boundary Waters Canoe Area Wilderness, Voyageurs National Park, Superior National Forest, several State forests, and major watersheds. It also includes parts of the Mesabi Iron Range, the "Cu-Ni District," and the Duluth metropolitan area–the 4th largest in Minnesota. Because these are two of the largest counties in the state, we've divided them for mapping purposes into three subareas for bedrock and four for surficial mapping (**Figure 1**). Work in each subarea involves one or more seasons of field mapping by four to six geologists, rotary-sonic drilling, trenching, and acquisition of drill hole, compositional, petrographic, geochronologic, and geophysical data. Work in the Central Arrowhead subarea is complete, including all components of a typical geologic atlas Part A—database, bedrock and surficial geology, bedrock topography and depth to bedrock, Quaternary stratigraphy, and sand distribution models. Components of the other subareas are in various stages of completion. To make the data available in a timely manner to individuals, agencies, and companies conducting studies in the region, preliminary products for all subareas are being published as they become available. The on-going repository for these products is MGS Open-File Report OFR2016-04. Once preliminary work in all subareas is published, the data will be recombined into county geologic atlases, currently targeted for completion by 2021.

Creation of these products is "team sport," involving 14 staff members from MGS and several from partner agencies. Mapping is conducted primarily at 1:24,000-scale, with printable products that are generalized from the companion digital data sets to scales of 1:100,000 to 1:200,000. This region differs significantly from those of prior atlas projects in many ways. Collectively the area is 10 times the size of the average Minnesota county. Crystalline bedrock lies at and near the land surface in much of the area. Pervasive chemical weathering and glacial erosion of bedrock created rugged topography, with limited road, trail, and water access in much of the area. Glacial sediments are comparatively thin, diverse, and commonly coarse-grained. These challenges required some new methods, with additional costs and time. Support is provided by the Environment and Natural Resources Trust Fund (as recommended by Legislative-Citizen Commission on Minnesota Resources—LCCMR), the USGS National Cooperative Geologic Mapping Program, and the Boards of Commissioners of St. Louis and Lake counties. County staff contribute in-kind effort by verifying locations of drill holes corresponding to records that are added to the County Well Index (CWI). In addition, staff members from the DNR Division of Ecological and Water Resources are conducting conventional seismic work to augment our mapping efforts and prepare for their construction of Parts B of the atlases.

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County Geologic Atlas Mapping in the Arrowhead, cont.

The region's bedrock includes portions of the Archean Superior Province (granite, greenstone, schist, gneiss, migmatite), Paleoproterozoic strata including the Biwabik Iron Formation, and Mesoproterozoic volcanic and intrusive rocks of the North Shore Volcanic Group and Duluth Complex (**Figure 2**). The latter hosts polymetallic mineral deposits under consideration for new mining. The bedrock in much of the region has been mapped to varied levels of detail in the past, driven in part by the pursuit of metallic mineral deposits and the geologic settings that might host them. Despite this, our current effort identified many gaps in data and detail, and it attempts to fill those voids and integrate the disparate sources of information. One of the more geologically interesting aspects of recent work is the recognition that chemical weathering of bedrock prior to glaciation (likely during the Cretaceous and earlier time periods) played a fundamental role in shaping the region's land-surface, bedrock topography, bathymetry, surficial geology, hydrogeology, and ecology. In this region where bedrock is at and near the land surface, recent field work indicates that differential erosion of saprolitic (weathered) bedrock reflects both the compositional and structural attributes of the rock. Essentially, the rugged bedrock surface in much of the area represents the somewhat transitional boundary between fresh and weathered rock. Remnants of saprolitic bedrock are

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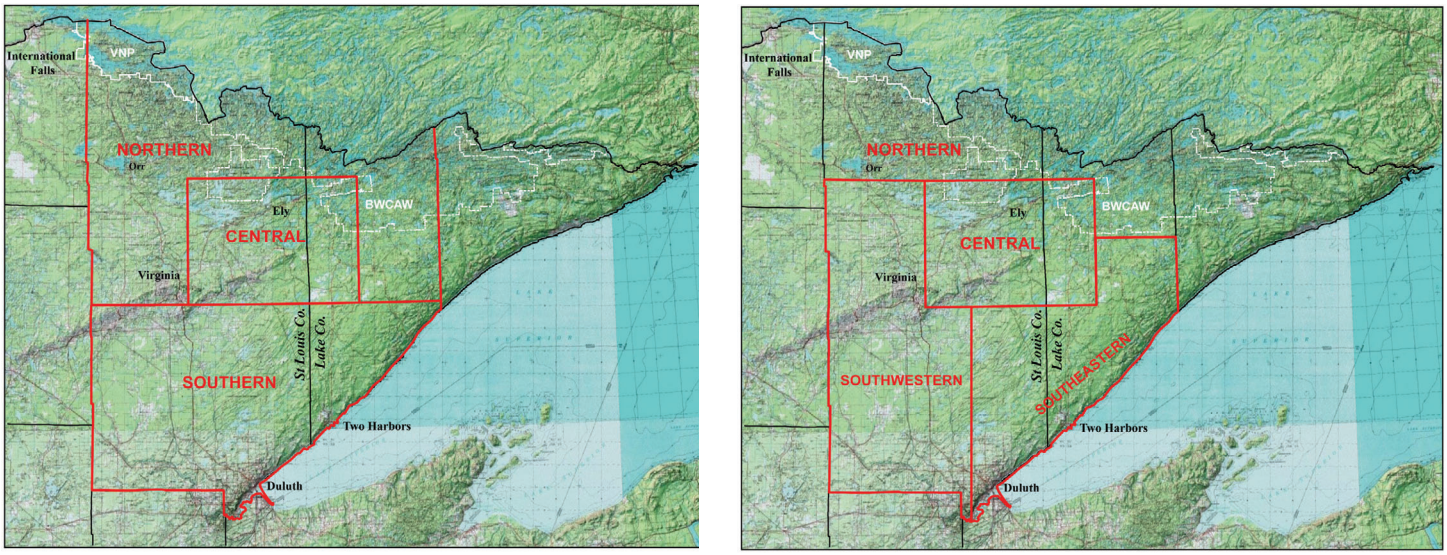

Figure 1. Maps of the arrowhead region showing county boundaries (black lines), Voyageurs National Park (VNP) and Boundary Waters Canoe Area Wilderness (BWCAW) boundaries (white lines), and the location of mapping subareas (red lines). Left image shows three bedrock subareas; right image shows four surficial subareas.

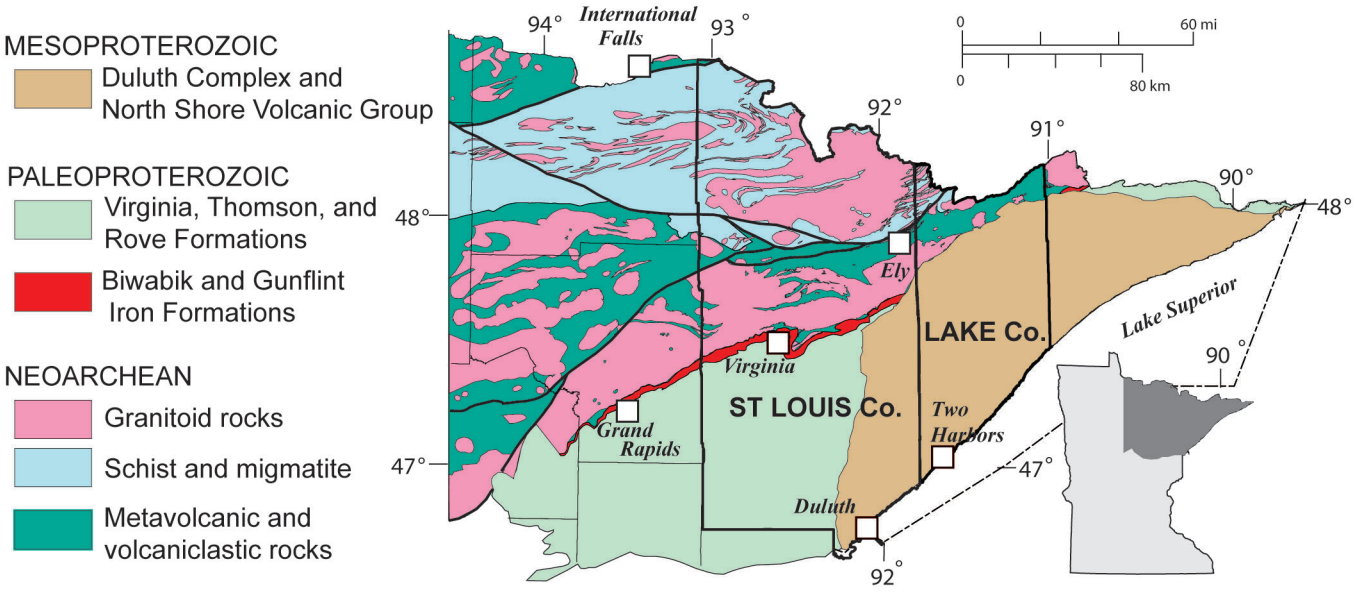

Figure 2. Generalized bedrock geologic map of northeastern Minnesota showing the location and geologic setting of county-scale mapping (geology modified from MGS State Map Series S-21).

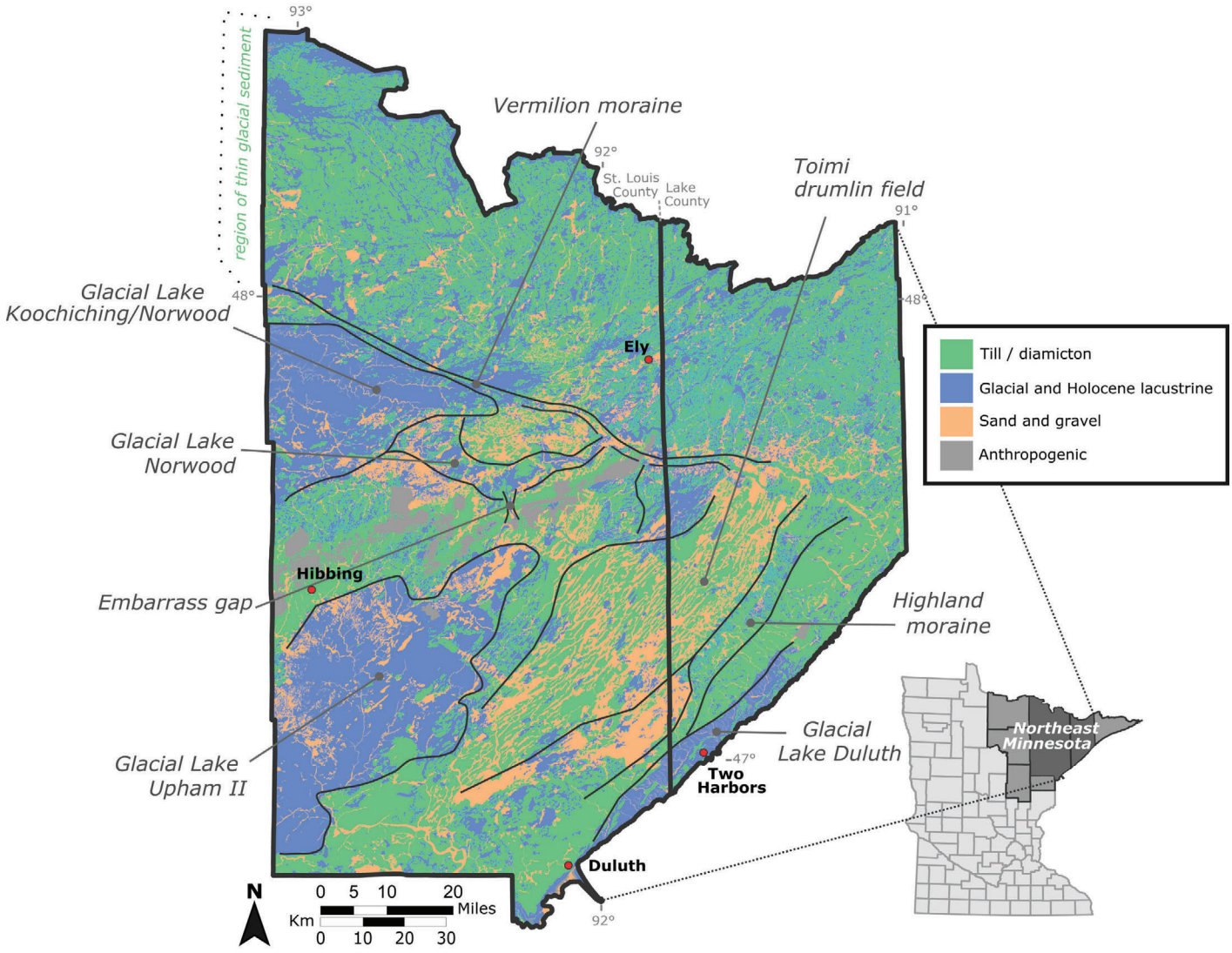

Figure 3. Generalized surficial geologic map of Lake and St. Louis counties, northeastern Minnesota showing the distribution of till, bedded sediment, and major geomorphic features.

preserved in some drill cores and outcrops, especially those near prominent linear depressions inferred to represent fractures and relict faults. The presence of varied thicknesses and compositions of saprolite likely contributes to hydrogeologic characteristics, though further study is needed. Studies elsewhere have shown that fractured and partially decomposed bedrock may act as an aquifer; thoroughly weathered rock, an aquitard.

Surficial and subsurface mapping of Quaternary sediments (**Figure 3**) builds on scant published interpretations using air photographs, LiDAR derivatives, National Wetlands Inventory and NRCS soil survey maps, data from the CWI, targeted scientific rotary-sonic and giddings drilling, and several seasons of field work. Sediment cover is thin in much of the map area, though locally as thick as 350 ft. on the down-ice (south) side of the Mesabi Iron Range. Anomalously thick packages of bedded sediment are present locally within and between till (diamicton) sequences, and also occupy channel and basin structures on the bedrock surface. The deepest and most prominent of these is a southwest-trending valley system that cuts through the Giants Range Batholith and Biwabik Iron Formation to form the "Embarrass Gap" near Biwabik—one of the few buried channels that cross the Mesabi Iron Range. One rotary-sonic drill core (Unique #: 277883), obtained from the channel thalweg near Embarrass, demonstrates the presence of nearly 200 ft. of bedded sand and gravel valley-fill atop granitic bedrock.

Sediments depicted on the current surficial maps are derived from the Rainy, Brainerd, Superior, and Koochiching lobes (including the St. Louis sublobe) of the late Wisconsinan Laurentide Ice Sheet. Visual, textural, and lithologic characteristics of each lobe's deposits reflect four unique bedrock source regions, or provenances (**Figure 4**); however, time-transgressive iceshed migration, coalescent ice margins, and polyphase depositional

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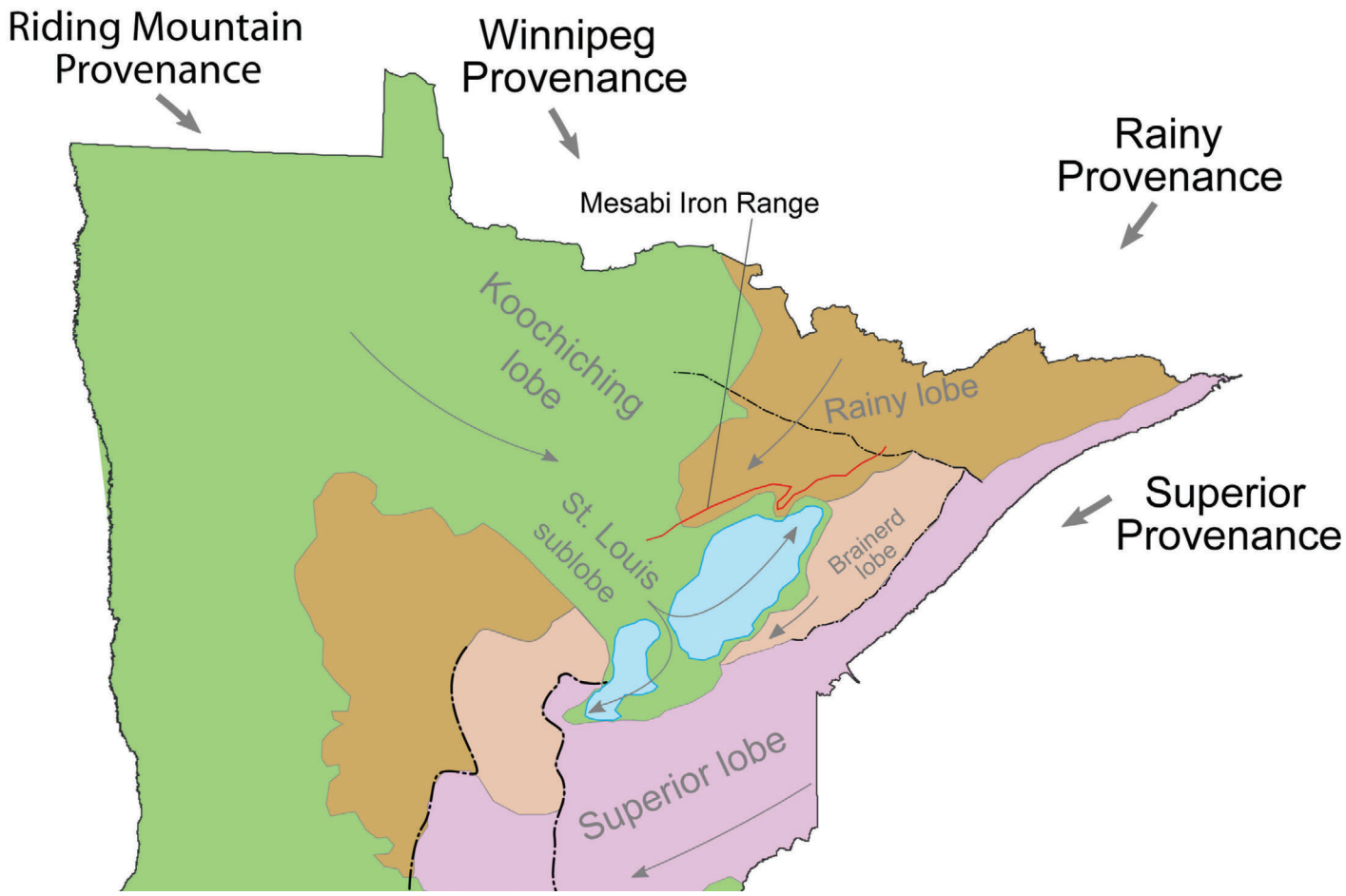

Figure 4. Generalized map of northern Minnesota illustrating the trajectories of ice lobes during the late Wisconsinan glacial episode (curved arrows), and the four recognized glacial sediment provenances in Minnesota. Major ice margins are indicated with a black line. Glacial lakes Aitkin II and Upham II are shown in blue.

histories contributed to the development of units with mixed provenance. Tills of the Rainy, Brainerd, and Superior lobes are typically sandy and clast-rich, which locally obfuscates distinction between these and other coarse-grained sediments deposited by glacial meltwater, particularly using drilling records. Fine-grained lacustrine sediments are pervasive at the surface in the map area, within numerous isolated depressions and the former basins of glacial lakes Upham II, Koochiching/Norwood, Norwood, and Duluth. Coarse grained sediment occurs along laterally continuous beach ridges, irregularly-spaced kames, and glacially-fed deltaic deposits that prograde to former shorelines. Elsewhere, coarse-grained bedded sediment occurs discontinuously at the surface within positive-relief, ice-contact glaciofluvial deposits (e.g., eskers), in swales between individual landforms of the Toimi drumlin field, and in broad channels that slope off the southwestern face of the Highland moraine. Given the diverse depositional histories, connectivity of sand and gravel bodies at the surface and in the subsurface tends to be variable. More site-specific and varied types of data are required to characterize this more fully.

The hydrogeologic implications of these and other geologic observations derived from Part A products will be investigated in detail by the Minnesota DNR—Division of Ecological and Water Resources, and reported in Parts B of the atlases. Those products will include maps and reports that delineate aquifers, flow systems, groundwater chemistry, and sensitivity to pollution.

Energy Underground

The Spring 2018 issue of the Carleton Voice provided a unique take on the college's plans for geothermal heating in "Energy Underground," by Pallav Kumar, including discussion of the interaction of groundwater flow systems with ground source heat pumps.

Cass and Hubbard County Geologic Atlas — Part A (Geology)

The Cass and Hubbard County Geologic Atlases–Part A (geology) were recently published by the Minnesota Geological Survey at the University of Minnesota. See the following press release links for additional information

Cass County Geologic Atlas, Part A

Hubbard County Geologic Atlas, Part A

The DNR will use this information to produce Part B (hydrogeology), which will include maps of water levels in aquifers, direction of groundwater flow, water chemistry, and sensitivity to pollution.

Partial funding for this project was provided by the Clean Water Fund and the Minnesota Environment and Natural Resources Trust Fund. For more program information see the following links.

Part A Geology: Minnesota Geological Survey, Barbara Lusardi, Supervisor, 612-626-4791

Part B Hydrogeology: Minnesota Department of Natural Resources, Paul Putzier, Supervisor, 651-259-5692

More groundwater well networks, longer time span

From the USGS

The U.S. Geological Survey (USGS) National Water Quality Program has updated its interactive web tool that maps decadal changes in groundwater quality across the Nation. The web tool, Decadal Change in Groundwater Quality, now includes more groundwater well networks and data analyzed over a longer time span.

In the update, groundwater quality data were added for an additional 218 wells in 6 well networks, increasing the number of wells to 1,718 and the number of well networks to 73. Additionally, data for 14 well networks resampled during 2012–14 were incorporated, allowing the user to visualize changes across three roughly decadal sampling events for those networks: 1990s, 2000s, and 2010s.

Using the web tool, users can easily visualize changes in both inorganic and organic constituent concentrations in groundwater, including chloride, nitrate, several pesticides, and some drinking-water disinfection byproducts. The website also includes a description of the methods used to evaluate changes in groundwater quality and a link to the complete set of data.

For additional information on the groundwater-quality web tool, or for data and methods used, contact Bruce Lindsey (blindsey@usgs.gov).

A novel high-frequency groundwater quality monitoring system

Saraceno, J., Kulongoski, J.T. & Mathany, T.M. A novel high-frequency groundwater quality monitoring system, Environ Monit Assess (2018) 190: 477.
https://doi.org/10.1007/s10661-018-6853-6

Abstract

High-frequency, long-term monitoring of water quality has revolutionized the study of surface waters in recent years. However, application of these techniques to groundwater has been limited by the ability to remotely pump and analyze groundwater. This paper describes a novel autonomous groundwater quality monitoring system which samples multiple wells to evaluate temporal changes and identify trends in groundwater chemistry. The system, deployed near Fresno, California, USA, collects and transmits high-frequency data, including water temperature, specific conductance, pH, dissolved oxygen, and nitrate, from supply and monitoring wells, in real-time. The system consists of a water quality sonde and optical nitrate sensor, manifold, submersible three-phase pump, variable frequency drive, data collection platform, solar panels, and rechargeable battery bank. The manifold directs water from three wells to a single set of sensors, thereby reducing setup and operation costs associated with multi-sensor networks. Sampling multiple wells at high frequency for several years provided a means of monitoring the vertical distribution and transport of solutes in the aquifer. Initial results show short period variability of nitrate, specific conductivity, and dissolved oxygen in the shallow aquifer, while the deeper portion of the aquifer remains unchanged—observations that may be missed with traditional discrete sampling approaches. In this aquifer system, nitrate and specific conductance are increasing in the shallow aquifer, while invariant changes in deep groundwater chemistry likely reflect relatively slow groundwater flow. In contrast, systems with high groundwater velocity, such as karst aquifers, have been shown to exhibit higher-frequency groundwater chemistry changes. The stability of the deeper aquifer over the monitoring period was leveraged to develop estimates of measurement system uncertainty, which were typically lower than the manufacturer's stated specifications, enabling the identification of subtle variability in water chemistry that may have otherwise been missed.

Generating false negatives and false positives for As and Mo

"Generating false negatives and false positives for As and Mo concentrations in groundwater due to well installation" by Ilka Wallis and Thomas Pichler (corresponding author, pichler@uni-bremen.de), https://doi.org/10.1016/j.scitotenv.2018.03.063

Introduction of an oxidant into an anoxic aquifer through use of an oxygen saturated drilling fluid served as the conceptual model for the trends where concentrations decreased with time. Mixing between drilling fluid and groundwater (i.e., dilution) was used as the conceptual model for scenarios where increasing trends were observed. Conceptual models were successfully tested through formulation and application of data-driven reactive transport models, using the USGS code MODFLOW in conjunction with the reactive multicomponent transport code PHT3D.

'Publications and Links' continues on page 14

Geoscience in Your State

How does geoscience affect your state?

The American Geosciences Institute's Geoscience Policy team created State Geoscience Information factsheets to inform geoscientists and decision makers on how geoscience impacts their state. These factsheets highlight geoscience areas including, employment, water, minerals, energy and hazards in each state. They also demonstrate how federal research agencies, such as the National Science Foundation, U.S. Geological Survey, National Aeronautics and Space Administration, and the National Ocean and Atmospheric Administration contribute beneficial geoscience information to each state.

For inquiries about this and other state factsheets, please contact AGI at govt@americangeosciences.org

Geoscience in Minnesota

american geosciences institute
connecting earth, science, and people

WHAT IS GEOSCIENCE?

Geoscience is the study of the Earth and the complex geologic, marine, atmospheric, and hydrologic processes that sustain life and the economy. Understanding the Earth's surface and subsurface, its resources, history, and hazards allows us to develop solutions to critical economic, environmental, health, and safety challenges.

Satellite image: NASA/USGS Landsat Program. State outline (not to scale): Matt Battison.

By the numbers: MINNESOTA

- 6,639 geoscience employees (non-federal/self-employed)[1]
- 776 million gallons/day: total groundwater withdrawal[3]
- $3.18 billion: value of nonfuel mineral production in 2017[4]
- 60 total disaster declarations, including 25 flood, 24 severe storm, and 3 tornado disasters (1953-2017)[6]
- $16.7 million: NSF GEO grants awarded in 2017[14]

WORKFORCE IN MINNESOTA

- 6,639 geoscience employees (non-federal/self-employed) in 2017[1]
- $69,746: average median geoscience employee salary[1]
- 13 academic geoscience departments[2]

WATER USE IN MINNESOTA

- 776 million gallons/day: total groundwater withdrawal[3]
- 2.45 billion gallons/day: total surface water withdrawal[3]
- 515 million gallons/day: public supply water withdrawal[3]
- 276 million gallons/day: water withdrawal for irrigation[3]
- 259 million gallons/day: industrial fresh water withdrawal[3]
- 79% of the population is served by public water supplies[3]

ENERGY AND MINERALS IN MINNESOTA

- $3.18 billion: value of nonfuel mineral production in 2017[4]
- Iron ore, sand and gravel (construction), sand and gravel (industrial): top three nonfuel minerals in order of value produced in 2017[4]
- 10.9 million megawatt hours: wind produced in 2017[5]
- 1.26 million megawatt hours: hydroelectricity produced in 2017[5]

NATURAL HAZARDS IN MINNESOTA

- 60 total disaster declarations, including 25 flood, 24 severe storm, and 3 tornado disasters (1953-2017)[6]
- $26 million: individual assistance grants (2005-2017)[6]
- $63 million: mitigation grants (2005-2017)[6]
- $290 million: preparedness grants (2005-2017)[6]
- $290 million: public assistance grants (2005-2017)[6]
- 32 weather and/or climate events, each with costs exceeding $1 billion (inflation adjusted) (1980-2017)[7]

1 U.S. Bureau of Labor Statistics, Occupational Employment Statistics, May 2017
2 American Geosciences Institute, Directory of Geoscience Departments, 53rd Edition (2018)
3 U.S. Geological Survey, Estimated Use of Water in the United States in 2015
4 U.S. Geological Survey, Mineral Commodity Summaries 2018
5 U.S. Energy Information Administration
6 FEMA Data Visualization: Summary of Disaster Declarations and Grants (accessed May 2, 2018)
7 NOAA National Centers for Environmental Information, U.S. Billion-Dollar Weather and Climate Disasters from 1980 to 2018 (accessed April 6, 2018)

AGI is a network of 52 member societies, representing more than 260,000 geoscientists.
Compiled by the AGI Geoscience Policy program, July 2018. This work is distributed under a Creative Commons BY-NC-ND 4.0 license.
https://www.americangeosciences.org/policy/factsheet/states | govt@americangeosciences.org

Geoscience, Minnesota, and Federal Agencies

american geosciences institute
connecting earth, science, and people

U.S. GEOLOGICAL SURVEY (USGS)

- $1.15 billion: total USGS budget in FY 2018 (5.8% increase from FY 2017)[8]
- The National Cooperative Geologic Mapping Program funds geologic mapping projects with federal (FEDMAP), state (STATEMAP), and university (EDMAP) partners
- $2.47 million: Minnesota STATEMAP funding (1993-2016)[9]
- University of Minnesota, University of Minnesota at Duluth, and University of St. Thomas have participated in EDMAP[9]
- USGS streamgages collect real-time or recent streamflow, groundwater, and water-quality data in Minnesota

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

- $20.7 billion: total NASA budget in FY 2018 (5.5% increase from FY 2017)[10]
- $1.9 billion: total NASA Earth Science budget in FY 2018 (0% change from FY 2017)[10]
- Gravity Recovery and Climate Experiment (GRACE) satellites measure groundwater changes in Minnesota
- Soil Moisture Active Passive (SMAP) satellite measures soil moisture in Minnesota

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

- $5.9 billion: total NOAA budget in FY 2018 (4.1% increase from FY 2017)[11]
- Next-generation geostationary (GOES) and polar orbiting (JPSS) satellites provide weather forecasting for Minnesota
- Deep Space Climate Observatory (DISCOVR) satellite monitors radiation and air quality over Minnesota
- 15 National Weather Service Automated Surface Observing Systems (ASOS) stations in Minnesota[12]
- 215 National Weather Service Cooperative Observer Program (COOP) sites in Minnesota[12]

NATIONAL SCIENCE FOUNDATION (NSF)

- $7.8 billion: total NSF budget in FY 2018 (4% increase from FY 2017)[13]
- $1.4 billion: total NSF Geosciences Directorate (GEO) awards in FY 2017 (7.2% increase from FY 2016)[14]
- 53 NSF GEO awards in Minnesota totaling $16.7 million in 2017[14]
- $13.6 million: NSF GEO grants awarded to University of Minnesota Twin Cities in 2017[14]

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

- $8.1 billion: total EPA budget in FY 2018 (0% change from FY 2017)[15]
- 25 active Superfund sites in Minnesota in 2018[16]
- $14.8 million: Drinking Water State Revolving Fund (DWSRF) grants in Minnesota in 2017[17]

FEDERAL FACILITIES IN MINNESOTA

- USGS Minnesota Water Science Center, Mounds View
- EPA National Health and Environmental Effects Research Laboratory, Mid-Continent Ecology Division, Duluth
- NSF National Center for Earth-surface Dynamics, St. Anthony Falls
- USDA Forest Service Center for Research on Ecosystem Change, Grand Rapids

YOUR STATE SOURCE FOR GEOSCIENCE INFORMATION

Minnesota Geological Survey
2609 West Territorial Road
St. Paul, MN 55114
https://www.mngs.umn.edu/
612-626-2969

8 U.S. Department of the Interior, FY 2019 Budet in Brief
9 U.S. Geological Survey, National Cooperative Geologic Mapping Program
10 National Aeronautics and Space Administration, FY 2019 Budget Estimates
11 National Oceanic and Atmospheric Administration, FY 2019 Bluebook
12 NOAA In Your State and Territory
13 U.S. House of Representatives, FY 2018 Omnibus Spending Bill (Division B) – Commerce, Justice, Science, and Related Agencies Appropriations Act, 2018
14 National Science Foundation, Budget Information System
15 U.S. House of Representatives, FY 2018 Omnibus Spending Bill (Division G) – Department of the Interior, Environment, and Related Agencies Appropriations Act, 2018
16 U.S. Environmental Protection Agency, Superfund Sites
17 U.S. Environmental Protection Agency, Drinking Water State Revolving Fund National Information Management System Reports

AGI's Geoscience Policy and Critical Issues programs support well-informed public policy and decision making by providing information and facilitating dialogue between the geoscience community and decision makers at all levels.
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https://www.americangeosciences.org/policy/factsheet/states | govt@americangeosciences.org

Link to the Lower St. Croix River Watershed GRAPS Report

Groundwater Restoration and Protection Strategies (GRAPS) reports are designed to help prioritize and target local efforts to restore and protect groundwater resources as part of local water planning. While groundwater is not broken into watersheds like surface water, several state agencies have worked together to compile information and strategies for groundwater below surface water watersheds. A GRAPS report uses existing state data and information about groundwater and land-use practices that affect groundwater in the watershed to identify key groundwater quality and quantity concerns. The interagency GRAPS team has recently completed a report for the Lower St. Croix River Watershed, which is available on the MDH GRAPS website.

MGWA Foundation Directors Sought for 2019

The MGWA Foundation board needs to fill director positions. The Directors oversee MGWA Foundation fundrasing, participate on scholarship committees, and assist with financial management of the endowment. Here's a chance for you or someone you nominate to advance groundwater education in Minnesota. Nominations will be accepted until 12/31/2018.

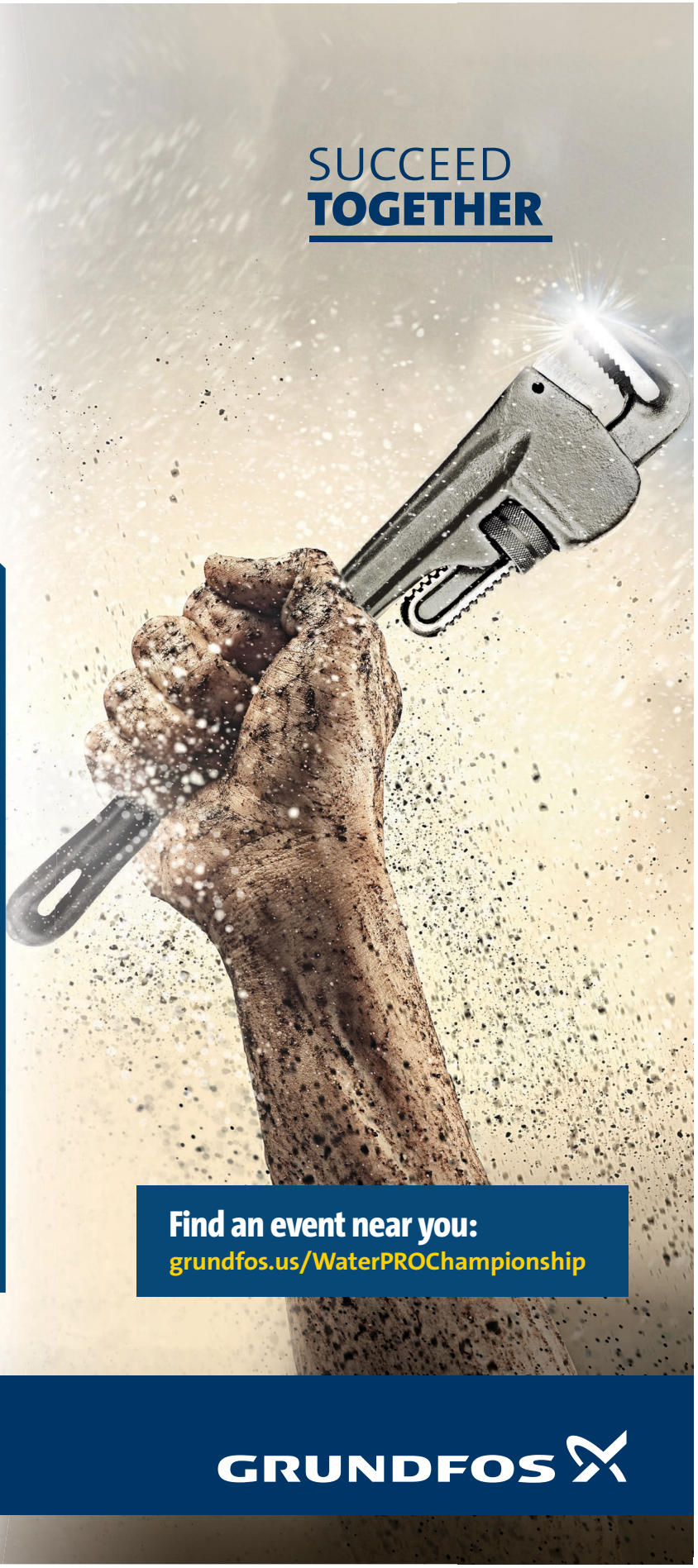
E-mail nominations to the MGWA at office@mgwa.org.

Yes, we really want to notice this opportunity!

GUTS AND GLORY

WaterPRO Championship

SUCCEED
TOGETHER



Compete for your chance to win $10,000 and a trip to NGWA's 2018 Groundwater Week

Think you have what it takes to be the Grundfos WaterPRO Champion?

Show us your skills with the Grundfos SP Submersible. If you are one of our top 12 competitors nationwide, we'll send you to NGWA's 2018 Groundwater Week to compete in the finals for $10,000 and the WaterPRO Champion title.

Stop by the Grundfos booth at your local qualify event to compete in the challenge!

Find an event near you:
grundfos.us/WaterPROChampionship

be
think
innovate

GRUNDFOS

MGWAF BOARD MINUTES

Meeting Date: March 22, 2018

MGWAF managers in attendance: Scott Alexander, Lanya Ross, Stu Grubb, Evan Christiansen, Eric Mohring, Stephanie Souter, Kara Dennis. Others: Jennie Leete, Sean Hunt

1. Approval of December minutes – Stephanie

Eric made motion to approve. Second from Kara. All in favor, motion passed.

2. Current finances – Kara

Kara provided an updated budget summary sheet. The investment funds went down a little, since the market cooled off in the first quarter of 2018. We are still up 5% overall, which is the goal. There were not much in the way of debits or credits for this quarter. Account values as of 3/22/18:

MGWAF Endowment: $191,559
HOP Funds: $51,658.63
Unrestricted funds: $19,127.63
Debits: $757.55 Advisory Fee
Credits: $5.28 Amazon Smile; $46.03 Deposit

Discussion on investment/advisory fees. These fees can be paid by MGWA, but Wells Fargo can't split them off separately, so MGWAF needs to "bill" MGWA to recoup those costs.

Action item: Kara will total up advisory fees to date (since account opened) and create and invoice to bill MGWA. She will send that bill to Jennie.

The fee went up to 1.5%, from 1%.

Action item: Jennie will send the Wells Fargo letter that indicated the increase in fee to the rest of MGWAF directors. Stu will reach out to Kent Seward to find out why the fee was raised and if anything can be done about it. In addition, MGWAF needs to order new checks from Wells Fargo with correct name and address.

3. **2018 scholarship**

Scholarship committee (Stephanie, Lanya, Jim Lundy, Joy Loughry, and Cathy Villas Horn) met on March 9th to review scholarship applications. There were 8 applicants total, 4 grad and 4 undergrad. One application in each group was incomplete, so the total was 3 for each. Great candidates overall, always a tough discussion for the committee. The recommendations of the committee are:

Undergraduate: Nicolas Budde
Graduate: Ryan Puzel

Eric: Motion to accept recommendation from committee. Second from Stu. All in favor, motion passed.

Action item: Stephanie will contact winners, ask them to attend MGWA meeting to accept their award, encourage a poster, and also offer to cover travel costs. Will work with Jennie on travel.

4. **New Grant Applications -**

a. Request from MGWA member who wants to donate $5,000 for a "need based" scholarship for graduate students. Discussion and considerations for how this might work and/or fit into existing programs.

Stephanie shared the information she collected through some correspondence. The group all agreed that we would like to discuss options with the member. Stu and Scott agreed to meet with him.

Action item: Stephanie will reach back out to this member to facilitate the connection with Stu and Scott.

b. No other new requests.

c. Nicollet-Brown sent a thank you for their grant, expressed concern about insurance costs. (see continued discussion below).

5. **2018/2019 Budgeting**

a. Overall budgeting

Between scholarships and children's water festival grants, we are on pace to award about between $10-12,000 for 2018.

Scholarships: $3000
Festivals: $8-10,000

Jennie brought up the question of insurance, some of the festivals have trouble securing it for the events. Discussion about whether MGWAF could provide that insurance support through other means. Stephanie will reach out to colleagues who plan the metro CWF to see how they have dealt with the insurance issue and report back.

b. Education committee, funding discussion

Evan brought up discussions that MGWA has been having about the education committee and work that may come out of that. MGWA would need to request funding from MGWAF to dedicate some funding for expanded education activities. Committee is going to re-form, make a plan, and they will likely have a request to MGWAF for some resources.

6. **Discuss offering a Calvin - Olaf scholarship for this summer**

Course fees - $1,250. Discussion on offering again, last year was two scholarships. Scott, Kara and two other members would be available to review applications. It would come out of the regular unrestricted funds, MGWAF could also ask MWGA for additional support.

Stu: Motion to approve use of unrestricted funds for two field camp scholarships at $1,250, and to request additional funds from MGWA to continue to support field camp and student scholarships. Eric: Second. All in favor.

Action item: Scott will review materials, work with Sean to get them posted to MGWA and advertised.

Action item: Evan will relay request back to MGWA to release past conference funds to MGWAF so that they can continue to fund field camp scholarships and other activities.

7. **Action Items from December**

HOP funds have been transferred to Wells Fargo.

Meeting adjourned, 1:00pm.

MGWA Foundation Board of Directors

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alexa017@umn.edu

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The MGWA Foundation is a 501(c)3 charitable organization. Donations to the Foundation are deductible on your state and federal income tax returns.

MGWA BOARD MINUTES

The MGWA Board meets once a month, currently over lunch, at 11:30 on the third Tuesday in the meeting room at Fresh Grounds on W 7th Street in St. Paul (entrance in back of the building).

Members are welcome to attend and observe

MGWA Board of Directors Regular Meetings

Meeting Date: Tuesday, May 15, 2018

Attendance: Ellen Considine, President; Evan Christianson, Past-President; Kate Pound, President-Elect; Anneka Munsell, Treasurer; Andrew Retzler, Secretary; Sean Hunt, WRI; Jeanette Leete, WRI; Sharon Kroening, MGWA Newsletter.

Past Minutes: Approved.

Treasury Report:

- Munsell updated the Board on the Treasury Report. The numbers as reported include a total income for the period of January 1, 2018 to May 15, 2018 of $55,593.04; net income for this period of $28,755.35; total assets for this period of $115,564.04.
- Christianson asked about transferring income to MGWAF. MGWA has traditionally transferred the previous year's profits. The Board agreed that any transferred funds need to be earmarked for their intended use. Retzler said we should ask the MGWAF Board for their recommendation about how these funds should be earmarked. Christianson will ask the MGWAF Board for their recommendation. Pound plans to hear more about the Education Committee's need for funds at the next meeting. The action to transfer MGWA income to MGWAF will be tabled for next meeting.

Newsletter Report:

- The Newsletter Team has been working on the June issue. Ruth MacDonald continues to help streamline the Newsletter process and overall template. Hunt will send his conference photos to Kroening for use in the upcoming Newsletter. Considine will send her President's Letter and a call for abstracts announcement for the Fall Conference. Considine suggested a call for MGWA Board nominations be placed in the June issue. Kroening will look at past issues as an example to draft the call for nominations.

WRI Report:

- Hunt shared the membership numbers: 418 Professionals; 39 Retirees; 28 Sustaining; and 3 Students. There are a total of 1567 members in the database with 488 of these being paid.
- Hunt and Leete were able to fix the printer issue and do not plan to purchase a new printer at this time. Hunt researched a number of new options ranging from $300 to $1200 to help guide any printer purchase in the near future.

Web Page: Hunt has the Spring Conference recap page live and is just waiting on the conference audio from the U of MN.

MGWAF Report:

- MGWAF has not met since last update.
- Christianson said they will now include Michigan in the list of eligible states for field camp scholarship requirements.
- The Board discussed the recent delays in scholarship announcements. Considine will contact Scott Alexander to discuss having a more consistent and earlier announcement deadline.

Social Coordinator: No updates.

White Paper Committee:

- Kroening relayed an email from Andrew Streitz on White Paper updates:
- The Executive Summary for the Drain Tile White Paper is now on the web page.
- The Drain Tile White Paper Workgroup thank you dinner went over well and the total bill was less than the amount allotted by MGWA. Streitz has already requested reimbursement from Munsell.
- Progress has been made on the compiling of the full Drain Tile White Paper. Hunt will put together an announcement email when complete.

Education Committee:

- Pound said the current committee includes 8 members and that they will meet later this afternoon. Pound will send Hunt a list of committee members. The committee plans to discuss how to best liaise between MGWA and MGWAF at the meeting.

Other Business:

Common Meeting Minutes:

- Christianson will ask the Foundation whether the new minutes template will work for them.

2018 Spring Conference:

- Hunt shared the conference evaluations with the Board. Members were generally pleased with the conference overall.
- Pound suggested in the future not having the mentors and mentees separated during the beginning of lunch and instead just having signed tables reserved for them.
- Pound also asked about adding a checkbox to conference registrations for those wanting to indicate their preference to participate in the mentoring program.
- Hunt said this will be easy to add to the paper registrations, but needs to investigate whether it can be added to the online registration process.
- Considine suggested mentioning the mentorship program on the conference brochure. Hunt will work on this.
- The Board felt that Pigeonhole was less engaging for this conference. It works best for conference panels and for polling the audience.
- Conference attendees enjoyed the shorter talks and lightning talks. Considine will continue to schedule a number of shorter talks for the next conference.

— continued on page 19

MGWA Minutes, cont.

- Some conference attendees reported having trouble hearing the speakers. Hunt will look into hearing accessibility options for future conferences.

2018 Fall Conference:

- Considine will put together a call for abstracts for Hunt to send out to membership.
- The Board discussed putting together a standard form for speaker and poster abstract submissions that includes general formatting guidelines and instructions. Hunt has an example speaker bio format that he'll send to Considine to help guide the call for abstracts form.
- Considine continues to look for speakers and has someone in mind as one of the outside keynote speakers.
- Christianson suggested bringing in a speaker to discuss a real-life example of a regional groundwater plan that was unsuccessful.
- The Board discussed potential MGWA Outstanding Service Awardees for the Fall Conference, and the ways in which the organization can improve on how this award is advertised to members for nominating candidates.
- Considine will ask past Board members how they dealt with the procedures of this award.
- Christianson suggested the Board consider any nominations for this award every June and to add it to the agenda.

Operations Manual:

- The Board set a deadline of August for the re-draft of the MGWA Operations Manual.
- The Board still plans to include a section on Sexual Harassment policies and procedures.
- Considine will research possible options.

Action Items:

- Christianson will ask the MGWAF for recommendations on earmarking MGWA funds before the Board votes to approve a transfer.
- Hunt will send conference photos to Kroening for use in the upcoming June Newsletter.
- Considine will send the Newsletter Team her President's Letter and a call for abstracts announcement for the Fall Conference.
- Kroening will put together a call for MGWA Board nominations in the June Newsletter.
- Hunt will add the conference audio clips to the web page upon receiving the file from the venue.
- Considine will contact Scott Alexander to discuss having a more consistent and earlier announcement of MGWAF scholarships.
- Hunt will put together an email announcement regarding the Drain Tile White Paper once the full document is complete and available online.
- Pound will send Hunt a list of Education Committee members.
- Christianson will ask the Foundation whether the new minutes template will work for them.
- Hunt will mention the conference mentoring program on conference brochures, and will add a checkbox on the paper conference registration forms (and possibly online) for those to indicate interest in wanting to take part.
- Hunt will ask the conference venue whether or not they provide hearing accessibility options for future conferences.
- Considine will put together a call for abstracts announcement for the Fall Conference that Hunt will email out to membership.
- Hunt has an example speaker bio format that will send to Considine.
- Considine will use the example speaker bio format from Hunt to help guide putting together a standard speakers and posters abstract submission form that includes general guidelines and instructions.
- Considine will ask past Board members about how they dealt with the MGWA Outstanding Service Award procedures and include a review of any member nominations for this award annually on the June agenda.
- The Board will have their re-draft of the MGWA Operations Manual completed by the August Board meeting.
- Considine will ask her father about the Sexual Harassment policies and procedures recently discussed in the organization he is involved with.

Meeting Date: Tuesday, June 19, 2018

Attendance: Ellen Considine, President; Evan Christianson, Past-President; Anneka Munsell, Treasurer; Andrew Retzler, Secretary; Sean Hunt, WRI; Jeanette Leete, WRI; Sharon Kroening, MGWA Newsletter.

Agenda: Approved.

Past Minutes: Approved with revisions.

Treasury Report:

- Munsell updated the Board on the Treasury Report. The numbers as reported include a total income for the period of January 1, 2018 to June 18, 2018 of $56,284.83; net income for this period of $28,874.51; total assets for this period of $113,398.12.

Newsletter Report:

- Draft of June Newsletter is ready.
- The Newsletter Team will meet next week to discuss items for the September issue.

MGWA 2019 Membership Dues

Sustaining Member	$65
Professional Member:	$45
Retired Member	$25
Full-time Student Member	$20
Newsletter (printed and mailed)	$20

Membership dues rates were revised at the July 1, 2015 meeting of the MGWA Board.

Save These Dates

MGWA Conferences

11/15/2018

04/25/2019

11/12/2019

MGWA Minutes, cont.

- Kroening reported that the new template for meeting minutes seems to work well.

WRI Report:

- Hunt sent out the call for abstracts for the Fall Conference to membership.
- The Drain Tile White Paper passed through another round of review.
- Hunt reported that a number of corporate memberships were renewed.
- Hunt found some older documents related to speaker bio formatting and the policies/ procedures of the Outstanding Service Award that he forwarded to Considine.
- Leete reported that MGWA has transferred between $20,000 to $40,000 worth of funds to MGWAF in the recent past. Leete will need to do some further research in the books to confirm transfer amounts in other years.

Web Page:

- Hunt finished updating the Spring Conference page by adding in the audio clips of presentations.
- Hunt updated some of the corporate logos on the web page.
- Hunt will create an Outstanding Service Award page that describes the award, nomination process and requirements, and lists the previous recipients of the award.

MGWAF Report: No updates.

Social Coordinator: No updates.

White Paper Committee:

- The Drain Tile White Paper is poised to announce the completed paper.
- Considine will contact the committee and check if they want to have a representative at the August Board meeting to provide further updates.
- Kroening mentioned Ruth MacDonald's ideas for adding metadata to the final PDF document for search engine optimization. Hunt will work with Ruth on this.

Education Committee:

- Considine will contact the committee and check if they want to have a representative at the August Board meeting to provide further updates.

Other Business:

Common Meeting Minutes:

- Postponed until after MGWAF's next meeting.

Fall Conference:

- Considine is looking to develop a better title that incorporates more than just successful projects. Leete brought up a title that includes "successes, near misses, and failures".
- Considine continues to work on possible headliner presenters, and has two options she will contact.
- The Board reviewed ideas and possible changes mentioned in the May Board meeting minutes that might need early action. These include: keeping the mother's room, checking into hearing augmentation at the conference location, ringing the bell sooner during breaks, keeping the majority of talks shorter in length, and making it easier for students and professionals to submit poster abstracts with clearer instructions. Hunt said the conference location's website does mention hearing augmentation. Munsell volunteered to draft submission requirements and instructions for poster abstracts.
- Hunt found some older documents regarding the mentorship process at conference meetings that he will distribute to the Board.
- Christianson suggested asking some presenters to give a lightning talk or poster in the event that we receive more presentation abstracts than time allotted.
- Considine will need to have a broad flyer ready for the conference by early September.
- Hunt will work on putting together the exhibitor information.

MGWA Outstanding Service Award:

- Leete and Hunt shared with the Board the original Outstanding Service Award documents describing how the award was defined and the procedures outlined for nominations.
- Considine shared with the Board her draft procedure for nominations. The Board likes the idea of following this procedure and including it in the MGWA Operations Manual, while also using the original definition and description of the Outstanding Service Award as a way to evaluate nominees. The Board agreed to archive all submitted nominations on Google Drive from now on.
- An informal nomination has been made for the Outstanding Service Award and Retzler has asked those members making the nomination to provide a more formal nomination for the Board to review in August.
- Hunt said he needs a one month lead time to have the award made.

Operations Manual:

- The Board reviewed and discussed the draft policies and procedures for handling complaints. Leete shared the GSA Code of Conduct with the Board. The Board plans to draft a MGWA Code of Conduct using GSA's as an example. This will help set a standard by which to know when to submit a complaint and evaluate one. Retzler volunteered to draft the Code of Conduct and have something by the August meeting. Hunt suggested we make a broad statement in the Bylaws referring to the Code of Conduct, but leave the details in the Operations Manual.

MGWA Minutes, cont.

- The Board discussed the policy and procedure for drafting letters of support. Most letters of support require a quick turnaround and the Board agreed that a discussion and Board vote on these matters can take place by email in the future. The Board also acknowledged that some letters of support would not be possible if the deadline is too quick or if there is a conflict of interest with a majority of Board members.

Action Items:

- Leete will do a further review of the books to confirm the transfer amounts to MGWAF in previous years.
- Hunt will create an Outstanding Service Award web page that describes the award, the nomination process and requirements, and lists the previous recipients of the award.
- Considine will contact the White Paper and Education Committee to check if they want to have a representative attend the August Board meeting to provide updates.
- Hunt will work with Ruth MacDonald to add metadata and keywords to White Paper PDF documents.
- Considine will contact possible headliner presenters for the Fall Conference.
- Munsell will draft submission requirements and instructions for poster abstracts.
- Hunt will distribute documents on conference mentorship he recently found to the Board.
- Hunt will work on putting together exhibitor information for the Fall Conference.
- Retzler will follow-up on an Outstanding Service Award nomination to have a formalized nomination ready for the Board to review in August.
- Retzler will draft a MGWA Code of Conduct.
- Retzler will work on the Operations Manual revisions and reorganization.

Call for Nominations

MGWAF Directors

Send nominations to office@mgwa.org by 12/31/2018

MGWA Foundation Holiday Fundraiser

The Weatherguide calendar has been Minnesota's favorite calendar for more than 40 years. Available in both a wall and engagement format, it includes daily information on sunrise/sunset times, moonrise/moonset, normal and record high/low temps, and record precipitation, along with moon phases, significant events and special dates, meteorology, phenology, astronomy, and amazing regional photography. Enjoy nature notes by Jim Gilbert (WCCO radio), articles by KARE 11 and MPR meteorologists, and gardening tips from Grow with KARE.

When you order your calendars at www.freshwater.org/fundraiser/ and use the code **2019MnGwtrAF** at checkout, $5 from every calendar sale will go directly to the MGWA Foundation!