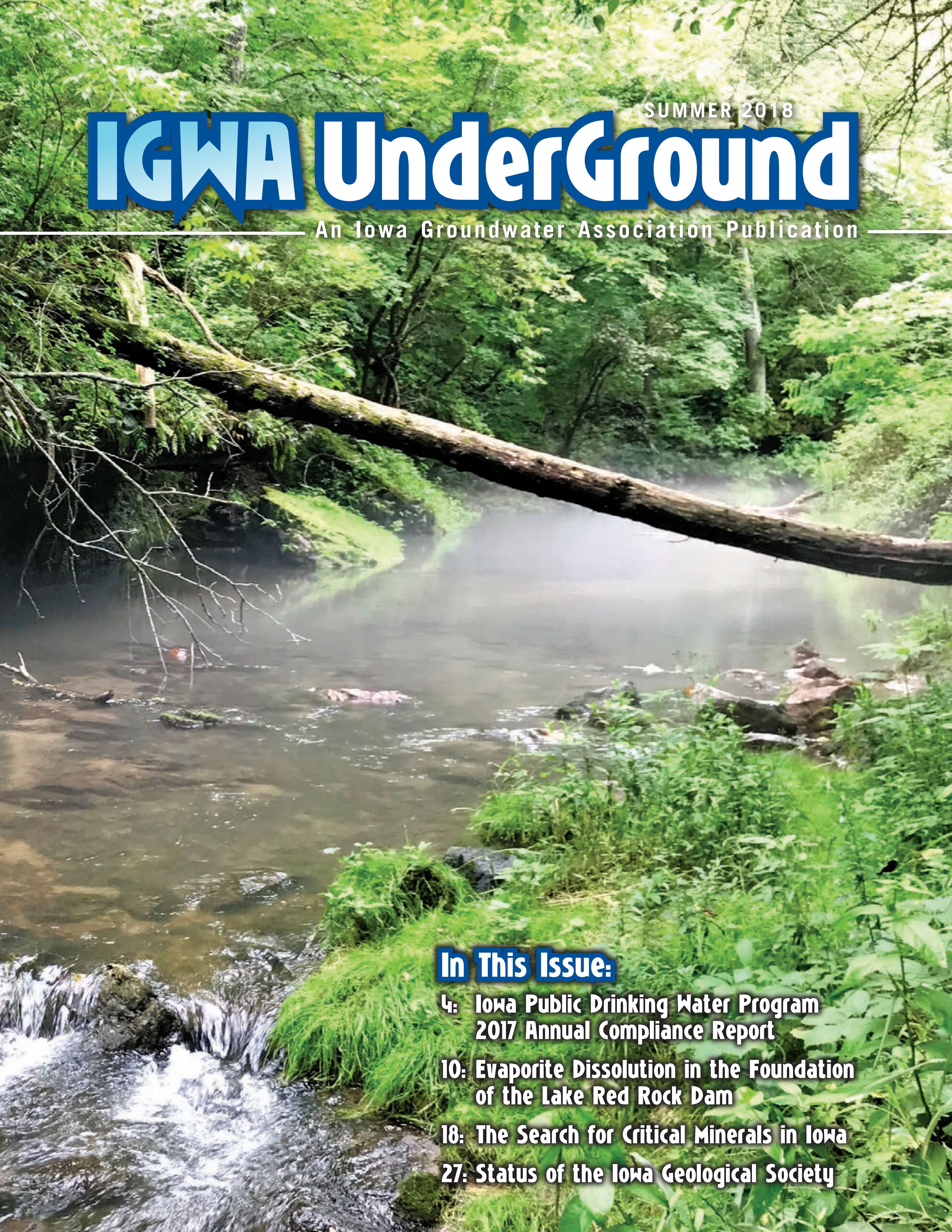


SUMMER 2018

IGWA UnderGround

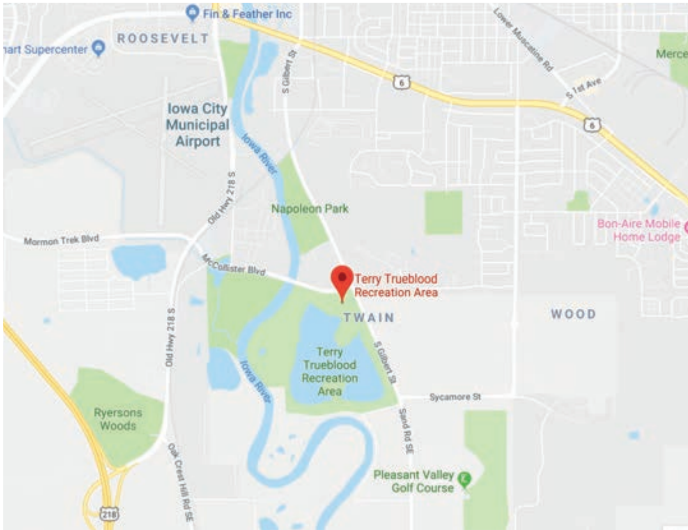
An Iowa Groundwater Association Publication

In This Issue:

Iowa Groundwater Association 2018 Fall Meeting

OCTOBER 10 & 11 2018

TERRY TRUEBLOOD RECREATION CENTER
579 MCCOLLISTER BLVD. | IOWA CITY, IOWA



FALL CONFERENCE SCHEDULE:

OCTOBER 10: PRE-CONFERENCE LEARNING AND SOCIAL OPPORTUNITY

Meet at 3:30 at the Big Grove Tap Room, 1225 S Gilbert St, Iowa City, Iowa
Leave shortly thereafter for a walking tour of Riverfront Crossing Park.
Tour Guide: Aaron Gwinnup, P.E., HR Green
Happy Hour at Big Grove Tap Room, Iowa City, Iowa

OCTOBER 11: CONFERENCE

VENUE:
Terry Trueblood Recreation Center
579 McCollister Blvd, Iowa City, IA

PRESENTATIONS:

Minnesota's Groundwater Protection Rule
Speaker: Larry Gunderson, Fertilizer Technical Unit Supervisor, Minnesota Department of Agriculture

Using Isotopes to Help Us Understand Sources of Nitrate in Iowa's Municipal Wells
Speaker: Claire Hruby, Ph.D., Iowa Department of Natural Resources

Water-Quality Monitoring in Groundwater Near Havana, Illinois
Speaker: Lance Gruhen, Hydrologist, U.S. Geological Survey

Data Mining - Using & Making Available Existing Data
Panel: TBD

Restoring Iowa's Water Quality & Hydrology - Law & Policy Solutions
Speaker: Joe Otto & Cindy Lane, Iowa Environmental Council

Engineers Without Borders - Installing Wells in El Salvador
Speaker: Mike Saeugling, P.E., VJ Engineering

Groundwater Nutrient Concentrations and Loading Rates at Iowa Golf Courses
Speaker: Keith Schilling, State Geologist, Iowa Geological Survey

Occurrence of Neonicotinoid Insecticides in Iowa Groundwater
Speaker: Darrin Thompson, Associate Director, Center for Health Effects of Environmental Contamination

Register online at www.igwa.org

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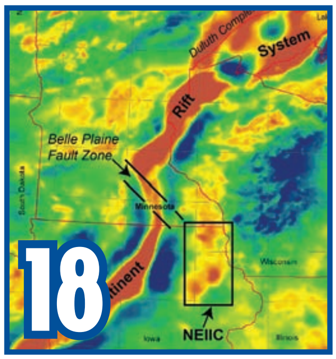


Objectives

- Promote education and research on Iowa groundwater issues.
- Foster cooperation and information exchange throughout its membership.
- Improve communication among state regulatory officials, professionals, and technicians working with groundwater.
- Cooperate with the activities of various state and national associations organized in the interest of groundwater use, conservation, management, and protection.

We are a not for profit organization.

Iowa Groundwater Association
P.O. Box 744 • Des Moines, IA 50303
www.IGWA.org

the President's message

Greg Brennan, President of Iowa American Groundwater Association

I would like to start with a reflection: what an exciting time the late-1980's into the 1990's were! I remember starting my career in 1989, roughly coinciding with the passing of the Iowa Groundwater Protection Act of 1987. The Act was a comprehensive policy focused on groundwater contamination, and implemented with remarkable impact by all that followed (e.g., the Leopold Center, CHEEC, county well testing and plugging, Ag-drainage wells, tank management, solid waste management, recycling, Groundwater Protection Fund, and the list goes on…). My career as a hydrogeologist was truly in front of me and that was very exciting!

Fast-forward to 2018, where my career is closer to the end than the beginning. It's a time when I have also come to appreciate the early years, and faces, of the Iowa Groundwater Association (IGWA) – what was anticipated and accomplished, and the "who" that helped make it possible for "me". Consider that IGWA's founding members, perhaps anticipating their moment in history, founded our Association in 1984 – years before the Groundwater Protection Act!

IGWA was established as an independent statewide association organized for the understanding of Iowa's groundwater resources, with a Mission to promote education and research, improve communication and collaboration, and participation in activities related to groundwater management and water resource protection (See: IGWA website at http://igwa.org/).

Next year will mark the 35th anniversary of the founding of the IGWA and the Mission remains as relevant now as it was then. Poised and ready to meet the challenges of their day, IGWA grew in its first 10 years to over 330 members! IGWA's early members certainly rose to the occasion and set a high standard for the years to come! In 2018, IGWA membership remains passionate and full of talent, albeit fewer in number at about 120. Regarding numbers, consider that we are already on the back end of the Baby Boomer generation – the generation responsible for the founding and flourishing of IGWA. Many of our long-term members are already retired – a factor reflected in current membership numbers. Many more are ready to do so in the next 5-10 years further impacting membership numbers and experience.

To ensure IGWA's Mission is advanced in Year 35 and beyond, we as an association need to encourage an active and growing membership. Our membership is continually challenged to stay relevant and fresh. Succession planning within the Association is a continuing process and we need to be vigilant by actively inviting our friends, colleagues, faculty, students, and clients, etc. to join our ranks and volunteer for committee and leadership positions. Outside the Association let us encourage our membership to step forward into community, ambassadorship, and leadership roles because it is there that professional relationships and friendships develop and move forward in the form of common interests.

Care and stewardship of our environment – groundwater in particular – represents a challenge and collective responsibility for all of us. We have a common heritage, not just up to the present time but extending into the future. Work well and with enthusiasm in the ordinary tasks of each day and people will notice. When they do, tell them: our profession is a noble one – join us!

Iowa Public Drinking Water Program 2017 Annual Compliance Report

The Iowa Department of Natural Resources (DNR) administers the Public Drinking Water Program in Iowa under delegation of authority from the United States Environmental Protection Agency (EPA). This is referred to as primacy for implementation of the federal Safe Drinking Water Act's (SDWA) Public Water Supply Supervision Program. The SDWA was first enacted in 1974 and most recently reauthorized in 1996. It applies to all 50 states, all U.S. territories, Native American tribal lands, and the District of Columbia.

There are several components of the rules governing public water supply systems (PWS). Limits are set for the regulated contaminants below which the water is safe for human consumption. These limits are known as maximum contaminant levels (MCL) and maximum residual disinfectant levels (MRDL). Because certain contaminants are difficult to measure, treatment techniques (TT) and action levels (AL) are used in lieu of MCLs to control unacceptable levels of those specific contaminants.

DNR is required to certify water treatment and water distribution system operators, certify environmental laboratories for analyte and method, and have a program to ensure the PWS has technical, financial, and managerial capacity. Onsite inspection, review of operational reports, and required timely correction of significant deficiencies are also components of the program.

The frequency of monitoring for the regulated contaminants is specified in an operation permit. In Iowa, the PWS collects the samples at the proper locations, using the correct techniques, and during the required time periods. The samples are submitted within the required holding times to the certified laboratory, which analyzes the samples and submits the analytical data directly to the DNR, as well as to the PWS. If a PWS has a result over the allowable limit, fails to monitor on the required frequency or at the required location, or fails to report its data or meet an operating condition, it then incurs a violation.

Anytime a violation happens, the PWS is required to notify its consumers of the violation through public notification. The notice must be clearly written, and include the violation, potential adverse health effects, corrective action steps that the PWS is taking, and the necessity and availability of using alternative water supplies until the violation is corrected. The contaminants that can cause an immediate adverse health effect require a quicker notice. All violations must be resolved and the system returned to compliance, which can sometimes be a lengthy effort.

The requirements for the public drinking water program are detailed in the Iowa Administrative Code 567—Chapters 40, 41, 42, 43, 81, and 83. The SDWA requires that each primacy state prepare an annual report on violations of national primary drinking water regulations within the state. The Iowa reports are all available here: www.iowadnr.gov/ws-annual-compliance-report.

The Iowa DNR's Drinking Water Program Components

The Iowa public drinking water program has the main components, conducted by staff located in Des Moines, Atlantic, Manchester, Mason City, Spencer, and Washington. There are also contracted county sanitarian offices that conduct inspections at specific PWS.

While all three parts of the DNR public drinking water program work together, there are specific responsibilities in each area. In each of the six Field Offices, the water supply program staff conducts routine onsite inspections of the entire system. Deficiencies are identified and required to be corrected in a timely manner. Monthly operational reports are reviewed from systems that have treatment, to ensure proper operation. Investigation of complaints and provision of assistance during disaster, spills, and system upsets are also components of the field office staff daily work.

The staff in the Water Supply Operation Section issues operation permits that list the PWS-specific monitoring, operation, and reporting requirements. Analytical data is evaluated to ensure compliance; violation notices, compliance schedules, and enforcement actions are issued as needed. Every violation must be resolved in order for the PWS to return to full compliance. The program staff also conducts the water supply operator certification and environmental laboratory certification programs.

The staff in the Water Supply Engineering Section reviews preliminary engineering reports and viability assessments, issues construction permits to ensure the design standards are followed so that the project will perform as intended as well as be functional for the anticipated design life, and provides source water protection information to the PWS.

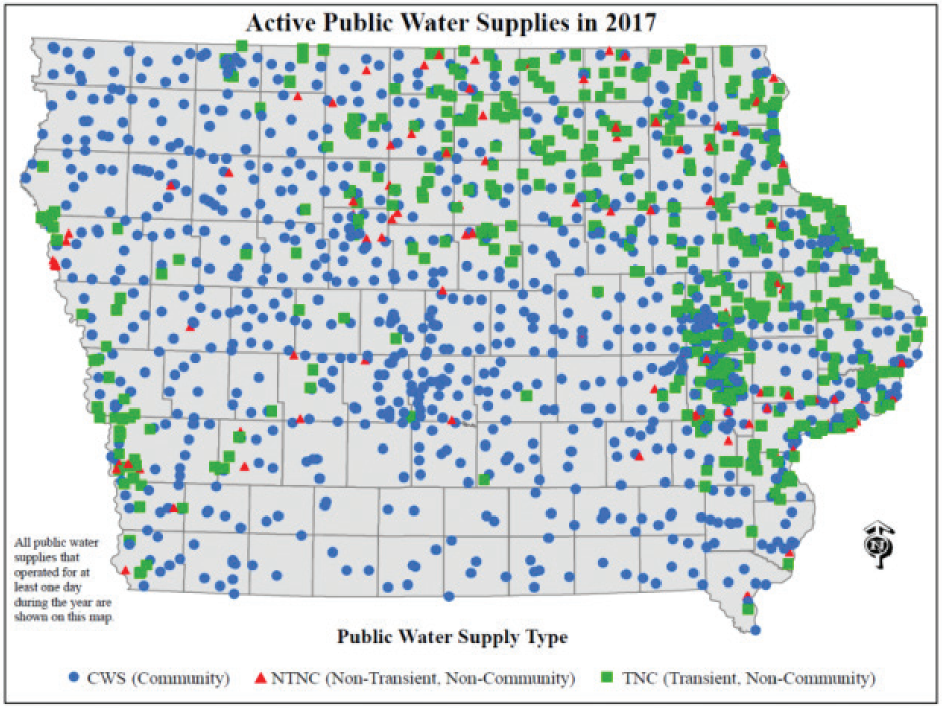
In partnership with the Iowa Finance Authority, DNR staff conducts the drinking water state revolving loan fund program, which makes low-interest loans to PWS for construction of drinking water sources, treatment, storage, and distribution systems to provide safe drinking water. DNR staff assists PWS with environmental reviews to expedite the process. In SFY2017, there were 36 PWS to which loans were made, for a total loan amount of $66.5M. Since 2001, $813M has been provided in loans to Iowa's PWS for 581 drinking water projects.

All of the water supply program staff provide technical assistance to operators, consulting engineers, and PWS owners, as part of their daily work efforts.

DNR also provides direct assistance to PWS through the following programs: Capacity Development, Area Wide Optimization Program (where operators learn to optimize and troubleshoot the existing treatment processes), Source Water Protection, and Technical Assistance Contracts.

Iowa's Public Water Supply Systems

A PWS is a system that provides water to the public for human consumption, which includes such activities as drinking, handwashing, bathing, ice-making, food preparation, and dishwashing. The PWS must have at least 15 service connections or regularly serve an average of at least 25 individuals daily at least 60 days out of the year. A well serving a farmstead with six residents is classified as a private water supply.



A PWS is further classified as a community water system, a non-transient non-community system, or a transient non-community system.

- A **community water system** (CWS) is a PWS that meets the above definition for year-round residents. Examples of CWS include municipalities, towns, subdivisions, and mobile home parks.

- A **non-transient non-community water system** (NTNC) is a PWS that regularly serves at least 25 of the same people four hours or more per day, for four or more days per week, for 26 or more weeks per year. Examples of these systems are schools, day-care centers, factories, and offices.

- A **transient non-community water system** (TNC) is a PWS other than a CWS or NTNC that regularly serves at least 25 individuals daily at least 60 days out of the year. Examples of TNCs are golf courses, camps, highway rest areas, bars, restaurants with fewer than 25 employees, and parks.

Number of PWS and Population Served

In 2017, over 2.82M Iowans were served by CWS, or 92.6% of the total state population, with the remaining population served by private water supplies at their residences. Iowa's 1,841 PWS in 2017 included 1,086 CWS, 140 NTNC, and 615 TNC.

PWS Size

Iowa is a small-system state, with 93% of our PWS each serving fewer than 3,300 people.

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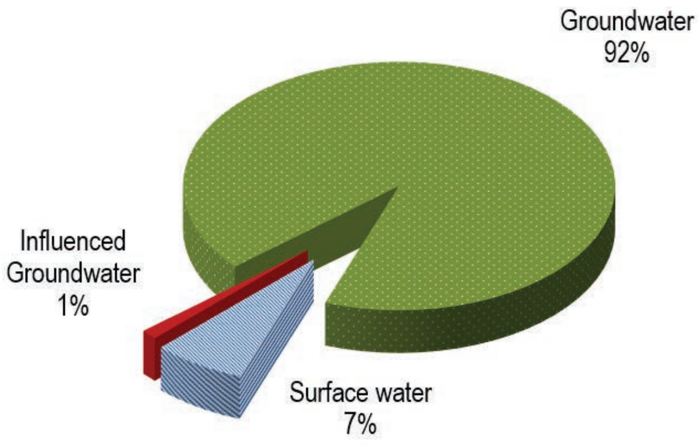
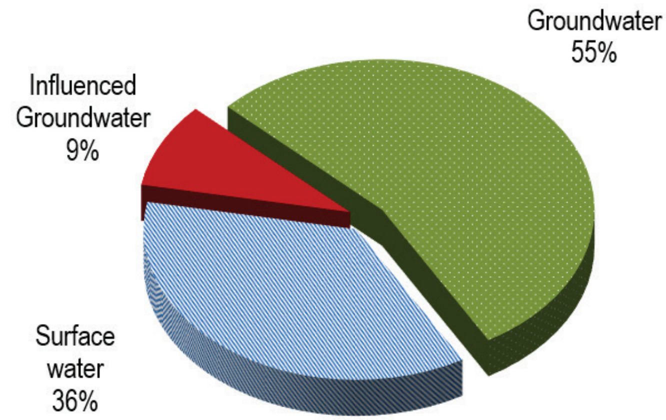


System Source Water Classification



Population Served by Source

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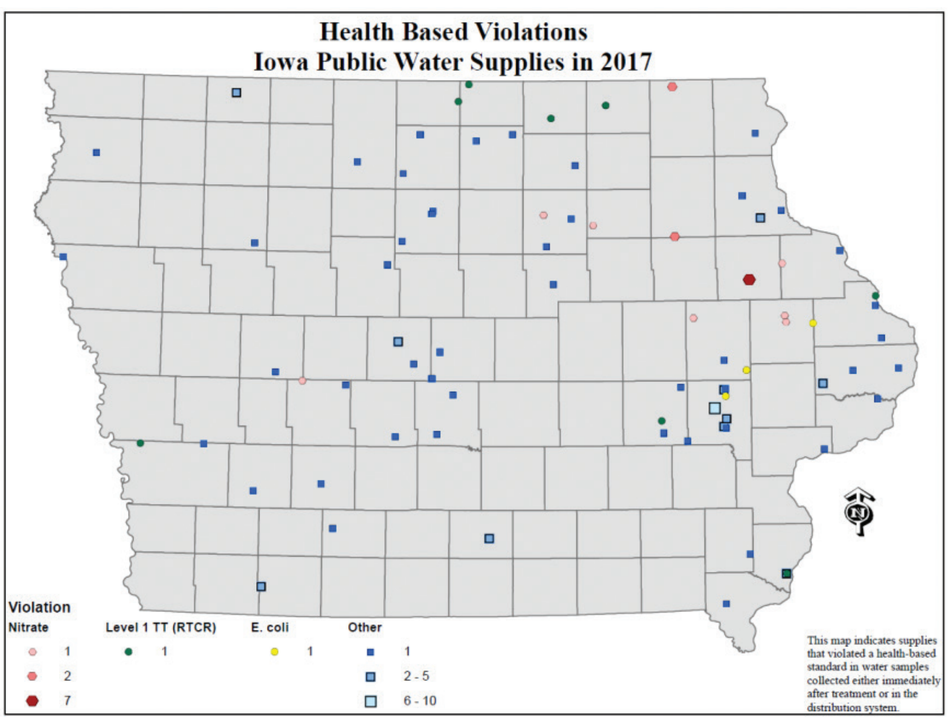
PWS Source Water

Iowa's drinking water is obtained from three sources:

- Groundwater from deep or shallow wells,
- Surface water from rivers, lakes, and reservoirs, and
- Groundwater that is under the direct influence of surface water as determined through testing by the presence of macroorganisms, and/or significant and relatively rapid shifts in physical and chemical water characteristics.

A PWS is classified by the source that is most vulnerable to contamination. Surface water PWS are the most vulnerable to contamination, followed by influenced groundwater PWSs. PWS using surface water or influenced groundwater sources have more complex operational and monitoring requirements, because of the necessity of more treatment to ensure potable water.



Groundwater is the source for 92% of Iowa's PWS, which serve 55% of the population. Surface water and influenced groundwater sources are used in the remaining 8% of PWS and serve 45% of the population.

Violation Data for Health-based Standards: MCL, MRDL, AL, and TT

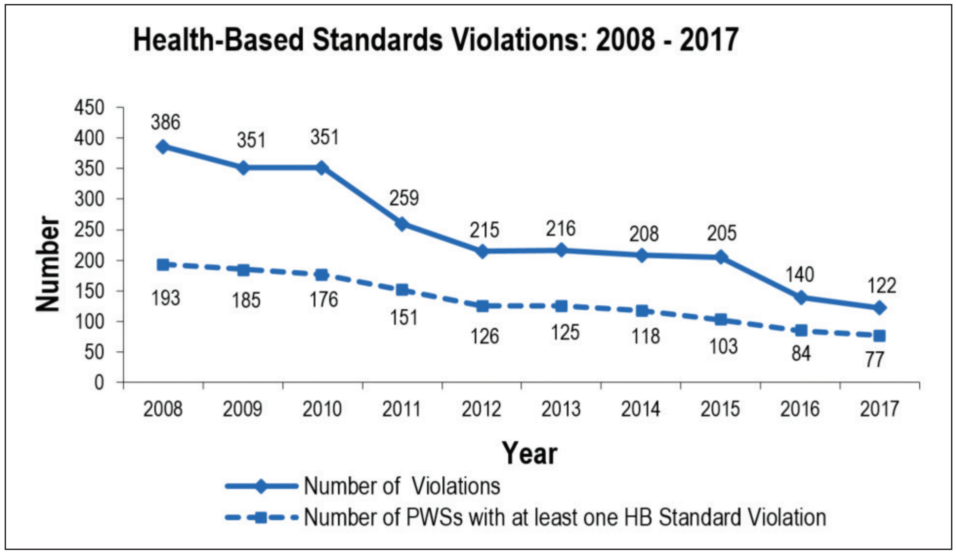
There were no waterborne diseases or deaths reported from any Iowa PWS. The map depicts the health-based standard violations that occurred in 2017. Three common violations are shown separately; the remaining violations are grouped together as "other." No MRDL violations were assigned in 2017. In 2017, 95.8% of the PWS were in compliance with all MCL, AL, and TT standards, with 77 PWS having at least one violation of an MCL, AL, or TT standard, serving 390,260 people. Population served by Iowa's PWS that met all drinking water standards was 86.2% (2.54M), which was 5.2% lower than 2016. There were three large PWS that incurred short-duration TT violations. There were 122 violations of 12 contaminants and 10 treatment techniques. The most frequent contaminant standard that was not met in 2017 was nitrate. The remaining contaminants with at least one violation include arsenic, benzene, copper AL, E. coli, gross alpha radionuclide, haloacetic acids (5), lead AL, nitrite, combined radium 226 & 228, selenium, and total trihalomethanes.

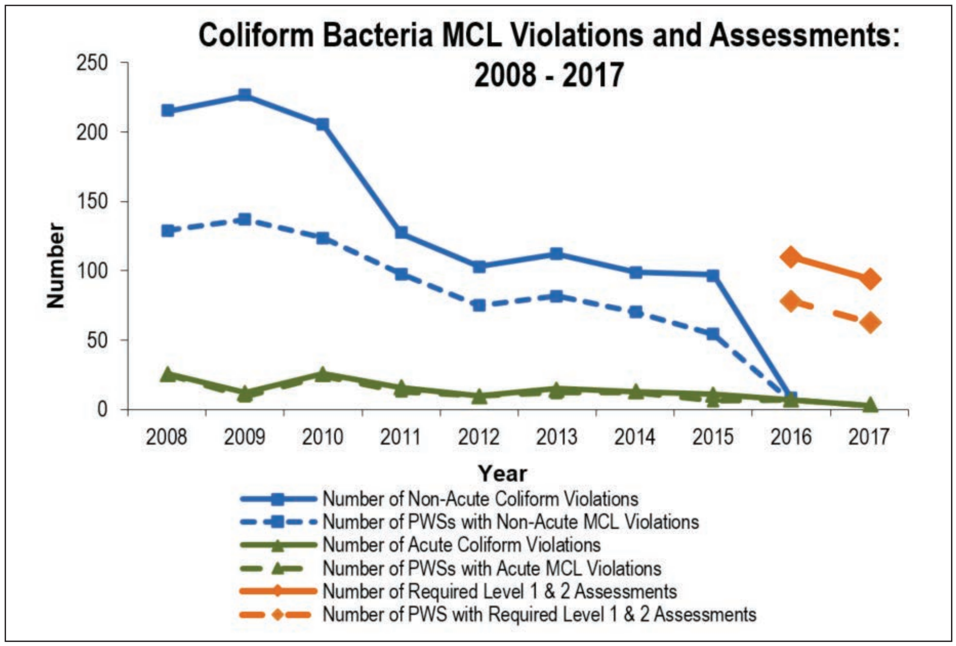
In 2017, both the number of PWS with violations of health-based standards and the number of violations continued the downward trend, with the lowest levels in the ten-year period. The revision of the TCR is a large part of the decline in violation numbers in 2016 and 2017, since non-acute MCL coliform bacteria violations were eliminated in the revised rule, effective April 1, 2016. Those violations had typically accounted for about half of all health-based standards violations each year, and were replaced with the requirement for the PWS operator or owner to conduct an assessment of their system, looking for sanitary defects (a Level 1 Assessment). Only if the PWS failed to conduct the assessment was a treatment technique violation incurred.

The number of PWS in compliance with all health-based standards in 2017 was the best in the past ten years.

The 2017 coliform bacteria MCL violation data is quite different than 2015, due to the revision of the TCR. The non-acute coliform bacteria MCL violation was replaced with Level 1 and/or Level 2 Assessments, which are not violations. If the required Level 1 and 2 Assessments are included in the chart, the numbers are similar to the previous five years. The number of E. coli MCL violations is at a 10-year low.

In 2017, there were 18 nitrate MCL violations at 10 PWS, which were very similar to the previous five years. However, the same ten PWS did not have violations during that timeframe. There were 38 PWS with 80 violations in that five-year period. In comparing 2016 and 2017, there were two PWS that had nitrate MCL violations in both years.





Major Monitoring and Reporting (M/R) Violation Data

A major monitoring violation is incurred when a required sample is not collected for a specific contaminant in a specific time period.

- Over 2.65M people regularly received water from Iowa PWS that complied with all major monitoring and reporting requirements.
- Major monitoring and reporting requirements were met by 80.8% of the 1,841 regulated PWS.
  - There were 483 major monitoring violations at 245 PWS serving 194,857 people.
  - There were 349 reporting violations at 185 PWS serving 106,709 people.
  - The PWS that incurred the most monitoring/reporting violations in 2017 had 39 monitoring/reporting violations.

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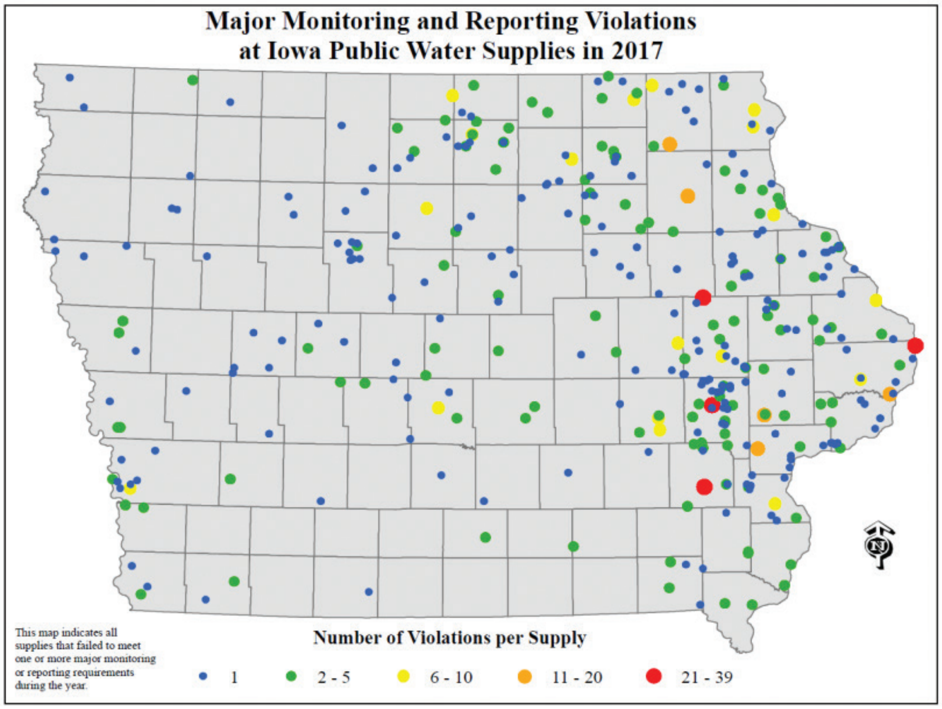

in 2017, averaged 82.7% over the past ten years, and fluctuated from 80.3% to 84.9%.

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Monitoring requirements for each contaminant are assigned to the PWS in an operation permit that is issued at least every three years. The monitoring requirements vary by contaminant, from sampling every four hours (turbidity) to sampling once every nine years (inorganic chemicals). Minor monitoring violations are those in which at least some of the required monitoring was completed, and are not included in this report. Coliform bacteria had the most major monitoring violations, with 251 violations at 153 PWS. Nitrate followed, with 62 PWS having 89 violations.

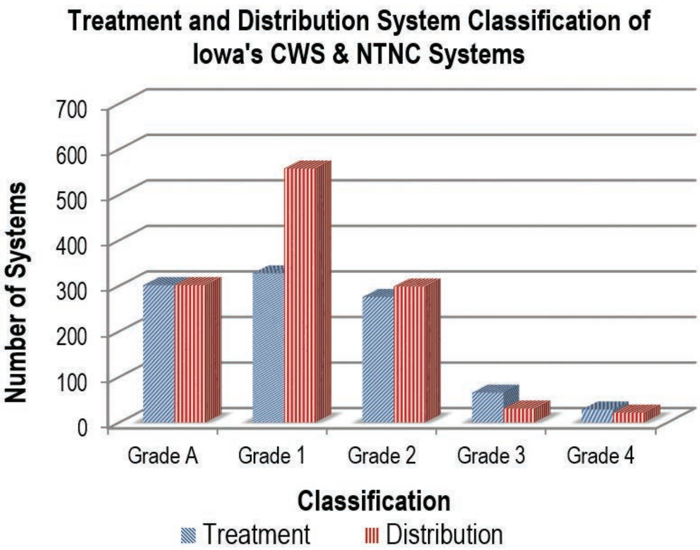
Monitoring & Reporting Compliance Rates: 2008-2017

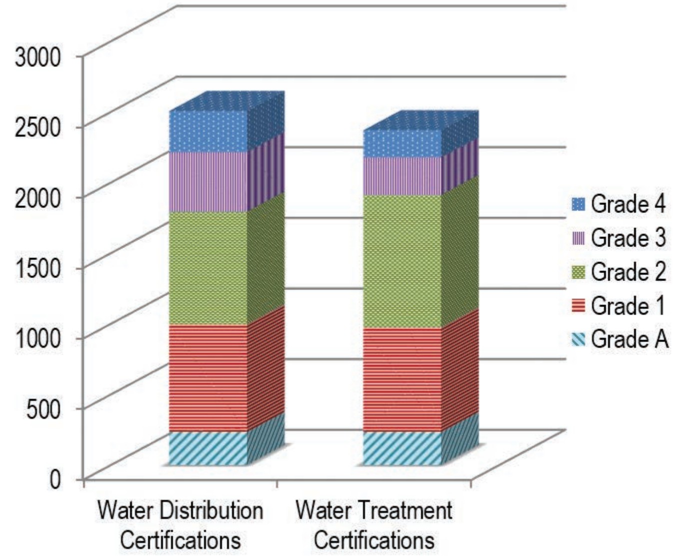
The number of PWS in compliance with all major monitoring and reporting requirements was 80.8% in 2017, averaged 82.7% over the past ten years, and fluctuated from 80.3% to 84.9%.

In 2017, the number of monitoring and reporting violations increased and the number of PWS with those violations decreased from 2016. The reporting violations increased in part due to an increase in the number of public notice violations that were not included in previous years' annual compliance reports. The violations were assigned and reported to the federal violations database in the proper year; however, the internal data query for this report had an error which resulted in lower counts for public notice violations.

Consumer Confidence Reports

All CWS must notify the public each year by July 1 with information on the quality of the water delivered by the PWS in the previous calendar year and any violations. This report, called a Consumer Confidence Report (CCR) must be prepared and made available by the CWS to its public. In 2017, 22 CWS (2.0%) failed to prepare and distribute their CCR for calendar year 2016, incurring a reporting violation.





Operator Certification

All CWS and NTNC are required to have a certified operator in direct responsible charge of the water treatment and distribution systems. The operators must at least be certified by the DNR at the same classification of the water treatment plant or distribution system.

Classification of Systems & Facilities
The facilities are classified according to complexity, with Grade 4 as the most complex. The Iowa CWS and NTNC in all classification levels are depicted in the chart. There are 211 PWS that have a distribution system but no treatment plant, because the water is purchased from another PWS.

Classification Grades for Operator Certification
The requirements are based upon the level of complexity of the facility. This chart depicts the number of operator certifications in each of the two types of drinking water certifications. Grade A, the least complex facility, is included in both certifications, since it is a combined water treatment and distribution certification.

Enforcement
Compliance actions were directed at three PWS that failed to have a certified operator in charge of their water supply and at four operators whose treatment and distribution certifications were surrendered via consent order.

Evaporite Dissolution in the Foundation of the Lake Red Rock Dam

Steve Gustafson, PG, ICPG, U.S. Army Corps of Engineers

Lake Red Rock is located on the Des Moines River, 40 miles southeast of Des Moines, Iowa and is Iowa's largest lake with over 15,000 acres of open water. The lake and associated Red Rock Dam (Dam) are owned and operated by the US Army Corps of Engineers, Rock Island District. The reservoir created by the Dam collects runoff and drainage from over 12,320 square miles of land in Iowa and southern Minnesota. Construction of the Dam was completed in 1969. The primary purpose of the Dam is to reduce flood damage along the Des Moines River below the Dam, as well as along the Mississippi River further downstream. Lake Red Rock also provides other benefits including recreational opportunities and natural resources on the water and surrounding public lands. While the Dam is founded on competent bedrock, the presence of sporadic evaporite deposits underlying the Dam approximately 70 feet below the valley floor has led to a series of investigations since construction.

Local stratigraphy on the Dam abutments consists of Wisconsinan Age Peoria Loess and Pre-Illinois till overlying Pennsylvanian Age Cherokee Group cyclothems. The Des Moines River valley floor on which the Dam embankment was constructed consists of alluvial materials. The first encountered bedrock under the Dam embankment is the Mississippian Age St. Louis Formation, which in turn overlies Mississippian Age Warsaw Formation massive dolomitic shales. Specifically, the St. Louis Formation consists of a weak sandstone, sandy limestone, well cemented sandstone and a dolomitic limestone. These alternating beds vary from 10 feet to 20 feet in thickness for an average thickness of the St. Louis Formation of approximately 40 feet. A discontinuous basal unit underlying the dolomitic limestone consists of evaporite beds, predominately comprised of gypsum with some anhydrite. Within and immediately above this basal unit is a cavity zone. This cavity zone is theorized to have been formed by the dissolution of the evaporites. The resulting cavities are filled with silt, clay, and sand, or with breccia. In some cases the cavities are empty. Exploratory borings indicate the noncontiguous evaporite deposits could be approximately 400 feet in total length, and is up to 17 feet thick. While the evaporite deposit is present underlying the left and right Dam embankments, it does not appear to be present under the central embankment, and appears to be present to a greater extent

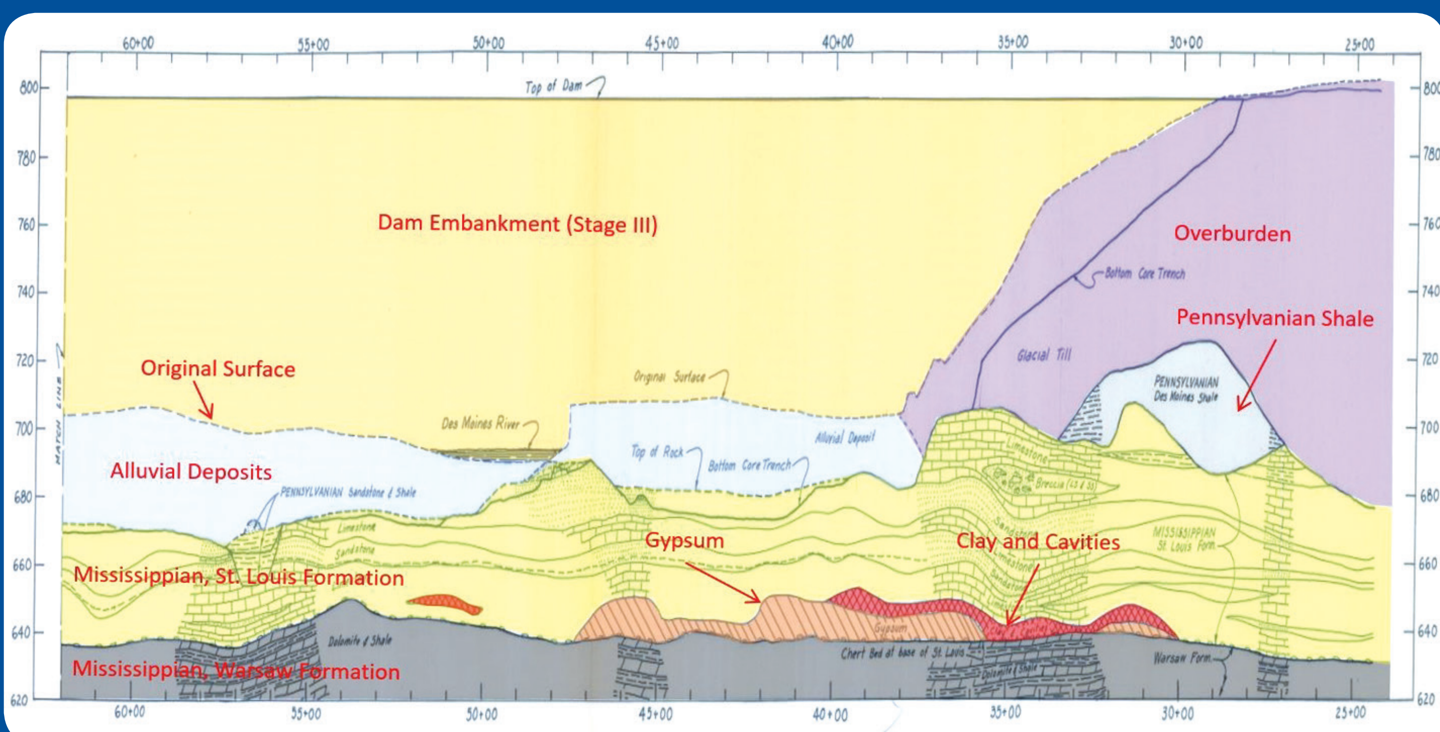


FIGURE 1: Mid-1980's geologic cross section of the northeastern end (left descending bank) of the Dam embankment.

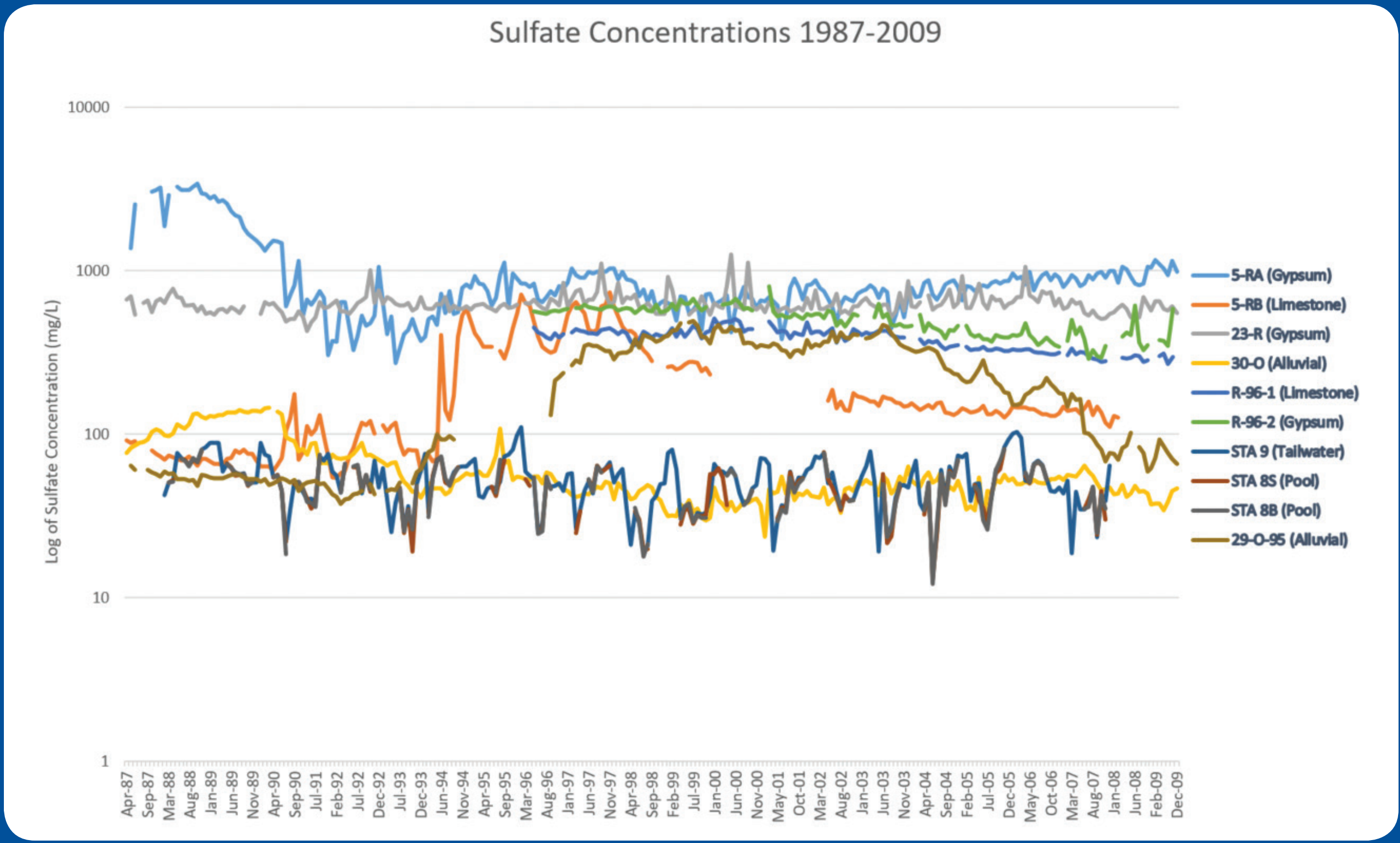


FIGURE 2: Monitoring well sulfate concentrations over time.

and with more cavities under the left embankment (**FIGURE 1**). This evaporite deposit and its potential for dissolution has been the primary motivation for subsequent seepage and geochemical investigations. An investigation of underseepage was initiated during the first year of Dam operation after areas of seepage were noted on the left descending bank. This initial investigation indicated that underseepage may be occurring, based on the observation of surface seepage and the limited water level data sets available. As data was collected over time it became apparent that underseepage was occurring and that there was potential for dissolution of the evaporite zone or migration of embankment materials into open joints and fractures in the St. Louis Formation. This lead to seven investigations through 2001 conducted by the Rock Island District, with periodic collaboration with the USGS Water Science Center in Iowa City, IA.

In addition to continuous collection and analysis of seepage data, geochemical analysis of seepage water began during the first year of Dam operation. While limited at first, over the years the analysis suite, monitoring schedule and sample locations grew in complexity. Various parameters were analyzed over the course of these investigations. Consistent analyses over time were major ions, alkalinity, water temperature, pH, specific conductance, total hardness and total dissolved solids. Geochemical sampling and analysis, as well as calculation of saturation indices were conducted by Iowa State University from 1987 to 2009 for the aforementioned parameters.

In 2017 a new study was initiated by the Rock Island District to evaluate the previous investigations, review all data collected to date, identify data gaps and concerns, and determine if further investigation is necessary. Due to the past investigations and available data, there are a significant amount of characteristics and conclusions that were drawn regarding subsurface conditions. The first of these is that underseepage is occurring to varying degrees in the left descending embankment alluvial materials and St. Louis Formation. In addition, groundwater flow, both vertically and horizontally, is complex and appears to vary based partially on Dam operations and reservoir elevations. The potentiometric surface in the right descending embankment has a steep hydraulic gradient, indicative of expected minimal seepage and low permeability, and indicative of less connectivity between the reservoir and alluvial materials and bedrock. In contrast, a gradual hydraulic gradient is present in the left descending embankment/abutment, an indication of a greater amount of seepage and greater connectivity between the reservoir and alluvial materials and bedrock.

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In terms of geochemistry, the reservoir pool water, alluvial materials groundwater and upper St. Louis Formation groundwater are undersaturated with respect to gypsum, while the lower St. Louis Formation groundwater is considered slightly undersaturated or at equilibrium with respect to gypsum. Sulfate concentrations in alluvial materials wells fluctuated significantly over the sample period, but appear to have reached a stable or declining trend by 2009. Sulfate concentrations in the left abutment upper St. Louis Formation and in the cavity zone appear to have been impacted by a grouting project in the 1990's, but remained fairly stable after the mid 2000's. The right embankment sulfate concentrations remained relatively stable through the sample period. Sulfate concentrations in the basal evaporite bed were initially higher in the two decades after Dam construction. In the left embankment, after some fluctuations, concentrations appeared to be stable to slightly increasing by 2009. In the right embankment, concentrations appeared to be declining. Overall, sulfate concentrations in the cavity zone and evaporite bed were at least one order of magnitude greater than sulfate concentrations in the reservoir pool, tailwater and alluvial materials. **FIGURE 2** indicates the sulfate concentrations of wells and surface water sampled by Iowa State University from 1987 to 2009. These observations indicate that evaporite dissolution has occurred and is likely still occurring. Also identified were data gaps which inhibit a full understanding of the subsurface conditions and risk associated with the evaporative dissolution. These data gaps include:

- The geochemical trends and concentrations since 2009 for reservoir pool water, and groundwater in the aforementioned water bearing units.
- The potentiometric surfaces and flow vectors since 2001, the date of the last report that compiled the water level data from the piezometers and observations wells.
- The current vertical and horizontal extent of evaporites to any certainty.
- The vertical and horizontal extent, inter-connectivity and conductivity of the cavities in and above the evaporite bed.
- Contribution of upstream groundwater to observed sulfate and calcium concentrations.
- Structural integrity of the bedrock above the evaporite zone.
- Integrity and extent of grout curtain remaining in the subsurface.
- The dissolution rates of the evaporites.

Although there are no indications of subsidence, damage or failure from the existing and current data, the 2017 investigation concluded there was insufficient data to further refine the risk to the Dam from underseepage through the St. Louis Formation, whether due to the high permeability of the St. Louis Formation in general and/or the potential for evaporate dissolution. To obtain the needed data with a higher level of confidence to support risk analyses, the 2017 investigation recommended five investigation tasks. These tasks are currently being implemented by the Rock Island District. The initial task is to utilize the seepage data collected since 2001 to create groundwater flow contour maps for the water bearing units. Review of this data will allow for comparison to historical groundwater mapping and studies, provide current conditions, and provide information regarding anomalies that may require further investigation or action. The next investigation task is to conduct geophysical exploration to determine the cavity extent and connectivity. Obtaining an understanding of the magnitude and extent of cavities and voids within the St. Louis Formation will allow a better understanding of the structural risk, and enable a baseline to which future assessments can compare to.

Task three is to create an updated geologic map, 3-D model and associated cross sections using all geological data to date. Current geologic maps and cross sections have not been updated with newer data. Updating the maps with more recent borelog data and with potential geophysical data, and creating a 3-D model will enable a greater understanding of the extent of evaporite deposits and cavities zones. Task four will restart the geochemistry monitoring program with potential additional monitoring points upstream of the areas of concern. The restarting of the monitoring will help determine current geochemical conditions, allow for comparison to past trends and patterns, and provide information regarding anomalies that may require further investigation or action. The final part of the investigation is to increase the frequency of surface monitoring on the Dam, to include focused areas based on the previous tasks. The investigation task results will be finalized in a peer reviewed report that will provide information for an upcoming Periodic Assessment of the Dam.

IOWA DNR AMBIENT GROUNDWATER QUALITY MONITORING PROGRAM SUMMARY FOR FY18

Claire Hruby, Ph.D., Iowa DNR Geologist

Introduction: The purpose of the Iowa DNR's ambient groundwater monitoring program is to document the quality of water in Iowa's aquifers, which are important sources of drinking-water. Results of these analyses help us to understand which contaminants are present, how they are distributed, and whether their concentrations change over time. This report summarizes the results of the fiscal year 2018 (FY18) groundwater monitoring effort. A more extensive report can be found on the Iowa DNR's ambient groundwater monitoring website. Currently, ambient groundwater monitoring data (2002 – 2017) are housed in the Iowa DNR's EQuIS database and are available via the AQuIA website: https://programs.iowadnr.gov/aquia/. FY18 data will be uploaded over the next 6 months.

The ambient groundwater quality monitoring effort in FY18 was designed to assess the occurrence of both natural and anthropogenic contaminants. Groundwater samples collected between October 2017 and March 2018 were analyzed for pH, total dissolved solids, nitrate, ammonia, chloride, bromide, sulfate, iron, manganese, seven neonicotinoid insecticides, gross alpha and beta radioactivity, and five radionuclides from the uranium-238 decay series, including polonium-210 and lead-210. Wells that have contained nitrate in the past were analyzed for nitrogen and oxygen isotopes to help identify sources of nitrate.

Untreated water was collected from 118 municipal water supply wells across Iowa **(FIGURE 1)**. These wells represented all major aquifer groups, and a wide range of depths, vulnerabilities based on estimated confining layer thicknesses, well ages, and types of land-use within the 2-year capture zone. An additional 16 wells were sampled only for isotopes of nitrogen and oxygen. These wells were selected by water operators that were interested in gathering information for source water protection planning. Samples were collected by certified water operators. IDNR staff collected duplicate samples at ten of the monitoring locations for quality control, along with two field blanks.

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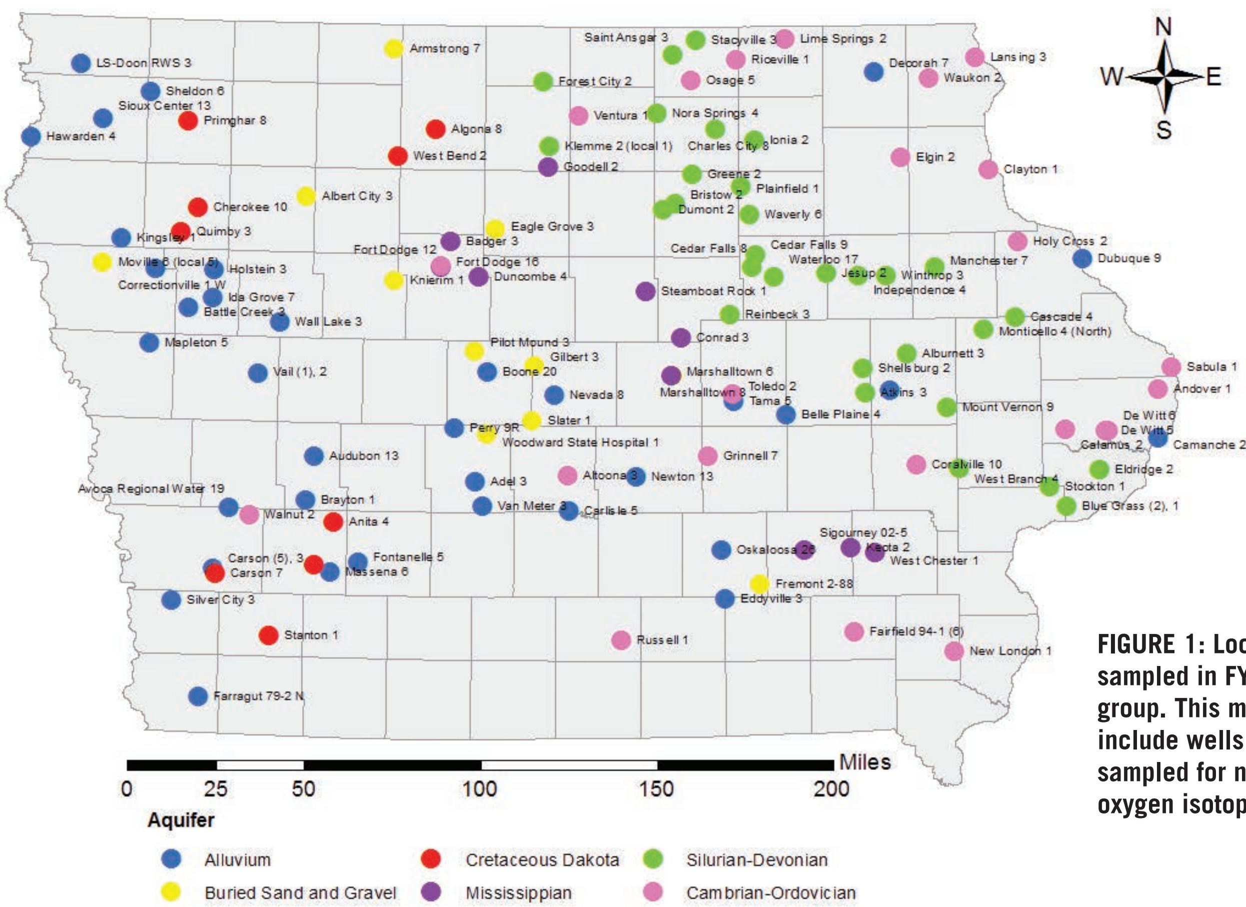

FIGURE 1: Locations of wells sampled in FY18 by aquifer group. This map does not include wells that were only sampled for nitrogen and oxygen isotopes.

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Analyte	N	Det. limit(s) (mg/L)	Det. Freq. (%)	Mean of Detects (mg/L)	Min. (mg/L)	Median (mg/L)	75th Percentile (mg/L)	Max. (mg/L)	Secondary Standard
pH	118			7.15	6.5	7.1	7.3	>10	6.5 – 8.5
Total Dissolved Solids	118	1.0	100	506	240	450	560	1950	500 mg/L
Chloride (Cl)	118	2 - 20	75	33.6	0.82	14.5	31.25	220	250 mg/L
Bromide (Br)	118	0.05, 0.1	29	0.16	<0.05	<0.05	0.05	0.89	No standard
Sulfate (SO_4)	118	1, 2, 4	96	99	<1	43	81	1100	250 mg/L
Iron (Fe)	54	0.02	59	0.05	<0.02	0.025	0.03	0.22	0.3 mg/L
Manganese (Mn)	54	0.02	48	0.18	<0.02	0.03	0.13	0.73	0.05 mg/L
Ammonia-nitrogen as N	118	0.05	63	1.16	<0.05	0.26	0.92	7	No standard
Nitrate + Nitrite as N	118	0.1, 0.2	36	6.6	<0.1	<0.1	3.1	29	**MCL** = 10 mg/L

TABLE 1: Summary of results for untreated groundwater samples taken from 118 wells in FY18. All analyses performed by the State Hygienic Laboratory.

New lessons from "old" analytes:

The water quality parameters listed in **TABLE 1** have long been used to help us understand the treatment challenges posed by Iowa's groundwater sources. These parameters can be used in new ways to help us assess the potential for contamination from natural or anthropogenic pollutants, and sometimes (like in the case of manganese) new information comes along which helps us see these compounds in a very different light.

Several of the parameters listed in Table 1 are known to have aesthetic, cosmetic, or technical effects on drinking-water supplies, and thus, have secondary drinking-water standards set by the U.S. EPA. Total dissolved solids (TDS), chloride, and sulfate, all contribute to salty tasting drinking-water. The majority of water samples obtained in FY18 fell below secondary drinking-water standards for these constituents. The Dakota sandstone aquifer in northwest Iowa is the "saltiest" with 55% of samples exceeding the TDS standard and 22% of samples exceeding the sulfate standard. Groundwater from deep Cambrian-Ordovician wells can also contain elevated TDS, with 48% samples over the secondary standard, and 24% of samples exceeding the secondary sulfate standard. TDS and sulfate generally increase to the southwest in Cambrian-Ordovician wells as these bedrock layers become deeper and the groundwater gets older, with more time to dissolve the rock (**FIGURE 2**). Groundwater content and ratios of various ions have been proposed as potential indicators of impacts on groundwater from waste treatment systems, agricultural activities, and use of road salt. In FY18, bromide was only found at concentrations above 0.2 mg/L in groundwater from Cambrian-Ordovician wells. As with other ions, bromide concentrations in Cambrian-Ordovician wells increased with depth.

Chloride/bromide ratios were significantly higher in samples with nitrate than those without ($p<0.0001$). The median value of chloride/bromide ratios in samples without nitrate was 170 compared to samples with nitrate present where the median Cl/Br ratio was 760 (**FIGURE 3**). These results confirm that Cl/Br ratios could be used as a screening tool for groundwater contamination from surface activities. Further analysis would be necessary to determine

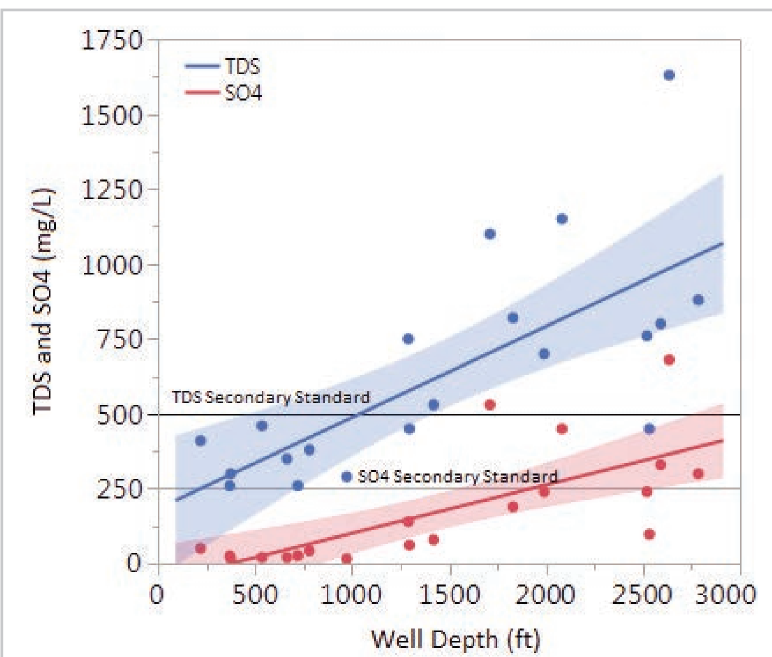

FIGURE 2: Concentrations of total dissolved solids (TDS) and sulfate (SO4) in samples from Cambrian-Ordovician wells by well depth.

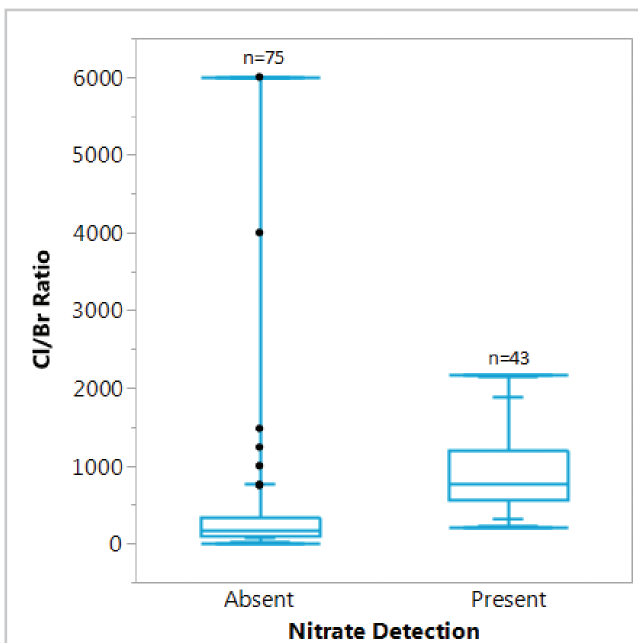

FIGURE 3: Quantile distributions of Cl/Br ratios in samples from FY18 with and without nitrate detections.

whether these ratios could be used to help differentiate between sources of contamination.

Manganese is a naturally-occurring element in groundwater that is known for causing aesthetic problems for drinking-water, such as black to brown color, staining, and bitter metallic taste, at levels greater than 0.05 mg/L. Recent studies have indicated that manganese may also have human health impacts. These studies have reported neurological effects, including decreases in memory and attention correlated to increased manganese concentrations in drinking-water, especially when concentrations exceed 0.1 mg/L (Bouchard et al., 2011; Oulhote et al., 2014). Infants are at greatest risk because their bodies are unable to excrete excess manganese (ATSDR, 2012). There is currently no primary drinking-water standard in the U.S. for manganese. Fortunately, many providers test their water and treat it to below 0.05 mg/L in order to avoid taste, odor, and staining complaints.

In FY18, samples from 54 wells were analyzed for manganese. These wells represented buried sand and gravel aquifers and bedrock aquifers, but did not include alluvial wells because these were assessed for manganese in 2013. Manganese was detected in 48% of these wells, with 28% (15) of the wells above 0.1 mg/L. By combining this set of results with tests at other wells obtained since 2002, we can better understand the distribution of this element in Iowa's groundwater. What we see, is that the highest concentrations of manganese are found in alluvial aquifers. The highest concentrations of manganese generally occur in anoxic (low oxygen) groundwater with low nitrate concentrations. Many communities dependent on alluvial systems may have to balance the challenges posed by nitrate with the challenges posed by manganese and iron. Concentrations of manganese above 0.1 mg/L can also be found in groundwater (in order of descending average concentrations) from the Dakota aquifer, buried sand and gravel aquifers, the Mississippian bedrock aquifer, and the Silurian-Devonian aquifer system. Manganese has been detected in Cambrian-Ordovician wells, but only at very low concentrations.

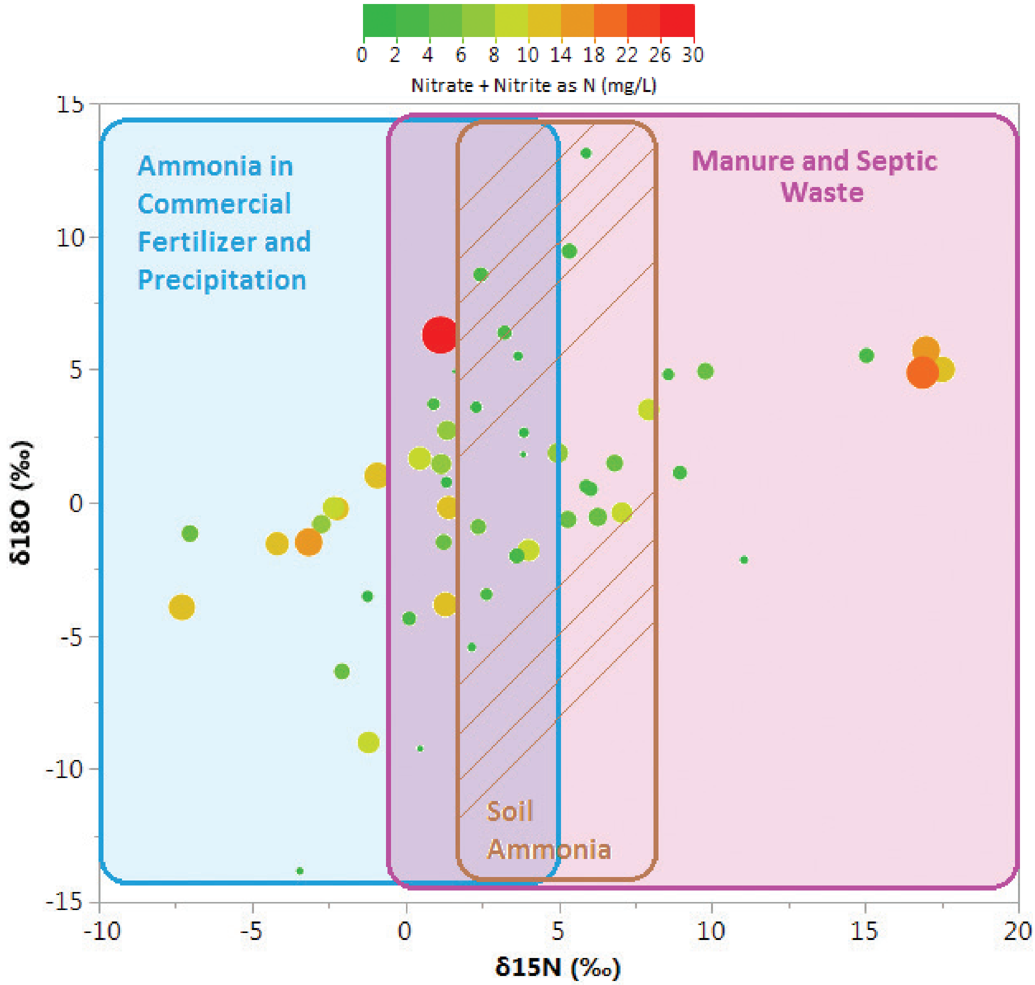

FIGURE 4: Nitrogen (δ15N) and oxygen (δ18O) isotopic ratios for groundwater samples collected in FY18. Size and color of points correspond to reported concentration of nitrate + nitrite as N in the sample. Colored areas show the typical ranges of values for sources of groundwater nitrate published by Kendall et al., 2007.

Communities struggling with nitrate issues might consider using a deep confined aquifer as an alternative water source. Unfortunately, this often means trading one problem for another. Groundwater from deeper wells often contains nitrogen in the form of ammonia, which does not pose a direct risk to human health, but does interfere with chlorination at concentrations above 0.2 mg/L, and can also interfere with manganese removal systems. Of the 118 wells sampled in FY18, 103 (87%) contained detectable concentrations of nitrate or ammonia. Six wells (5%) contained detectable levels of both forms of nitrogen (all alluvial wells), and only 7 wells (6%) did not contain either form of nitrogen.

Using isotopes to help identify sources of nitrate in groundwater:

Communities working to reduce nitrate in their source waters are increasingly looking to understand not only where on the landscape the nitrate could be coming from, but also what practices have

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contributed nitrate to their wells. In FY18, samples were collected from 60 wells for nitrogen and oxygen isotopic analyses which can be used to help differentiate between nitrate sources in groundwater (Kendall et al., 2007). Sampling locations included 44 wells that have been tested historically as part of the ambient groundwater monitoring network and 16 wells sampled by water operators interested in gaining additional information for their source water protection planning efforts. Samples from 5 wells did not contain sufficient nitrate to be processed for isotopes.

Ratios of ^{18}O to ^{16}O ($\delta^{18}O$) and ^{15}N to ^{14}N ($\delta^{15}N$) from nitrate were measured at the Nebraska Water Sciences Laboratory using an azide reduction and trace gas preconcentrator method. These ratios were then compared to standard values of mean ocean water and air, respectively, and reported in parts per thousand (‰). For both isotope pairs, a reported value of 1 is the equivalent to a measured ratio 1000 times higher than the standard. Based on analysis of duplicate field samples, $\delta^{18}O$ values vary less than 2.2 ‰, and $\delta^{15}N$ values vary less than 0.8 ‰.

Isotope results and corresponding nitrate concentrations are plotted in Figure 4. All of the FY18 groundwater samples fell in the -15 to 15 $\delta^{18}O$ ‰ range, indicating that the nitrate originated in the form of ammonia, either from commercial fertilizer, precipitation, soil ammonia, manure, or septic waste. Values of $\delta^{15}N$ above 7.5 ‰ suggest that the nitrate in these samples was most likely derived from manure or septic waste (20% of samples), while values of $\delta^{15}N$ below "0" suggest that the nitrate was derived from ammonia-based commercial fertilizer sources or ammonia in precipitation (15% of samples). Reported concentrations of ammonia in precipitation in Iowa rarely exceed 1 mg/L as N, therefore, it is unlikely that precipitation was the sole source of nitrate in all, but one, of these wells. Most (65%) samples contain $\delta^{15}N$ between 0 – 7.5 ‰, which means that the nitrate could be derived from multiple sources. For the 4 samples with relatively low concentrations of nitrate (<1 mg/L), and isotopic values between 2.5 – 7.5 ‰, it is possible that all the nitrate was soil-derived.

It is important to consider that nitrate in each well may result from activities on the landscape anywhere from days to decades before it is detected in groundwater. Even when the isotopic results plot to the far right (manure or septic) or the far left (ammonia-based commercial fertilizer or precipitation) of the diagram, it is possible that a mixture of sources is present. In addition, the sources of nitrate may change seasonally, and from year to year, complicating the interpretation of these results. A thorough review of all available geological, hydrological, water quality, and well construction information is necessary before an effective plan to reduce nitrate concentrations can be formulated.

Occurrence of neonicotinoid insecticides in Iowa's groundwater:

In FY18, IDNR is partnering with researchers at the University of Iowa, who are working to understand the occurrence, exposure, and health consequences of the use of neonicotinoid insecticides in the environment. Estimates of neonicotinoid use in Iowa, and throughout the Midwest, have increased dramatically since 2004 (NAWQA, 2018). Neonicotinoids are used in both urban and rural environments to protect row-crops, orchards, ash trees, gardens, house plants, and pets, from insects.

Little is known about the health effects of these compounds on humans. The U.S. Environmental Protection Agency is currently reviewing the available research and developing risk assessments. There are currently no drinking water standards for these insecticides in the United States. These compounds have been shown to be highly soluble in water, increasing the risk of transport to surface and groundwater. Neonicotinoids have been detected in surface waters in the Midwest (Hladik et al., 2018). This sample collection is the first statewide assessment of neonicotinoids in Iowa's groundwater.

Samples from 118 wells were collected between October and March, and analyzed for seven neonicotinoid compounds: acetamiprid, clothianidin, dinotefuran, imidacloprid, sulfoxaflor, thiacloprid, and thiamethoxam. Results of this fall/winter sampling are summarized in **TABLE 2**. Thirty-seven percent

Neonicotinoid	Number of Detections	Detection Frequency (%)	Mean of Detections (ng/L)	Median of Detections (ng/L)	Quantiles of All Results 75% (ng/L)	90% (ng/L)	Max (ng/L)
Acetamiprid	0	0					
Clothianidin	41	34	2.91	0.98	0.22	3.22	12.79
Dinotefuran	1	1	1.32	1.32	ND	ND	1.32
Imidacloprid	15	13	0.49	0.22	ND	0.14	2.41
Sulfoxaflor	0	0					
Thiacloprid	0	0					
Thiamethoxam	18	15	2.23	0.41	ND	0.17	20.56

TABLE 2: Summary statistics for neonicotinoids in untreated water from 120 samples from municipal water supply wells collected in the fall/winter (2017-18) in Iowa. The detection limit for all samples was 0.096 ng/L. ND = not detected.

of the wells had detections of one or more neonicotinoids: 19% contained a single neonicotinoid, 11% contained two neonicotinoids, 6% contained three compounds, and one sample (1%) contained a combination of four of these insecticides.

Neonicotinoids were detected more frequently in wells identified as highly vulnerable to contamination from the surface based on the estimated confining layer thickness. Neonicotinoids were present in 63% of wells completed in aquifers confined by less than 50 feet of low permeability materials, while only 14% of wells with thicker confining layers had positive detections.

Neonicotinoid insecticides are commonly applied in the spring and summer, and elevated concentrations have been observed in surface waters during the summer months (Hladik et al., 2018). To capture potential variability in those wells that are more likely to undergo seasonal variations, an additional round of sampling of the vulnerable subset of wells will be completed between June – August 2018.

Uranium-series radionuclides in groundwater:

Although much of the publicity regarding drinking-water quality in Iowa is focused on contamination caused by surface activities, naturally-derived contaminants associated with well-documented health effects also pose a serious challenge to public water supplies. While it is impossible to avoid exposure to radioactivity from natural sources, cumulative exposure to radioactivity increases the risk of developing cancer, therefore, it is important to understand and minimize potential exposures whenever possible. Although the gross alpha and gross beta standards are designed to assess the potential risk from multiple sources of radioactivity, knowing which radionuclides are present can greatly improve our understanding of overall risk. In FY18, water samples from 54 wells screened in buried sand and gravel or bedrock aquifers were analyzed for gross alpha radioactivity (including uranium), gross beta radioactivity, radium-226, uranium-234, uranium-238, polonium-210, and lead-210 by the State Hygienic Laboratory. **TABLE 3** summarizes the results of analyses for radioactivity for FY18 samples. Samples from 9 wells (17%) contained activities of Ra-226 above the combined radium standard of 5 pCi/L. Measured values greater than the minimum detectable activity (MDA) of Po-210 were reported for 41 of the 54 samples (76%). Seventeen samples (31%) had measured activities of lead-210 above the MDA. Lead-210 activities were significantly higher in samples from wells screened in the Dakota aquifer. While higher levels of Po-210 were also observed in samples from the Dakota, they were not statistically different from the other aquifers sampled in FY18. None of the samples contained Po-210 or lead-210 activities above the MDH's estimated 1:10,000 cancer risk values.

Radionuclide	Uncertainty Range (pCi/L)	MDA Range (pCi/L)	Summary statistics (pCi/L)			
			Min	Median	Mean	Max
Gross Alpha including Uranium	0.7 - 3.1	0.8 – 3.2	<MDA	3.55	5.28	28.8
Gross Beta	0.9 - 2.0	1.4 – 2.6	<MDA	5.3	6.58	33.7
Radium-226	0.1 - 0.6	0.5 – 0.9	<MDA	3.275	2.70	14.6
Uranium-234	0.026 - 0.403	0.012 – 0.236	0	0.397	0.716	3.0
Uranium-238	0.020 - 0.222	0.013 – 0.182	0	0.115	0.181	1.27
Polonium-210	0.0354 - 0.165	0.0123 – 0.120	0	0.159	0.134	0.597
Lead-210	0.07-0.376	0.245 – 0.440	-0.546*	0.169	0.201	0.977

*Negative values reported for lead-210 are the result of measured values minus background values.

TABLE 3: Summary of radionuclide analyses for FY18 groundwater sampling (N=54).

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For more information, contact Claire Hruby at claire.hruby@dnr.iowa.gov. Additional discussion of these results are planned for the upcoming IGWA meetings, so stay tuned!

THE SEARCH FOR CRITICAL MINERALS IN IOWA

Ryan Clark, Geologist, Iowa Geological Survey

The United States has a rather large appetite for minerals. Vast quantities of Rare Earth Elements (REEs), Platinum Group Elements (PGEs), and other rare minerals are vital to industries such as technology, automotive, alternative energy generation and storage, national defense, and the medical field just to name a few. Nanotechnology and highly efficient electronics are an ever-expanding part of our everyday life. To meet these demands, and to lessen our dependence on foreign sources, the U. S. Geological Survey (USGS) has been tasked with evaluating the country's ability to satisfy these needs. The first step in this process was to identify what a critical mineral is and how many of them there are, which led to the publication of a report highlighting the 23 mineral commodities deemed critical to our mineral independence (Schulz et al. 2017). Recognizing that locating domestic sources of critical minerals is simply the first step, the USGS has been characterizing the most likely sources of these minerals, the Precambrian (>540 million years old) "basement" of the U.S. for many years. The bulk of known deposits of critical minerals is hosted in magmatic terranes that were emplaced during the early formation of the Earth's crust. These mineral deposits were not homogeneously distributed however, leaving certain mineral deposits in areas of the world that are either politically or geographically inaccessible.

In 2011, geologists David Pals and Raymond Anderson with the Iowa Geological Survey (IGS) gave a presentation at a meeting of the Geological Society of America on the subject of the mineral potential of the Midcontinent Rift System (MRS) in Iowa (Pals and Anderson 2011). The MRS is a Precambrian (~1.1 billion years old) failed rift that extends from Kansas to Michigan, with the most well-preserved segment running from southwestern to north-central Iowa (**FIGURE 1**). The presentation highlighted the need

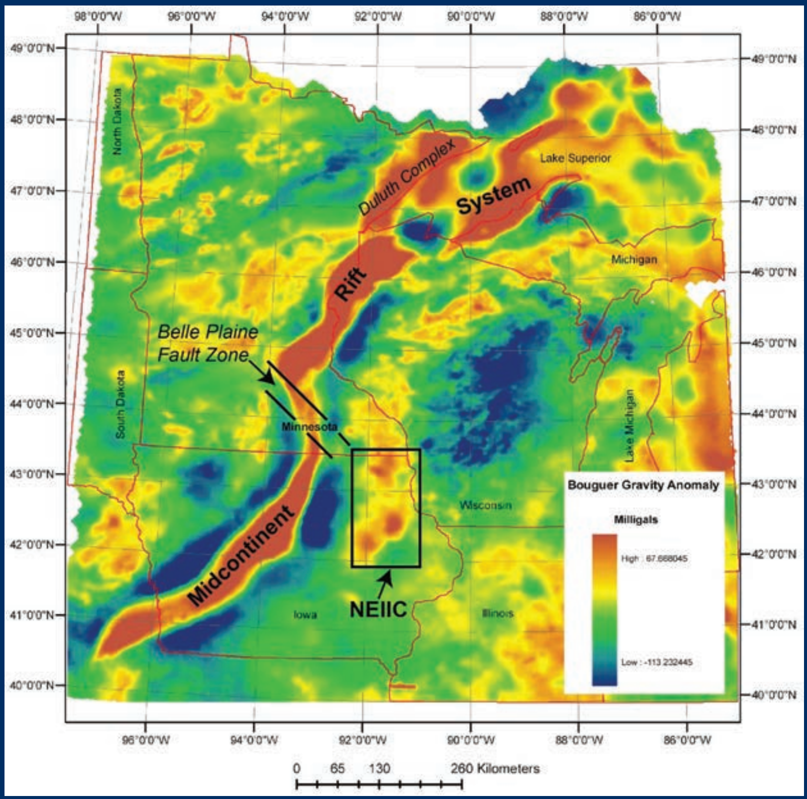

FIGURE 1: Bouger Gravity Anomaly map of the north-central United States. Gravity data compiled by the USGS Crustal Imaging and Characterization Team.

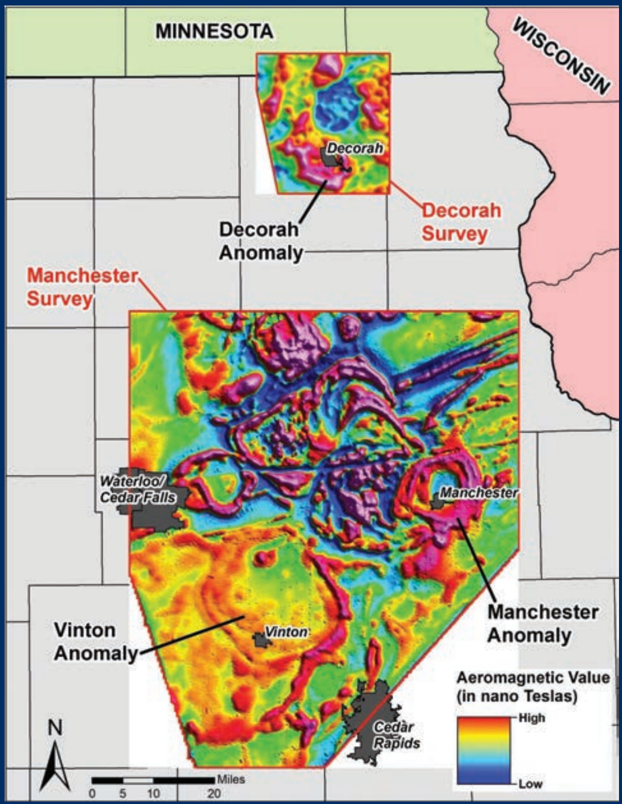

FIGURE 2: Map of northeast Iowa and neighboring states showing the two survey areas. Aeromagnetic survey data is shown to illustrate the major anomalies that the USGS considers as potential targets for future investigation.

to better understand the unique geologic terrane in northeastern Iowa that was identified by airborne geophysical surveys done in the 1950's. This terrane, known as the Northeast Iowa Intrusive Complex (NEIIC), is situated along the eastern flanks of the MRS (**FIGURE 1**). 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).

Geophysical Surveys

Beginning in 2012, the USGS began the arduous process of characterizing the deep Precambrian geology of northeastern Iowa. The first phase of the project included a relatively small survey area encompassing the vicinity of Decorah, Iowa and expanding into Minnesota (**FIGURE 2**). The Decorah Survey included high-resolution aeromagnetic, airborne gravity gradient (AGG), and time-domain electromagnetic (TDEM) surveys. Aeromagnetic surveys generally detect variations in iron content in the rocks whereas gravity gradient surveys detect subtle differences in rock densities. The TDEM survey was aimed at imaging the depth to the Precambrian surface and overlying sedimentary bedrock aquifer units. Neither was successful enough to merit further airborne EM surveys. The survey was flown at low altitude (80-100 m) with tight flight line spacing (400 m) to produce the highest resolution possible. The process of data acquisition and processing was completed during the winter of 2012-2013. Ben Drenth, lead geophysicist for the USGS in Denver, Colorado, utilized the survey data to compile a geologic map of the Precambrian bedrock surface (**FIGURE 3**) and published his interpretations in the Canadian Journal of Earth Sciences (Drenth et

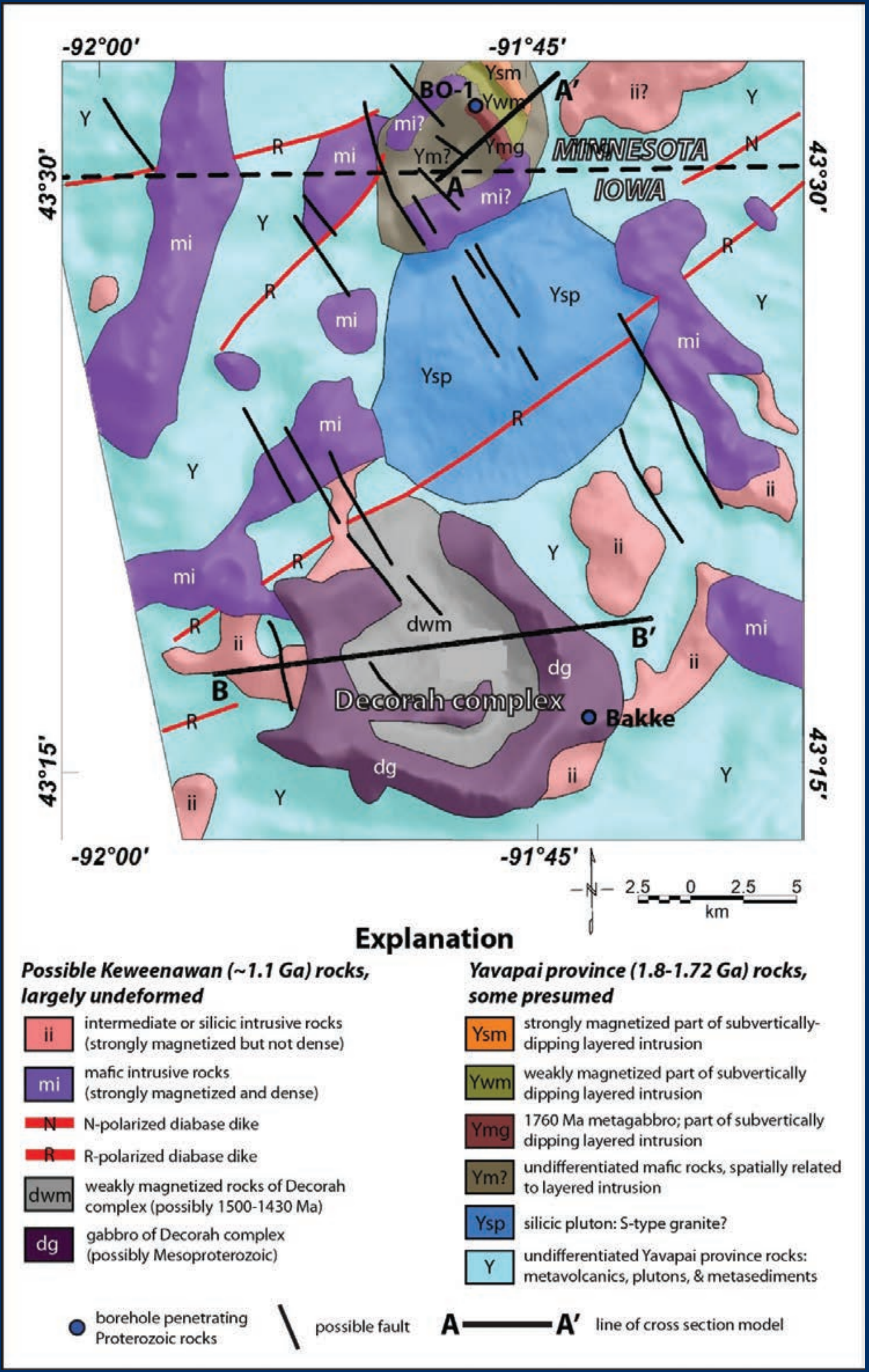

FIGURE 3: Geologic map of crystalline Precambrian rocks, interpreted from geophysical anomalies and limited borehole data. (from Drenth et al. 2014)

al., 2014). The primary focus of this research was to establish the relative age of the NEIIC with the hope of correlating its formation with that of the MRS and the Duluth Complex, which are both Keweenawan-age (~1.1 billion years old). The map identifies several key geologic features, including the horseshoe-shaped Decorah Complex, which is both dense and highly magnetic, as well as several linear bodies

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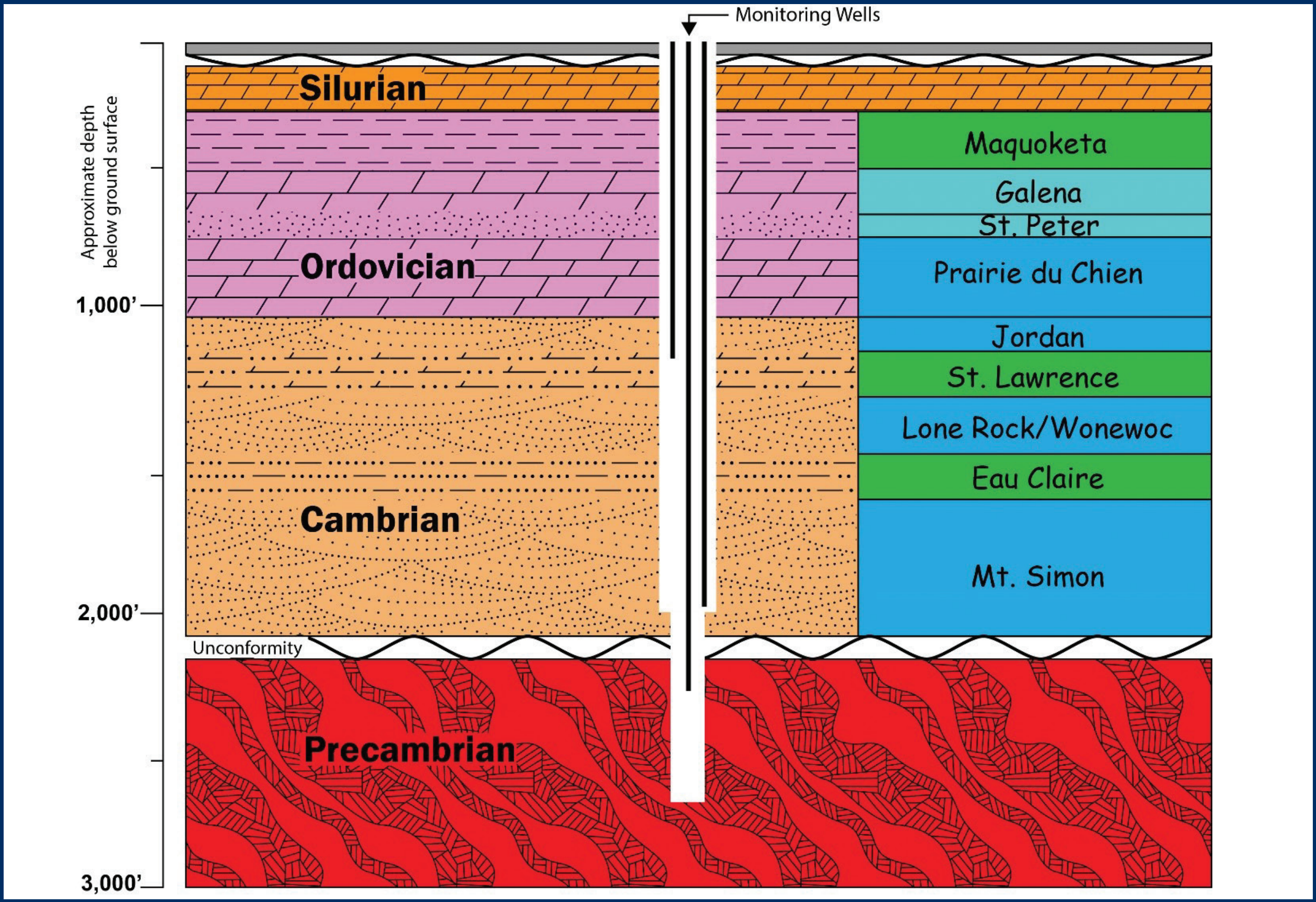

FIGURE 4: Schematic cross-section of the anticipated geology that would be encountered by the NEIIC borehole.

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presumed to be dikes. The cross-cutting relationships illustrated by the dikes provides relative ages of the major features in the survey area, however a numerical age date remains elusive without actual samples from the Precambrian bedrock.

Based on the success of the Decorah Survey, a second survey was done over a larger area of the NEIIC called the Manchester Survey (**FIGURE 2**). The Manchester Survey is almost four times the size of the Decorah Survey and thus commanded a larger price tag to complete. To combat the additional cost, the USGS decided to only collect aeromagnetic data at a similar resolution as the Decorah Survey and collect the gravity gradient data using ground-based survey methods, which took more than three years to complete. The resulting data has not yet been fully processed or interpreted. However, the preliminary results are quite promising and have generated substantial interest within the USGS-Mineral Resources Program (MRP) to investigate further. Of primary interest are the Manchester and Vinton anomalies (**FIGURE 2**). These anomalies have similar ring-shaped geometries as other well-known magmatic intrusions that host economic mineral deposits (Drenth et al. 2014). The logical next step, now that the majority of the NEIIC has been surveyed, is to collect samples from one of the target anomalies for geochemical and geochronological analyses.

Research Borehole

A proposal to drill a deep research borehole was submitted to the USGS-MRP in 2017 and received approval. However, USGS budget cuts have stalled the project before it has even begun. A silver lining to this financial cloud appeared in late 2017 with a Presidential Executive Order, spurred by the aforementioned critical minerals status report, to focus efforts on breaking our dependency on foreign mineral supplies. It appears that some funding might be allocated to programs that are directed at domestic mineral research, of which the NEIIC is perfectly positioned as a "shovel ready" project. If this renewed push provides the shot in the arm necessary to move the borehole project forward, samples could be pulled from the depths of the NEIIC sooner than later. However, in the case of the NEIIC borehole project, the story does not necessarily stop at the collection of rock samples for laboratory analyses. Although folks in the USGS-MRP will be fully satisfied with a numerical age date from one of the anomalies, many others are hoping to glean even more information from the borehole.

Depending on the funding situation, additional "value added" modifications may be completed to maximize the use of the borehole. It has been proposed to construct one or more monitoring wells within the borehole once core sampling is completed. This scenario would be ideal given that a borehole penetrating deep (> 100 m) into the Precambrian basement bedrock of northeastern Iowa has never been done. Depending on the location of the borehole, as many as three major aquifer systems may be intersected by the borehole (**FIGURE 4**). A well nest with intervals crossing the Silurian, Cambrian-Ordovician, and Mt. Simon aquifers would be an extremely valuable asset to groundwater characterization in the region. Some hydrogeological work is already woven into the initially approved proposal, primarily packer testing, borehole water sampling, and flow measurements during drilling. These activities will be focused on the hydrogeology of the unconformity that marks the base of the Cambrian and underlying Precambrian crystalline basement. A research group from Utah State University is part of the borehole planning team and is interested in the hydrogeological properties of the unconformity as it pertains to induced seismicity. They have completed similar work in other areas of the US but not yet in the Midwest. Another key question would be whether groundwater chemistry at the unconformity shows any indication of potential mineralization of the crystalline rocks beneath.

Should the USGS-MRP fully fund the borehole project, it would likely cover only core sample collection and backfilling the borehole, so additional funding is currently being sought to construct monitoring wells. Further complications arise when attempting to find a suitable location for the borehole since public land is quite scarce within the target areas of the Manchester and Vinton anomalies. Drilling and placing a long-term monitoring well on private land would necessitate access agreements, land easements, and possible compensation for property/crop damage. The IGS is working to find a suitable borehole location and obtain necessary funding for monitoring well installations. With resolution of these issues, exploration of the NEIIC will provide Iowans with much needed information on mineral and groundwater resources in the region. Stay tuned for future developments!

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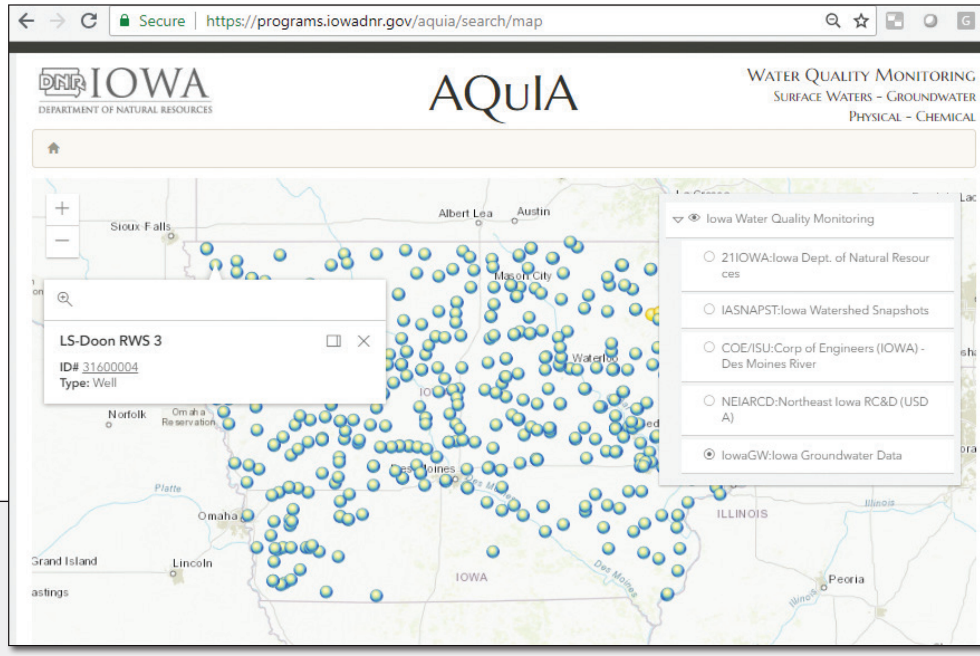
COOL NEW TOOLS!

Claire Hruby, Geologist, Iowa Department of Natural Resources

AQuIA: Iowa DNR has replaced the IASTORET website, with a new information portal that allows the public to view and download water monitoring data (for both surface and groundwater). You can use a map or the search tool to gather records from individual sites by watershed, aquifer, analyte, or group of analytes. Records for most ambient groundwater monitoring (IowaGW) sites begin in 2002.

Check it out at:
https://programs.iowadnr.gov/aquia/

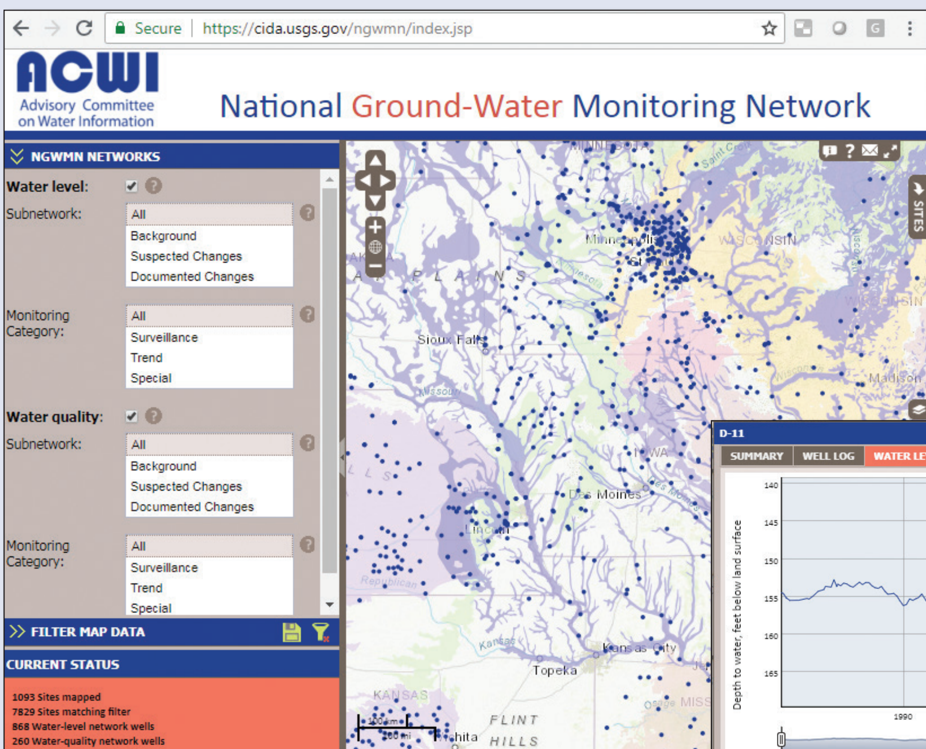


Query Results

SiteID	Site	Sample Date	Project/Task	Fraction	Analyte		Result	Unit
31600004	LS-Doon RWS 3	04/02/2013	GWM	Total	Inorganic nitrogen (nitrate and nitrite) (AS N)		3.6	mg/l
31600004	LS-Doon RWS 3	01/26/2015	GWM	Total	Inorganic nitrogen (nitrate and nitrite) (AS N)		1.9	mg/l
31600004	LS-Doon RWS 3	01/04/2016	GWM	Total	Inorganic nitrogen (nitrate and nitrite) (AS N)		3.4	mg/l
31600004	LS-Doon RWS 3	10/25/2016	GWM	Total	Inorganic nitrogen (nitrate and nitrite) (AS N)		7.7	mg/l

NGWMN: The National Ground-Water Monitoring Network links water quality and water level data from Federal, State, and local monitoring networks across the nation. In FY18, Iowa DNR and IIHR each successfully obtained grants to become new data providers to the NGWMN.

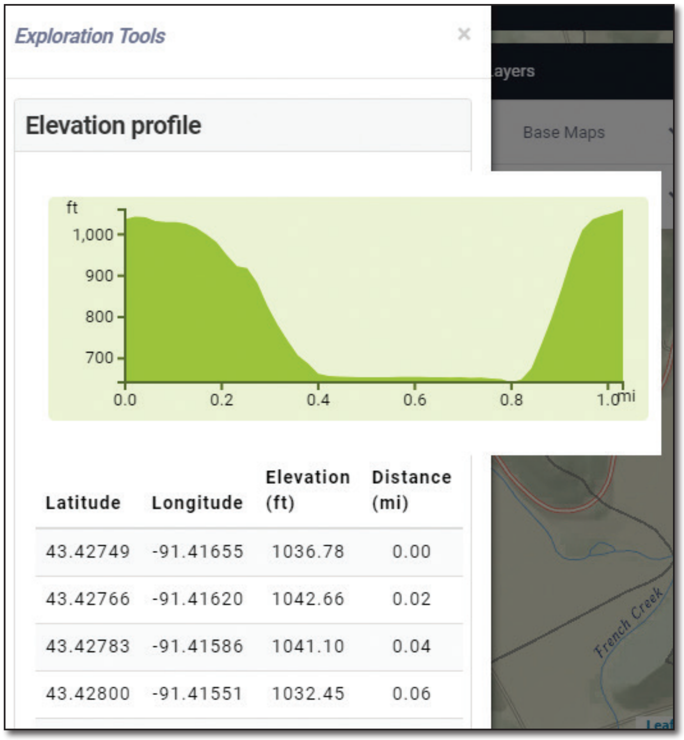
An interactive map of monitoring sites can be found at:
https://cida.usgs.gov/ngwmn/index.jsp

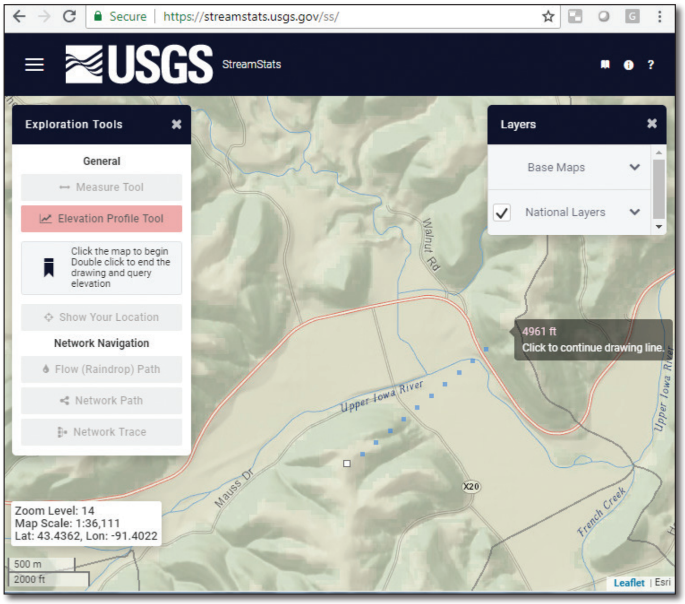


StreamStats and the Iowa Elevation Tool:

Need elevation data? The USGS has a great website for gathering data related to streams, called StreamStats. One of the tools available from StreamStats is an elevation profile tool. The Iowa DNR provides a similar tool, which allows users to select a profile line, view the profile, and export elevation data in .csv format.

Check out these websites:
StreamStats: ***https://streamstats.usgs.gov/ss/***

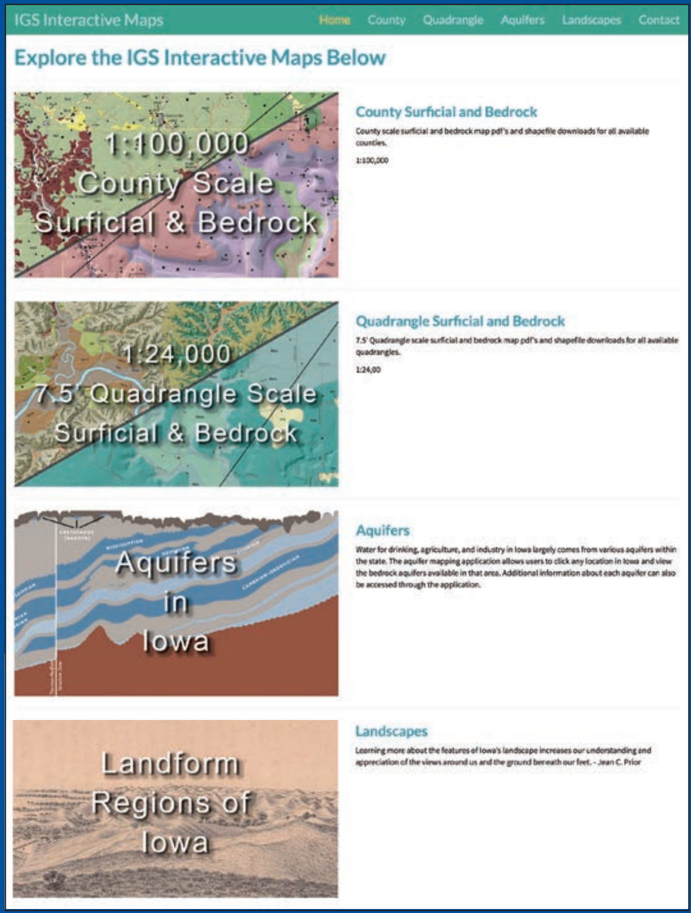




IGS Interactive Maps:

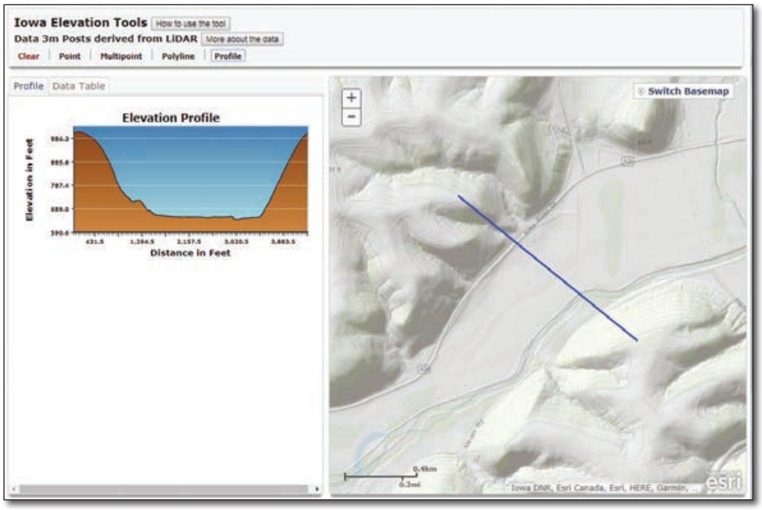
The Iowa Geological Survey has recently made 4 new interactive maps available to users with county and 7.5' quadrangle scale surficial and bedrock data, aquifer data, and landscape data.

To view these maps go to:
https://www.iihr.uiowa.edu/igs/publications/map/index.html



Iowa Elevation Tool:

https://programs.iowadnr.gov/maps/elevation/



U.S. Geological Survey IGWA Update Summer 2018

Adel /E. Haj, Hydrologist, U.S.

FIGURE 1

Over the last calendar year, there have been organizational changes in the U.S. Geological Survey (USGS) at both the local and national levels. These changes are intended to streamline the organization, improve our science capabilities and include the merging of state water science centers.

The Missouri Water Science Center (MO WSC) and Illinois-Iowa Water Science Center (IL-IA WSC) have merged to become the Central Midwest Water Science Center (CMWSC). The merger will not adversely impact current programs in the former water science centers but will enhance the science capabilities of our combined offices and improve the long-term viability of our scientific programs and resources, providing broader science capabilities to address large-scale societal issues.

The CMWSC offices are in Iowa City, Fort Dodge, and Council Bluffs in Iowa; DeKalb, Mount Vernon, and Urbana in Illinois; and, Lee's Summit, Olivette, and Rolla in Missouri (**FIGURE 1**). A new Central Midwest Water Science Center webpage is under development and should go live fall of 2018.

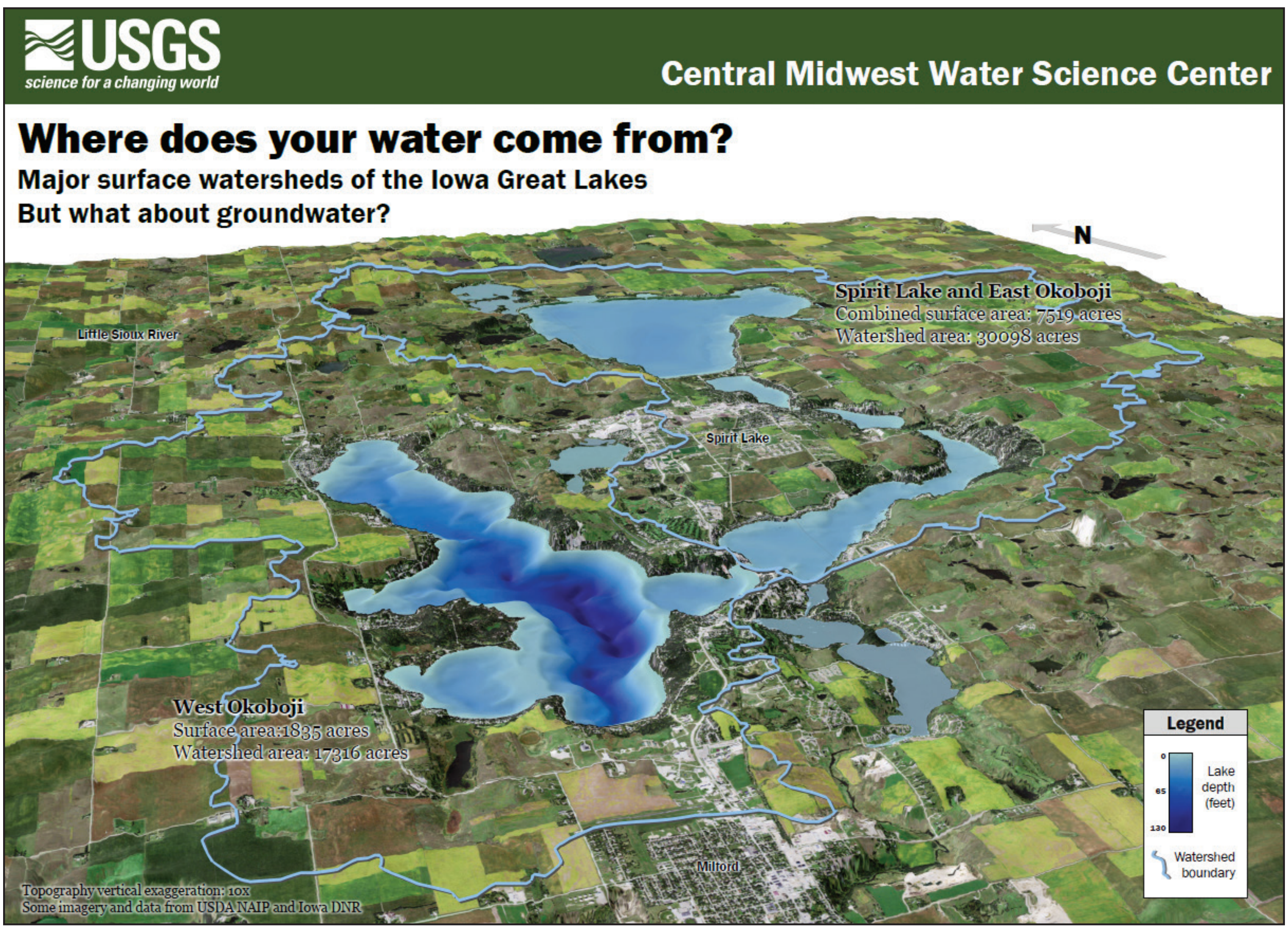


FIGURE 2

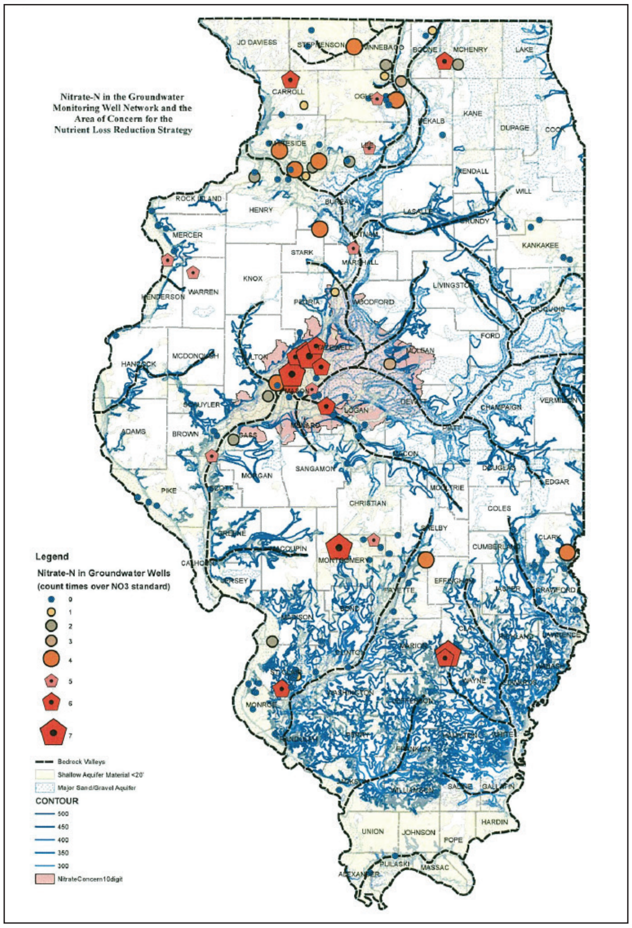


FIGURE 3

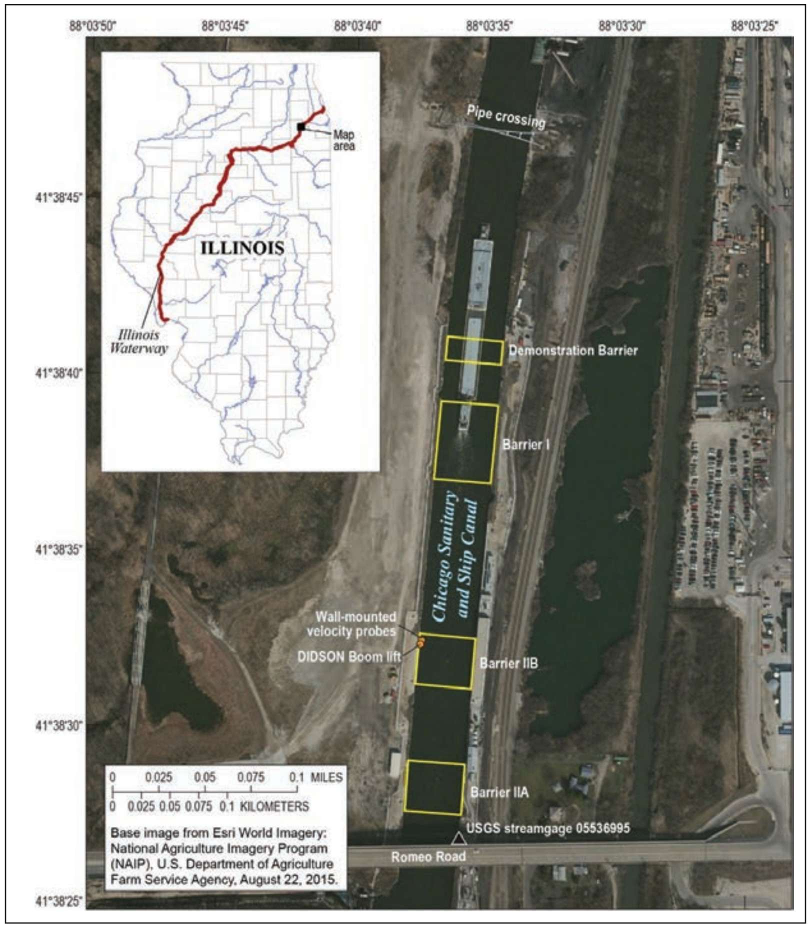


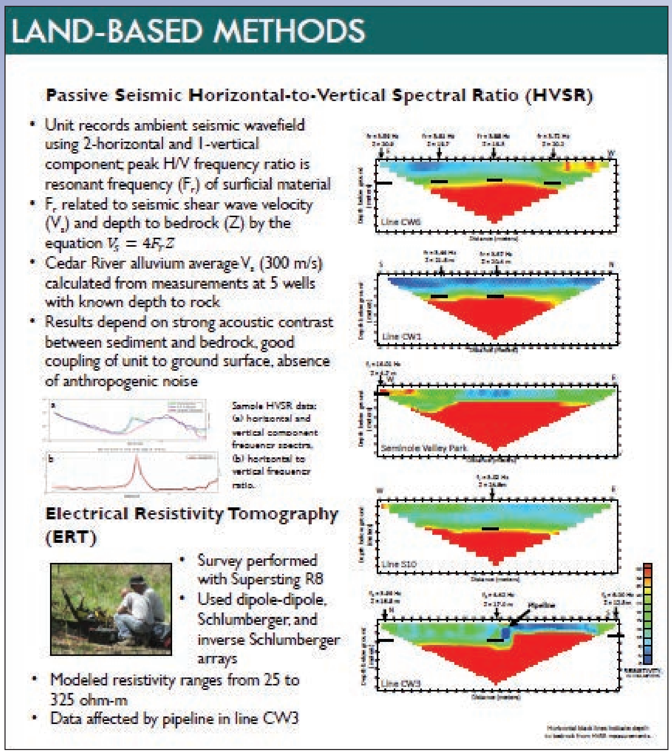
FIGURE 4

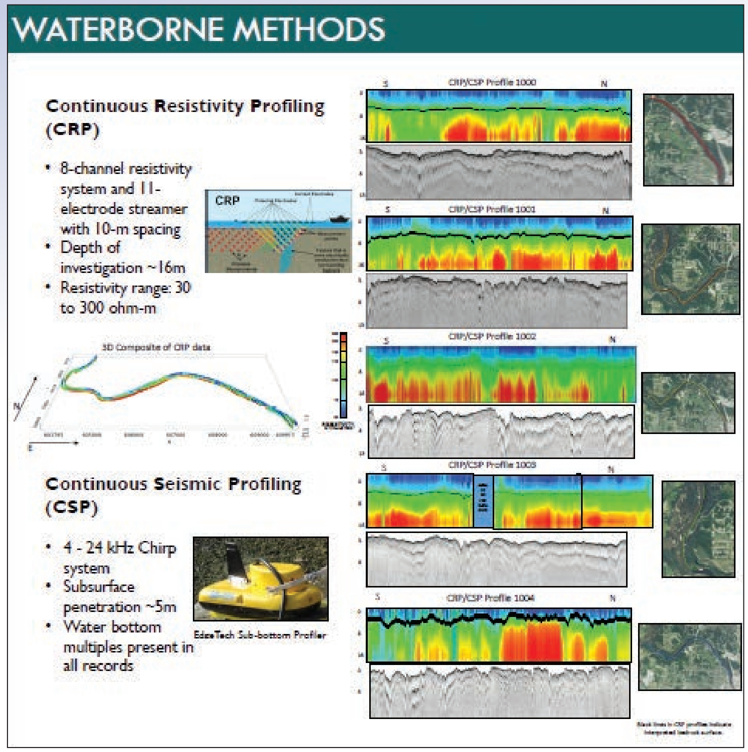
The CMWSC is conducting a broad spectrum of scientific investigations in water quality, surface water, and groundwater. A few examples include the development of a water budget for the Iowa Great Lakes Chain, continuous nitrate changes in shallow groundwater, strategies to deter the spread of invasive species in Illinois, geophysical techniques to map groundwater in Iowa, and Flood Inundation Maps in Missouri.

The CMWSC Iowa offices in cooperation with the Dickinson County Water Quality Commission is currently collecting data and developing a hydrologic water budget for the Iowa Great Lakes Chain. The Iowa Great Lakes Chain serves as an important drinking water source for several communities in Northwest Iowa. The Lakes also are a large economic driver in the region, providing recreational opportunities that support a substantial tourism industry. The water budget developed by CMWSC will help people living in the region and water managers better understand the amount and extent of surface-water and groundwater source contributions to lake inflows and system outflows. Please see **FIGURE 2** showing the Iowa Great Lakes Chain.

The CMWSC Illinois office, in cooperation with the Illinois Environmental Protection Agency, is currently working on the assessment of temporal groundwater nitrate concentration changes due to seasonality and/or irrigation practices in the Havana lowlands by continuous monitoring of nitrate and field parameters. The main objectives of this study are to one, determine the fluctuations in nitrate concentration resulting from seasonal climatic changes or groundwater conditions such as dissolved oxygen or pH. Two, determine temporal nitrate concentrations resulting from agricultural practices such as irrigation or fertigation. To accomplish the objectives a nitrate sensor is installed in an observation well adjacent to a well that has shown high nitrate concentrations. The data will provide continuous nitrate concentrations that are used to help determine the possible causal relations between nitrate concentrations and the local conditions. **FIGURE 3** from the Illinois Department of Agriculture monitoring network shows a density of wells (hotspots) in west-central Illinois near the study area where concentrations of nitrate in groundwater often exceed the drinking water standard of 10 mg/L (communication with Rick Cobb, IEPA, 2016).

(continued on page 26)





FIGURES 5 & 6

(continued from page 25)

The CMWSC Illinois offices are involved in many invasive species related projects with the Great Lakes Restoration Initiative, U.S. Fish and Wildlife (USFWS) and with the U.S. Army Corps of Engineers (USACE). One example from 2016 is when the USFWS, USGS, and USACE undertook a field study in the Chicago Sanitary and Ship Canal near Romeoville, Illinois to determine the influence of tow transit on the effectiveness of the Electric Dispersal Barrier System (EDBS) in preventing the passage of juvenile fish (total length < 100 millimeters). The study showed that the efficiency of the EDBS in preventing the passage of small, wild fish is compromised while tows are moving across the barrier system. In particular, tows moving downstream through the EDBS create a pathway for the upstream movement of small fish and therefore may increase the risk of transfer of invasive fishes from the Mississippi River Basin to the Great Lakes Basin. **FIGURE 4** shows the location and layout of the study site and EDBS.

The CMWSC in Iowa is currently building a new groundwater model for the City of Cedar Rapids of the Cedar River alluvial aquifer that can simulate stresses and drawdowns experienced during extreme drought and demand. The new groundwater model considers river connectivity to the aquifer, alluvial aquifer connectivity to the bedrock aquifer, subsurface recharge sources such as tributary inflows and buried valleys, and wetland and oxbow lake connectivity to the alluvial aquifer. A suite of geophysical methods is being employed to efficiently and non-invasively map aquifer thickness and bedrock connectivity for parameterization of this model. These geophysical methods include waterborne and land-based seismic and resistivity surveys and an airborne electromagnetic survey. **FIGURES 5 & 6** show examples of both Land-based and waterborne geophysics methods.

The CMWSC Missouri Offices have completed many flood inundation mapping studies, an example of one of those studies is the Flood-Inundation Maps and Wetland Restoration Suitability Index for the Blue River and Selected Tributaries, Kansas City, Missouri, and Vicinity, 2012. The Blue River and selected tributaries (Brush Creek, Indian Creek, and Dyke Branch) at Kansas City, Missouri, and vicinity, were created by the USGS in cooperation with the City of Kansas City, Missouri. The flood-inundation maps can be accessed through the USGS Flood-Inundation Mapping Science Web site at *http://water.usgs.gov/osw/flood_inundation/*. Additional information in this report includes maps of simulated stream velocity for an 8.2-mile, two-dimensional reach of the Blue River and a Wetland Restoration Suitability Index (WRSI) generated for the study area that was based on hydrologic, topographic, and land-use digital feature layers.

If you have any questions about these projects or conducting similar research in your area, please contact the Iowa City Office, Jon Nania, jfnania@usgs.gov, 319-358-3655.

STATUS OF THE IOWA GEOLOGICAL SURVEY

Keith Schilling, Ph.D., State Geologist, Iowa Geological Survey

Just as all U.S. presidents declare "The state of our union is strong!" at some point in their annual State of the Union address, I can state with equal conviction that the state of the Iowa Geological Survey is as strong as ever. We've had some interesting times over the past few years, which I will describe briefly below, but we've also had the opportunity to streamline our operation and rededicate ourselves to delivering high-quality service and products to our stakeholders.

IGS History

The Iowa Geological Survey was established in 1892, and we celebrated our 125th anniversary last year. In case you weren't around in 1892, some highlights from that year included the election of Grover Cleveland as U.S. president and the first basketball game, which was played in Springfield, Mass. Meanwhile, you could purchase a loaf of bread for less than a nickel. Clearly, it was a different world. But in Iowa, the state legislature had the foresight to establish a permanent geological survey, which was led by Professor Samuel Calvin (**FIGURE 1**), the first state geologist of Iowa. The legislature established a mandate calling for "… investigating the characters of the various soils and their capacities for agricultural purposes; the growth of timber, the animal and plant life of the state, the streams and water power, and other scientific and natural history matters that may be of practical importance and interest."

(continued on page 28)

FIGURE 1: Samuel Calvin, Iowa's first state geologist, standing next to "The Sentinel," Newton Township, Iowa.

(continued from page 27)

Today, more than 125 years later, IGS carries on with this mandate, albeit with a slightly different mission statement, that is “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.” It is interesting to note that regardless of the time, the work of IGS involves delving into the science and natural history of Iowa to unlock and manage our water and natural resources. I take satisfaction in knowing that the mission of IGS has remained consistent the years.

From its inception in 1892, IGS reported directly to the governor, but things changed in 1986 when the IGS organization was moved to become a bureau and later several sections within the Iowa Department of Natural Resources. Many folks in Iowa probably still think of IGS at the Iowa DNR under the capable long-term leadership of Don Koch and Bob Libra. However, in 2014, times changed again, and the oversight of IGS was moved to the University of Iowa to become part of IIHR—Hydroscience & Engineering (IIHR), a research institute within the University of Iowa’s College of Engineering.

The transition of IGS from IDNR to IIHR has been quite a process. First, because IGS staff were DNR employees, those staff moving to IIHR had to resign from DNR and be hired as university employees. For some staff, this change meant retirement from IGS, and for others, it meant staying in DNR, changing positions, and moving to Des Moines. Beyond the personnel issues, there was also the issue of the State of Iowa Administrative Code. Because the Code of Iowa stated that IGS was

FIGURE 2: The Iowa Geological Survey staff in 2017 (clockwise from far left): Rick Langel, Keith Schilling, Mike Gannon, Rosemary Tiwari, Matthew Streeter, Huaibao (Paul) Liu, Nathan Holt, Zachary Demanett (no longer at IGS), Stephanie Surine, Ryan Clark, Jason Vogelgesang, and Phillip Kerr.

part of the DNR and the state geologist of Iowa was a DNR employee, modifications to the Code of Iowa were needed for IGS to officially become part of the university. Because this sort of thing takes time, IGS operated under a contract from DNR from 2014–18 to provide geological services to the state. Finally, during the 2018 legislative session, the legislature change the Code of Iowa so that the IGS and the state geologist position would become officially part of the University of Iowa. Although migrating the IGS from the DNR to UI was a huge undertaking, the challenge was met head on by Larry Weber (then director of IIHR, and now executive associate dean for the UI College of Engineering) and our colleagues from DNR, including Chuck Gipp, Bill Ehm, and Sharon Tahtinen. The legislative effort was also supported by many valued friends and stakeholders of IGS.

IGS Today

Where does that leave IGS today? Well, some things haven't changed — our main office is still located on the third floor of Trowbridge Hall at the University of Iowa, and our rock and core facility remains at the UI Research Park (formerly known as the Oakdale campus). We may be a little smaller in size than you remember. IGS currently comprises 10 staff members, but the diverse skills of our geologists and hydrogeologist continue to provide a wide range of expertise to Iowans (**FIGURE 2**).

Quaternary geologists Stephanie Surine and Phil Kerr, along with bedrock geologists Ryan Clark and Huaibao (Paul) Liu, focus on mapping Iowa's surficial and bedrock resources. Using funding from the U.S. Geological Survey's Statemap program, they leverage these resources to delineate economic and aggregate resources, identify formations and aquifers, and provide geologic characterization and interpretations for use at local and regional scales across the state. Geologist Rick Langel manages the IGS Oakdale facility and maintains IGS's popular and irreplaceable geologic database, GEOSAM. Rick also leads the IGS groundwater level monitoring network. Matthew Streeter is an Iowa State–trained soil scientist who assists with many field and watershed projects and operates our new truck-mounted Giddings drilling rig. We've given the new drilling rig a workout in its first year, mapping geologic deposits and installing monitoring wells for groundwater studies.

IGS hydrogeologists, led by Mike Gannon and Nathan Holt, are working with many different stakeholders in Iowa to evaluate, manage, and model Iowa's groundwater resources. Over the past year, Mike and Nathan have been busy working with local stakeholders in Linn and Johnson counties to develop an enhanced groundwater flow model for the Cambrian-Ordovician aquifer. Further, they have been providing groundwater resource and modeling services to many municipal and rural water systems in Iowa over the past few years. Jason Vogelgesang assists with these hydrogeologist studies and leads the IGS in the use of geophysics for geologic characterization. With electrical resistivity (ER) and electromagnetic terrain conductivity (EM31) equipment, Jason characterizes subsurface conditions using these non-invasive methods. Mike, Nathan, and Jason have also been working on drought assessments and developing methods for mitigation at vulnerable water supplies.

As part of the IGS code change, a new state geologist position at the University of Iowa was created, and it was my good fortune to be named Iowa's state geologist in July 2018. Assisted by administrative assistant Rosemary Tiwari, I am leading and directing the IGS as it enters a new era at the University. I am proud to be selected for this position, and it's an honor and a privilege that I take very seriously. Along with these duties, my focus at IGS is primarily on nonpoint source pollution and nutrient-related issues impacting Iowa's watersheds and aquifers.

I should note that this new era has given us the opportunity to become more entrepreneurial in our approach to projects and clients. IGS is now able to provide 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 a game-changer for IGS because we can market our services to the broader community and better integrate with stakeholders to provide customer-centered solutions. New service contracts have included projects focused on groundwater exploration and modeling, geophysics, and mineral exploration and mapping. The use of service contracts opens many opportunities for IGS to collaborate with partners across the state.

It's worth repeating — the IGS is stronger than ever. Now operating within IIHR at the University of Iowa, we have greater flexibility to respond to requests for service, more opportunities to lead and partner on Iowa-related projects and research, and a clear mission to help Iowans manage our natural resources for long-term sustainability and economic development. The future is bright, and we welcome the opportunity to work together with our fellow Iowans to best manage our water and natural resources.

MICHAEL SIMON

UNIVERSITY OF IOWA

Michael D. Simon,
Bridge Pier Debris Accumulation Rate

Michael Simon graduated with a BS in Geoscience from The University of Iowa, May 2018. He is currently working on a startup company called Clean River Solutions and investigating how large debris buildups occur. Clean River Solutions is developing the RC Beaver (Remote Control Beaver), a machine designed to remove unwanted woody debris from waterways.

Floods bring woody debris, including trees, branches, roots, corn stalks, and other plant material, as well as human-made items down rivers. Debris often accumulates on bridge piers. Sometimes the debris pile is left alone, in hopes that "Mother Nature" will take care of it. Sometimes the next flood does take it away; other times, when it becomes a more persistent problem, the debris must be removed manually with heavy equipment such as cranes, excavators, and barges. From 2013 -2017, the Iowa Department of Transportation (DOT) spent over $1 Million on debris removal from their bridge piers.

Michael believes the problem may be dealt with head on by preventing large pileups through real time removal during high water, which will reduce the bill for bridge maintenance and relieve headaches of bridge owners. Environmentalists may support this method because less heavy equipment needs to be used to remove debris piles, which reduces carbon footprint, lessens the chance of petroleum product spills into the environment, decreases stream bank erosion, and allows nature to have the natural wood back for wildlife.

Michael will use IGWA research funding to complete site investigation.

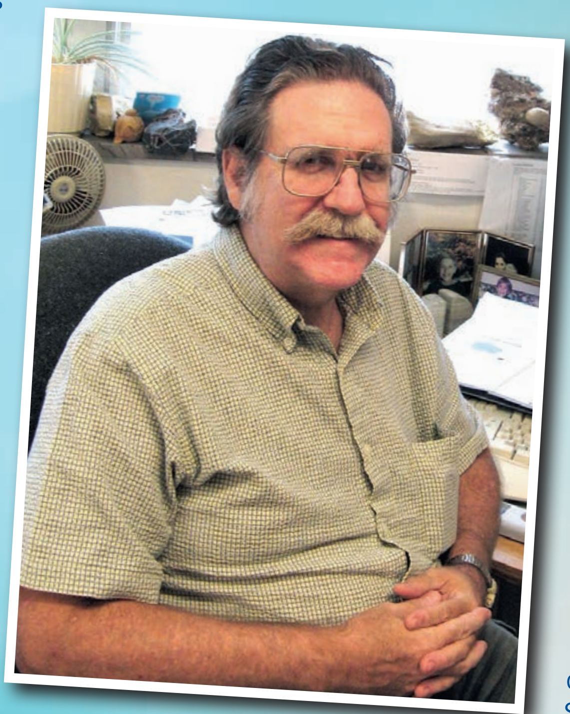
GROUNDWATER HERO

Bob Libra, Past State Geologist, Iowa Geological Survey

PAUL VANDORPE

When you think of people that have contributed to the understanding and use of Iowa's groundwater, you can come up with a fairly long list. When you have them doing so for almost 40 years, the list gets much shorter in a hurry. And if you talk about those who have taken pictures of it all, you end with this year's Groundwater Hero, Paul VanDorpe!

A native of Detroit, Paul earned his degrees at Wayne State University. Following completion of his Masters, Paul took a position with the Iowa Geological Survey in 1975. His first assignments were with the Coal Program, which began in response to energy shortages and the Mideast oil embargo of the early 1970's; followed by a stint with the Abandoned Mine Lands Inventory. By the early 1980's, Paul had moved to the Water Resources group, and his work with groundwater began in earnest.



Paul was one of the first members of IGWA when it formed, and served as treasurer and editor of the newsletter for many years. He was also an active participant in the Geological Society of Iowa, the Children's Water Festival, the Iowa Academy of Science, and the Midwest Groundwater Conference. He frequently organized meetings and field trips related to these and similar groups. And of course, if photos were taken at meetings or on field trips, Paul was taking them. His motto was: *"Have Camera, Will Travel"*, and his collection of water tower photos backs that up!

One of Paul's long-term efforts was the development and oversight of the Municipal Water Supply Inventory, the first comprehensive collection of data on the state's public supplies. First, as paper files and later electronic, MWSI was a precursor to the current databases used for Source Water Protection and many other groundwater applications. He was deeply involved with rules and publications regarding heat-pump wells, proper well closure, the homeowners guide to water wells, and Groundwater Basics. Paul routinely spread the good word of groundwater to well contractors, public health officials, DNR and other agency staff, and the public at large. While he had moved on from full-time work with coal, Paul played a major role in preserving Iowa's underground mine maps, and often investigated suspected mine subsidence problems.

One of Paul's later endeavors was looking into arsenic in Iowa's groundwater, particularly after the drinking water standard was lowered. Paul was part of the team working on the arsenic "hot spot" in northern Iowa, which led to successful guidelines for avoiding high arsenic concentrations in private wells.

But of all of Paul's roles in Iowa groundwater, the largest may be that of "well forecaster in chief". For most of his time at the Survey, Paul provided forecasts of anticipated well depths, yields, quality, construction advice, and any red flags to drillers, homeowners, towns, farms and businesses. From the routine to the complicated, his advice helped make many successful wells happen. He also worked with drillers and consultants on problems with existing wells, often supplying the experience and guidance needed to bring about resolution.

Paul retired from IGS in 2014, and he and his wife Jill remain in Iowa City. Congratulations to a career-long job well done to Paul, this year's Iowa Groundwater Hero!

IGWA Member News

MEMBERSHIP RECOGNITION

New Members

• Bryan Bross • Krista Dawson • Ray Francis • Dave Gammon • Lyle Hammes • Sandra McGrath • Christina Murphy • Mark Thurow • David Wildharber

1-Year Members

• Crystal Davis • Debbie Dietzenbach • John Dunn • John Gaines • Katie Goff • Steve Gustafson

5-Year Members

• Jennifer Coughlin • Mike Gannon • Diane Pals • Sushil Tuladhar

10-Year Members

• Caley Parrish • Tim Wilson

15-Year Members

• David Constant • Daniel Ries

20-Year Members

• Doug Groux • Sherman Lundy • Mark Wiseman

25-Year Members

• Valerie Chambers • Michael Leat • Jeff White

30-Year Members

• Bob Libra • Ken McFadden • Russell Tell

Thank you to the following members for being with IGWA for over 30 years:

• Michael Burkart • Reed Craft • Bob Drustrup • Nancy Hall • Don Koch • Dana Kolpin • Gary Shawver • Paul VanDorpe

DID YOU KNOW

that IGWA accepts government groups, such as Iowa DNR sections or county public health departments and corporate memberships?

Contact an IGWA Board member for details.

IGWA
Iowa Groundwater Association

Upcoming Events

IRWA Okoboji Fall Conference September 11-12, 2018
Okoboji, Iowa • *www.iowaruralwater.org/events_fall_conference.html*

NAAMLP 2018 Annual Conference September 9-13, 2018
Williamsburg, Virginia • *https://dmme.virginia.gov/dmlr/amlconference/AMLindex.shtml*

2018 Iowa Section AWWA Annual Conference October 16-18, 2018
Dubuque, Iowa • *www.ia-awwa.org/conferencesandtraining/annualconference.html*

Iowa Groundwater Association Fall Meeting October 11, 2018
Iowa City, Iowa • *www.igwa.org*

2018 IEHA/NEHA Region 4 Iowa Environmental Health Conference October 3-4, 2018
West Des Moines, Iowa • *https://www.ieha.net/2018FallIEHC*

IRWA Dubuque Fall Conference October 23-24, 2018
Dubuque, Iowa • *www.iowaruralwater.org/events_fall_conference.html*

Indiana Ground Water Association Central District Fall Meeting November 1, 2018
Michigan City, Indiana • *http://www.indianagroundwater.org/*

Minnesota Ground Water Association Fall Conference November 15, 2018
St. Paul, Minnesota • *http://www.mgwa.org/mgwa-conferences/*

2018 EPI Fall Symposium November 12-13, 2018
Johnston, Iowa • *www.epiowa.org*

NGWA 2018 Groundwater Week December 3-6, 2018
Las Vegas, Nevada • *www.groundwaterexpo.com/*

IWWA Annual Convention & Trade Show January 31- February 1, 2019
Altoona, Iowa • *https://www.iwwa.org/water-well-education*

IRWA 44th Annual Conference February 18-20, 2019
http://www.iowaruralwater.org/events_annual_conference.html

Iowa Groundwater Association
P.O. Box 744
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www.IGWA.org

COVER PHOTO: Spring Branch Creek at Bailey's Ford Park. Photo Taken by Matthew Graesch.