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Iowa Geological Survey *Update*

Keith Schilling, Ph.D.

**Director and State Geologist, Iowa Geological
Survey, University of Iowa**

January 22, 2024



Iowa Geological Survey - Who we are...



Our Mission:

“To collect, reposit, and interpret geologic and hydrogeologic data, to conduct foundational research, and to provide lowans with the knowledge needed to effectively manage our natural resources for long-term sustainability and economic development.”

Some Details:

Location:

University of Iowa
Iowa City, IA

Within the University:

IIHR Hydroscience &
Engineering
College of Engineering

State Geologist:

Keith Schilling, Ph.D.

Staff:

12 FTE geologists and
hydrogeologists
2 shared/part-time
1 administrative support

University of Iowa campus
Trowbridge Hall



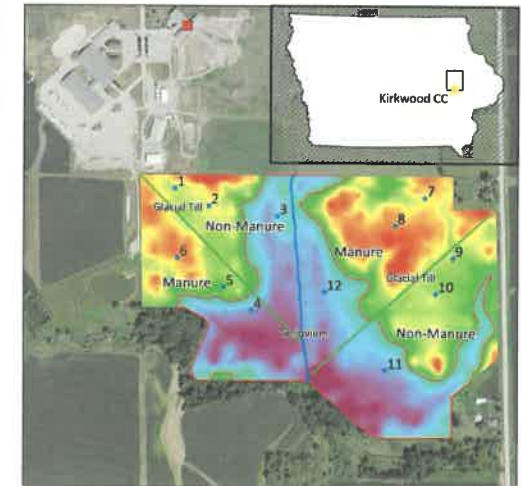
University of Iowa
Oakdale Research Park



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Consistent with our mission:

- Groundwater resource evaluation
- Geologic mapping and characterization
- Making geologic and water resource information available for the public

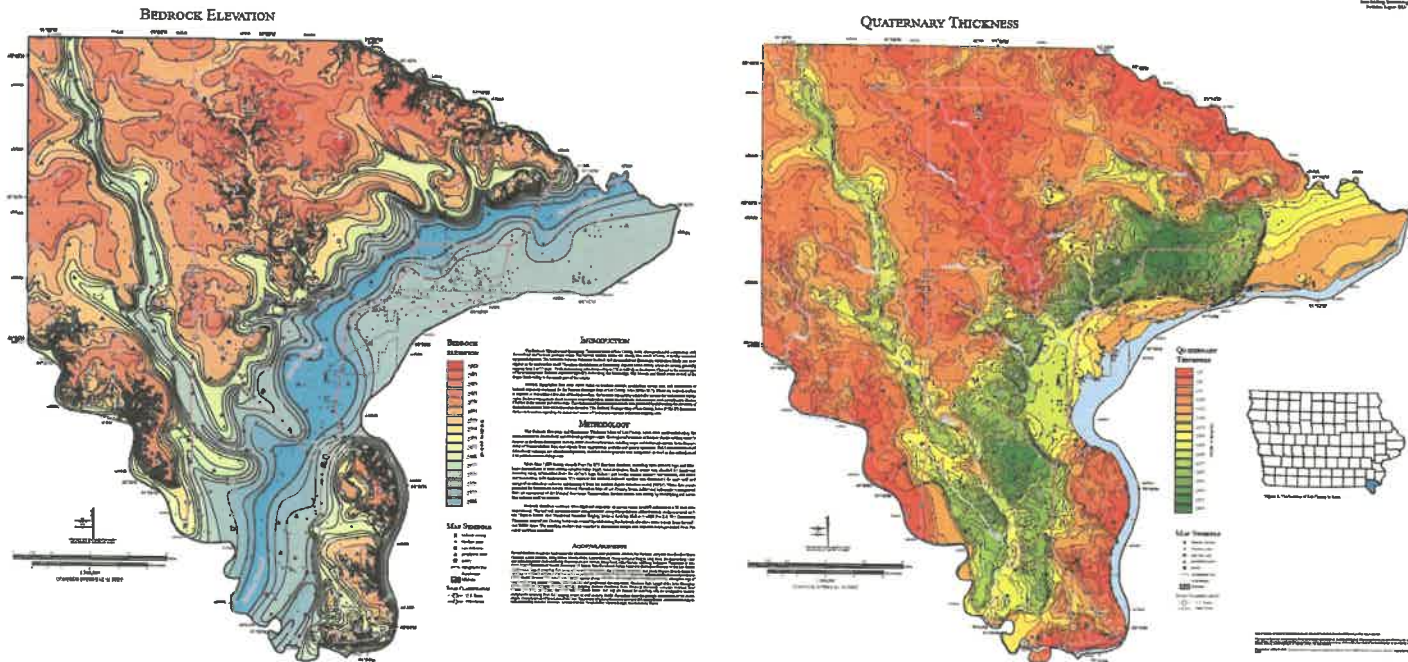


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Completed geologic mapping in southeast Iowa

BEDROCK ELEVATION AND QUATERNARY THICKNESS MAPS OF LEE COUNTY, IOWA

IOWA Iowa Geological Survey
Open File Map: OF18-05-1
Lee County, Iowa



Cooperative program with USGS

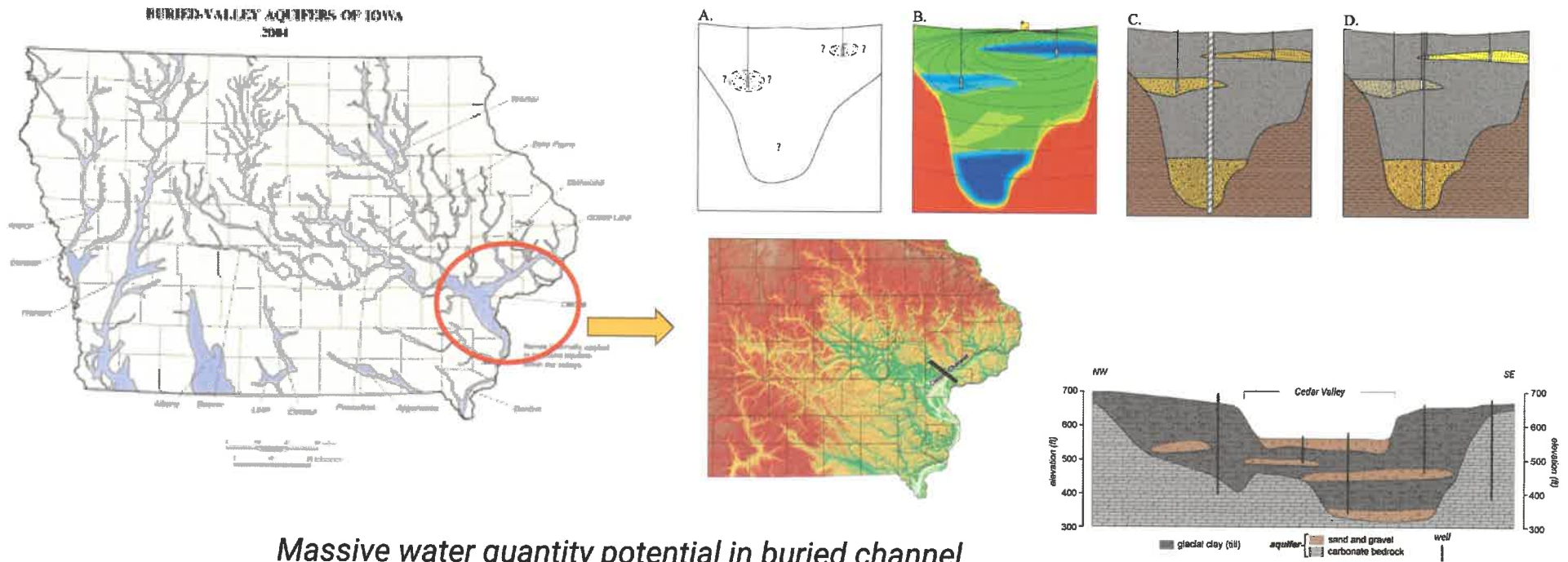
Compilation of 2017-2022 effort

Unraveled unique geology of region

Data now available for multiple purposes

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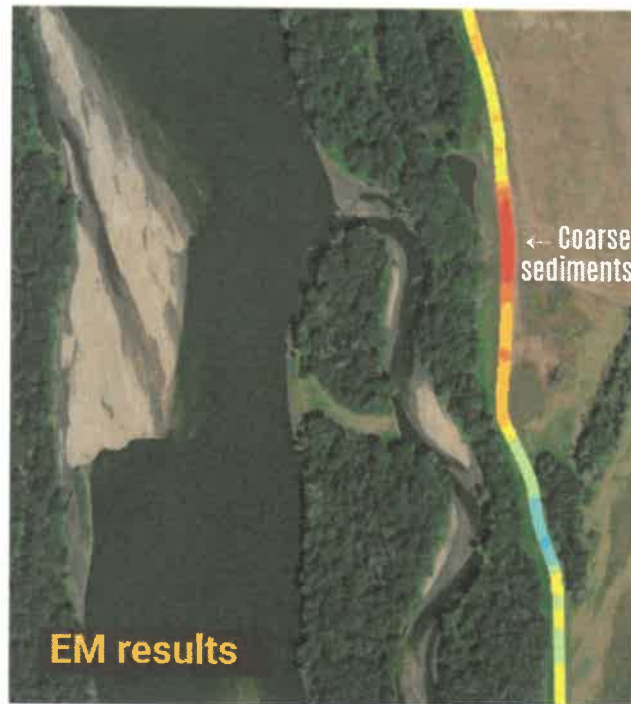
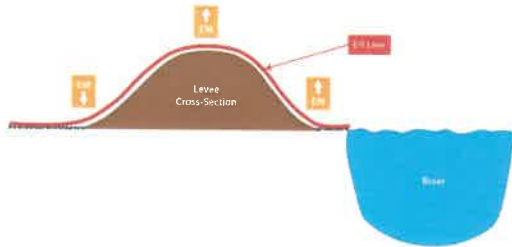
New mapping in Muscatine County area – focus on buried alluvial aquifer system



Massive water quantity potential in buried channel aquifers in Iowa – understudied and untapped

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New levee mapping project funded through appropriation to HSEMD (complete 900 mi in 5 years)



Year 1- 100 levee miles completed

- 25 levees
- 12 levee sponsors
- >260,000 conductivity measurements

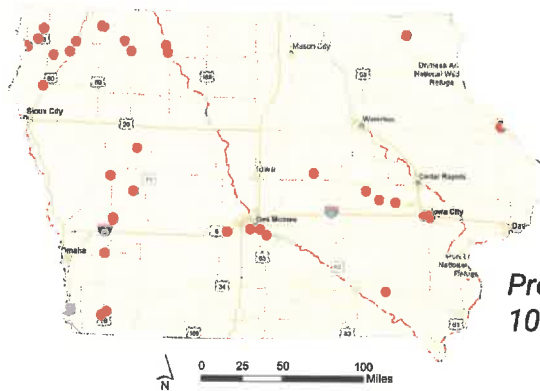
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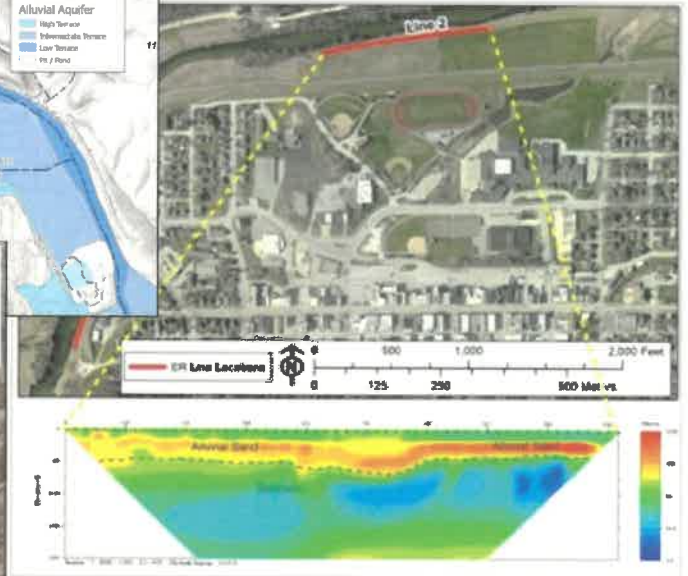
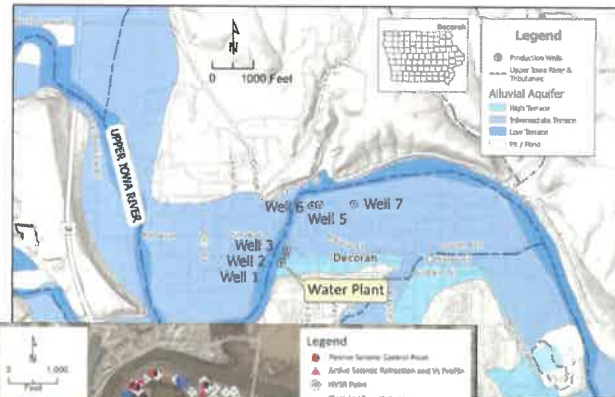
Groundwater quantity projects with local communities

2022-2023 Projects

- Iowa City
- Decorah source water
- Belle Plaine
- Marshalltown
- Iowa Lakes Regional Water



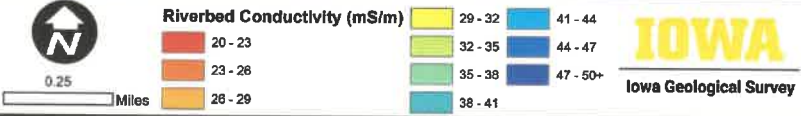
Projects in last 10 years



Canoe EM Survey



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Need for Groundwater Plan for Iowa

Plan would balance current and future needs with long-term sustainability

Des Moines Sunday Register

SUNDAY, DECEMBER 3, 2023 | THE NEWS IOWA DEPENDS UPON | DESMOINESREGISTER.COM

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SNOW GETAWAY

'Adding another straw to this big drink'

Parts of Iowa drier than the Dust Bowl; state preps for water shortages



Iowa needs a plan for using its precious groundwater



Your Turn
Keith Schilling
Guest columnist

A confluence of several factors, some natural and some self-imposed, is leading to recognition that the state of Iowa needs a plan to safeguard groundwater reserves in the future.

Droughts occur on average about once per decade in Iowa, and current drought was preceded by droughts in 2012, 2000, 1988-89 and beyond. Less rainfall during drought reduces infiltration recharge to shallow groundwater, lowers water table levels and reduces groundwater discharge as baseflow to rivers and streams. Drought conditions invariably increase the demands for agricultural crop irrigation, and many communities find that water use increases during drought from lawn watering and other outdoor water uses. In addition, new and increasing pumping demands from a rapidly urbanizing population, ethanol plants and other industrial facilities, data centers (requiring vast quantities of cooling water), animal confinements and other users are challenging urban and rural water systems to keep groundwater supplies on

pace with demand.

Groundwater in Iowa is not evenly distributed, and there are water-rich and water-poor areas of the state. Northwest Iowa is relatively groundwater rich because the bedrock aquifers in the area consisting of fractured carbonate rocks are able to store, transmit and yield large quantities of groundwater for use. Groundwater in this area is rapidly replenished with rainfall and snowmelt. On the other hand, western and southern Iowa are relatively groundwater poor, as the bedrock is either too fine-textured and impermeable to yield much water, or the aquifer is capped by hundreds of feet of clay-rich glacial soils that limit precipitation recharge. In these areas, water suppliers often focus on extracting groundwater from shallow sands and gravels that occupy river valleys (alluvial aquifers) or pumping from deep bedrock aquifers like the Cambrian-Ordovician aquifer (aka "Jordan" aquifer). Both of these aquifer types are vulnerable to drought and overuse. Water levels in shallow alluvial aquifers are rapidly lowered during drought when pumping continues as precipitation recharge stops. Water levels in deep bedrock aquifers decline because new and increasing demands exceed recharge.

A groundwater plan is needed for

Iowans to sustainably balance groundwater use with recharge. Think of a groundwater supply like your checkbook at home. You get paid on a regular basis, and from this weekly "recharge" to your bank account, you pay your mortgage, bills, and occasionally go out to eat. It is important to have your checkbook balanced so that your expenses do not exceed your income and you fall into debt. The aquifers that contain our groundwater supply are similar to your checkbook. They receive recharge from precipitation or from leakage through other geologic units, they build up their water levels, and from this supply, we are able to withdraw water from the aquifer "bank" to meet societal needs.

A groundwater plan would produce a water budget for the major aquifers of Iowa. The budget would tell us how much water is recharged to the aquifers, how much groundwater they contain, how much water is discharged to streams and leaked to lower aquifers, and how much water can be sustainably withdrawn without depleting them. For alluvial aquifers, creating a water budget would include mapping the horizontal and vertical extent of the sand and gravel deposits in the state. The Iowa Geological Survey is well equipped to do this with geophysics, drilling and landscape analysis

of glacial and post-glacial sedimentology. Although some mapping of alluvial deposits is done at local scales for water supply systems, there is a need to do this at a statewide basis where local interests can be put in the context of statewide needs. For example, local users of the Raccoon River alluvial groundwater rightly focus on their individual piece of the pie, but how much groundwater is available to everyone and how much can be sustainably pumped without depleting the resource and impacting flow to the Raccoon River? For bedrock aquifers where groundwater exploration can be expensive, groundwater budgets can be created using existing geospatial and rock core data available at Iowa Geological Survey.

Computer models of bedrock systems can then be developed to evaluate groundwater sustainability.

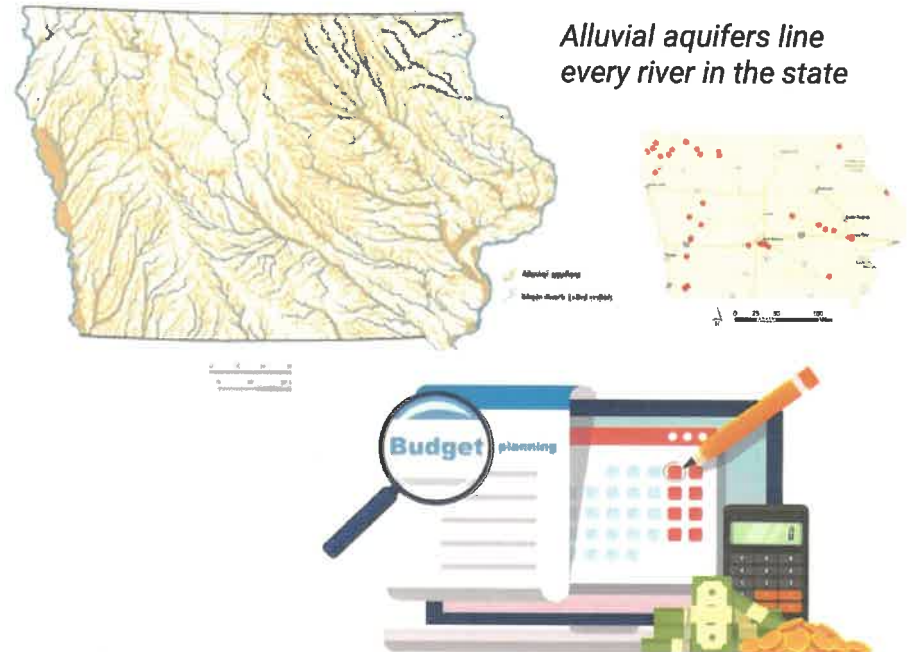
There is a need for the state to fund the research, mapping and analyses needed to improve our understanding of Iowa's groundwater resources. A groundwater plan would balance the current and future needs for groundwater extraction with long-term sustainability for future generations.

Keith Schilling is state geologist and director of Iowa Geological Survey at the University of Iowa.

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Funding to the Iowa Geological Survey for groundwater planning and resource assessment

- Map aquifers – Use geophysics, drilling and landscape analysis to develop 3D understanding of Iowa's aquifers
- How much groundwater is actually available for use? How much is recharged and allocated?
- Construct water budgets for aquifers – just like your checking account

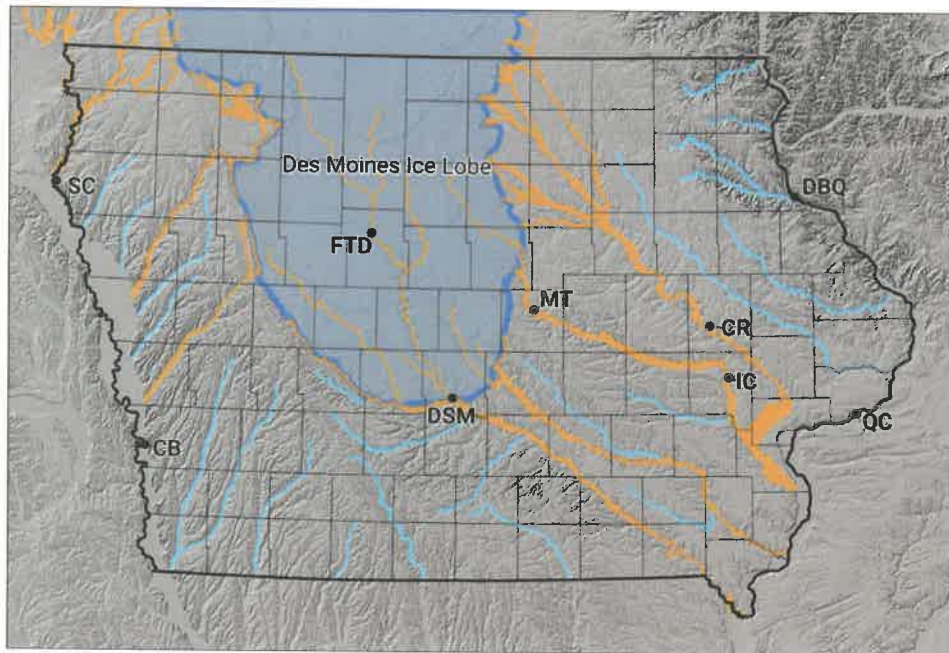




Alluvial aquifers line every river in the state

GROUNDWATER BUDGET

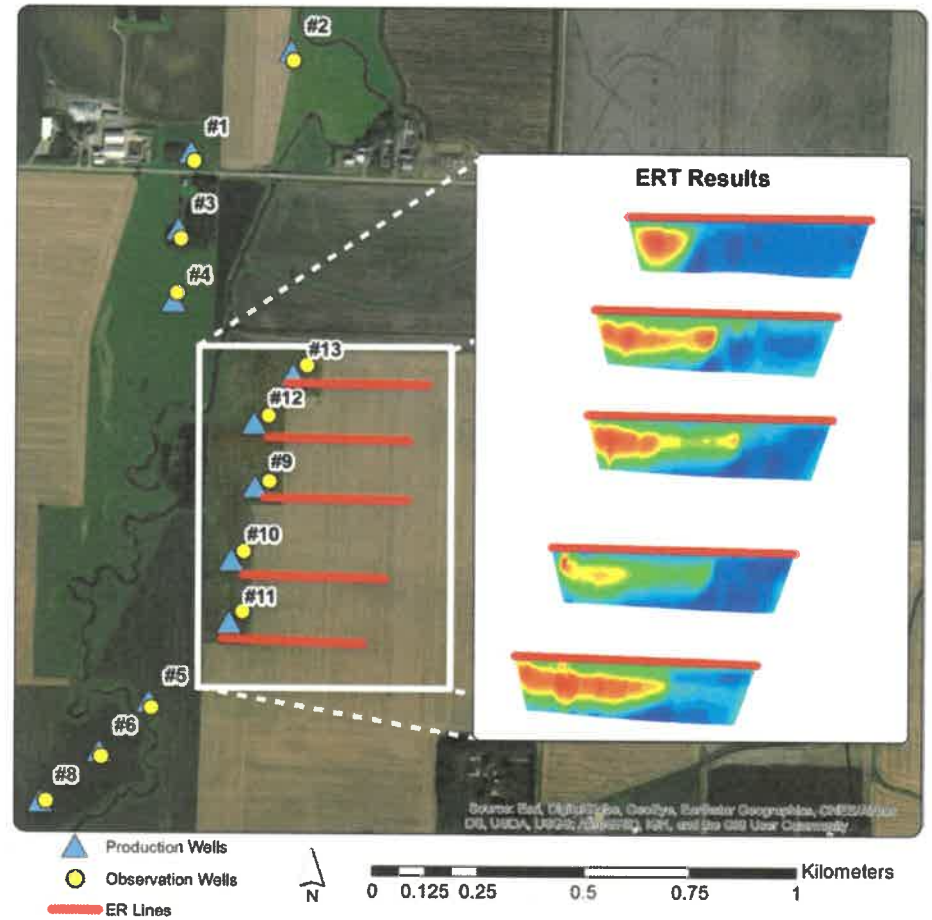
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IGS Landscape Analysis



-  *glacial gravel valley*
-  *fine-grained valley*

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Latest news in geologic carbon sequestration

IOWA'S POTENTIAL FOR GEOLOGIC SEQUESTRATION OF CO₂

BACKGROUND

WHAT IS GEOLOGIC CARBON SEQUESTRATION?

Carbon capture, utilization, and storage (CCUS) is more commonly referred to as carbon sequestration. Once CO₂ gas is captured and compressed into a liquid, it can be stored underground. Geologic carbon sequestration, or geologic storage, is the process of injecting the liquid CO₂ into porous bedrock formations such as petroleum reservoirs or deep saline aquifers. The CO₂ must be injected at least 2,700 feet below the ground surface to keep it in a liquid phase. In some cases, such as with basalt rock, some of the CO₂ may convert to calcite, a very common and stable mineral.



TWO TYPES OF GEOLOGIC STORAGE

Enhanced oil recovery (EOR) is the process of injecting CO₂ into petroleum reservoirs to push out any remaining oil or natural gas. Since Iowa does not have any petroleum reservoirs, this type of geologic storage would not occur in our state.

Saline aquifer storage (SAS) involves injecting the CO₂ into deep aquifers. Only aquifers with groundwater too mineralized (saline) to be used for drinking water are considered.

POTENTIAL 45Q TAX CREDIT VALUE

Enhanced Oil Recovery
\$60 / metric ton → **\$738M+** annually for Iowa ethanol producers

Saline Aquifer Storage
\$85 / metric ton → **\$1.05B+** annually for Iowa ethanol producers

WHAT ARE THE BENEFITS OF STORING CO₂?

1. The federal tax incentive program 45Q offers financial benefits for geologic storage of CO₂. Iowa leads the nation in ethanol production with more than 4.1 billion gallons annually. That also means Iowa's ethanol industry emits about 12.3 million metric tons of CO₂ into the atmosphere each year.
2. States that have adopted low carbon fuel standards (LCFS) pay higher premiums for fuel with a low carbon intensity score. Iowa ethanol producers can meet these standards if they capture and geologically store their CO₂. This provides an even greater financial benefit that may outlast the tax credits.
3. Geologic storage in Iowa may reduce the need to export our CO₂ via lengthy pipelines for geologic storage in other states.

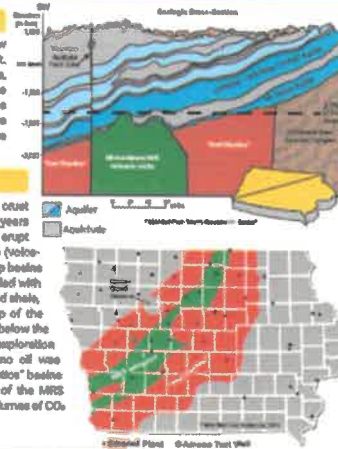
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IOWA'S POTENTIAL FOR GEOLOGIC SEQUESTRATION OF CO₂

GEOLOGY

CAN CO₂ BE STORED IN IOWA?

Some aquifers in southern Iowa extend below the 2,700 feet cutoff depth. The Jordan and Mt. Simon aquifers are possible storage targets, especially in southwestern Iowa. However the quality of the groundwaters in these aquifers has not been characterized. Further investigation is necessary to determine whether these aquifers are suitable for SAS.



MIDCONTINENT RIFT SYSTEM (MRS)

The MRS was formed when North America's crust began rifting (pulling apart) about 1.1 billion years ago. This caused large volumes of lava to erupt along the rift axis. The erupted basaltic rocks (volcanics) make up the central core of the MRS. Deep basaltic flank either side of the core basalt and are filled with sedimentary rocks like sandstone, siltstone, and shale, collectively called the "Red Chert". The top of the MRS in Iowa is generally more than 2,800 feet below the land surface. In 1987, Armooc drilled an oil exploration well that was 17,850 feet deep. Although no oil was discovered, the test well proved the "Red Chert" basins are exceptionally deep. The unique geology of the MRS could provide a target for storing enormous volumes of CO₂ generated by Iowa's ethanol industry.

PROPOSED IOWA CO₂ STORAGE PILOT PROJECT

Funding Model	Activities	Duration	Cost
Federal Grant	<ul style="list-style-type: none"> Proposial preparation Diary gathering/processing Collecting new seismic data Test drilling (2 deep holes) Analyses & modeling Reporting, outreach, & compliance Injection well permitting 	3-4 years	\$10-14M
Direct Funding Model	<ul style="list-style-type: none"> Reprocessing existing data Test drilling (1 deep hole) Analyses & modeling Reporting Injection well permitting 	1-2 years	\$2-4M

* Costs and timelines are dependent on the size and scope of the project.

Contact information

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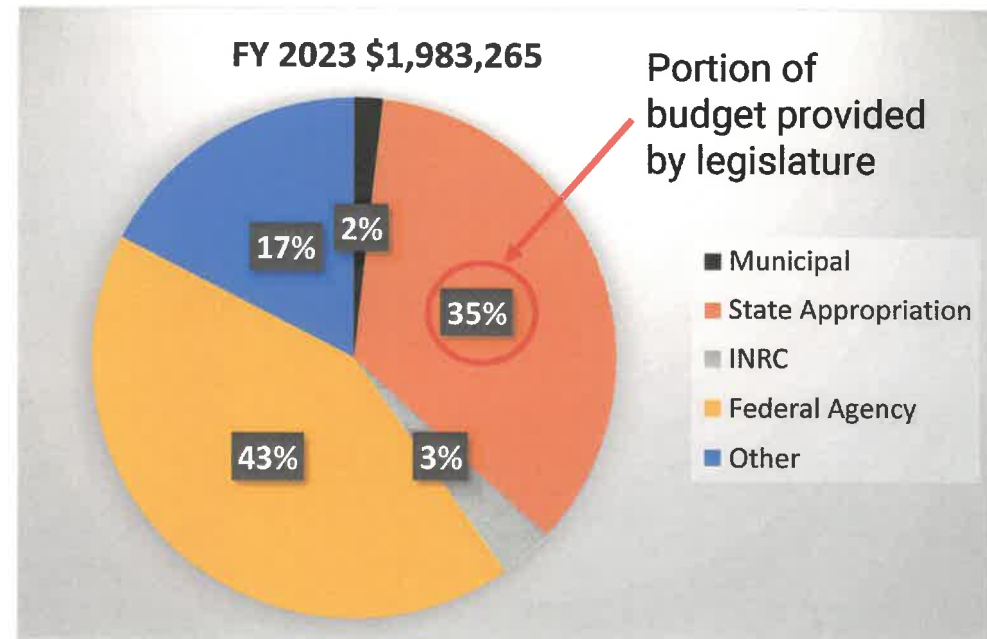
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- There is potential for storing CO₂ deep underground in Iowa
- IGS is working on DOE proposals with outside entities
- Contact IGS for more information

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What is the budget for IGS?

- Total operating costs ~2.0 M
- We receive an appropriation of \$695,000 from the legislature
- Majority of our operating budget must be sourced from outside contracts for specific projects



An increase in the annual state appropriation to IGS would allow us to place more focus on regional statewide initiatives

Current Funding Status

Division 5
Environment First Fund
General Appropriations

Sec.26. STATEUNIVERSITYOFIOWA--IOWA GEOLOGICAL SURVEY. There is appropriated from the environment first fund created in section 8.57A to the state university of Iowa for the fiscal year beginning July 1, 2022, and ending June 30, 2023, the following amounts, or so much thereof as is House File 2560, p.16 necessary, to be used for the purposes designated:

1.OPERATIONS For purposes of supporting the operations of the Iowa geological survey of the state as created within the state university of Iowa pursuant to section 456.1, including but not limited to providing analysis; data maintenance, collection, and compilation; investigative programs; and information for water supply development and protection:.....\$200,000

2. WATER RESOURCE MANAGEMENT For purposes of supporting the Iowa geological survey in measuring, assessing, and evaluating the quantity of water sources in this state and assisting the department of natural resources in regulating water quantity as provided in chapter 455B, subchapter III, part4, pursuant to sections 455B.262 Band 456.14:.....\$495,000

IGS appropriation has been the same since transition to UI in 2014

Rising costs mean budget cuts

IGS could do so much more with increase in base funding

Funding to support the mission of the Iowa Geological Survey

- Groundwater Resource Management and Drought Forecasting
 - *Identify groundwater supplies, develop management tools, provide drought assessment, develop mitigation strategies*
- Geologic Resource Characterization
 - *Evaluate groundwater potential in formations, map economic reserves*
- Data Accessibility and Education/Outreach
 - *Develop maps and visualization tools, provide data accessibility to lowans*
- Geologic Hazards
 - *Map and evaluate geologic hazards (karst, landslides, etc), assess groundwater vulnerability*
- State Geologist
 - *Provide leadership to IGS programs, interface with public and government*

Statewide information needed for lowans

Vital to Iowa's future economic and water sustainability



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New IGS Geode magazine is now available!



Hard copy will be in your legislative mailboxes

Annual report describing activities of the IGS in FY2022-23

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