WATER CURRENT

NEBRASKA WATER CENTER
PART OF THE ROBERT B. DAUGHERTY WATER FOR FOOD GLOBAL INSTITUTE AT THE UNIVERSITY OF NEBRASKA

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Water tour to central Platte River basin June 27-29, 2017

The summer Water and Natural Resources Tour will look at surface and groundwater issues in the central Platte River basin June 27-29.

Nebraskans rely heavily on water flowing through this critical stretch of the Platte River to support a very diverse range of important issues that includes agriculture, hydropower production, recreation and water for wildlife and threatened and endangered species. It is arguably the most critical section of river in the entire state, according to Steve Ress, communicator for the University of Nebraska's Nebraska Water Center (NWC), part of the Daugherty Water for Food Global Institute (DWFI).

NWC and DWFI are co-sponsoring and co-planning the annual tour with The Central Nebraska Public Power and Irrigation District. Other sponsors include UNL's Institute of Agriculture and Natural Resources and Nebraska Public Power District.

Increasing and competing demands on the basin's finite supplies of water will be central to discussions and stops on this summer's three-day tour as it delves into surface and groundwater irrigation, water rights, hydropower production, trans-basin diversions of water and many other topics.

The tour begins and ends in Holdrege. It will visit an organic farming operation, irrigation and hydropower production facilities, Natural Resources District projects, and look at the history and current directions for water use in the basin, including presentations on current and planned diversion projects.

"The Platte River, which travels more than 1,000 miles from its headwaters in Colorado to the Missouri River, is fed primarily by snowmelt from the Rocky Mountains and is one of the most significant tributary systems in the Missouri River watershed. Tour topics thus focus on topics associated with the interaction between development and preservation and efforts to wisely utilize its water to meet the many demands placed upon it," said CNPPID public relations coordinator Jeff Buettner, a tour organizer.

Points of interest will include Frito-Lay's Gothenburg Corn Handling Facility and Monsanto's Water Utilization Learning Center and a Nebraska Game and Parks Commission hatchery at North Platte.

Cropping and irrigation experts at UNL's West Central Research and Extension Center in North Platte will speak on advancements in research and technology. Recently completed water transfer and pipeline facilities built by the Nebraska Cooperative Republican Platte Enhancement Project (or NCORPE) will

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Looking for nesting and endangered species on the Platte River near Lexington.

Inside

Nebraska Water Center
Daugherty Water *for* Food Global Institute

National and international travel, work on grants, increasing collaborations highlight past few months

From the Director
Chittaranjan Ray, Ph.D., P.E.

The weeks and months since our last issue of the Water Current have flown by in a flurry of activity, so this is a good time for me to recap what we have been doing here at the Nebraska Water Center since mid-January.

As I write this, I am at a National Science Foundation (NSF) and Indo-U.S. Science and Technology Forum workshop on innovations on the nexus of food, energy and water at Bangalore, India. While here I also spent three days in Delhi, India with representatives from Valmont Industries helping to explore the feasibility for center pivot irrigation systems for smallholder farmers in India.

Earlier in April I was very involved with meetings and helping to host international visitors in conjunction with the Daugherty Water for Food Global Institute's global conference Water for Food Security: From Local Lessons to Global Impacts that was held at Nebraska Innovation Campus April 10-12. This was an extremely well planned and successful event that attracted a record number of colleagues and other interested parties from around the globe. It was a wonderful opportunity to make some new contacts that will help further our work in the near future.

During the first week in April, I traveled to U.S. Department of Agriculture/National Institute of Food and Agriculture offices in Washington D.C. to speak with them about the modeling efforts being done as part of our multi-campus NIFA project studying long-term use and viability of the Ogallala Aquifer. There were also consortium meetings in Amarillo, Texas in connection with this research including some one-to-one meetings between economists and a modeling sub-group.

While in Washington D.C. I visited research staff at both USDA and the U.S. Environmental Protection Agency for collaboration and attended the Global Food Security Symposium organized by the Chicago Council, where Pongpun Juntakut, one of my Ph.D. students was selected as the prestigious "Next generation delegate" to the Chicago Council for 2017. Juntakut is originally from Thailand, is an officer in the Royal Thai Army and teaches at the Royal Thai Military Academy.

In late February, Ben Beckman and I attended annual meetings of the National Institutes for Water Resources for three days of meetings and presentations from top USGS officials, federal and national partners, and fellow Water Resources Research Institute (our official name) directors from across the U.S. Getting better acquainted with fellow directors and their staff is a great way to expand our contacts and capabilities here in Nebraska. While the problems we face as individual water centers and the potential solutions we look to for them may not always have much in common, the common threads of water quality and quantity management could be found throughout the meetings and provided new perspectives on our local challenges.

Another important aspect of these meetings is the chance to sit down with representatives from Nebraska's congressional delegation to share the importance of our mission and programs. With much of our funding coming from federal funds via the USGS and USDA, sharing our work in the state and how we are able to leverage those federal funds to make an even larger impact is important.

Our elected representatives have a difficult job that covers every aspect of leading our country into the future. If we at the NWC can help this process by showing them that every dollar in federal funding they help provide can potentially return two to five times that amount in impacts through studies, outreach, and education directed at state water quality and quantity challenges, then our annual meetings with them are time very well spent.

Closer to home, we conducted our spring semester faculty retreat at our Nebraska Innovation Campus offices in February, spending much of the available time discussing where opportunities exist for meaningful collaborative research.

We also attended Nebraska Association of Resources Districts legislative meetings in January, were we organized and presented a poster session for University of Nebraska students and faculty, plus visiting scholars from India that are here as part of the WARI program (you can read more about that program elsewhere in this issue).

In January, we joined with the Daugherty Water for Food Global Institute in hosting Professor Arjen Hoekstra of the University of Twente in the Netherlands. Dr. Hoekstra gave a very well attended lecture on water foot printing.

Also in January we hosted three fellow water center directors who conducted a five-year administrative review of our center. It was a very thorough review that took note of our many strengths, but more importantly helped to point-out some areas that we can improve and strengthen. We are now in the process of developing strategies to make those improvements. We thank Doug Parker, director of the California Institute for Water Resources; Colorado Water Institute director Reagan Waskom; and Maryland Water Resources Research Center director Kaye Brubaker for their expertise in conducting this review and their time to come here and do it.

On the proposal writing front, we have a collaborative proposal pending with the National Science Foundation to study the nexus of food, energy and water graduate research and education that I am teaming with eight other faculty members on. We will be anxious to see how our proposal fares in front of NSF.

Our annual water and natural resources summer tour is about 95 percent planned and ready to go thanks to the efforts of our staff and those at The Central Nebraska Public Power and Irrigation District in Holdrege. As usual, we will have a limited number of tour bus seats, probably around 50, that will be sold on a first-come, first served basis. We expect them to go very fast once registration opens. The tour is looking at water use issues in what is arguably our most critical stretch of river, the central Platte River basin. We will be touring between Holdrege and Ogallala June 27-29. Look elsewhere in this issue for more information on the tour.

Before closing, I want to thank colleagues Pat Shea and Martha Rhoades in UNL's School of Natural Resources for helping plan and conduct one of the most successful spring semester water and natural resources seminars we have had in recent years. Public attendance at many of the lectures was up considerably and Pat and Martha had a record, or at least near record, number of students taking the seminar for class credit. The lectures were themed to "The right water for the right use at the right time" which seemed to resonate well with both our students and our public audience.

Nebraska Water Center
Daugherty Water *for* Food Global Institute

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"Airlift Environmental" commercializing University of Nebraska research into an innovative technology for groundwater cleanup

A Lincoln-based startup company that specializes in innovative, research-based ways of removing industrial solvents and petroleum-based pollutants from groundwater is taking off.

AirLift Environmental, 5900 N. 58th St., Lincoln, that began five years ago, is an outgrowth of scientific research that started at the University of Nebraska–Lincoln.

"It is gratifying to see that our years of research is bearing practical, easy to use treatments for cleaning up contaminated groundwater" said Steve Comfort, a longtime soil and water chemist in UNL's School of Natural Resources.

For more than six years, Comfort and his co-researchers and graduate students have worked to perfect oxidant-paraffin candles, a chemical-wax cylinder containing oxidizing compounds, such as potassium permanganate or sodium persulfate, that transform toxic chemicals, like vinyl chloride (VC), trichloroethylene (TCE) and perchloroethylene (PCE), into harmless carbon dioxide and chloride.

Permanganates and persulfates have long been known to be effective in remediating these contaminants; the trouble is they are traditionally injected in liquid form and this heavier-than-water remediation solution can sink below where it is needed to treat groundwater contamination. "Traditional treatments inject liquid oxidants into the aquifer and these oxidants are carried away with groundwater flow. If the treatment doesn't work within the first week or so, it's likely not going to work," Comfort said.

Through trial and experimentation at many contaminated sites across Nebraska, Comfort, his students and co-researchers perfected first, second, and now third generation Oxidant Candles® and a system to use them that negates that problem and is as user-friendly as dropping them down pre-drilled holes, where they slowly dissolve and intercept the contamination in the groundwater.

"Our oxidant candles provide a solid, continuous source of oxidant to the contaminated aquifer that can last months to years, which is an advantage over liquid injections" said Mark Christenson, AirLift co-founder, president and former graduate student of Comfort's. The reloadable design developed by AirLift allows new candles to be easily installed when old candles run out, providing additional years of protection at minimal cost.

"Part of the trick in making this successful was finding a way to prevent the oxidant from migrating downward from the candles."

"Pneumatic circulators were developed that aerated or released bubbles at the base of the candle to prevent the oxidant from sinking and facilitating its horizontal distribution throughout the aquifer," said AirLift President and former graduate student of Comfort's Mark Christenson.

The physical action of aeration, which prevents the oxidant from sinking is how "AirLift" Environmental got its name, he explained.

"We started AirLift as a way to compete for funding and keep the research going" said Comfort. "Mark and I have been meeting weekly since he graduated in 2011 and through perseverance and some luck, we were able to obtain Phase I and II small business grants from the National Institutes of Health." This funding has allowed us to stay in research mode, improve the technology and involve others at UNL. Yusong Li, a professor in UNL's Department of Civil Engineering, was also part of the Phase II grant and she and graduate students Chuyang Liu and Ann Kambhu are developing mathematical models that will predict how the oxidant will spread from the aerated candles in the field," Comfort said.

"Airlift has taken the research into an established, commercial realm, a natural outgrowth of the research we began at UNL," said Christenson. "Mark excelled at developing innovative solutions to groundwater contamination problems and his master's thesis was the first to install slow-release oxidant candles in the field," Comfort said of his protégé and business partner.

Christenson helped develop and test the first generation of the oxidant candles in 2010 when he was still a graduate student. Since then, he and Comfort have teamed with additional graduate students, UNL technologist Wei Tang, and AirLift researcher James Reece to refine and further test their candles. They even added solar-powered compressors to their system to aerate the candles and eliminate electricity costs.

Like Christenson, Reece is a former student of Comfort's who has a well-rounded background in environmental chemistry and field experience to help AirLift develop and manufacture the paraffin candles. He is currently the company's only full-time employee.

"We hit the jackpot when we hired James," Christenson said. "He has really pushed AirLift forward in the last year."

With current Phase II NIH funding, this private-university collaboration will be selecting and treating contaminated sites in Nebraska for "proof-of-concept" testing. This means testing their latest, reloadable version of the oxidant candles that can be installed with simple, direct-push equipment. This second phase of funding, which sunsets later this year, also helps AirLift do on-site trials so the efficacy of the direct-push aeration candles can be tried under a range of soil and aquifer conditions.

Field results from contaminated test sites in Lincoln, Cozad, Grand Island, Beatrice and Sargent have all proven that the science, and the evolving technology of the candles and how they are used, are working as they are designed to, Christenson said.

"We feel real fortunate to have received Phase II NIH funding, which has allowed us to improve the candles, simplified the technology and continue to develop commercial products that can provide a less expensive alternative to treating contaminated groundwater," Comfort said.

Steve Comfort, James Reece and Mark Christenson of AirLift Environmental.

AirLift Environmental's Mark Christenson.

Easy installation of oxidant candles by AirLift Environmental.

Oxidant candles manufactured by AirLift Environmental in Lincoln.

Among those attending an April Indo-U.S. workshop in Bangalore, India were (beginning fifth from right, front row), Nebraska Water Center director Chittaranjan Ray, Daugherty Water for Food Global Institute director of research Christopher Neale and DWFI post-doctoral research associate Mesfin Mekonnen. The workshop, addressing the nexus of food, energy and water, was sponsored by the Indian Institute of Science, Indo-US Science and Technology Forum, University of Nebraska–Lincoln and the National Science Foundation.

Water Leaders accepts seventh and largest class to date

The Nebraska Water Leaders Academy has accepted its seventh and largest class to date. Nineteen men and women from across the state have been accepted into the one-year program that provides leadership training and educates participants about the vital role rivers, streams and aquifers play in the economic sustainability of the state.

Included are DeAnna Bartruff, a land administrator for the Central Nebraska Public Power and Irrigation District, Holdrege; Ben Beckman, research and extension communication specialist with the Nebraska Water Center/ Daugherty Water for Food Global Institute, Lincoln; John Berge, general manager of the North Platte NRD, Scottsbluff; Andy Bishop, rainwater basin joint venture coordinator for the U.S. Fish and Wildlife Service, Grand Island; Tim Burnham, environmental health scientist, Nebraska Health and Human Services Office, Drinking Water and Environmental Health, Grand Island; Casey Campbell, engineer with Ducks Unlimited, Inc., Grand Island; Brenda Densmore, hydrologist, U.S. Geological Survey, Lincoln; Brent Downey, vice president of Downey Drilling, Inc., Lexington; Travis Figard, senior engineer, Olsson Associates, Lincoln; Kyle Hauschild, storm water/floodplain specialist, Lower Platte South NRD, Lincoln; Kimberly Howell, staff assistant, HHS water well standards program, Lincoln; Kevin Kruse, water resources department manager, JEO Consulting Group, Inc., Lincoln; Rick Kubat, government relations attorney, Metropolitan Utilities District, Omaha; Don Masten, division manager for Ag Valley Water Resources, Loomis; Ryan McIntosh, associate attorney, Mattson Ricketts Law Firm, Nebraska City; Benjamin Miller, supervisor in the water permits division of the Nebraska Department of Environmental Quality, Lincoln; John Miller, natural resources program specialist, Nebraska Department of Natural Resources, Lincoln; Dylan Rowe, farmer with T Rowe, Inc., Lexington; Bret Schomer, water resources specialist, Lower Platte North NRD, Wahoo; and Jack Wergin, projects department manager, Upper Big Blue NRD, York.

Water tour to central Platte Riverbasin June 27-29, 2017

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be visited, as will NPPD's Gerald Gentleman power plant near Sutherland and many of the structures used for regulating water use and flows into and out of Lake McConaughy near Ogallala.

Time will be spent kayaking CNPPID's main irrigation supply canal from Midway Lake to the Gallagher Canyon State Recreation Area on the tour's third and final day.

"We want to include as many entities and organizations with a stake in using the basin's waters as we possibly can and to present as broad an overview of why this stretch of the river is so important to all of us in the three days we have," Ress said.

Tour information is online at watercenter.unl.edu as it become available. Organizers anticipate limiting registrations to about 55 people. Registration is $475 per person single occupancy or $400 per person double occupancy. Registration includes all lodging, food and motor coach expenses. Space is limited and registration is first-come, first-served. To register, email hrahmann@cnppid.com or phone (308) 995-8601.

The tours began as summer irrigation field tours initiated by then UNL Chancellor D.B. "Woody" Varner more than 40 years ago.

"Their scope and emphasis has evolved and broadened since then to encompass many other water, natural resources and environmental-related topics impacting Nebraska," Ress said.

The Platte River in central Nebraska.

Four chosen for summer IRES program in Czech Republic

Steve Ress

Three Nebraska students and one from California have been selected to attend this summer's session of International Research Experiences for Students (or IRES) in the Czech Republic.

Funded by the National Science Foundation and open to U.S. undergraduate and graduate students majoring in the sciences or engineering fields, IRES is hosted by Prague's Czech Technical University (CTU) and will be held May 29 to July 21, said Nebraska Water Center director Chittaranjan Ray, who coordinates the program.

Chosen to study at CTU this summer were: Zablon Adane and Catherine Finkenbiner, University of Nebraska–Lincoln; Jessica Bozell, University of Nebraska–Omaha; and Alisha Rodriguez, University of the Pacific, Stockton, Calif.

"The program wants to facilitate U.S.-Czech Republic student research experience on research on vadose zone for understanding water and chemical transport at various scales between the University of Nebraska–Lincoln and CTU," Ray explained.

Primary student mentor for the eight-week program in Prague is CTU's Michal Snehota, Ray said, adding that students will work with a number of his colleagues and staff for experiments and assistance.

IRES participants live on-campus in CTU dormitories and work collaboratively with Czech students and researchers in the laboratory and at field sites within various watersheds in the Czech Republic. Students will also analyze data for pore structure for undisturbed soil cores to examine preferential flow pathway and measure hydraulic conductivity of unsaturated soils in the field.

"I will be in Prague for their first week and then go again for the last week for final evaluations and closure of the program," Ray said.

The University of Nebraska pays the students' airfare, a stipend and living expenses while participating in the program.

Before making the trip to Prague, Hana Waisseova of the University of Nebraska will give students an introduction to Czech history and culture. Ray will also give them a primer on the types of experiments they will be doing and what they will need to study before leaving for the Czech Republic.

"Last summer's IRES program was very successful and I have no doubts that this year's session will be, as well," Ray said.

Waverly High School students sample rural domestic wells as part of the Water Sciences Laboratory's "Know your well" program. More than a dozen Nebraska high schools will soon be participating in the program.

Know Your Well program gets sampling start at Waverly High

Steve Ress

Students at Waverly High School, not far from Lincoln, were among the first of what will be students from sixteen different schools across Nebraska to learn more about possible contaminants in their well water through a hands-on program called "Know your well" being conducted by the Water Sciences Laboratory at the University of Nebraska–Lincoln.

We want these students to learn about possible groundwater contaminants and how they can affect well water quality, how to test well water and learn differences between test kits and laboratory methods, said UNL graduate student Chris Olson who is managing the Nebraska Environmental Trust (NET) funded "Know your well" program at UNL.

"The project is about helping people understand what might be in their well water and how to sample and test groundwater samples. It's about helping rural residents be informed consumers and replacing indifference or uncertainty with knowledge," he said of the program that involves a consortium of UNL experts. The program is designed to train students in assessing the quality of drinking water derived from rural domestic wells. Ultimately it will involve science and agricultural education programs and FFA chapters at 16 Nebraska high schools Olson said.

The first to sample well water under the program were about a dozen students from Waverly High School, just a few miles northeast of Lincoln.

"We met with and accompanied teacher Kris Spath and her students on their first sampling expedition in early April," said Dan Snow, director of the Water Sciences Laboratory (WSL) at UNL.

Spath is Waverly High's agriculture teacher and FFA adviser, as well as a UNL IANR ag education alumni.

Other schools that will be conducting samplings this year include Newman Grove, Central City, Auburn and Filmore-Geneva High Schools, Snow said.

Over the three-year project, each participating school group will be given multiple test kits for measuring common water contaminants and will be provided with training needed to properly use all of the kits, Olson said.

A mobile app will be developed as part of the project to ease data entry and will be used directly by the students to upload data to an online database. Students will also provide information about well construction and land use from each of the wells sampled.

The results of student-tested water samples will be compared with analysis of samples collected by the students and analyzed by research technicians at the WSL, Snow said.

It's important for students to learn both about well water quality, what factors can affect well water, and the wide variety of ways to measure and analyze groundwater contaminants, Olson said.

Most Nebraskans rely on groundwater drawn from wells for their drinking water and very few of domestic wells are regularly tested, he said, noting "Well testing can be an expensive, time-consuming and sometimes confusing process."

"National surveys suggest that rural domestic wells may be susceptible to a variety of natural and synthetic contaminants. Some of these are potentially detrimental to health, such as bacteria, radon, arsenic, uranium, nitrate, fluoride, and pesticides such as atrazine," Snow said.

Collected samples will be analyzed for a suite of pesticide residues, nitrate, metals, and dissolved minerals by staff at the WSL. Researchers will analyze the gathered land use data and the well testing results to determine whether certain land uses, well construction and aquifer characteristic have any relationship to well water quality. Annual workshops will be

conducted at UNL to provide students and teachers with feedback on well test results, updates on methods, and provide interaction with UNL faculty and staff.

UNL faculty cooperating on the program in addition to Snow include Nebraska Water Center director Chittaranjan Ray, Ashok Samal of UNL's Department of Computer Science and Engineering, and Matt Kreifels of UNL's Department of Agricultural Leadership, Education and Communication.

Funding for the project, which began last year, is through a three-year grant from the Nebraska Environmental Trust.

The WSL and Nebraska Water Center are part of the Daugherty Water for Food Global Institute at the University of Nebraska.

State groundwater levels still recovering from 2012 drought

Shawna Richter-Ryerson

Groundwater levels in the spring of 2016 continued to rise following above-normal and near-average precipitation recorded for the year across the state, but many parts of the state still saw groundwater levels remain below spring 2012 levels, according to the 2016 Nebraska Statewide Groundwater-Level Monitoring Report.

The Conservation and Survey Division at the School of Natural Resources, University of Nebraska–Lincoln, recently released the report, which examines groundwater level changes, using data collected from nearly 5,000 wells across the state. It studies the rate of drawdown and recharge measured in regional wells and gives a general depiction of the current state of groundwater levels on a yearly basis. It also looks at historical trends, comparing regional water levels over extended periods of time.

The report is available for $7 from the Nebraska Maps and More Store in the lobby of UNL's Hardin Hall, 3310 Holdrege St., or online at marketplace.unl.edu/nemaps or amazon.com. Phone orders are accepted at (402) 472-3471. A PDF of the report can be downloaded at go.unl.edu/groundwater.

The authors of this year's annual report found water levels rose on average 0.69 feet from spring 2015 to spring 2016, with significant rises in the Panhandle, along the Platte River Valley and the eastern third of the state. The rest of the state saw near-average precipitation and modest, localized water level changes.

Although the one-year rises look good, many parts of the state remain below 2012 levels, when drought hit the state and lasted through spring 2013. During that time, Nebraska saw significant groundwater level declines. In much of eastern and central Nebraska groundwater levels are still 10 to 15 feet below 2012 conditions. However, if the state continues to see above-average precipitation, as it did last year, groundwater drawdowns will continue to be reduced.

In-depth maps in the report look at one-year groundwater level changes, but also examine five-year and 10-year changes, in addition to changes since the beginning of irrigation development. The maps are based on information collected by the Conservation and Survey Division, U.S. Geological Survey, U.S. Bureau of Reclamation, Nebraska Natural Resources Districts and Central Nebraska Public Power and Irrigation District. The reports and maps are produced by the Conservation and Survey Division and have been since the 1950s. Groundwater monitoring began in Nebraska in the 1930s.

Authors of this year's report are Aaron Young, survey geologist; Mark Burbach, environmental scientist; Leslie Howard, geographic information science and cartography manager; Michele Waszgis, research technician; Matt Joeckel, state geologist and CSD associate director; and Susan Olafsen Lackey, research hydrogeologist.

For more information on groundwater or groundwater maps, visit go.unl.edu/groundwater. For more information on the report or associated studies, contact Young at (402) 472-8339.

This 10-foot section of core is a part of a nearly 500-foot-deep core, drilled by the Conservation and Survey as part of a CSD mapping program in eastern Cherry County during 2015-2016.

CSD repository is a trove worth exploring

Shawna Richter-Ryerson

It's never been easier to access cuttings and core samples from the Conservation and Survey Division Geological Sample Repository.

A recent upgrade to the website includes a new PDF form for samples requests that can be emailed directly to Michele Waszgis, research technician who manages CSD's collection of geological samples at both Nebraska Hall and Mead facilities.

The repository collection contains millions of samples from CSD test-hole and well-drilling sites, Nebraska Department of Roads, Nebraska Oil and Gas Conservation Commission, and some private drillers. The collection includes cores, cuttings and sample material from all 93 of Nebraska's counties, dating back to the late 19th century when a core was drilled near present-day Capitol Beach Lake in Lincoln in the search for brines and salt deposits. Parts of that same historic core remain in the CSD collections.

Sample material can be accessed onsite or through a loan program, where samples are shipped.

"The cores have a high scientific value," Waszgis said, "and I would like to see them used more. I would really like to see them utilized for science, for geology and for the benefit of the State of Nebraska."

Data obtained from the samples can help inform decisions on Nebraska's water, mineral, hydrocarbon and other natural resources, as well as assist in answering environmental, agriculture, industrial and engineering questions, the website states. Among other things, they can be used to identify water resources and aquifer properties; locate mineral deposits, including the rare earth deposits of the Elk Creek carbonatite in southeastern Nebraska; define the composition and order of layers of soil and rock below earth's surface; and for research for theses and dissertations.

"Some cuttings are past 4,000 feet deep," Waszgis said. "That's almost a mile into the earth. That's incredibly deep when you think about it." A core nearly 1,000 feet deep fills 99 boxes in the repository, she said.

Cores and cuttings are tested in the field for basic elements, logged, analyzed and then stored chronologically. The field logs recording this information also are available upon request.

"Each core is unique in its own right," Waszgis said. "They were each taken from a certain spot, with a certain circumstance of how it was buried. The subsurface could be totally different 100 yards away. … Fifty years later, you can go back and discover additional geologic and scientific information outside of its original purpose. You just don't know."

Previously, Waszgis has had an average of five to seven requests for samples each year. Since the inception of the revised website, she's already logged three requests and expects to surpass the previous average.

Her long-term goal is to digitize and barcode the entire collection and make it available through a single database. Right now, the search for samples is a largely manual process and background information on samples comes from three sources: the CSD test-hole and well-drilling database and the Nebraska Oil and Gas Conservation Commission website.

NRDs team on Bazile Groundwater Management Area

Northeast Nebraska's Upper and Lower Elkhorn, Lewis and Clark, and Lower Niobrara Natural Resources Districts have teamed to help local producers increase nutrient efficiency through cost shares and outreach to improve groundwater quality in parts of three counties that have been battling contamination from nitrogen fertilizer.

Consumption of groundwater with nitrate-N above the U.S. Environmental Protection Agency (EPA) maximum contaminant level of 10 parts per million has been linked to a number of human health concerns, including blue baby syndrome (methemoglobinemia) which can reduce the ability of blood to carry oxygen in infants, unborn children, and the elderly.

Previous groundwater quality studies, including those conducted by the University of Nebraska–Lincoln's Conservation and Survey Division that began more than 25 years ago, noted area aquifers are particularly vulnerable to contamination, primarily from agricultural sources of nitrogen. Historical use, and in some cases overapplication of fertilizer, has led to increased concentrations of groundwater nitrates. Increasing groundwater nitrates is a common problem throughout Nebraska, though this region of the state has been dealing with the issue for many decades.

"Nitrate contamination in northeast Nebraska has been a source of debate and study since the late 1970s. In an area where much of the drinking water for rural and municipal sources comes from the underlying aquifer, the slow and steady increase in groundwater nitrates has become a focus of local and state action," said Ben Beckman, a research and extension communications specialist for the Nebraska Water Center, Daugherty Water for Food Global Institute and Nebraska Extension at UNL.

To get an idea of the scope of the project, BGMA is a 756 square mile region covering portions of Antelope, Knox, and Pierce counties. The area has a population of more than 7,000 and a complex mixture of heavily farmed, well drained sandy soils and shallow water tables that contribute to a "perfect storm" for groundwater nitrate contamination.

To help find practical and lasting solutions to this issue and restore groundwater quality in northeast Nebraska, the four northeast Nebraska NRDs joined forces with local producers and state agencies six years ago to create the Bazile Groundwater Management Area (or BGMA) to promote practices addressing rising nitrate levels.

With a recent EPA grant and support from the U.S. Department of Agriculture/Natural Resource Conservation Service through the National Water Quality Initiative BGMA will provide cost sharing assistance to producers who implement best management practices (BMPs) like flow meter installation, deep soil and vadose zone nitrate sampling, crop tissue analysis, soil moisture sensor utilization, and improved timing and type of fertilizer application.

Incentivizing practices that help producers manage natural resources more efficiently, as well as stay profitable through better efficiency of applied nutrients and water will hopefully bring about a lowering of groundwater nitrate levels.

Ideally, BGMA will lead to an overall decrease in excess nitrogen lost from the soil leaving more available for crops to use. While reduced nitrate losses from the crop rooting zone may not be reflected immediately in the aquifer, a reduction in groundwater contamination will eventually show up as declining groundwater nitrate concentrations.

Promotion of these practices is paired with educational outreach to all members of the community, Beckman said.

Increasing awareness by local residents on the impact their actions will have on local water quality is one more step in reducing nitrate loading.

Finally, there is a commitment to partnering with groups like the UNL Water Sciences Laboratory, Nebraska Water Center, and Nebraska Extension to provide research and gather relevant and practical data for more informed decision-making.

"Better understanding of factors that lead to nitrate formation and movement once it has left the root zone where it is available to plants or the slow but steady movement of groundwater itself can help direct funds towards programs that will create the most impact," Beckman said.

Improved nutrient and fertilizer management can have an impact on groundwater nitrate concentrations. For example, similar circumstances of sandy soils and shallow water tables in the Platte River valley led the Central Platte NRD to create a Groundwater Quality Management Program 30 years ago. Subsequent voluntary management efforts by producers there have led to a slowing and stabilizing of groundwater nitrate levels, said Beckman.

Problems with groundwater contamination are showing up with greater frequency in many areas of Nebraska and the U.S. And nitrates are not the only chemical that may end up in drinking water where sandy soils, heavy water use or improper/outdated well construction can allow pesticides, bacteria, and other contaminants such as uranium and arsenic to enter water supplies at levels threatening human health.

Increases in naturally occurring arsenic and uranium in groundwater may be linked to nitrates and any of these occurring above the maximum EPA contaminant level means having to relocate drinking water wells or installation of expensive water treatment equipment.

"While groundwater quality issues are not an easy or quick fix, the commitment of resources and cooperation between stakeholders in the BGMA is another great example of Nebraskans working together to help make drinking water safer for all," said Beckman.

Crop model aids decision-making for western Nebraska corn irrigation

Nam Tran

If you could produce the same amount of food with fewer resources, wouldn't you?

That is the goal of new research led by Justin Gibson, a PhD student in the University of Nebraska–Lincoln's School of Natural Resources and a Robert B. Daugherty Water for Food Global Institute student support grantee.

Gibson and several of the institute's Faculty Fellows recently published a paper examining corn irrigation patterns in western Nebraska and their implications for water managers. The research shows reduced pumping water savings models for various irrigation scheduling strategies and offers recommendations for hyper-resolution land surface modeling to aid irrigation decision-making.

"We are interacting with producers out in the field, helping them understand how they can use less water to produce the same amount of food," Gibson said.

Gibson presented the project at the 2016 Water for Food Global Conference and earned second place in the institute's poster competition.

UNL hydrogeophysicst and DWFI Faculty Fellow Trenton Franz is also involved with the project.

"There are no yield impacts from a widely used crop model," Franz said. "That means water managers can evaluate the economics of investing in such technologies and the likely water savings versus the cost of implementing the technology."

The research helps inform how much water is necessary to produce irrigated corn, Gibson said. It allows researchers to test different scenarios, such as climate impacts or new irrigation policies.

The researchers came up with four plausible irrigation algorithms using weather data, soil information and more to recreate a historical irrigation time series. Their findings show that as the level of technology increases, the pumping savings also increase.

We saw that you could reduce pumping by nearly 30 percent without significantly hurting yield, Gibson said.

"That is an important consideration because the irrigation savings may not be worth it to farmers if they are losing yield," Gibson said. "But if you aren't impacting yield, that's just free money sitting on the table."

In the paper, the researchers state that the human use of water for irrigation is often ignored or poorly represented in land surface models and operational forecasts.

"As we face an ever-changing climate, we need to be agile and nimble in our efforts to produce food with limited resources," said Gibson.

The research was published Feb. 20 in the Journal of Hydrology and Earth System Sciences as a special issue in honor of Eric F. Wood, "Observations and Modeling of Land Surface Water and Energy Exchanges Across Scales." In addition to Gibson and Franz, co-authors include Tiejun Wang, John Gates, Patricio Grassini, Haishun Yang and Dean Eisenhauer. Read more on the study here.

(Editor's Note: Nam Tran is an intern in the Daugherty Water for Food Global Institute)

Justin Gibson, doctoral student in the University of Nebraska–Lincoln's School of Natural Resources and a Daugherty Water for Food Global Institute student support grantee.

Current Members of the Nebraska Water Center advisory board

The advisory board advises and strengthens the Nebraska Water Center as it carries out its mission of supporting water-related research, education and outreach, and sharing information with constituent groups.

The advisory board combines many existing advisory functions into one board. Examples of issues on which advice may be sought include research needs, particularly in Nebraska; events and programs for facilitating interdisciplinary research; shaping of academic programs; seed grant awards; and outreach event topics.

Current members:

John Bender, Nebraska Department of Environmental Quality

John Berge, North Platte NRD

Dana Divine, UNL School of Natural Resources and Conservation and Survey Division

Bruce Dvorak, UNL Department of Civil Engineering

Tom Franti, UNL Department of Biological Systems Engineering

Richard Holland, Nebraska Game and Parks Commission

Shannon Bartelt Hunt, UNL Department of Civil Engineering

Suat Irmak, UNL Department of Biological Systems Engineering

Alan Kolok, UNO Nebraska Watershed Network

Peter McCornick, NU Robert B. Daugherty Water for Food Global Institute.

Dan Miller, U.S. Department of Agriculture/ARS

John Miyoshi, Lower Platte North NRD

Chittaranjan Ray, Nebraska Water Center and UNL Department of Civil Engineering

Jennifer Schellpeper, Nebraska Department of Natural Resources

Tim Shaver, UNL Department of Agronomy and Horticulture and West Central Research and Extension Center

Bob Swanson, USGS Nebraska Water Science Center

Steve Thomas, UNL School of Natural Resources

Karrie Weber, UNL School of Biological Sciences and Earth and Atmospheric Sciences

Newly installed board members are Berge, Irmak, McCornick, Schellpeper and Swanson. Four that recently completed terms on the board, that we thank for their service to the Nebraska Water Center, are Jesse Bradley, Nebraska Department of Natural Resources; Dean Eisenhauer, UNL Department of Biological Systems Engineering (emeritus) and Daugherty Water for Food Global Institute; Roberto Lenton, Daugherty Water for Food Global Institute; and Ron Zelt, USGS Nebraska Water Science Center.

Second wave of WARI scholars begins to arrive

Steve Ress

The second contingent of WARI scholars are beginning to arrive at the Nebraska Water Center and Daugherty Water for Food Global Institute.

WARI, short for Water Advanced Research and Innovation Fellowship program, is a partnership between NWC, DWFI, the University of Nebraska–Lincoln (UNL), the government of India's Department of Science and Technology, and the Indo-U.S. Science and Technology Forum to help Indian students and scientists gain access to world class research facilities at UNL, promote cooperative research in many water science and engineering arenas, and help pave the way for the next generation of scientists and technologists from India to work with their peers in the U.S. The program's primary goal is to foster long-term research and development connections.

WARI program coordinator Jesse Starita at DWFI said that of this second contingent of scholars, the first to arrive has been intern Jahangeer Ali, who arrived at UNL on April 1. He will be working primarily with Yusong Li in UNL's Department of Civil Engineering.

"We anticipate the next intern will arrive on May 1 and then there will be a scattershot of arrivals through late June," Starita said.

"This year there are a total of 11 WARI scholars. Of the original group of WARI interns and scholars that came to us last year, Rajesh Singh is the only one who has not yet returned to India. He will be with us until July," Starita said. Singh is still active with research fieldwork under the guidance of Water Science Laboratory director Dan Snow and UNL Biological Sciences professor Karrie Weber. In April, Singh co-authored a poster on some of this work that was presented at DWFI's Global Conference at Nebraska Innovation Campus.

The full slate of expected WARI fellows and interns for the coming year at UNL include the following:

Fellows

Paromita Chakraborty, Ph.D., assistant professor, SRM University, Chennai

Richa Kothari, Ph.D., assistant professor, Babasaheb Bhimrao Ambedkar University, Lucknow

Shaik Rehana, Ph.D., assistant professor, International Institute of Information Technology, Hyderabad

Rajendran Selvakumar, Ph.D., associate professor, PSG Institute of Advanced Studies, Coimbatore

Riddhi Singh, Ph.D., assistant professor, Indian Institute of Technology – Hyderabad

Interns

Ram Chavan, Ph.D. student, Birla Institute of Technology & Science, Goa

Omkar Damodar Gaonkar, Ph.D. student, Indian Institute of Technology – Madras

Jahangeer Ali, Ph.D. student, Indian Institute of Technology – Roorkee

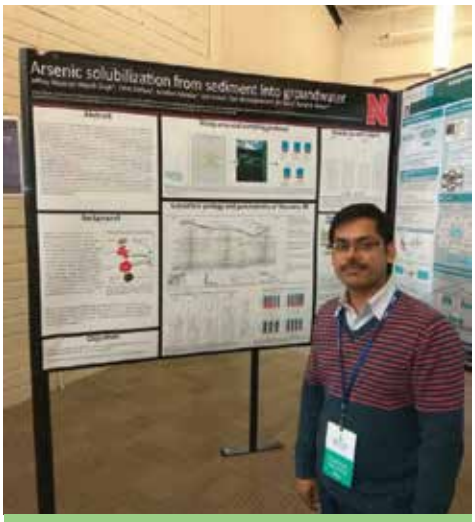
Anurag Kumar, Ph.D. student, Indian Institute of Science Education and Research, Kolkata

Ashish Kumar, Ph.D. student, Indian Institute of Technology – Bombay

Swati Suman, Ph.D. student, Banaras Hindu University

Jahangeer Ali and Nebraska Water Center director Chittaranjan Ray.

Water Sciences Laboratory director Dan Snow and WARI intern Rajesh Singh.



WARI intern Rajesh Singh exhibits a poster at April's Global Conference at Nebraska Innovation Campus.

WRAP meets in conjunction with Water for Food Global Conference

Steve Ress

The University of Nebraska's Water Resources Advisory Panel (or WRAP) met April 11 in conjunction with the Daugherty Water for Food Global Institute's (DWFI) annual global conference.

The breakfast meeting was a short but social one that came just ahead of opening sessions for the 2017 Water for Food Global Conference on "Water for Food Security: From Local Lessons to Global Impacts."

DWFI executive director Peter McCornick opened the meeting by welcoming WRAP members to the conference, which was hosting a record attendance of nearly 500 registered participants at Lincoln's Nebraska Innovation Campus. McCornick told WRAP he was very pleased with the overall slate of speakers and topics for the event, how many countries were represented among the speakers and attendees and the overall increase in the conference's international content and flavor.

Steve Goddard, interim vice chancellor for research and economic development at the University of Nebraska–Lincoln updated those present on potential cuts in budgeting for science research by the Trump administration, saying that UNL's Office of Research and Economic Development (ORED) was keeping a close eye on events on the national level, as well as funding opportunities for Nebraska researchers.

ORED's assistant vice chancellor, Monica Norby also updated WRAP on the progress of researchers involved in an ethanol-based jet fuel program.

Dean and director of Nebraska Extension Chuck Hibberd gave updates on the very successful Nebraska Ag Water Management Network and their work with Nebraska's natural resources districts on nitrogen management and extension participation in a demonstration farm in China that is helping introduce Chinese producers to American best management practices, as well as American farming and irrigation equipment.

In updating the group on happenings within UNL's Institute of Agriculture and Natural Resources, UNL Harlan vice chancellor for IANR and University of Nebraska vice president for agriculture and natural resources Mike Boehm reminded WRAP members that evidence of Nebraska and IANR's continuing momentum is that 40 percent of IANR faculty have been hired in the last five years, since 2012. Targeted, strategic hiring of faculty will continue, he said, noting that IANR is poised to move into the next phase of strategic planning.

Boehm then helped recognize WRAP member Eugene Glock for his recent induction into the Nebraska Hall of Agricultural Achievement and his many years of service to Nebraska and UNL.

Glock, who farms in Butler County, was instrumental in establishing the Nebraska Soybean Association in the 1970's and served 12 years on the staff of U.S. Senator Bob Kerrey among his many agricultural leadership contributions. He also served in a leadership role for the Ag 40 group that was instrumental in establishing IANR. He currently serves on NU President Hank Bound's advisory council, as well as WRAP.

Lincoln attorney Lee Orton of the Nebraska State Irrigation Association, updated WRAP members on the current Water Leaders Academy class, the academy's largest class yet, and also noted that offices for the Nebraska Water Balance Alliance (or NEWBA) would soon be moving to Lincoln.

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Nebraska's Top 10 Water Challenges

The Nebraska Water Center is reviewing it's list of Top-10 state water challenges that are used as a general set of guidelines and framework for the work it does on behalf of all Nebraskans.

The list was last revised in November 2016 and we are soliciting your input to any possible future additions, deletions from the current list, or redefinition of current listed challenges.

If you have input to this list, please send comments to sress@nebraska.edu by July 1.

Water Quantity

1. Effects of water consumption and conservation practices on instream-flows, groundwater recharge and water supplies (municipal and industrial); realizing the maximum water use efficiency for irrigation.
2. Potential effects of climate change, especially impacts of increased climate variability, on the availability and use of water resources of Nebraska.
3. Potential for high efficiency irrigation to improve sustainability of production agriculture in Central/Western Nebraska.
4. Development of tools and technologies for sensing soil moisture, control of irrigation and pumping systems, and data analysis.

Water Quality

5. Solutions to increasing incidence of nitrate, uranium, arsenic, and other contaminants in drinking water sources.
6. Management of non-point source (NPS) nutrient and sediment inputs in lakes, streams and reservoirs, including toxic algae treatment and prevention, and maximum contaminant loadings (MCLs) for nutrients in Nebraska.
7. Understanding the consequences of surface and groundwater contamination from emerging contaminants such as steroids, antibiotics, pesticides, surfactants, nanomaterials, and disinfectants from wastewater sources.

Water Institutions

8. Alternatives and solutions for aging water infrastructure, including drinking water distribution systems, wastewater treatment, irrigation systems, dams, levees and canals.
9. Improvements to water economics models and water policies , including establishing water markets and water banking, recreation, and wildlife habitat.
10. Creating effective social systems to influence individual and institutional behavioral change for sustainable water resources management

This listing is unranked and it recognizes that several challenges may fit into more than one of the three sub-categories