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David R. Barker, PhD, *Iowa City*
Sherry Bates, *Scranton*
Nancy Boettger, *Harlan*
Milt Dakovich, *Waterloo*
Nancy Dunkel, *Dyersville*
Zackery Leist, *Clarion*
Jim Lindenmayer, PhD, *Ottumwa*

Mark J. Braun, Executive Director

MEMORANDUM

January 13, 2020

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

Ms. Meghan Nelson
Chief Clerk of the House
State Capitol Building
Des Moines IA 50319

Glen Dickinson, Director
Legislative Services Agency
State Capitol Building
Des Moines IA 50319

Re: Center for Health Effects of Environmental Contamination Annual Report

Dear Members of the Iowa General Assembly:

Pursuant to Iowa Code 263.17.4.b, enclosed is the Center for Health Effects of Environmental Contamination Annual Report prepared by the University of Iowa.

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

Sincerely,

A handwritten signature in blue ink, appearing to read "M. J. Braun". The signature is fluid and cursive, with a long horizontal flourish extending to the right.

Mark J. Braun

\\Box Sync\Board of Regents Shared\BF\Legislative\2020 session\Reports\

Attachments

cc: Robin Madison
Legislative Liaisons
Legislative Log

Annual Report to the Iowa Legislature

For 2019

Submitted by:

The Center for Health Effects of Environmental Contamination

At

The University of Iowa

January 2020

1. Background

The Center for Health Effects of Environmental Contamination (CHEEC) at The University of Iowa (UI) is submitting this progress report for 2019 to the Iowa General Assembly in accordance with requirements outlined in the 1987 Iowa Groundwater Protection Act. Mandated within the Act was the establishment of CHEEC, whose mission is *"to determine the levels of environmental contamination which can be specifically associated with human health effects."* Center activities include:

- developing and maintaining environmental databases to be used in conducting research and disseminating environmental health information to the general public;
- cooperating and collaborating on community-engaged environmental health research programs and projects;
- managing a seed grant program to support fundamental research and discovery in environmental health and related disciplines;
- supporting training and professional development for students at Iowa universities and colleges interested in environmental health careers;
- providing environmental health education programs to the citizens of the state and the region; and
- serving on state and local committees to provide environmental health expertise.

CHEEC is comprised of faculty from the UI Departments of Civil and Environmental Engineering, Epidemiology, Occupational and Environmental Health, Chemistry, Geographical and Sustainability Science and the State Hygienic Laboratory. Participating research organizations include the Iowa Registry for Congenital and Inherited Disorders, and other Centers and Institutes at the University of Iowa. CHEEC also works cooperatively with the Iowa Departments of Natural Resources (IDNR), Public Health (IDPH), Agriculture and Land Stewardship (IDALS) and other universities across the state.

2. Executive Committee

The CHEEC Executive Committee met twice over the past year, on March 22 and September 17, 2019. During the Spring 2019 meeting, the committee reviewed applications received for the Center's annual Seed Grant Program. The Center received nine applications and all proposals were reviewed by at least one external technical specialist and a member of the Executive Committee prior to the full committee review. Two proposals, described in section 9 of this report, were recommended for funding. During the Fall 2019 meeting, the Executive Committee discussed the Center's budget, reviewed the request for proposals for the next round of seed grant funding, and was provided an update on ongoing projects including the Northeast Iowa Well Study, the Grants to Schools program, and data visualization efforts on private wells and drinking water quality.

The Executive Committee (**Table 1**) includes one member from the State Hygienic Laboratory and seven members from UI. University members represent the Departments of Civil and Environmental Engineering, Occupational and Environmental Health, Chemistry and Epidemiology.

Table 1. CHEEC Executive Committee Membership.

Name	Title	Affiliation
David Cwiertny	Director, Professor	CHEEC/ University of Iowa, Department of Civil and Environmental Engineering
R. William Field	Professor	University of Iowa, Department of Occupational and Environmental Health
Tori Forbes	Associate Professor	University of Iowa, Department of Chemistry
Gabriele Ludewig	Professor	University of Iowa, Department of Occupational and Environmental Health
Paul Romitti	Professor	University of Iowa, Department of Epidemiology
Silvia Secchi	Associate Professor	University of Iowa, Department of Geographical and Sustainability Sciences

Donald Simmons	SHL Lab Cert Manager	State Hygienic Laboratory at the University of Iowa
Michelle Scherer	Professor	University of Iowa, Department of Civil and Environmental Engineering

3. Advisory Committee

The CHEEC Advisory Committee met on March 29, 2019. During the meeting, the Advisory Committee reviewed the Center’s budget and were also provided an overview of CHEEC research, student training, and educational outreach activities that were conducted over the previous year. Independent committee members, led by Advisory Committee Chair Ken Sharp of IDPH, voted unanimously to approve the FY 2019 budget. The Committee also discussed future opportunities and strategic planning for CHEEC activities related to data visualization, water quality research, and education/outreach opportunities.

The Advisory Committee (**Table 2**) is currently comprised of representatives from seven organizations outside of UI, including IDNR, IDPH, IDALS, State Hygienic Laboratory, US Geological Survey, University of Northern Iowa, and Iowa State University. The Advisory Committee also has six members from UI representing the Departments of Occupational and Environmental Health, Geography, and Civil and Environmental Engineering, the College of Law and School of Urban and Regional Planning.

Table 2. CHEEC Advisory Committee Membership.

Name	Title	Affiliation
Kelly Baker	Assistant Professor	University of Iowa, Department of Occupational and Environmental Health
Steven Bradbury	Professor	Iowa State University, Department of Entomology
Jonathan Carlson	Professor	University of Iowa, College of Law
Margaret Carrel	Associate Professor	University of Iowa, Department of Geography
Chad Fields	Geologist	Iowa Department of Natural Resources
Brandi Janssen	Clinical Assistant Professor	University of Iowa, Department of Occupational and Environmental Health
Craig Just	Associate Professor	University of Iowa, Department of Civil and Environmental Engineering
Dana Kolpin	Hydrologist	U.S. Geological Survey
Lucie Laurian	Professor	University of Iowa, School of Urban and Regional Planning
Jenifer Lara	Program Coordinator	Iowa Department of Agriculture and Land Stewardship
David McClenahan	Associate Professor	University of Northern Iowa, Department of Biology
Michael Schueller	Assistant Director Environmental Operations	State Hygienic Laboratory at the University of Iowa
Ken Sharp	Director, Committee Chair	Iowa Department of Public Health

4. FY 2018 Budget

CHEEC receives 9% of the annual receipts in the Agricultural Management Account of the Iowa Groundwater Protection Fund. CHEEC's allocation from the account totaled \$778,604 in Fiscal Year (FY) 2019. This allocation is larger than usual because the Center received \$326,696 in July 2018. CHEEC normally receives these funds in June, at the end of the fiscal year instead of the beginning. Over the past five years, the Center has received an average of \$500,000 per year from this account. Personnel expenses **increased** by 1.7% compared to FY2018.

The personnel budget is presented in the categories of administration, data management, education programs, and research programs to reflect effort in these areas. General operating costs within each area are presented separately for expenses charged to the General Account (Agricultural Management Account funds).

FY 2019 Operating Budget

Revenue	
Agricultural Management Account	\$778,604
Carryover from FY 2017	\$233,281
	<hr/>
Total Revenue	\$1,011,885
Expenditures	
Personnel (Salary + Fringe)	
Administration	\$62,757
Data Management	\$48,355
Education	\$36,739
Research	\$43,919
Subtotal	\$191,770
	<hr/>
Administration	
Travel	\$1,687
Supplies (office, research and other)	\$2,440
Computers, devices, equipment	\$4,703
Postage	\$53
Telecommunication	\$3,470
General (Publication, Conference, etc)	\$1,828
Relocation expense provided by UI	(\$3,689)
Subtotal	\$10,492
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Education Programs	
Education program grant	\$3,600
Student Graduate Research Assistantship	\$38,000
Subtotal	\$41,600
	<hr/>
Research Programs	
Seed Grants	\$189,868
CHEEC Studies (NE Iowa, ARG/ARB, GtC, School Lead	\$165,000
Subtotal	\$354,868
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Total Expenditures	\$598,730
Free Balance from FY 2019	\$413,155

5. Data Management

CHEEC maintains databases on Iowa water quality, including the Iowa Historical Municipal Water Treatment and Supply Database, the Municipal Analytical Water Quality Database, and the Statewide Rural Well Water Survey (SWRL). Safe Drinking Water Act data through 2017 were added for all Iowa public water systems to the Municipal Analytical Water Quality Database.

5.1 Iowa Municipal Water Systems

The CHEEC Municipal Analytical Water Quality Database contains information from numerous sources including state and federal special surveys, regulatory programs (Safe Drinking Water Act), and various academic studies. This database houses information from the 1950s to the present. The Historical Municipal Water Supply Source and Treatment Database contains information dating back through the early 1900s. In 2019, CHEEC updated this database with information provided by IDNR for all Iowa public water systems. CHEEC is currently working to restructure this database and create a publically available dashboard that will display water quality, source and treatment for all community water systems across Iowa. CHEEC aims to launch this dashboard, being developed in coordinate with IDNR, by Fall 2019. The final dashboard will be similar to the Iowa Well Forecasting System described below.

5.2 Iowa Private Drinking Water Wells

CHEEC maintains data from surveys of Iowa private drinking water wells. The Iowa Statewide Rural Well Water Survey (SWRL, 1988–89) was conducted by CHEEC and the Iowa Geological Survey Bureau as part of the implementation of the Iowa Groundwater Protection Act. SWRL provided a statistically valid assessment of the proportion of private rural wells and rural residents affected by various water contaminants. A total of 686 wells were sampled for coliform bacteria, nitrate, 27 pesticides and major inorganic ions. A second phase of the SWRL study (SWRL2) was conducted in 2006–08, in which 473 private rural drinking water wells were sampled; 116 of the wells were original SWRL wells; the other wells were randomly selected from the IDNR’s Private Well Tracking System. SWRL2 tested for the same contaminants as the original SWRL, with the addition of arsenic and several pesticide degradates. The Iowa Community Private Well Study (2002–03) includes water quality data for 230 private drinking water wells in 50 incorporated Iowa towns not served by a public water supply system.

5.3 Iowa Well Forecasting System

In May 2019, CHEEC, in collaboration with the UI Hydroinformatics Lab (UIHI Lab) and the Iowa Geological Survey (IGS), released an information system to assist the management of private wells in Iowa. The Iowa Well Forecasting System (IWfOS) is a publicly accessible web platform that allows users to view spatial information regarding groundwater aquifer depths and groundwater quality in Iowa (see **Figure 1**). IWfOS integrates publicly available data on well geology from the IGS database GeoSam with water quality data from the Private Well Tracking System (PWTS) that is managed by the Iowa Department of Natural Resources.

The IWfOS was designed as a public resource for well drillers and well users. Aquifer and water quality information can be used to make decisions during well construction to ensure a safe drinking water supply. The IGS has a tradition of providing this information, called a well forecast, to the public. However, such well forecasts are only available during normal business hours. Accessible online, IWfOS allows users to explore the state of Iowa and select the potential location of a new well. Using available information from adjacent wells, the user is then provided estimates regarding the depths of the different subsurface aquifers at that location. CHEEC is currently finalizing a tutorial video to show users how to operate and engage with IWfOS. This tutorial should be available in early 2020.

IWfOS is available at: <https://www.iuhr.uiowa.edu/igs/wellforecasting/>.

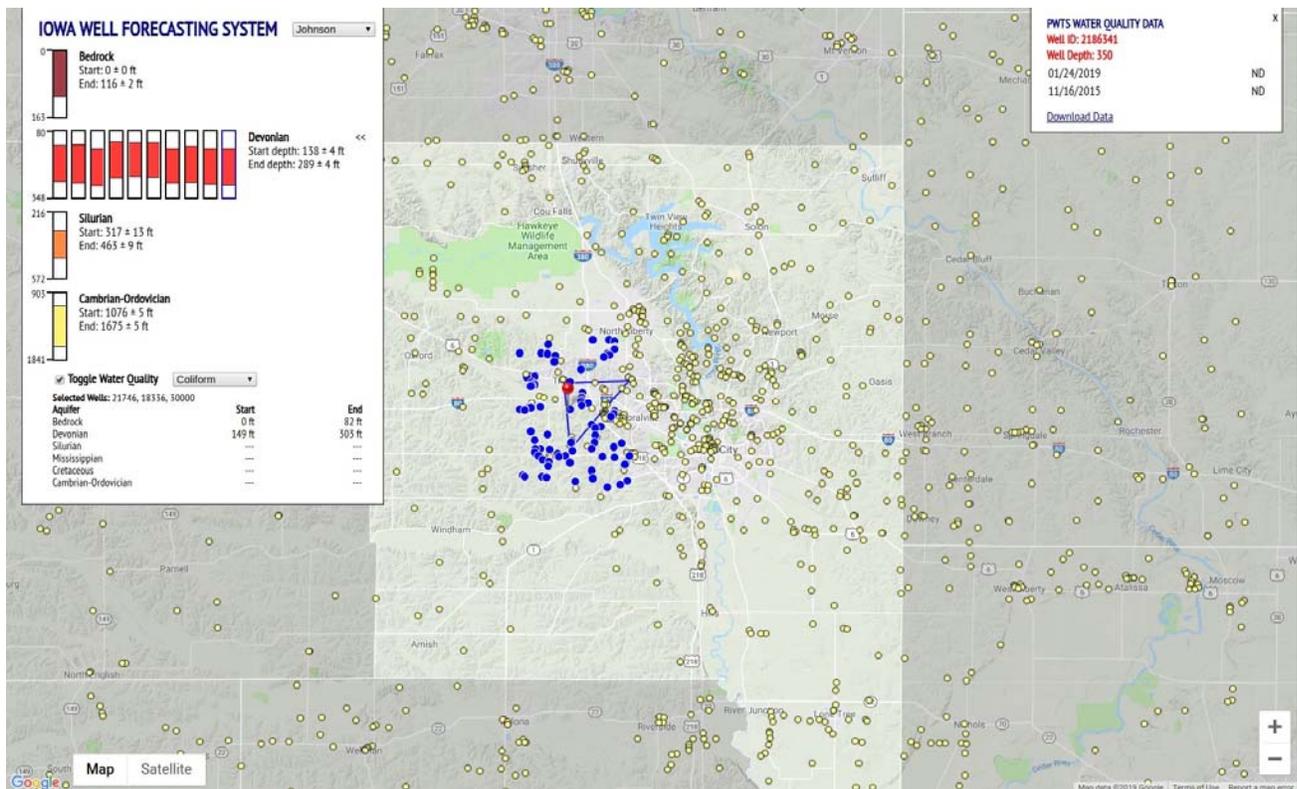


Figure 1. Screenshot of Iowa Well Forecasting System (IWFoS) application developed by CHEEC and the UI Hydroinformatics Laboratory. Using the characteristics of existing wells (yellow dots on map), the depths of aquifers at the proposed location (red pin on map) can be estimated. Water quality available through the IDNR’s Private Well Tracking Systems (PWTS) of adjacent private wells (blue dots on map) are also displayed to provide information about potential water quality at the location.

6. Research

6.1 Seed Grant Funding

CHEEC administers a Seed Grant Program that supports pilot level research across a range of environmental research topics. Seed grant projects are small-scale studies designed to test new and unusual hypotheses, develop innovative methodologies in laboratory and field settings, or perform initial statistical analyses to support efforts to acquire federal or private grants for larger studies. The funding primarily provides support for graduate students, which strengthens graduate programs, creates innovative research, and fosters interdisciplinary development of research opportunities.

Historically, CHEEC has awarded about one-third of its annual Agricultural Management Account allocation in seed funding. ***Since 1989, this investment has generated almost ten dollars in external funding for every dollar invested by the program; seed grant projects have attracted over 51 grants worth over twenty-eight million dollars in external funding for additional research.***

Projects funded through the Seed Grant Program are required to address issues relevant to the State and citizens of Iowa. In the last funding cycle, awarded projects focused on examining the effects of pesticide exposure on (i) fetal growth and neurodevelopment and (ii) thyroid function. The full list and a brief summary of the Seed Grant awarded by CHEEC in FY 2019 follow:

Role of the Placenta in Cypermethrin-Induced Disruption of Fetal Growth and Neurodevelopment

Investigators: B. Elser, H. Stevens, HJ. Lehmler, UI College of Public Health; UI Carver College of Medicine

Project Institutions: UI College of Public Health; UI Carver College of Medicine

Abstract: Prenatal exposure to pyrethroid insecticides has been identified as a risk factor for low birth weight and neurodevelopmental delay. Cypermethrin, a type II pyrethroid, has broad agricultural and household use, and may represent a source of exposure to pregnant women. Little is known about the mechanisms that alter fetal growth and neurodevelopment, including both fetal growth restriction and neurodevelopmental delay. Experiments are being performed to characterize the effects of cypermethrin on placental growth and function, to assess mechanisms relevant to altered nutrient transfer and neurodevelopmental programming, and to determine whether maternal exposure to cypermethrin effects embryonic neurodevelopment.

Pesticide exposure among Iowa Agricultural Health Study participants and measures of thyroid function in their offspring

Investigators: P. Romitti, J. Suhl, C. Lynch, K. Conway, J. Oleson, V. Sheffield, S. Berberich, T. Henry, L. Beane Freeman, D. Sandler

Project Institutions: UI College of Public Health; UI Carver College of Medicine; State Hygienic Laboratory of Iowa (SHL); National Cancer Institute; National Institute of Environmental Health Sciences

Abstract: Congenital hypothyroidism (CH) is among the most common metabolic conditions presenting among live births in the United States (US). If untreated or if treatment is delayed, CH can produce several complications, including disrupting normal neurodevelopment. Previous studies suggest pesticides may influence thyroid function in adults; however, few studies have explored the role of parental pesticide exposures on thyroid function in offspring. The researchers are working with Iowa Agricultural Health Study (AHS) participants to explore relations between parental pesticide exposures and thyroid function, including confirmed diagnoses of primary CH, in their offspring. The study will provide further insights into the role of environmental factors on newborn thyroid development and function.

6.2 Cooperative Grant Funding

The CHEEC Cooperative Research Program seeks to leverage research funds from university, state, and federal entities to conduct research in areas of mutual interest; the collaboration requires matching funds from participating entities. ***Since the Cooperative Research Program was established in 1999, 17 projects have been funded. Over the life of the Cooperative Research Program, this investment has generated almost \$1,750,000 in matching funds, or almost four dollars in match for every dollar awarded by the Center.*** Like the Seed Grant Program, it seeks to establish innovative lines of environmental health research leading to preliminary results that may be used in seeking further larger grant funding from federal and private sources.

CHEEC awarded the following cooperative research grant in FY 2019.

Prevalence and concentrations of antibiotic resistant microbes and genes in Iowa streams and rivers

Investigators: Laura E. Hubbard, Dana W. Kolpin, Carrie E. Givens, Rachel F. Lane, Shannon M. Meppelink

Cooperative Partners: U.S. Geological Survey

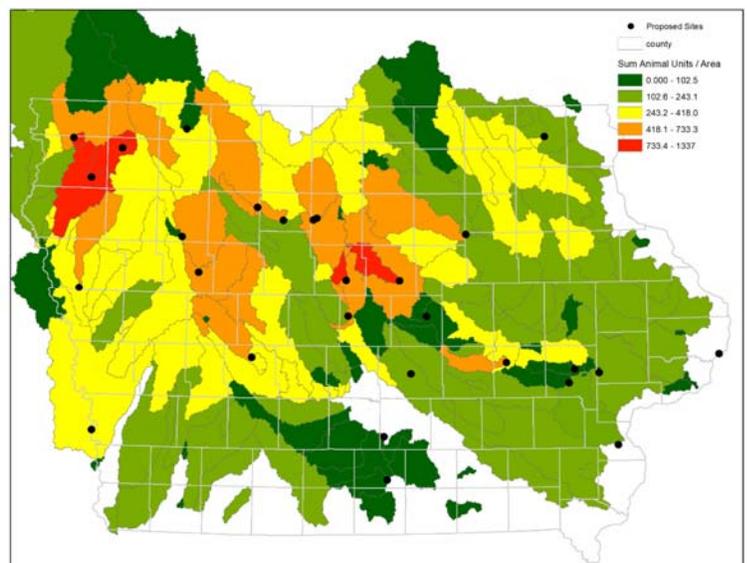


Figure 2. Map of sites to sampled for antibiotic resistant bacteria and genes in Iowa.

Abstract: The emergence of antibiotic resistance worldwide is one of the most serious global public health concerns of the 21st century and results in the reduction in efficacy of life saving antibiotics. Antibiotic resistance occurs naturally but is primarily accelerated due to the overuse and misuse of antibiotics. The study aims to 1) provide the first statewide assessment of antibiotic resistant bacteria (ARB) and antibiotic resistant genes (ARG) in Iowa streams and rivers in multiple environmental compartments (i.e. water and bed sediment) and 2) to assess where and how many ARB and ARG are present in environmental stream systems across Iowa in order to better understand the risk of such contamination to human, livestock, and wildlife health (see **Figure 2**).

6.3 CHEEC Research Projects

Northeast Iowa Well Water Study

In FY2019, CHEEC completed a pilot study covering 47 households in eight eastern Iowa counties (see **Figure 3**). The study was a comprehensive microbial and chemical analysis of tapwater from private wells. It also included urinary biomonitoring of inorganic chemicals and pesticides. Overall, the study examined exposure risks for nearly 300 environmental contaminants, including inorganics species (e.g., arsenic, lead, manganese, and nitrate), pesticides, per- and polyfluoroalkyl substances (PFAS), antibiotics, pharmaceuticals, and selected microbes. Sampling was conducted from Dec 6, 2018 to Feb 11, 2019.

Sample processing and analysis is ongoing, with all results expected by May 2020. Preliminary results have documented the occurrence of various contaminants in wells, including nitrate (68% of samples), total coliform (30%) and other microbe (up to 98%), and pesticides (up to 62%). There were no detections of lead or arsenic above reporting limits. A non-targeted analysis of water samples from 15 households also found PFAS, polymeric surfactants, plasticizers and stormwater related contaminants. Laboratory results for several compounds are still pending. Upon completion of sample analysis, CHEEC plans to publish a final report detailing the study's findings by December 2020.

CHEEC's experience with this study was also helped secure a new grant from the Center for Disease Control (CDC) for the SHL. This 5-year project includes statewide surveillance to gain insights into population level exposure to various environmental contaminants (metals, agricultural chemicals, and industrial chemicals) and laboratory analysis to determine gestational exposures. In particular, a focus of the Northeast Iowa Well Water Study was neonicotinoid insecticides, which are one of the chemical targets included in the new CDC grant. SHL will leverage methodologies and sampling protocols from the Northeast Iowa Well Water Study as part of their CDC grant protocols.

Radium in Iowa's Private Wells

Radium is naturally present in the environment in two different forms, radium-226 and radium-228. Radium-226 is produced from the decay of uranium. This form is also responsible for producing radon gas as it decays. Radium-228 is produced from the decay of thorium in rocks. Both kinds of radium naturally dissolve from rocks deep in the ground and enter groundwater that supplies wells.

The primary human exposure pathway for radium is ingestion via drinking water. Drinking or cooking with water with high levels of radium is associated with anemia, cataracts, dental problems, and different types of cancer. Radium is a radioactive element that produces "ionizing radiation" because it can release electrons from atoms and molecules and turn them into ions. Ionizing radiation damages

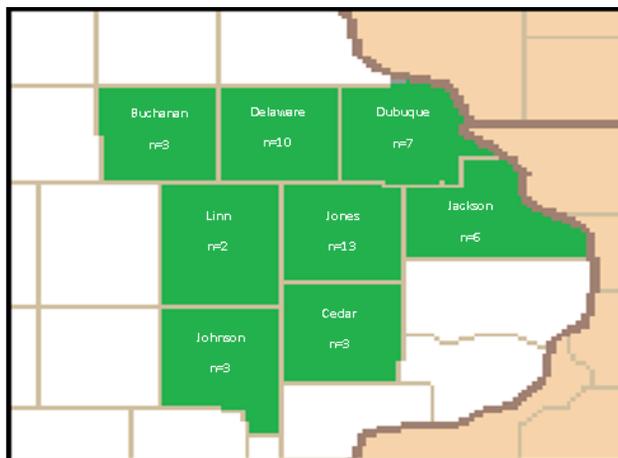


Figure 3. Map of counties included in Northeast Iowa Well Water Study

DNA. The EPA has classified all ionizing radiation as “known to cause cancer in humans,” and has set a health guideline of zero for all radioactive elements, including radium, in drinking water.

The U.S. Environmental Protection Agency has set a limit of 5 pCi/L (a measurement for the radioactivity per liter of water) as a maximum level for drinking water provided by public water systems that serve communities. Currently, there is no health-based regulation for radium in private well water. In Iowa, some public water systems have exceeded the safe level even after treating source water. Because of this history, private wells in Iowa might also have high levels of radium above 5 pCi/L.

Through the statewide Grants to Counties program, SHL and CHEEC are conducting an initial survey of 11 counties in Iowa to understand radium levels in private drinking water wells. This survey intends to characterize the amount of radium in wells in Iowa and help homeowners with high levels of radium improve their drinking water quality. In partnership with the IGS, we have identified several counties in Iowa that may be vulnerable to radium contamination of groundwater as a result of where naturally occurring radium is likely to be found. For these counties, private well water samples were collected in Fall 2019. Analysis is ongoing and a full set of results is expected in late Spring 2020.

Grants to Counties Program Review

In August 2019, CHEEC and UI Public Policy Center (PPC) published a report that examined the state’s Grants to Counties (GtC) program (see **Figure 4**). The GtC program provides Iowa counties with money each year for (i) testing private water wells for total nitrate (including nitrite) and total coliform bacteria, at a minimum, with the option to test also for arsenic; (ii) reconstructing private water wells; and (iii) plugging of abandoned private water wells (including cisterns that present a contamination risk to groundwater). Between FY13 and FY18, the state has appropriated an average of \$2.8 million annually, with participating counties receiving \$23,469 to \$36,082 each year.



Iowa’s Grants to Counties Program: A Valuable but Underutilized Program for Protecting the Public Health of Private Well Users

Silvia Secchi, Department of Geographical and Sustainability Sciences and Public Policy Center, University of Iowa

David Cwiertny, Center for Health Effects of Environmental Contamination, Public Policy Center and Department of Civil and Environmental Engineering, University of Iowa.

OVERVIEW OF THE GRANTS TO COUNTIES PROGRAM:

Nearly 300,000 Iowans rely on private wells for their primary drinking water supply. Because private water wells fall outside the jurisdiction of the Safe Drinking Water Act, there are no federal regulations for the quality and routine testing of private well water. Instead, the EPA states that it is the homeowner’s responsibility to ensure the safety of their water.

The Grants to Counties program (641 IAC – Chapter 24) was created in 1987 as part of the Groundwater Protection Act to assist private water well owners in Iowa. Funded through the Agricultural Management Account within the State’s Groundwater Protection Fund (Iowa Code 455E.11), the Grants to Counties program provides money each year for (i)

The CHEEC report found that the GtC program, while valuable, has not been fully utilized and that there are opportunities to improve and strengthen the program. Specifically, during the report’s review period (FY 13-FY18), the program saw some severe underutilization, with between 29–55% of the awarded funds remaining unspent by the participating counties. The analysis, led by Director David Cwiertny and Executive Committee member Silvia Secchi, found that the counties that spent more of their allocated funds tended to have a larger number of active wells and more readily funded water quality testing, whereas counties with greater underspending often had greater access to rural water and fewer active wells. These observations are encouraging, as the

Figure 4. Image of Grants to Counties Program review prepared by CHEEC in 2019

GtC funds are being spent in the areas that need them the most and for the most socially valuable activities.

The report also noted the value of the GtC has provided to Iowa over the past 30 years. The program has distinguished the state from other Midwestern states through its commitment to funding for protecting private well owners. Few states set aside funds each year to assist private well users. The report also

identified five opportunities for improving the GtC program, including (i) expanded testing; (ii) prioritization of spending on vulnerable wells; (iii) allowing use of funding to assist with remedial actions; (iv) improved marketing to increase participation; and (iv) closing gaps in the inventory of existing private wells and well users.

The full GtC report by CHEEC is available at:

https://cheec.uiowa.edu/sites/cheec.uiowa.edu/files/CHEEC-2019-01_Grants_To_Counties_3.pdf

CHEEC's Grants to Schools Program

In March 2019, CHEEC started offering free lead and copper testing to Iowa elementary schools with older drinking water infrastructure (see **Figure 5**). CHEEC worked with the SHL to offer the testing. This testing covers every water outlet in each school. Through the Grants to Schools program, CHEEC has committed to provide up to \$10,000 per school to be used for the removal and replacement of high priority drinking water outlets that are found to have unsafe levels of lead. CHEEC plans to work with between 5 to 10 schools per year.

In Spring 2019, CHEEC piloted the program in two schools, Midland Elementary (Oxford Junction) and Strawberry Hill (Anamosa) in Jones County, in partnership with Linn County Public Health. Combined CHEEC tested 170 outlets and found one with concentrations of lead above EPA's action level of 15 ppb and eight that exceed EPA's action level for copper (1.3 mg/L). All outlets with exceedances were repaired with CHEEC's support, including the installation of four new bottle fillers. Six additional elementary schools were tested during Fall semester of FY2020 in Keokuk and Dubuque.

NEWS >

Iowa schools test for lead in drinking water

UI program offers free testing and remediation up to \$10K



Figure 5. UI student, Amina Grant, helps CHEEC test for lead in school drinking water

6.4 Research Publications

Over 130 articles from research supported by CHEEC have been published. A link to publications can be found on CHEEC's website at: <https://cheec.uiowa.edu/research/publications>. In 2019, the 11 new publications were published in peer-reviewed journals.

- *Ligand-Centered Boremium Reactivity in Triaminoborane-Bridged Diphosphine Complexes*
Authors: Kyoungsoon Lee, Clara Kirkvold, Bess Vlasisavljevich, Scott R. Daly
Journal: *Inorganic chemistry* 57, 2018, 13188-13200.
<https://pubs.acs.org/doi/full/10.1021/acs.inorgchem.8b01601>
- *Isolation of ligand-centered borocations in molybdenum complexes containing a triaminoborane-bridged diphosphorus ligand*
Authors: Kyoungsoon Lee, Chan Woo Kim, Jimmy L. Buckley, Clara Kirkvold, Bess Vlasisavljevich, Scott R. Daly
Journal: *Dalton Transactions* 48, 2019, 3777-3785.
<https://pubs.rsc.org/en/content/articlehtml/2019/dt/c9dt00733d>
- *Physical and Chemical Morphology of Passively Sampled Environmental Films*
Authors: Jacob S. Grant, Zihua Zhu, Christopher R. Anderton, Scott K. Shaw
Journal: *ACS Earth and Space Chemistry*, 2019, 305-313.

- <https://pubs.acs.org/doi/abs/10.1021/acsearthspacechem.8b00158>
- *Light management on silicon utilizing localized surface plasmon resonance of electroless plated silver nanoparticles*
Authors: Bingtao Gao, Wenqi Duan, Aaron D. Silva, Alexander C. Walhof, Weitao Dai, and Fatima Toor
Journal: Optical Materials Express 9, no. 9 (2019): 3753-3764.
<https://www.osapublishing.org/ome/fulltext.cfm?uri=ome-9-9-3753&id=417032>
 - *Passively Sampled Environmental Films Show Geographic Variability and Host a Variety of Microorganisms*
Authors: Jacob S. Grant, Patrich M. Richards, Christopher R. Anderton, Zihua Zhu, Timothy E. Mattes, Scott K. Shaw
Journal: ACS Earth and Space Chemistry (2019)
<https://pubs.acs.org/doi/full/10.1021/acsearthspacechem.9b00234>
 - *Quantifying the Interdependence of Metal–Ligand Covalency and Bond Distance Using Ligand K-edge XAS*
Authors: Kyoungsoon Lee, Anastasia V. Blake, Courtney M. Donahue, Kyle D. Spielvogel, Brian J. Bellot, Scott R. Daly
Journal: Angewandte Chemie International Edition 58, no. 36 (2019): 12451-12455
<https://onlinelibrary.wiley.com/doi/full/10.1002/anie.201905635>
 - *Temporal Dynamics of Bacterial Communities in Soil and Leachate Water After Swine Manure Application*
Authors: Elizabeth L. Rieke, Michelle L. Soupir, Thomas B. Moorman, Fan Yang, Adina C. Howe
Journal: Frontiers in microbiology 9 (2018): 3197.
<https://www.frontiersin.org/articles/10.3389/fmicb.2018.03197/full>
 - *Semen and reproductive hormone parameters in fertile men with and without varicocele*
Authors: J. Bruce Redmon, Erma Z. Drobnis, Amy Sparks, Christina Wang, Shanna H. Swan
Journal: Andrologia (2019): e13407
<https://onlinelibrary.wiley.com/doi/full/10.1111/and.13407>
 - *Chlorinated Byproducts of Neonicotinoids and Their Metabolites: An Unrecognized Human Exposure Potential?*
Authors: Kathryn L. Klarich Wong, Danielle T. Webb, Matthew R. Nagorzanski, Dana W. Kolpin, Michelle L. Hladik, David M. Cwiertny, Gregory H. LeFevre
Journal: Environmental Science & Technology Letters 6, no. 2 (2019): 98-105
<https://pubs.acs.org/doi/full/10.1021/acs.estlett.8b00706>
 - *Synergistic Association of House Endotoxin Exposure and Ambient Air Pollution with Asthma Outcomes.*
Authors: Angelico Mendy, Jesse Wilkerson, Paivi M. Salo, Charles H. Weir, Lydia Feinstein, Darryl C. Zeldin, Peter S. Thorne
Journal: American journal of respiratory and critical care medicine 200.6 (2019): 712-720.
<https://www.atsjournals.org/doi/full/10.1164/rccm.201809-1733OC>
 - *Photochemical Transformations of Dichloroacetamide Safeners*
Authors: Andrew E. Kral, Nicholas C. Pflug, Monica E. McFadden, Gregory H. LeFevre, John D. Sivey, David M. Cwiertny
Journal: Environmental Science & Technology (2019), 53, 12, 6738-6746.
<https://pubs.acs.org/doi/abs/10.1021/acs.est.9b00861>

7. Education, Outreach and Engagement

Since 1989, CHEEC has supported hands-on learning opportunities for undergraduate and graduate students to enhance their educational experience and to prepare them for their careers. In FY2019, CHEEC's inaugural graduate fellow Mr. Muhammad Sit, a second year MS student in Computer Science

at UI working on hydroinformatics research at IIHR-Hydrosience & Engineering finished developing an automated groundwater well forecasting system, IWFoS (see **Figure 6**). This system was described earlier in the report. The system was released publically on June 20, 2019 at <https://cheec.uiowa.edu/outreach/news/cheec-leads-partnership-new-iowa-drinking-water-well-information-system>. In FY2020, CHEEC recruited a new graduate fellow, Muneeb Shahid. Mr. Shahid is a first year MS student in Computer Science at UI working on hydroinformatics research at IIHR-Hydrosience & Engineering. Mr. Shahid is working with CHEEC to restructure the Center’s existing water quality databases so that a public dashboard for municipal water quality can be created, similar to the IWFoS. Funding for this GRA was provided through support from the UI Graduate College.



Figure 6. Screenshot of IWFoS homepage.

The Center also supported students with internship and employment opportunities at CHEEC, SHL, U.S. Geological Survey and the UI Office of Sustainability and the Environment.

- Matthew Poch, a second year Masters of Public Health student, worked with CHEEC for his field practicum, a requirement for graduation. During his time with CHEEC, he helped sample and test water for the Northeast Iowa Well Water Study, and he also analyzed trends related to nitrate concentrations in municipal water systems.
- Maria Wong, a Bioinformatics MS student, was been employed by CHEEC to analyze data related to exposure to nitrate and water quality and affordability for manufactured home communities.
- Sarah Douglas, a second year MS student in Civil and Environmental Engineering, worked with SHL to identify the major harmful algal bloom toxins (e.g., microcystins) in Iowa by analyzing samples from the State Beach Monitoring Program. Data collected will be used to develop a rapid strain identification test and a cyanobacteria library. Findings from this study will help facilitate environmental risk management and develop mitigation strategies to reduce



Figure 7. Daily Iowans article on project looking at pesticide application and human exposure on UI campus.

human and animal health risk.

- Danielle Hollingshead, a second year MS student in Civil and Environmental Engineering, worked with U.S. Geological Survey on the CHEEC supported study to test for antibiotic resistant bacteria and genes in Iowa waterways. Ms. Hollingshead helped to collect stream and sediment samples for analysis.
- In partnership with the UI Office of Sustainability and the Environment, Guadalupe Munoz Rocha was hired as an intern to investigate human exposure to pesticides applied on campus. The project aims to educate students about the chemicals being applied and to work with the university so that student are informed when application takes place (see **Figure 7**).

CHEEC participates in environmental health education activities through organizing, funding and hosting educational programs, and giving presentations at conferences, workshops and public meetings across the state. In 2019, CHEEC participated in a number of programs on water quality in Iowa across the state. Talks were presented at the Iowa Governor's Conference on Public Health, Pesticides and Water Monitoring Meeting at Iowa Department of Natural Resources, Iowa Ground Water Association Meeting, Iowa Rural Health and Environmental Journalism Summits at Grinnell College, the Practical Farmers of Iowa conference at Iowa State University, the Izaak Walton League National Convention, and the Des Moines Water Works Citizens Academy. The Center was also co-sponsored a symposium on Extreme Weather in Iowa in Des Moines.

CHEEC also provided support to the State Hygienic Laboratory. These efforts aim to increase awareness about the possible presence of nitrates and bacteria in private well water and to promote regular well testing (see **Figure 8**). Two videos were created that can be found on CHEEC's website at

<https://cheec.uiowa.edu/outreach/resources>.

CHEEC's work was also highlighted in the media. The following is a list of stories from the past year.

- <https://www.thegazette.com/subject/news/school-water-testing-lead-university-of-iowa-20191202>
- <https://www.desmoinesregister.com/story/money/agriculture/2019/06/20/nitrates-iowas-drinking-water-may-tied-cancer-study-says/1487951001/>
- <https://www.desmoinesregister.com/story/money/agriculture/2019/06/24/nitrates-iowa-drinking-water-what-you-should-know-health-effects-cancer-well-water-farm-pollution/1547189001/>
- <https://www.desmoinesregister.com/story/money/agriculture/2019/04/24/thousands-iowa-wells-have-unsafe-levels-contaminates-new-study-says/3538172002/>
- <https://www.iowapublicradio.org/post/sioux-city-finds-higher-levels-disinfection-chemicals-its-water-system>
- <https://www.iowapublicradio.org/post/iowa-dnr-starts-testing-manganese-public-water-systems>
- <https://www.iowapublicradio.org/post/iowa-dnr-plans-look-manganese-issues-public-water-across-state#stream/0>

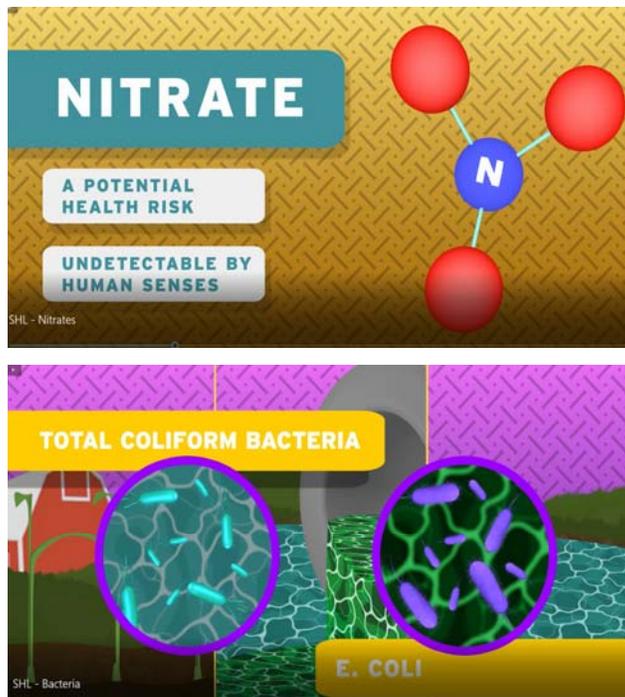


Figure 8. Screenshot of informational videos on nitrate and bacteria in private wells produced by SHL with support from CHEEC.

- <https://www.iowapublicradio.org/post/dnr-suspects-chemicals-sioux-city-base-may-be-contaminating-residents-private-wells>
- <https://www.iowapublicradio.org/post/where-are-iowas-private-wells-new-online-map-shares-location-water-quality-data>
- <https://www.iowapublicradio.org/post/private-well-testing-program-underutilized-researchers-find#stream/0>
- <https://www.wsj.com/articles/farms-more-productive-than-ever-are-poisoning-drinking-water-in-rural-america-11547826031>
- <https://www.thegazette.com/subject/news/report-many-iowa-counties-underusing-private-well-testing-funds-20190820>
- https://www.telegraphherald.com/news/tri-state/article_f9bf7c3d-c183-524e-a032-2883cdeb0e81.html
- <https://www.kcrg.com/content/news/University-of-Iowa-study-found-counties-under-utilizing-funding-for-well-water-testing-557906101.html>

8. Planned Activities for Upcoming Year

In 2020, CHEEC will continue to work on several existing and new initiatives to improve the environmental health of Iowans. CHEEC is restructuring its database with municipal drinking water quality data. The redesigned database will then be used to create a data visualization platform, similar to IWfOS, that will allow residents of Iowa to better access information related to their current and historical drinking water quality. The new system, being developed in coordination with DNR, will display data related to the source, treatment, and quality of drinking water in all Iowa communities. This system will be accessible online, free of charge to all Iowans.

In research, CHEEC will continue to lead efforts related to water quality in private wells. In 2020, beyond finalizing radium and Northeast Well Study sampling data, the Center has plans to test private well water for lead and copper, and per- and polyfluoralkyl substances (PFAS). CHEEC is also working with the UI Maternal Fetal Tissue Bank (UI MTF) to identify environmental exposures linked with preeclampsia. Preeclampsia is health complication that affects pregnant women that is characterized by high blood pressure and may lead to liver and kidney damage. This condition can also affect the fetal development leading to preterm birth, stillbirth and infant death. CHEEC and UI MTF are currently analyzing environmental and public health data to better understand environmental factors that may be linked to the development of preeclampsia.

CHEEC is also continuing its evaluation of the Grants-to-Counties program. During this fiscal year CHEEC will be conducting a state-by-state comparison of well user assistance programs, define the population served by private wells in Iowa and neighboring states, and intends to conduct a survey of well users. The Center will also be conducting a geo-spatial analysis to identify factors, such as well age, depth and proximity to pollution source, that may be predictors of drinking water quality vulnerabilities.

Finally, CHEEC will continue testing for lead in Iowa elementary schools. The Center has tested water for six schools in Keokuk and Dubuque (3 each) in Fall 2019. Tentatively, CHEEC has identified 3-5 schools in Calhoun and Johnson counties for Spring 2020. CHEEC will facilitate the sample collection and testing for lead and copper in elementary school drinking water, and in cases of lead and/or copper detection, provide financial assistance to schools to help remedy the source of contamination. During the upcoming year, CHEEC also intends to prepare a progress report on the Grants to Schools program to share with relevant state agencies summarizing our findings to date regarding lead and copper occurrence and details of the expenditures that have been needed to assist schools when lead and/or copper is found above safe levels in water outlets.