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BOARD OF REGENTS
STATE OF IOWA

MEMORANDUM

May 28, 2019

The Honorable Kim Reynolds
State Capitol
1007 East Grand Ave.
Des Moines, IA 50319

Mr. Charlie Smithson
Secretary of the Senate
State Capitol Building
Des Moines IA 50319

Ms. Carmine Boal
Chief Clerk of the House
State Capitol Building
Des Moines IA 50319

Re: State Geologist Annual Report

Dear Governor Reynolds and Members of the Iowa General Assembly:

Pursuant to the 2018 Iowa Acts, Ch. 1023.15**,** enclosed is the State Geologist Annual Report for 2017-18.

If you have any questions or need more information, please don't hesitate to contact me.

Sincerely,

Mark J. Braun

\Box Sync\Board of Regents Shared\BF\Legislative\2019 session\Reports\

Attachments
cc: Robin Madison
Legislative Liaisons
Legislative Log

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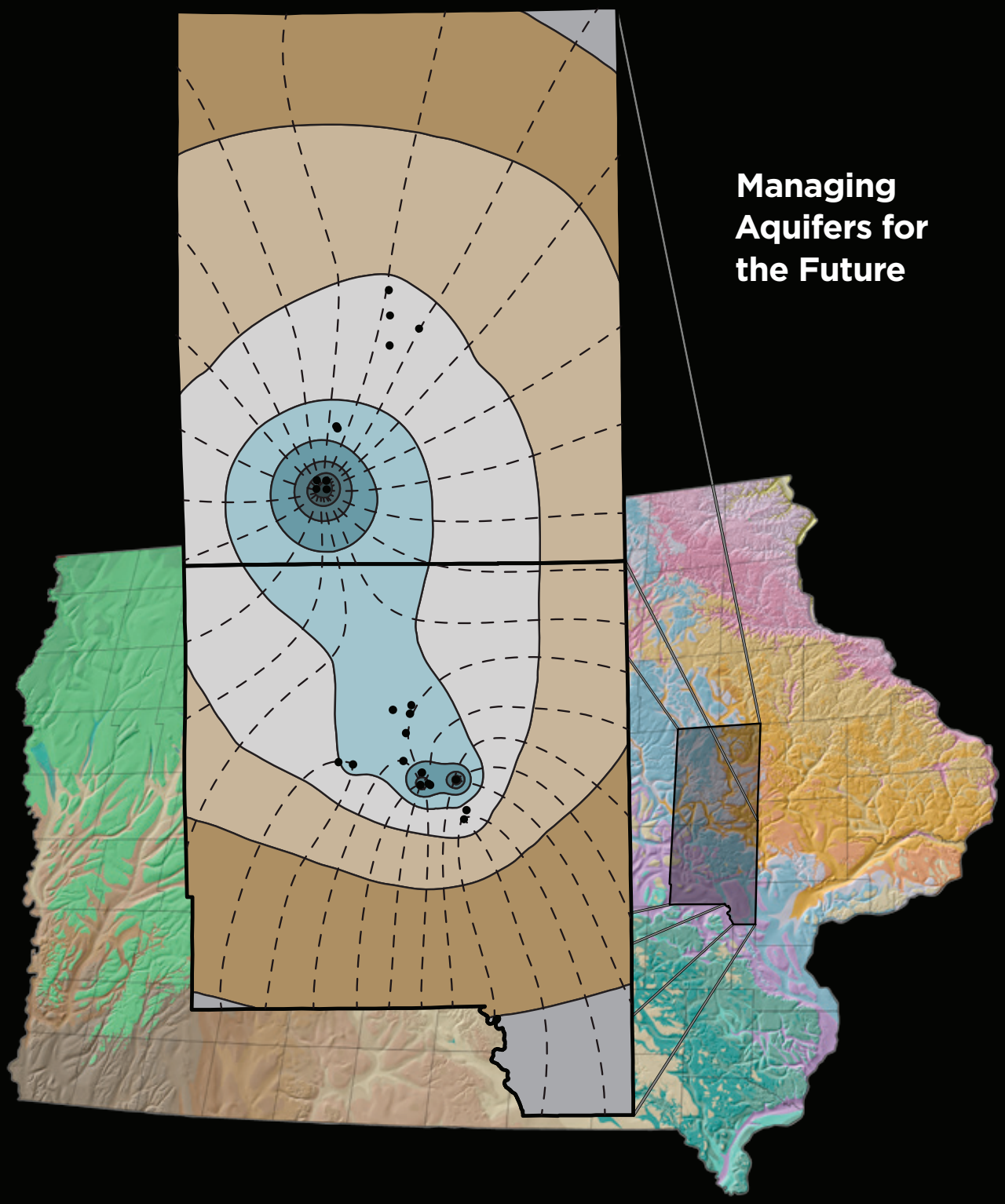
www.iowaregents.edu

the IGS Geode

ACTIVITIES OF THE IOWA GEOLOGICAL SURVEY, 2017–18



Managing Aquifers for the Future

The University of Iowa
Iowa Geological Survey

The IGS Geode

Activities of the Iowa Geological Survey, 2017–18

ON THE COVER: This stylized groundwater model and bedrock map of the state, both developed by the Iowa Geological Survey, depict future water levels in the Jordan aquifer beneath the Linn and Johnson counties protected water source area. The collaborative groundwater modeling effort among the IGS, Iowa Department of Natural Resources, and individual water users—including cities and industry—will assure the region will have a sustainable water supply from the Jordan aquifer into the future.

THE IGS MISSION: To collect, reposit, and interpret geologic and hydrogeologic data; to conduct foundational research; and to provide Iowans with the knowledge needed to effectively manage our natural resources for long-term sustainability and economic development.

THE IGS VISION: To be a nationally recognized leader in geologic and hydrogeologic sciences, building upon our rich scientific heritage and serving Iowans through research, education, and outreach.

DIRECTOR OF DEVELOPMENT AND COMMUNICATIONS:
Carmen Langel

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Jacqueline Hartling Stolze

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Contents

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From the State Geologist

WELCOME TO THE 2018 EDITION of the Iowa Geological Survey's annual magazine, *The IGS Geode*! This year's magazine is our second annual report, and I think you will enjoy this outstanding collection of stories about the projects and activities the IGS staff completed in the last year. Beyond these updates, however, 2018 also represents a major milestone year in the long and distinguished history of the survey.

If you recall, in 2014, oversight of IGS was moved from the Iowa Department of Natural Resources (IDNR) to the University of Iowa (UI). The IGS became part of IIHR—Hydroscience & Engineering (IIHR), a research institute within the UI College of Engineering. Although the staff transition from IDNR to IIHR went very well, we had to overcome several logistical hurdles for the change to become permanent. The biggest of these required a change in the State of Iowa Administrative Code to officially move the IGS (and the state geologist of Iowa position) to the university. The IGS continued to operate under a contract with the IDNR from 2014–18 to provide geological services to the state. However, during the 2018 legislative session, the legislature changed the code to officially move the IGS and the state geologist position to the University of Iowa. Although migrating the IGS from the IDNR to UI was a huge undertaking, the challenge was met head-on by Larry Weber (then director of IIHR) and our colleagues from IDNR, including Chuck Gipp, Bill Ehm, and Sharon Tahtinen. Many valued friends and IGS stakeholders supported this legislative effort.

THE IOWA GEOLOGICAL SURVEY STAFF (clockwise from left) H. Paul Liu, Nathan Holt, Matthew Streeter, Ryan Clark, Phillip Kerr (center), Keith Schilling, Rick Langel, Mike Gannon, Stephanie Surine, Jason Vogelgesang, and Rosemary Tiwari.

The code change created a new state geologist position at the UI, and it was my great good fortune to be named Iowa's state geologist in July 2018. It is an honor and a privilege to lead and direct the IGS as it enters a new era at the university. Along with these duties, my focus at IGS continues to be on nonpoint source pollution and nutrient-related issues impacting Iowa's watersheds and aquifers.

With the Code of Iowa successfully changed, IGS now receives funding directly from the state through a legislative appropriation. Although the base funding level is not enough to entirely fund IGS, it is a welcome component of our funding stream. To make up the deficit, IGS is becoming more entrepreneurial in its approach to projects and clients. Our staff provides geologic and hydrogeologic services to clients under specific contracts, so we can work directly for paying customers or as part of subcontract agreements. In many ways, this is becoming a game-changer for IGS because we can market our services to the broader community and better collaborate with stakeholders to provide customer-centered solutions.

This issue of *The IGS Geode* highlights several of these IGS-private partnerships, most notably represented by the efforts of hydrogeologists Mike Gannon and Nathan Holt, whose work with local stakeholders in Linn and Johnson counties is developing an enhanced groundwater flow model for the Cambrian-Ordovician aquifer. Groundwater resource and modeling services provided by IGS staff are helping many municipalities and rural water systems in Iowa better manage their water supplies for long-term sustainability. Efforts by IGS staff to develop sustainable solutions for alluvial water supply systems and to delineate local aquifers using geophysics are clear examples of our work with local communities. Funding provided by the Iowa Nutrient Research Center also supplements the IGS. This issue of *The IGS Geode* also highlights several important projects focused on quantifying nutrient reductions in Iowa. Geologists' work to map statewide surficial and bedrock resources is foundational to the success of the IGS, and it's not often that we have the opportunity to map a new glacial advance across a state. Through systematic study, funded in large part by the USGS STATEMAP program, Stephanie Surine and Phil Kerr have identified and mapped the Sheldon Creek Formation, a new glacial advance with global implications.

As *The IGS Geode* documents, these are exciting times at IGS. We look forward to working together with our fellow Iowans to best manage our water and natural resources!

Keith Schilling

KEITH SCHILLING
State Geologist

Rick Langel of the Iowa Geological Survey conducts feildwork.

Iowa Joins NGWMN

THE IOWA GEOLOGICAL SURVEY (IGS) continued its long tradition of making data publicly accessible by joining the National Ground-Water Monitoring Network (NGWMN). The NGWMN provides a common platform for groups across the country to collect and share long-term water-level and water-quality data that meet established quality standards. The NGWMN website allows users to simultaneously view data across several states and to easily find water-level and water-quality data.

Until this year, Iowa was conspicuously absent from the network. Collaborating with NGWMN officials, we selected 40 of the IGS' water-level wells that meet the applicable standards to be added to the network. The Iowa DNR (IDNR) also selected more than 100 water-quality sites for inclusion.

The NGWMN requires real-time access not only to the water-level and water-quality data, but also to information about the well where the data originated. This allows the network to display the same information if any changes are made to the data. The IGS developed protocols that transfer all the well information for both the IGS and IDNR sites.

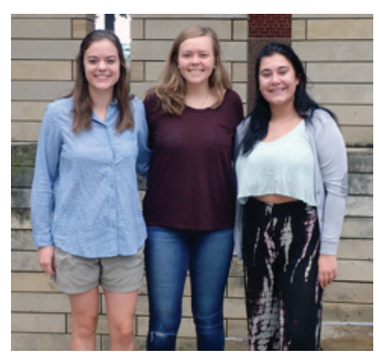
Iowa is now well-represented on the NGWMN platform, filling a critical gap in national water-level and water-quality data.

Internships Offer Valuable Training, Service

TRAINING THE NEXT GENERATION of geologists is a top priority for the Iowa Geological Survey (IGS), and on-the-job training remains a valuable capstone for undergraduates finishing their degrees. For that reason, several students from the Department of Earth and Environmental Department (EES) at the University of Iowa completed summer internships with the survey. They assisted IGS geologists with numerous tasks and ventures related to IGS projects and research.

Alethea Kapolas and Megan Koch generated new striplogs to assist STATEMAP projects. Berkley Grimm performed a geochemical analysis on Pennsylvanian cores, while Brittany Stolfus examined conodonts in Mississippian strata. Students also helped with data management and fieldwork. Their hard work helped IGS geologists further their efforts to generate high-quality research and products.

A National Science Foundation grant overseen by Bradley Cramer (EES) made this student opportunity possible. Emily Finzel (EES) and Cramer also provided additional student project supervision.



UI EES INTERNS (l to r): Brittany Stolfus, Megan Koch, and Alethea Kapolas (not shown, Berkley Grimm).

Special Feature in *Wetlands*

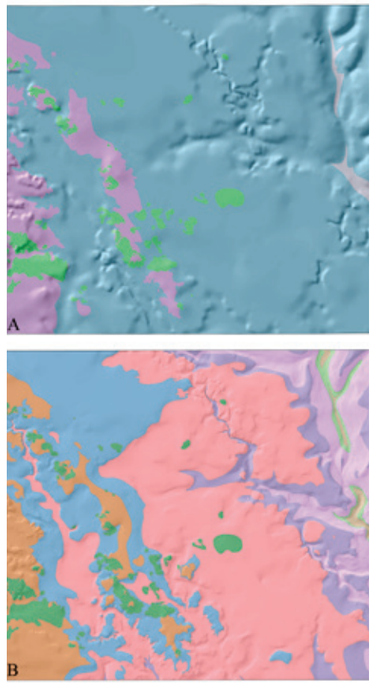
STATE GEOLOGIST KEITH SCHILLING and Steve Dinsmore from Iowa State University led the publication of a special feature, titled "Iowa Farmed Wetlands" in the journal *Wetlands*. The feature included nine published papers on a single study funded by the U.S. EPA, with contributions from 12 authors focused on various aspects of water, soils, and ecosystem services of farmed and drained wetlands in the Des Moines Lobe. IIHR and IGS contributors from the University of Iowa included Schilling, Antonio Arenas Amado, Marcela Politano, Chris Jones, Matthew Streeter, Stephanie Then, and Larry Weber, as well as external partners from several agencies and organizations. The special collection of papers is among the first to describe the ecosystem value and complexity of these understudied wetland systems.

The special collection of papers is among the first to describe the ecosystem value and the complexity of these understudied wetland systems.

LEFT: Bird use of temporarily ponded water in a drained prairie pothole wetland.

IGS Completes Maps of Floyd County

by Phillip Kerr and H. Paul Liu



THE COMPLETED BEDROCK MAP OF FLOYD COUNTY: (A) was produced in 2010 at 1:500,000 scale; and (B) was newly mapped at 1:100,000 scale to allow for a higher level of detail. This new mapping subdivided the Devonian Cedar Valley and Wapsipinicon groups into six formations and produced a bedrock elevation map with a 25′ contour interval, a major improvement over the 50′ contour interval of the statewide map.

COMPLETION OF SURFICIAL AND bedrock geologic maps for Floyd County in 2018 represents the end of a successful eight-year mapping effort in north-central Iowa. Geologists at the Iowa Geological Survey combed through thousands of well records, described hundreds of bedrock outcrops, and drilled dozens of Quaternary cores and borings to produce the maps for the county.

The bedrock surface of Floyd County mainly comprises shallow marine sediments, i.e., limestone, dolomite, and shale. The primary objective of the bedrock portion of this project was to divide the Devonian Cedar Valley Group and underlying Wapsipinicon Group, which cover most of Floyd County, into formations. The new maps provide more detailed information for investigations into groundwater resources and other geologic research.

The surficial landscape, which is made up of materials deposited during the Quaternary, is muted due to extensive periglacial erosion during the last glacial maximum. This process created a package of reworked materials that covers most of the uplands and hillslopes. Beneath this veneer, geologists have found evidence for the Sheldon Creek Formation and have delineated part of the boundary for that advance. (see story, p. 12)

These discoveries will help Iowans seeking protected water sources and provide important data to the geological community.

New Achievements of the Winneshiek Project Research

by H. Paul Liu and Robert M. McKay

THE NSF-FUNDED WINNESHIEK project, which focused on the unusual Middle Ordovician fossils and the Decorah impact structure in northeast Iowa, is winding down. However, the year 2017–18 was a productive period for the project in terms of both publications and public education. Five new collaborative articles appeared in scientific journals during this period, including descriptions of some new Winneshiek taxa, fossil taphonomy investigations, biochemostratigraphic studies, comprehensive analysis of the Decorah impact structure, and a periodical summary of the Winneshiek research.

The University of Iowa Mobile Museum also featured findings and artifacts from the project, which resulted in significant public exposure for the Winneshiek research. More than 35,000 people toured the exhibit in the UI Mobile Museum, which participated in 54 events across Iowa.

TOP: The UI Mobile Museum exhibited findings from the Winneshiek project at the 2017 Iowa State Fair.

ABOVE: the Ordovician "sea scorpion" appears on the cover of a children's coloring book designed and published by the UI Mobile Museum.

More than 35,000 people toured the exhibit in the UI Mobile Museum, which participated in 54 events across Iowa.

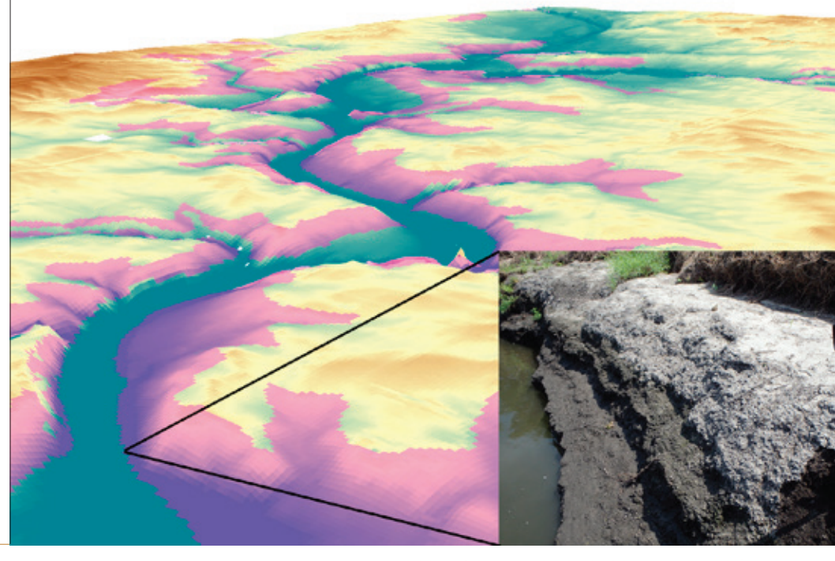
Quantifying Sediment Delivery in an Eastern Iowa Basin

by Matthew Streeter

SEDIMENT AND PHOSPHORUS (P) eroded from agricultural croplands are major contributors to water-quality impairment in midwestern streams. Over the last few decades, improvements in land management have reduced field-scale erosion, but reducing the amount of erosion occurring from plot to plot is not the same as reducing the amount of sediment exported from a watershed. Sediment delivery ratios (SDRs) are used to estimate the fraction of gross erosion that is exported from a watershed for a given time. The Iowa Geological Survey (IGS) recently completed a study of a small eastern Iowa watershed and found that the current SDR for the basin (~ 4%) was much lower than estimates produced by previous USDA approaches.

The study, published in the journal *Soils and Sediment*, found that farmers are making significant progress in reducing sediment export. With funding from the Iowa Nutrient Research Center, IGS is continuing this work by focusing on annual sediment and total P exported from sheet, rill, and streambank erosion from five eastern Iowa watersheds ranging in size from 8 to 1487 km². We will determine new SDRs that consider the effects of existing conservation practices on the landscape.

BELOW: Average annual soil erosion of an eastern Iowa watershed. IGS found that less than 4% of this eroded soil made it to the stream.



Assuring a Long-Term Supply of Water for the Cedar Rapids and Iowa City Area

by Mike Gannon and Nathan Holt

"The model has allowed the city to maximize water production while minimizing the impact on the aquifer. It's been a win-win for the city and the other area water users."

GREG METTERNICH,
NORTH LIBERTY WATER MANAGER (LEFT, WITH MIKE GANNON, RIGHT, AND ASSISTANT WATER SUPERINTENDENT SHANNON KOPECKY, CENTER)

IOWANS RELY ON A SAFE AND dependable supply of water to meet the needs of cities, industries, and agriculture, including drinking water, process and cooling water for agribusinesses and industry, and water for Iowa's ever-expanding livestock industry. Population growth in Linn and Johnson counties requires an increasing supply of water for North Liberty, Tiffin, Marion, Coralville, and Iowa City, which are among the fastest growing communities in Iowa. Cedar Rapids agribusiness giants Archer Daniels Midland and Ingredion provide jobs, energy, and an abundant food supply for Iowa and the world. A growing population and economic vitality both require an adequate long-term supply of water.

The region around Linn and Johnson counties relies heavily on a deep confined ("Jordan") aquifer for its water supply, but declining water levels in many of the Jordan wells prompted the Iowa Legislature to adopt the Linn and Johnson County Groundwater Protected Area (LJCPA) in 2014 to manage aquifer sustainability for the region. Because of these regional concerns, the Iowa Geological Survey (IGS) established a unique public-private partnership with local water users to quantify the long-term availability of water from the Jordan aquifer in the two-county area. IGS staff developed and calibrated a three-dimensional local-scale groundwater flow model, and then used it to predict future water availability for both industrial and municipal users.

The City of North Liberty, with the second fastest population growth rate in the state, was a key beneficiary of the project. North Liberty's growth increased the city's need for more water, about 90% of which is pumped from the Jordan aquifer. Working closely with North Liberty's water manager Greg Metternich, IGS was able to simulate the groundwater flow system around North Liberty's wells and assess current and future pumping rates to identify vulnerabilities. Metternich said, "The work performed by IGS has allowed North Liberty to pump more water from the Jordan aquifer. Prior to the modeling effort, the Iowa Department of Natural Resources had capped the city's water production from the Jordan due to the uncertainty in the sustainability of the aquifer. The model has allowed the city to maximize water production while minimizing the impact on the aquifer. It's been a win-win for the city and the other area water users."

Another major concern in the Iowa City and Cedar Rapids area is the long-term, collective well interference created by the combined pumping of high-capacity public and industrial wells (see map, p. 9). Declines in groundwater levels in confined aquifers often extend radially many miles from each production well. These depressions can interact with each other to accelerate and increase the overall drop in groundwater levels throughout the protected area. Collective well interference makes prediction of long-term pumping water elevations at individual wells virtually impossible using observed water levels exclusively. Even proactive water utilities that reduce their overall groundwater withdrawals may see long-term declines in pumping water levels as a result of well interference or drawdown from another nearby water user.

Based on the model simulation results, IGS found that additional future growth in water supplies is available for users in the LJCPA. A 30% increase in water use by all users in the LJCPA over the next 20 years appears to represent the maximum sustainable water use. However, since not all of the water users in the LJCPA want an increase in water use, growing communities or industries may see an opportunity to increase individual water uses above the 30% threshold.

The IGS presented a conservative approach to the Iowa Department of Natural Resources that establishes a water use increase of no more than 30% for a five-year period. This approach allows communities and industries the opportunity to expand their water use, but also protects the aquifer for future generations. We will continue to monitor pumping water levels in each production well to evaluate future allocations.

Groundwater modeling results indicate the Jordan aquifer can remain a long-term source of water for users in Linn and Johnson counties. However, the results made clear that users in the LJCPA must begin to identify and develop alternative water sources in order to assure a sustainable future water supply. Potential alternative water sources may include the Silurian aquifer, alluvial aquifers, buried sand and gravel aquifers, surface water, and purchased water from municipalities with surplus water capacity.

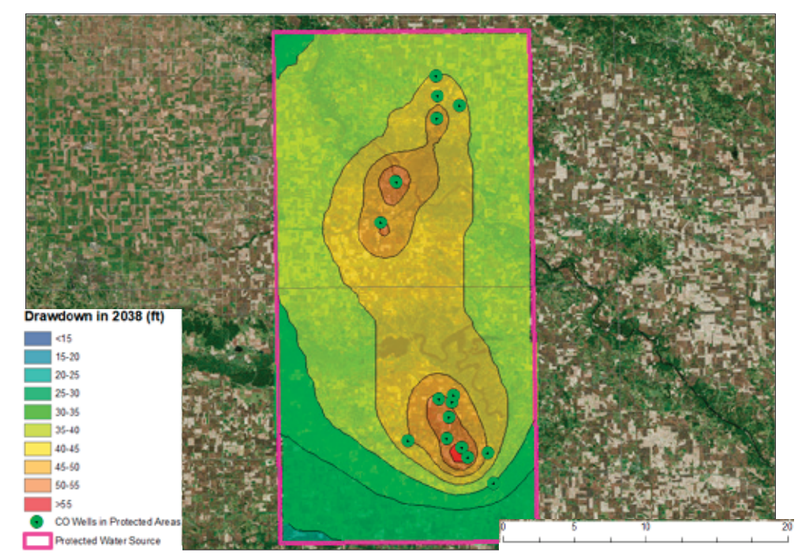
Overall, the IGS-led partnership among water users, the Iowa DNR, and IGS hydrogeologists represented a real "win" for everyone involved with the project and sets the stage for the development of similar regional partnerships in other vulnerable areas of the state.

Groundwater modeling results indicate the Jordan aquifer can remain a long-term source of water for users in Linn and Johnson counties.

TOP ROW OF THREE IMAGES: Industry and residential water usage in Cedar Rapids and Iowa City both tap into the Jordan aquifer.

MAP BELOW: Predictive drops in groundwater levels, 2018–38, in the Cedar Rapids and Iowa City area.

PHOTO AT RIGHT: Rick Langel conducts a pump test in North Liberty.



The Search for Critical Minerals in Iowa

by Ryan Clark

CRITICAL MINERALS (RARE EARTH elements, platinum group elements, and copper-nickel sulfides) are vital to many industries, including information technology, automotive, alternative energy, and national defense. To meet the increasing demands for these minerals and to lessen our dependence on foreign sources, the U.S. Geological Survey (USGS) is evaluating the country's mineral reserves.

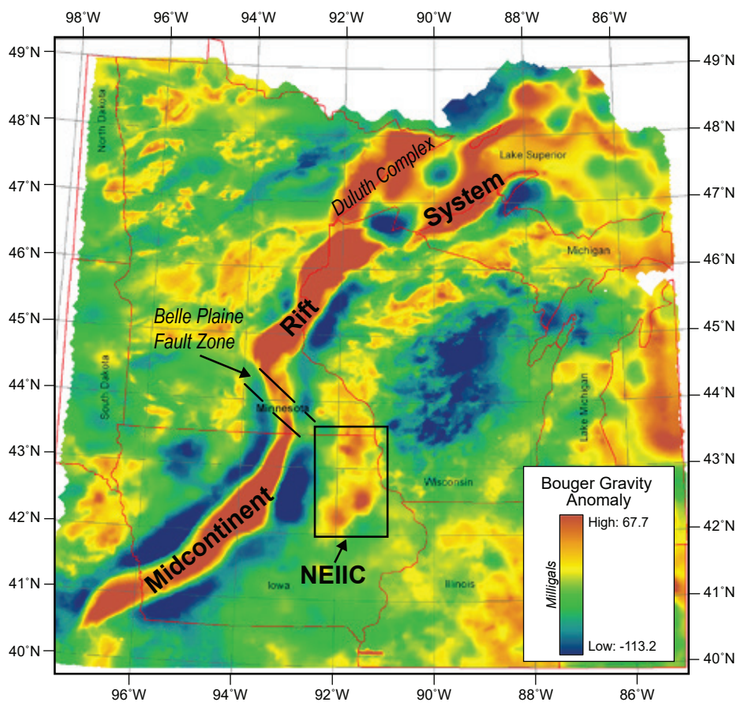
The USGS issued a report defining what a critical mineral is and highlighting the 23 mineral commodities deemed critical to our mineral independence (Schulz et al. 2017). For many years, the USGS has been characterizing the most likely source of these minerals, the Precambrian (> 540 million years old) "basement" bedrock of the United States. The bulk of known critical mineral deposits exists in magmatic terranes emplaced during the early formation of the Earth's crust.

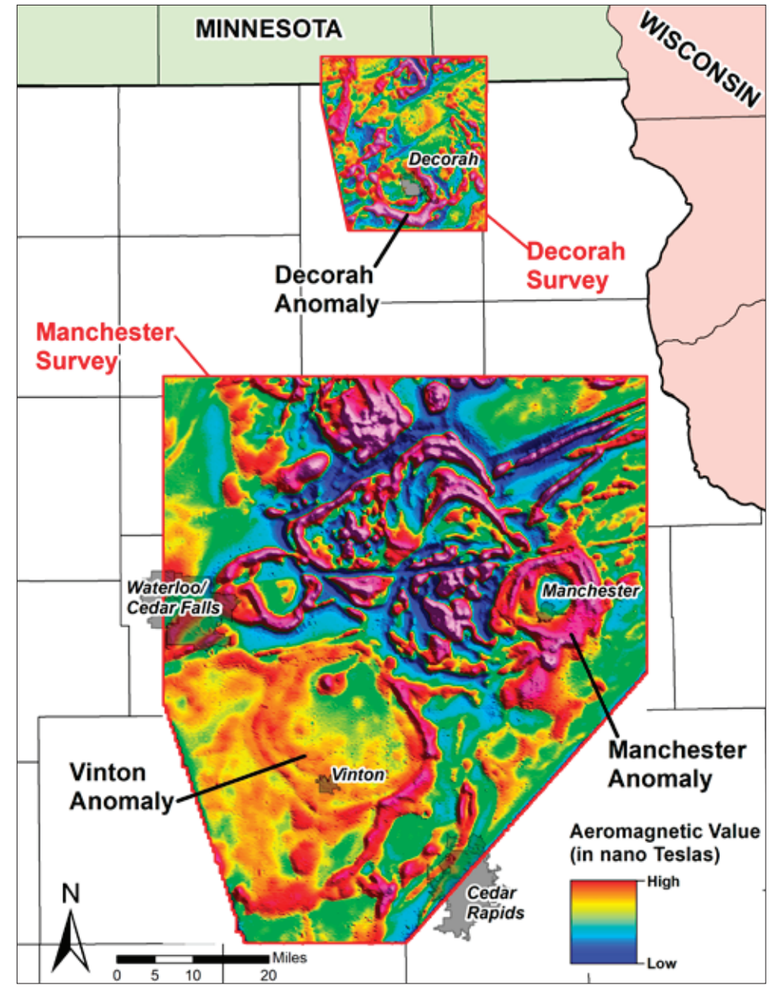
The Midcontinent Rift System (MRS) is a Precambrian (~1.1 billion years old) failed rift that extends from Kansas to Michigan; perhaps the most well-preserved segment runs from southwestern to north-central Iowa. This geologic terrane, known as the Northeast Iowa Intrusive Complex (NEIIC), is situated along the eastern flanks of the MRS. The sub-parallel orientation to the MRS axis is strikingly similar to the well-known Duluth Complex in northeastern Minnesota, which yields platinum group elements and other economic mineral resources (Miller et al. 2002).

Beginning in 2012, the USGS began the process of characterizing the deep Precambrian geology of northeastern Iowa using geophysical techniques over a relatively small survey area encompassing Decorah, Iowa, and expanding into Minnesota. The Decorah Survey included high-resolution aeromagnetic and airborne gravity gradient (AGG) surveys. Aeromagnetic surveys generally detect variations in iron content in the rocks, whereas AGG surveys detect subtle differences in rock densities. The results of the survey improved our understanding of the Precambrian geology and identified the Decorah Anomaly, which appears quite similar in nature to existing geophysical anomalies known to produce economically valuable mineral deposits elsewhere in the world (Drenth et al. 2014).

Based on the success of the Decorah Survey, the USGS conducted a second survey over a larger area of the NEIIC called the Manchester Survey. This effort further resolved the character of the Manchester and Vinton anomalies and has generated substantial interest within the USGS-Mineral Resources Program (MRP) to investigate further. The primary goals, to establish the age of the NEIIC and determine whether it is in fact related to the MRS, have yet to be fulfilled.

The next step is drill into one of the anomalies and collect rock core samples to assess the age and petrology of the anomaly. The USGS is committed to the drilling project; however, budget constraints have stalled the process. The IGS has been attempting to secure funds to complete the drilling project and possibly construct a monitoring well nest in the borehole after core sampling is completed. The prospect of one borehole providing not only information that could prove the NEIIC hosts critical minerals, but also valuable groundwater quality and quantity data from the overlying aquifers, would be a win-win scenario for Iowa's future.





OPPOSITE PAGE: Bouger Gravity Anomaly map of the north-central United States. Gravity data were compiled by the USGS Crustal Imaging and Characterization Team.

LEFT: Map of northeast Iowa and neighboring states showing the two survey areas. Aeromagnetic survey data are shown to illustrate the major anomalies that the USGS considers potential targets for future investigation.

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A Glacier Story: Sheldon Creek Formation

by Phillip Kerr and Stephanie Surine

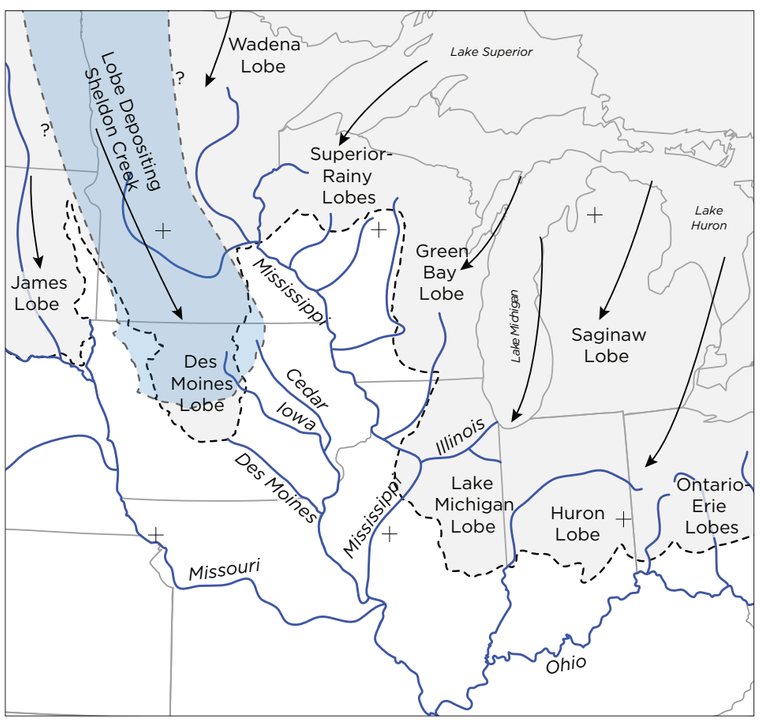
IOWA HAS BEEN GLACIATED numerous times during the last two million years (Quaternary period). The most recent glacial episode, called the Wisconsin, occurred between 46,000 and 13,000 years ago. The ice body that advanced into Iowa during this time, called the Des Moines Lobe (DML), covered only the north-central portion of the state, providing a unique window into past behavior of North American ice sheets. For the last several decades, the Iowa Geological Survey (IGS) has been assembling the story of the middle Wisconsin ice advance – one that would change previously held ideas about the glacial history of North America.

Since the 1880s, geologists have put forth numerous interpretations of glacial advances and stratigraphic relationships in Iowa. Iterations of glacial stratigraphy and ice sheet positions have been proposed, debated, and then modified. Since the 1940s, studies have suggested there was another Wisconsin episode glacial advance before the advance of the DML. However, these models lacked the numerical dates needed to constrain this earlier ice advance.

The advent of radiocarbon dating helped solve this problem. In the late 20th century, researchers collected numerous organic samples from a glacial package beneath the DML. The buried material looked similar to the DML sediment; however, radiocarbon dates showed that the organic material was much older than samples from the DML. This older Wisconsin-aged advance was named the Sheldon Creek Formation, though its extent was unknown.

Recently, the IGS has undertaken geologic mapping in north-central Iowa east of the DML as part of the STATEMAP program. One goal was to find evidence for the Sheldon Creek Formation. However, the area east of the DML was extensively eroded due to permafrost caused by frigid ice-age temperatures combined with strong weather events. We used more than 50 cores collected in Worth, Cerro Gordo, Mitchell, and Floyd counties to construct a boundary for the formation. A handful of cores yielded organic samples with radiocarbon ages that correlated with those collected from beneath the DML.

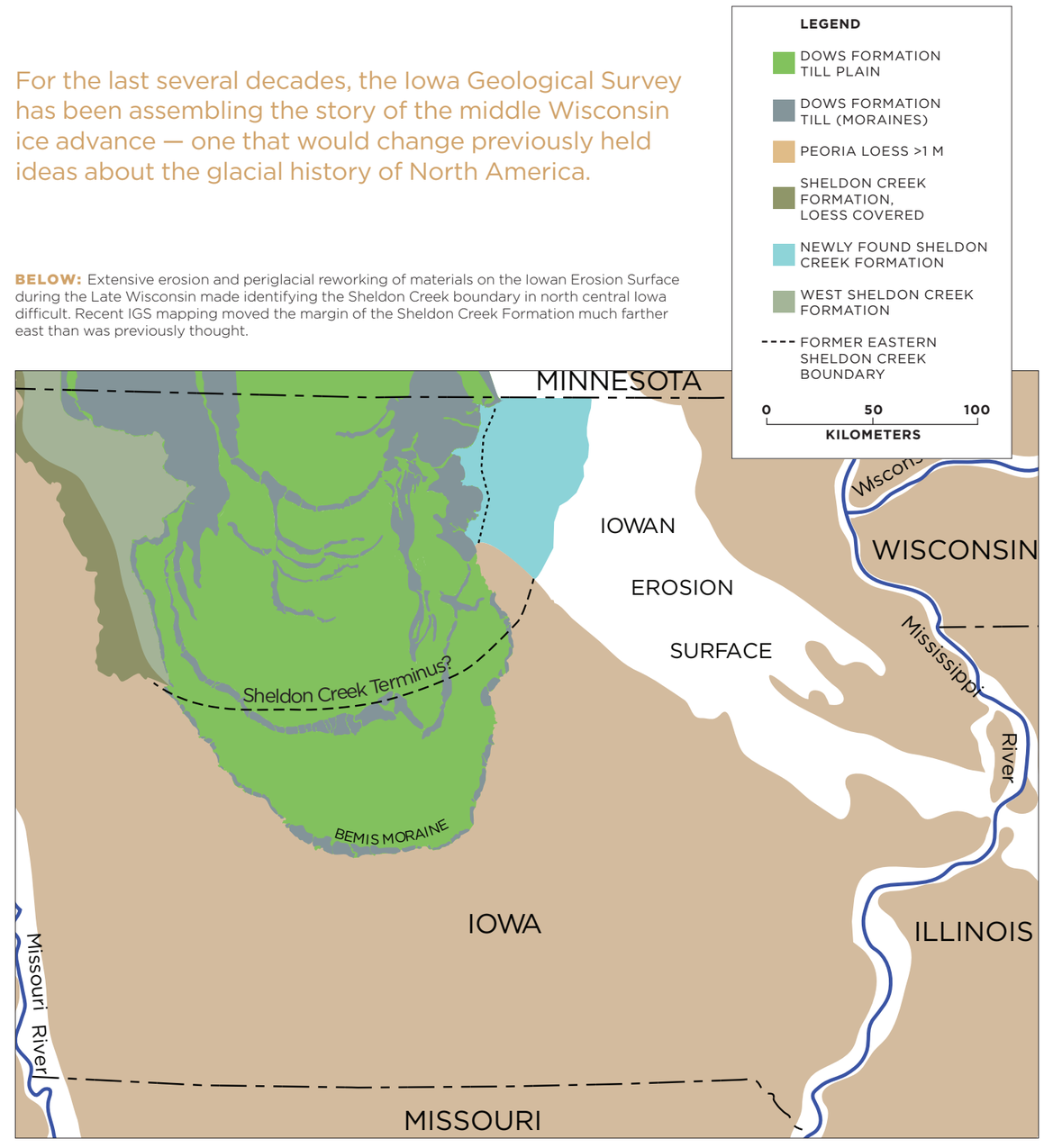
The chronology and distribution constructed by IGS staff, combined with work done on the lithology of the till by University of Iowa graduate students, indicate that two advances of Sheldon Creek Formation ice descended from Canada. The first advance was between 46,000 to 40,000 years ago, while the younger was from 34,000 to 29,000 – well before the advance of the DML at 17,000 to 13,000. Continued exploration in Iowa will one day help tell the full story of glaciers in North America.



RIGHT: This map shows the direction of the ice lobe depositing the Sheldon Creek Formation in relationship to the extent and flow directions of other Late Wisconsinan glacial lobes. The major rivers are shown at their likely orientation during the advance of the Middle Wisconsin ice.

For the last several decades, the Iowa Geological Survey has been assembling the story of the middle Wisconsin ice advance — one that would change previously held ideas about the glacial history of North America.

BELOW: Extensive erosion and periglacial reworking of materials on the Iowan Erosion Surface during the Late Wisconsin made identifying the Sheldon Creek boundary in north central Iowa difficult. Recent IGS mapping moved the margin of the Sheldon Creek Formation much farther east than was previously thought.



Iowa Nutrient Research Center Funding Supports IGS Projects

by Keith Schilling, State Geologist

FUNDING FROM THE IOWA NUTRIENT Research Center (INRC) has supported several projects at the Iowa Geological Survey (IGS) over the past few years. Established by the Iowa Board of Regents in response to legislation passed by the Iowa Legislature in 2013, the INRC pursues science-based approaches to evaluate the performance and implementation of current and emerging nutrient reduction practices. Led by State Geologist Keith Schilling, the IGS has been awarded funding for at least one project in every funding cycle, tackling research projects as diverse as paired watershed monitoring, oxbow restorations, quantification of phosphorus losses from streambank erosion, and an assessment of the nutrient reduction benefits of roadside ditches.

JUNE 2016 AUGUST 2016 MAY 2017

QUANTIFYING THE NUTRIENT REDUCTION BENEFITS OF OXBOW RESTORATIONS

Oxbows are natural floodplain features formed when a river cuts off a meander loop as it migrates within its floodplain. Natural oxbows are among the most biologically diverse aquatic systems in the world, but accumulation of sediment and organic material often fills the oxbow over time, and systems transition from a lentic to a terrestrial habitat. Removing the oxbow fill material and restoring the lentic habitat are considered oxbow reconstruction.

IGS has worked with partners including The Nature Conservancy, Iowa Soybean Association, U.S. Fish and Wildlife Service, and Linn County Conservation Board to monitor oxbow restorations in central and eastern Iowa. At the central Iowa site, IGS monitored an oxbow that was reconstructed to receive flow and nutrients from subsurface field tiles. In field investigations conducted over separate two-year and one-year time periods, IGS researchers documented that the oxbow reduced nitrate-nitrogen loads into the oxbow by an average of 42±6%. At the eastern Iowa site, the oxbow was reconstructed to receive inputs from groundwater seepage and overbank flooding. Over a one-year period, the oxbow reduced nitrate loading delivered by a flood pulse by approximately 74.2%.

IGS research has shown that oxbows fed by tile drainage provide greater nitrate mass reduction than oxbows fed by flood pulses and groundwater. IGS staff, along with project partners, are using data from these oxbow studies to develop a new INRC conservation practice centered on oxbows. Study results appeared in the journals *Ecological Engineering* and *Journal of Environmental Management*.

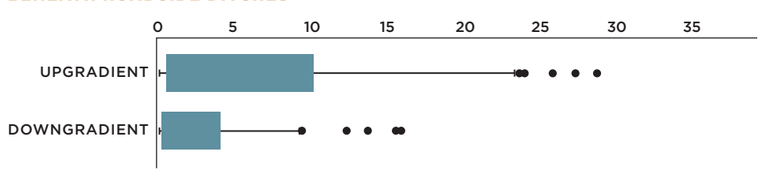
SUBSURFACE NUTRIENT PROCESSING CAPACITY IN AGRICULTURAL ROADSIDE DITCHES

Urban and rural roadside ditches are integral components of watershed-scale hydrologic processes, but their capacity to reduce nutrients in the subsurface environment has not been investigated. In this INRC-funded study, IGS researchers Keith Schilling and Matthew Streeter, along with project partners from University of Northern Iowa and Coe College, characterized the vegetation, soil, and groundwater conditions in six roadside ditches in the 66 km² Lime Creek watershed in eastern Iowa.

We installed shallow water table wells at 17 locations in six transects and sampled monthly throughout 2017 to evaluate spatial and temporal patterns. Our team observed that groundwater NO3-N concentrations decreased from upgradient to downgradient positions at four locations (average 60% reduction).

Water table levels were very shallow (< 0.3 m) at nearly all sites, and the rich, loamy, organic ditch soils appeared to be sufficiently anaerobic for subsurface processing of NO3-N via denitrification to occur. With estimated NO3-N reductions equivalent to typical wetland N reductions, roadside ditches could serve as "linear wetlands" for watershed-scale treatment of nonpoint source pollution. Research from the project appeared in the journal *Science of the Total Environment* in 2018.

NITRATE CONCENTRATIONS (MG/L) IN SHALLOW GROUNDWATER BENEATH ROADSIDE DITCHES



OPPOSITE PAGE: Oxbow reconstruction in eastern Iowa at Morgan Creek Park.

ABOVE AND LEFT: Matthew Streeter sampling a roadside ditch monitoring well.

Groundwater Availability Prospecting

by Jason Vogelgesang and Nathan Holt

IN THE PAST, CITIES AND WELLFIELD operators often drilled new wells where land and infrastructure were available. While these are important considerations, new approaches and technology used by IGS hydrogeologists are allowing water managers to make informed decisions on where best to locate new wells. Choosing the proper well location the first time can make financial sense and eliminate problems down the road.

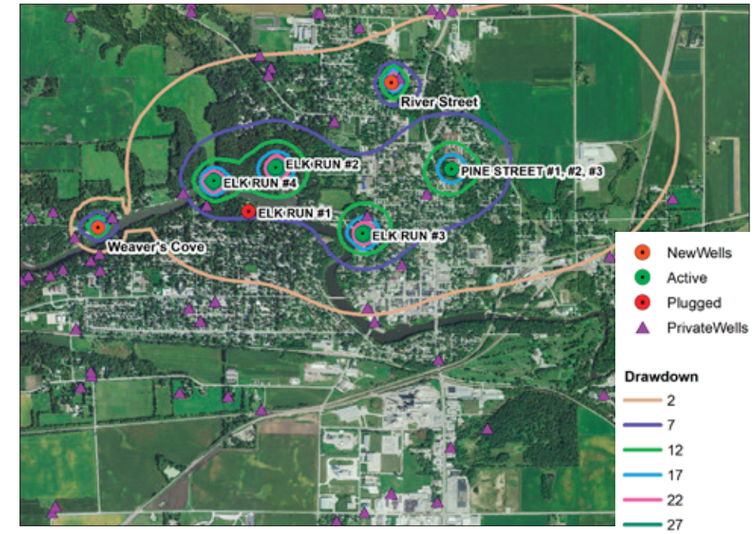
IGS typically uses geophysical surveying and groundwater modeling to locate new wells. Electrical resistivity surveys use electricity to image the subsurface and provide a colorful representation of water-producing zones in the aquifer. Field-based geophysical surveys offer a non-intrusive, efficient way of assessing the extent and capacity of the aquifer, often reducing the need for costly drilling.

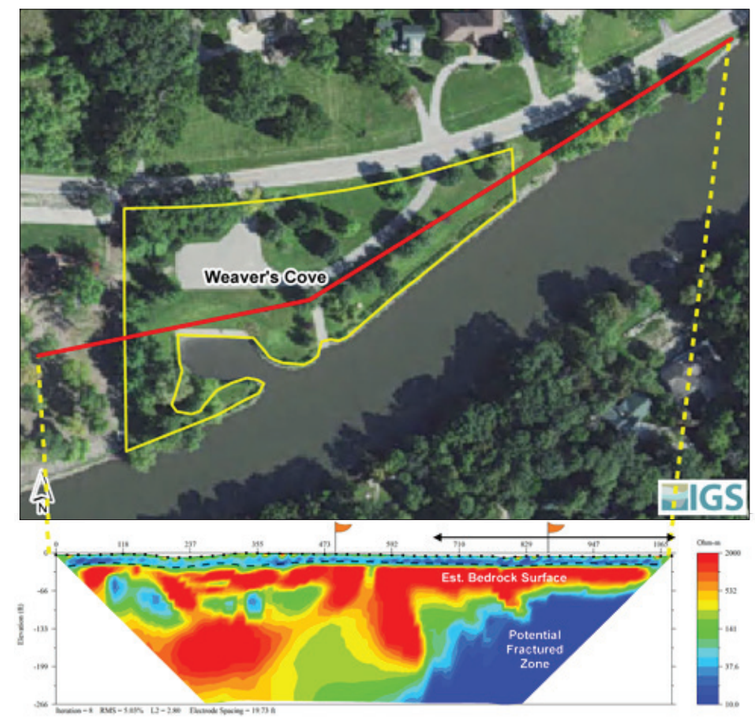
After identifying optimum site(s), IGS creates a groundwater model of the local aquifer. Groundwater models incorporate all hydrogeologic information for an area to create a computer simulation. The model is calibrated to measured parameters and then used to predict how the aquifer will respond to different stresses. Questions often addressed by the groundwater model include:

- If well withdrawals increase, will the wells go dry?
- If a new well is installed, will it affect neighboring wells?
- If a city population increases by 20% in the next 10 years, will the aquifer be able to meet increased demand?
- If a severe drought occurs, will wells still be able to produce?

IGS recently helped the City of Iowa Falls locate the best site for new wells in the Mississippian Aquifer. We completed geophysical surveys in four areas identified by city officials for possible well installation. Geophysical results identified two preferred sites for well development. We analyzed existing wells to determine aquifer information. The IGS team also developed a groundwater model to estimate the production potential of the new wells, to determine if the wells would interfere with neighboring wells, and to assess the impact of the additional pumping on the local aquifer.

As always, IGS stands willing and able to assist local communities or industries with any groundwater-related projects.





BOTTOM LEFT: Jason Vogelgesang installs an electrode as part of a geophysical survey.

BOTTOM CENTER: Nathan Holt collects water levels from a well during a pump test.

TOP CENTER: Jason Vogelgesang conducts a geophysical survey for groundwater exploration during the cold of winter.

TOP RIGHT MAP: A figure from a groundwater simulation showing the impact of an additional well on groundwater levels in Iowa Falls.

BOTTOM RIGHT MAP: Electrical resistivity model of the subsurface used to identify potentially productive locations for water supply within the aquifer.

Alluvial Aquifer Drought Resiliency Toolbox

by Mike Gannon, Jason Vogelgesang, Nathan Holt, and Keith Schilling

ABOVE: Randy Iedema, the water operator from Rural Water System #1 in Hospers, Iowa, discusses a drought resiliency solution being installed at his alluvial wellfield with Jason Vogelgesang of the Iowa Geological Survey.

OPPOSITE PAGE: Summary of alluvial aquifer strategies for drought resiliency.

ALLUVIAL AQUIFERS – groundwater resources in shallow sand and gravel deposits near rivers and streams – can be vulnerable to drought and water-quality issues, potentially threatening water availability for the people who rely on them. IGS staff worked with multiple water supply operators in northwest Iowa and analyzed five engineered systems used to increase the drought resiliency and/or water quality of alluvial wellfields. The benefits of the different approaches are summarized at right for groundwater quantity and quality; the IGS also created a new alluvial aquifer toolbox handout with this information.

IGS staff worked with multiple water supply operators in northwest Iowa and analyzed five engineered systems used to increase the drought resiliency and/or water quality of alluvial wellfields.

ALLUVIAL WELLFIELD TOOLBOX

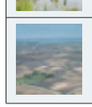
IOWA GEOLOGICAL SURVEY

THE UNIVERSITY OF IOWA

Which solution is right for you?

Alluvial aquifers — groundwater resources in shallow sand and gravel deposits near rivers and streams — can be vulnerable to drought and water-quality issues, potentially threatening water availability for the people who rely on them. The Iowa Geological Survey (IGS) can help you evaluate a range of potential solutions to these problems. IGS staff analyzed five engineered systems used in Iowa to increase the drought resiliency and/or water quality of alluvial wellfields and summarized each system's benefits to groundwater quantity and quality below.

COMPARISON OF SYSTEMS

		Cost	Groundwater Storage Benefits	Recharge Benefits	Potential Well Yield Benefits	Water Quality Benefits
RIVER SYSTEMS						
	**RIFFLE STRUCTURES** Rock riffle structures raise the stage or water level of a river, which provides water to the aquifer, offering additional groundwater storage and recharge during a drought. The higher the river stage, the greater the benefit to the aquifer. Rock riffles provide a gradual, environmentally-friendly gradient change.	Medium ($150-250k)	High	High	High	Low
	**EXCAVATED CHANNELS** Former river channels are common in alluvial floodplains. These naturally-depressed areas can be excavated to current river levels to allow surface water to infiltrate and bring surface water closer to production wells. This increases groundwater storage and recharge. Excavated channels can be combined with riffle structures to provide even greater benefits.	High (>$250k)	High	High	High	Low
FLOODPLAIN SYSTEMS						
	**BASINS** Excavated basins or existing gravel pits can be flooded to provide additional groundwater storage. Water in these basins infiltrates into the aquifer, allowing wellfields to maintain water production during a drought for multiple years. This strategy can also reduce nitrate concentrations in the groundwater recharge (the slow process of replenishing groundwater by drainage through the soil).	Medium ($150-250k)	High	High	High	Medium
	**FLOODPLAIN PONDS** Floodplain ponds can improve water quality in an aquifer and provide a gradual source of groundwater recharge. They may be shallow and are not typically excavated into the aquifer. Floodplain ponds have been shown to provide a source of high-quality recharge to aquifers.	Low (<$100k)	Low	Medium	Medium	High
	**LAND USE/COVER** Land use and land cover changes near a wellfield can have a dramatic effect on the water quality. Establishment of cover crops, riparian buffers, and implementation of other conservation practices can reduce nutrient and sediment loads in surface water, which feeds alluvial aquifers.	Medium ($150-250k)	None	None	None	High

Publications by IGS Staff in 2017–18

Arenas Amado, A., **K.E. Schilling**, C.S. Jones, N. Thomas, and L.J. Weber, 2017. "Estimation of tile drainage contribution to streamflow and nutrient loads at the watershed scale based on continuously monitored data," *Environmental Monitoring and Assessment*, 189:426, doi:10.1007/s10661-017-6139-4.

Arenas Amado, A., **K.E. Schilling**, J. Niemeier, and L.J. Weber, 2018. "Evaluating the timing and interdependence of hydrologic processes at the watershed scale based on continuously monitored data," *Water*, 10, 261, doi 10.3390/w10030261.

Beck, W., T. Isenhart, P. Moore, **K.E. Schilling**, R. Schultz, and M. Tomer, 2018. "Streambank alluvial unit contributions to suspended sediment and total phosphorus loads, Walnut Creek, Iowa, USA," *Water*, 10, 111, doi:10.3390/w1002011.

Bergström, S.M., B. Schmitz, **H.P. Liu**, F. Terfelt, and R.M. McKay, 2018. "High-resolution δ13Corg chemostratigraphy links the Decorah impact structure and Winneshiek Konservat-Lagerstätte to the Darriwilian (Middle Ordovician) global peak influx of meteorites," *Lethaia*, v. 51, pp. 504–512.

Briggs, D.E.G., **H.P. Liu**, R.M. McKay, and B.J. Witzke, 2018. "The Winneshiek biota: exceptionally preserved fossils in a Middle Ordovician impact crater," *Journal of the Geological Society* (London), v. 175, pp. 865–874.

Clark, R., **H.P. Liu**, **S. Tassier-Surine**, and **P. Kerr**, 2018. Bedrock geologic map of the Sperry 7.5' Quadrangle, Des Moines County, Iowa: Iowa Geological Survey, Open File Map OFM-18-3, 1:24,000 scale map sheet.

Clark, R., **H.P. Liu**, **S. Tassier-Surine**, and **P. Kerr**, 2018. Bedrock geologic map of the West Burlington 7.5' Quadrangle, Des Moines County, Iowa: Iowa Geological Survey, Open File Map OFM-18-5, 1:24,000 scale map sheet.

Drake, C.W., C.S. Jones, **K.E. Schilling**, A. Arenas Amado, and L.J. Weber, 2018. "Estimating nitrate-nitrogen retention in a large constructed wetland using high-frequency, continuous monitoring and hydrologic modeling," *Ecological Engineering*, 117:69–83.

French, B.M., R.M. McKay, **H.P. Liu**, D.E.G. Briggs, and B.J. Witzke, 2018. "The Decorah structure, northeastern Iowa: Geology and evidence for formation by meteorite impact," *GSA Bulletin*, v. 130, pp. 2062–2086.

Gannon, J.M. and **N. Holt.**, 2018. "Cambrian-Ordovician aquifer sustainability study, Linn and Johnson County Groundwater Protected Area," *Water Resources Investigation Report No. 18*, Iowa Geological Survey, IIHR—Hydroscience & Engineering, Iowa City, Iowa.

Gassman, P.W., A.M. Valcu-Lisman, C.L. Kling, S.M. Michelson, Y. Panagopoulos, R. Cibin, I. Chaubey, C.F. Wolter, and **K.E. Schilling**, 2018. "Assessment of bioenergy cropping scenarios for the Boone River watershed in north-central Iowa, United States," *Journal of the American Water Resources Association*, 53(6):1336–1354.

Hawkins, A.D., **H.P. Liu**, D.E.G. Briggs, A.D. Muscente, R.M. McKay, B.J. Witzke, and S. Xiao, 2018. "Taphonomy and biological affinity of three-dimensionally phosphatized bromalites from the Middle Ordovician Winneshiek Lagerstätte, northeastern Iowa, USA," *Palaios*, v. 33, p. 1–15.

Jones, C.S., C.A. Davis, C.W. Drake, **K.E. Schilling**, S.H.P. Debionne, D.W. Giles, I. Demir, and L.J. Weber, 2018. "Iowa statewide stream nitrate load calculated using *in situ* sensor network," *Journal of the American Water Resources Association*, 54(2):471–486.

Jones, C.S., J.K. Nielsen, **K.E. Schilling**, and L.J. Weber, 2018. "Iowa stream nitrate and the Gulf of Mexico," *PLoS ONE*, 13(4):e0195930.

Jones, C.S., **K.E. Schilling**, I.M. Simpson, and L.J. Weber, 2018. "Iowa stream nitrate, discharge and precipitation: 30-year perspective," *Environmental Management*, (in press).

Kerr, P., **S. Tassier-Surine**, **M.T. Streeter**, **H.P. Liu**, and **R. Clark**, 2018. Surficial geologic map of Floyd County, Iowa: Iowa Geological Survey, Open File Map OFM-18-2, 1:100,000 scale map sheet.

Liang, X., H. Zhan, Y.K. Zhang, and **K.E. Schilling**, 2018. "Base flow recession from unsaturated-saturated porous media considering lateral unsaturated discharge and aquifer compressibility," *Water Resources Research*, doi: 10.1002/2017WR020938.

Liang, X., H. Zhan, Y.K. Zhang, and **K.E. Schilling**, 2018. "Reply to comment by Roques et al. on 'Base flow recession from unsaturated-saturated porous media considering lateral unsaturated discharge and aquifer compressibility,'" *Water Resources Research*, 10.1002/2017WR022378.

Liu, H.P., **P. Kerr**, **R. Clark**, and **S. Tassier-Surine**, 2018. Bedrock Geologic Map of Floyd County, Iowa: Iowa Geological Survey, Open File Map OFM-18-1, 1:100,000 scale map sheet.

McLellan, E.L., **K.E. Schilling**, C.F Wolter, M.D. Tomer, S.A. Porter, J.A. Magner, D.R. Smith, and L.S. Prokopy, 2018. "Right practice, right place: a conservation planning toolbox for meeting water quality goals in the Corn Belt," *Journal of Soil and Water Conservation*, 73:29A–34A.

Schilling, K.E.. and S. Dinsmore, 2018. "Monitoring the wildlife, hydrology, and water quality of drained wetlands of the Des Moines Lobe, northern Iowa: introduction to special feature," *Wetlands*, 38(2), 207–210.

Schilling, K.E., B.J. Haines, C.S. Jones, and M. St. Clair, 2018. "Effectiveness of a newly reconstructed floodplain oxbow to reduce NO3-N loads from a spring flood," *Journal of Environmental Management*, 215:385–393.

Schilling, K.E., P.J. Jacobson, and C.F. Wolter, 2018. "Using riparian zone scaling to optimize buffer placement and effectiveness," *Landscape Ecology*, 33:141–156.

Schilling, K.E. and **M.T. Streeter**, 2018. "Groundwater nutrient concentrations and mass loading rates at Iowa golf courses," *Journal of the American Water Resources Association*, 54(1):211–224.

Schilling, K.E., **M.T. Streeter**, E.A. Bettis III, C.W. Wilson, and A.N. Papanicolaou, 2018. "Groundwater monitoring at the watershed scale: An evaluation of recharge and nonpoint source pollutant loading in the Clear Creek Watershed, Iowa," *Hydrological Processes*, 32:562–575.

Schilling, K.E., **M.T. Streeter**, T.M. Isenhart, W.J. Beck, M.D. Tomer, K.J. Cole, and J.L. Kovar, 2018. "Distribution and mass of groundwater orthophosphorus in an agricultural watershed," *Science of the Total Environment*, 65:1330–1340.

Schilling, K.E., S.R. Then, and C.D. Ikenberry, 2018. "Water balance modeling of temporary ponding in a drained prairie pothole wetland," *Environmental Modeling and Assessment* (in press).

Streeter, M.T. and **K.E. Schilling**, 2018. "Effects of golf course management on subsurface soil properties in Iowa," *Soil*, 4:1–8.

Streeter, M.T. and **K.E. Schilling**, 2018. "Sediment delivery and nutrient export as indicators of soil sustainability in an Iowa agricultural watershed," *Journal of Soils and Sediment*, 18(4)1756–1766.

Tassier-Surine, S., **P. Kerr**, **R. Clark**, and **H.P. Liu**, 2018. Surficial Geologic Map of the Sperry 7.5' Quadrangle, Des Moines County, Iowa: Iowa Geological Survey, Open File Map OFM-18-4, 1:24,000 scale map sheet.

Tassier-Surine, S., **P. Kerr**, **R. Clark** and **H.P. Liu**, 2018. Surficial Geologic Map of the West Burlington 7.5' Quadrangle, Des Moines County, Iowa: Iowa Geological Survey, Open File Map OFM-18-6, 1:24,000 scale map sheet.

Give to the Iowa Geological Survey

The Iowa Geological Survey has been serving Iowans for more than 125 years – now you can give back to the IGS through the University of Iowa Center for Advancement.

The IGS can now accept your gifts in support of a variety of activities, including hosting field trips, preparing guidebooks, presenting at conferences and workshops, funding student employees, improving the rock library, and more.

To make your tax-deductible gift, contact:
Elizabeth Simpson
(Elizabeth.Simpson@foriowa.org, 319-467-3403)

State Geologist Keith Schilling
(keith-schilling@uiowa.edu, 319-335-1422)

Carmen Langel
(carmen-langel@uiowa.edu, 319-335-5841).

Please add "IGS" to the memo line of your check.

Thank you!

IOWA GEOLOGICAL SURVEY

Selected Presentations by IGS Staff in 2017–18

Clark, R.J., "Iowa's Aquifers," Iowa Water Well Association, Altoona, Iowa, Feb. 2, 2017

Clark, R.J., "Geology and Reclamation at the Waterloo South Quarry," Geological Society of Iowa, Waterloo, Iowa, April 22, 2017

Clark, R.J., "Revisiting the Devonian-Carboniferous Boundary Interval in the U.S. Midcontinent: Type Kinderhookian Area of Illinois, Missouri, and Iowa," Geological Society of America, Seattle, Wash., Oct. 23, 2017

Gannon, J.M., "The Value of Technical Assistance for Source Water Assessments," American Water Works Association NE Iowa Chapter, Manchester, Iowa, March 7, 2018

Gannon, J.M., "Drought Strategy and Aquifer Sustainability: Improving Drought Resiliency of a Rural Water System in Northwest Iowa," Iowa Rural Water Association Conference, Okoboji, Iowa, Sept. 12, 2017

Gannon, J.M., "Drought Strategy and Aquifer Sustainability: Improving Drought Resiliency of a Rural Water System in Northwest Iowa," Iowa Groundwater Association Fall Meeting, Coralville, Iowa, Oct. 5, 2017

Holt, N., "Groundwater Sustainability: Modeling of the Jordan Aquifer in Linn and Johnson Counties," Iowa Groundwater Association Spring Conference, Newton, Iowa, March 2018

Holt, N., "Investigation of a Floodplain Pond to Improve Alluvial Aquifer Drought Resiliency," American Water Works Association Iowa Section 102nd Annual Conference, Council Bluffs, Iowa, October 2017

Kerr, P.J., "Identifying Rocks in Iowa," Iowa Association of Naturalists Fall 2017 Workshop, Indianola, Iowa, November 2017

Kerr, P.J., "The Glacial History of Iowa," History at the Grove Series, Iowa City, Iowa, May 2018

Kerr, P.J., Bettis, E.A., **Tassier-Surine, S.A.**, Quade, D.J., Woida, K., and Kilgore, S.M., "Evidence for middle Wisconsin glaciation in North Central Iowa," Geological Society of American Annual Meeting, Seattle, Wash., October 2017

Kerr, P.J., **Tassier-Surine, S.A.**, Bettis, E.A., Quade, D.J., and Woida, K., "Timing of Two Middle Wisconsin Glacial Advances into North Central Iowa," Geological Society of American North Central Section Meeting, Ames, Iowa, April 2018

Langel, R.J., "Challenges in Data Preservation," The National Geological and Geophysical Data Preservation Program Workshop, Salt Lake City, Utah, Sept. 26, 2017

Langel, R.J., "The Iowa Groundwater Network," NGWA Groundwater Summit 2017, Dec. 6, 2017

Langel, R.J., "Information at your fingertips: The IGS' databases," Illinois State Geological Survey and Illinois State Water Survey, April 16, 2018

Liu, H.P., "The Unusual Winneshiek Lagerstätte," Iowa Academy of Science Speaker Series at Saylorville Lake, July 15, 2017; Nanjing Institute of Geology & Paleontology, China, April 24, 2018; Anhui University of Science & Technology, China, May 4, 2018

Liu, H.P., "The Geology and Fossils of the Rockford Fossil Site and Surrounding Area," Iowa Master Conservationist Program, July 24, 2018

Schilling, K.E., "Nitrate-nitrogen reductions measured in newly reconstructed oxbows located on and off the Des Moines Lobe, Iowa: different hydrology, similar benefits," Midwest Fisheries Conference, Milwaukee, Wis., Jan. 29, 2018; Iowa Water Conference, Ames, Iowa, March 21, 2018

Schilling, K.E., "A Watershed Perspective on Water Quality," Des Moines Water Works Watershed Academy, Oct. 12, 2017

Schilling, K.E., Papanicolaou, T., and Wilson, C., "Assessing Variations in Groundwater Recharge and Nutrient Loading at a Watershed Scale," North-Central Section, Geological Society of America Meeting, Ames, Iowa, March 26, 2018

Streeter, M.T., **Schilling, K.E.**, and Wolter, C., "Assessment of Sediment Delivery and Nutrient Export as Indicators of Soil Sustainability," Soil Science Society of America Annual Meeting, Tampa, Fla., Oct. 25, 2017

Tassier-Surine, S.A., **Kerr, P.J.**, Bettis, E.A., Quade, D.J., and Woida, K., "Redefining the Middle Wisconsin Sheldon Creek Boundary in North Central Iowa," Geological Society of American North Central Section Meeting, Ames, Iowa, April 2018

Tassier-Surine, S.A., "Iowa Geological Survey and Geologic History of the Devonian Fossil Gorge," University of Northern Iowa and Iowa Limestone Producers Iowa Geology Teachers Course, Coralville, Iowa, July 2018

Vogelgesang, J.A., "GeoCore: Encapsulating the Iowa Geological Survey's Core Samples in a Web Application," The National Geological and Geophysical Data Preservation Program Workshop, Salt Lake City, Utah, Sept. 26, 2017

Vogelgesang, J.A., "Drought Strategy and Aquifer Sustainability: Improving Drought Resiliency of a Rural Water System in Northwest Iowa," Iowa Rural Water Association Conference, Dubuque, Iowa, Oct. 10, 2017

Vogelgesang, J.A., "GeoCore: Encapsulating the Iowa Geological Survey's Core Samples in a Web Application," United States Geological Survey – National Geological and Geophysical Data Preservation Program, Webinar, May 30, 2018

Selected FY18 Projects by IGS Staff

Annual and Seasonal Water Budget and Nitrogen Mass Analysis for the Frye Oxbow Restoration: *Keith Schilling*; The Nature Conservancy

Baseline Assessment of Geisler Farm Site: Collection of Pre-BMP Monitoring Data: *Keith Schilling*; Iowa Nutrient Research Center (INRC)

Connecting the Iowa Geological Survey's Iowa Water-Level Network Wells with the National Ground-Water Monitoring Network: *Richard Langel*; United States Geological Survey (USGS)

Developing Areas and Impaired Watershed Mapping in Southeast Iowa: Bedrock and Surficial Geologic Maps of the Sperry and West Burlington Quadrangles: *Stephanie Surine*; USGS

Development of a Groundwater Modeling Tool for the Jordan Aquifer Protected Area in Linn and Johnson Counties with Site-Specific Model Applications (seven individual projects with local users): *Mike Gannon*; City of Iowa City, Ingredion, University of Iowa, City of Coralville, City of North Liberty, City of Tiffin, Archer-Daniels, and City of Marion

Evaluating the Nutrient Processing Capacity of Roadside Ditches: *Keith Schilling*; INRC

Groundwater Consulting Services Proposed Prestige Pork Processing Plant: *Mike Gannon*; I+S Group

Groundwater Investigations for Golden Grain Energy: *Mike Gannon*; Short Elliott Hendrickson Inc.

Impaired Watershed Mapping in Floyd County, Iowa: Bedrock and Surficial Geologic Maps of Floyd County: *Stephanie Surine*; USGS

Migrating Electronic Well Records into GeoSam: *Jason Vogelgesang* and *Richard Langel*; USGS

Mississippian Aquifer Groundwater Exploration and Modeling: *Jason Vogelgesang*; City of Iowa Falls

Scientific Borehole in Northeast Iowa: Ryan Clark; USGS

Total Phosphorus Loads in Iowa Rivers and Estimation of Steam Bank Phosphorus Contribution: *Keith Schilling*; INRC

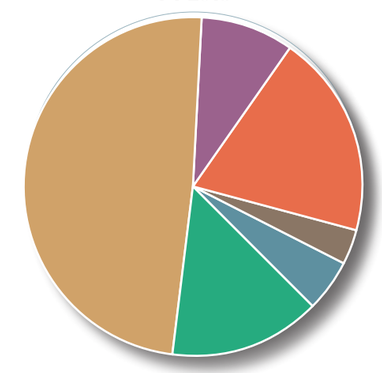
Well-Field Geophysical Investigation near Hudson, S.D.: *Jason Vogelgesang*; Northwest Iowa Regional Water

Wellfield Geophysical Investigations near Hospers, Iowa: *Jason Vogelgesang*; Rural Water System #1

Financials

	FY 2015	FY 2016	FY 2017	FY 2018
Municipal	41,221	148,435	77,433	212,803
USGS	243,701	215,859	193,857	282,855
INRC	54,956	12,614	80,191	127,563
Unsupported	90,210	73,835	168,587	69,362
Other	43,253	95,932	76,927	50,699
IDNR	882,660	793,640	797,097	707,445
	$1,356,001	**$1,340,314**	**$1,394,092**	**$1,450,727**

FY 2018



Municipal: City water supply projects
USGS: United States Geological Survey
INRC: Iowa Nutrient Research Center
Unsupported
Other: Outside non-municipal projects
IDNR: Iowa Department of Natural Resources

THE IOWA GEOLOGICAL SURVEY (IGS) is dedicated to serving Iowans. The IGS had a remarkable research record in 2017–18, including a wide variety of projects that span many areas of study.

As of July 1, 2018, the IGS moved from the oversight of the Iowa Department of Natural Resources (IDNR) to its new home at the University of Iowa, where the IGS is part of IIHR—Hydroscience & Engineering (IIHR). The Iowa Legislature changed Iowa code to reflect this. The same legislation moved the state geologist position and its attendant duties to the IGS.

FY2018 marked the end of funding from the IDNR for IGS operations. Future appropriations will come directly to the IGS at the University of Iowa, as approved by the legislature. The IGS continues to leverage funding from other sources, including municipalities, U.S. Geological Survey, and more. Despite all these activities and initiatives, an increase in annual state appropriations would help IGS to ensure sustainable water resources for Iowans, and to provide science-based information to support well drillers, government officials, and individuals. With appropriate support, we can continue to amplify our efforts for Iowans.

Drilling Through the Decades

Drilling allows geologists access to the subsurface and has been important for Iowa Geological Survey geologists for many decades. The photos illustrate how drilling has been conducted at IGS over the years.

TOP LEFT: Coring and monitoring well installation at Oakdale, circa early 1990s.

TOP RIGHT: Trailer-mounted Giddings drill rig used primarily from the 1980s to early 2010s.

ABOVE AND ABOVE RIGHT: Inaugural well installation and soil coring with new IGS truck-mounted Giddings drill rig, 2017.

RIGHT: Rotary and core drilling conducted in the 1970s to early 1990s. Photo from a 1988 Clayton County project.

IGS

IHR Hydroscience & Engineering

The University of Iowa