

Nebraska Water Center

Annual Report

2019-2020



**Nebraska
Water Center**

Daugherty Water *for* Food Global Institute



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If there is magic
on this planet, it is
contained in water.

//

— Loren Eiseley, *The Immense Journey*, 1957

On the Cover

Nebraska landscape photographer Erik Johnson captured this barn near Wilber in 2015 after a storm passed before twilight. Johnson's photos are also featured on the report's section dividers.

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Foreword

For decades, Nebraskans have steadily built expertise in irrigated and rainfed agriculture, as well as in water issues that ripple beyond crop and livestock production. More recently, Nebraska has become a testbed for precision agricultural water use techniques, as well as for agricultural innovation in general. Much of the state's water research, teaching and outreach springs from the Nebraska Water Center (NWC), a hub extending the University of Nebraska's water efforts to citizens across the state.

NWC is part of the Daugherty Water for Food Global Institute (DWFI) and collaborates with the University's Institute of Agriculture and Natural Resources (IANR), straddling the water issues of Nebraska and the broader global community and pioneering innovation in water use and conservation.

Of course, there have been plenty of uncharted waters of late. We all have had to navigate the challenges of the global COVID-19 pandemic — from supply and demand shocks on the farm to the transformation of teaching and learning on campus.

While undoubtedly challenging, these events have also unlocked new ways to work and connect. Along with our partners, NWC has cultivated an environment of innovation, encouraging faculty, staff and students to collaborate virtually and in-person. Whatever the platform, these collaborations produce practical solutions, which are widely shared with the university's stakeholders, including Nebraska farmers and ranchers. In this report, you will read about our collective efforts to better steward Nebraska's water legacy.

Students in UNL's College of Agricultural Sciences and Natural Resources (CASNR) play an important role. They dedicate themselves to understanding the complex, integrated natural resource systems dependent on Nebraska's water and soil. At NWC, these students put theory into practice, learning how to become our next generation of water scientists, teachers and leaders.

Much of the water-related action, especially in water quality testing and analysis, happens at the Water Sciences Laboratory (WSL). A major arm of NWC, the lab conducts cutting-edge water research and incubates future professionals in the field. WSL is unique among U.S. water centers and is vital to ensuring that Nebraskans are aware of what's in their water.

Finally, NWC provides critical support for production agriculture and the state's role as a supplier of nutritious and safe food, fuel, feed and fiber for the U.S. and the world. Ultimately, water matters because it is essential for food security, energy and the environment.

Nebraska has demonstrated to the world what it takes to grow food more abundantly and efficiently, and also how to do so in a way that conserves water and soil and ensures the continued economic vitality of our local communities. Recent events like the global pandemic and historic flooding demonstrate that new challenges will emerge. NWC will continue to work with partners and stakeholders to overcome these trials and help develop solutions based on the needs of Nebraskans.



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Harlan Vice Chancellor

Institute of Agriculture and
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Director's Letter

Chittaranjan Ray

Director

Nebraska Water Center
University of Nebraska

Many have called Nebraska a living laboratory for the study of water. The vast groundwater reserves and boundless, braided miles of rivers and streams that we channel for agriculture, ecosystems, power generation, tourism, recreation and communities, provide both challenges and opportunities to better manage our most fundamental resource. The Nebraska Water Center — part of the Daugherty Water for Food Global Institute at the University of Nebraska — is brimming with water research, education and outreach with stakeholders across the state. In your hands is the synopsis of two years' worth of work from all corners of our state.

In 2019 and 2020, NWC forged ahead with projects. In the spring of 2020, we adapted to maintain public health and university guidelines in the wake of COVID-19. I am proud of our team and what we accomplished during these challenging times. This includes convening stakeholders virtually and in-person around reducing nitrate to improve water quality (p. 23), jumpstarting a new program on the Farm of the Future, centered on digital technology and other innovations, and assembling a Water and Integrated Cropping Systems (WICS) team to coalesce water and Extension faculty across the university (p. 26).

In partnership with four Natural Resources Districts, and together with Nebraska Extension, we ramped up efforts in the Bazile Groundwater Management Area (p. 24). These efforts — aimed at cooperatively addressing rising groundwater nitrate levels — included hiring a new Extension educator responsible for educational programming, establishing demonstration farms, hosting outreach events and creating a new website.

We also share research priorities with DWFI, focusing on high productivity agriculture and supporting freshwater ecosystems and public health. For example, page 14 demonstrates how NWC catalyzed research that led to a Platte River charitable endowment and resources for producers in need following a canal collapse. Meanwhile, our postdoctoral scholars (p. 32) are performing cutting-edge water research in the field and in the cloud.

The Water Sciences Laboratory is another type of living lab and integral to keeping us competitive in state-of-the-art water research. 2020 marked the lab's 30th anniversary and their recent growth, on several fronts, is detailed in this report on page 10.

Though our state is fortunate to have natural resources, I also recognize the contributions of dedicated stakeholders like you. I hope you will learn from this annual report how our Nebraska partners enrich endeavors to make our state and university an international leader in water.

Thank you for helping us continue our mission and serve all Nebraskans for years to come.

A handwritten signature in black ink that reads "Chittaranjan Ray". The signature is written in a cursive, flowing style.

The Nebraska Water Center

NWC was established by Congressional mandate as one of 54 state-based Water Resources Research Institutes in 1964. We coordinate research and programs that support the University of Nebraska as an international leader in water research, teaching, extension and outreach.

Our fundamental goals are to:

- Coordinate a wide range of research impacting water issues
- Foster a deeper understanding of water and its many beneficial uses
- Help develop new water researchers
- Train future water researchers and engineers
- Extend water research results to water professionals and the public through publications, seminars and conferences, electronic media, lectures and tours

Timeline:



1964

Water Resources Research Act establishes NWC as one of 54 water centers nationwide

1968

Spring Water Seminar Series starts

1971

Annual Nebraska Water Conference inaugurated

1972

Nebraska Water and Natural Resources Tour begins

1990

University of Nebraska Water Sciences Laboratory (WSL) established

2006

Water Resources Advisory Panel (WRAP) established



To achieve these goals, we:

- Work collaboratively with the Water Resources Advisory Panel, NWC Advisory Board, University of Nebraska partners and local, state and federal stakeholders to direct and share research with water professionals and the public
- Support research and extension activities by connecting faculty to external collaborators and stakeholders, fostering interdisciplinary teams, informing faculty of funding opportunities and providing grants
- Aid new scientists through mentoring, seed grants and helping build their research portfolio
- Train future leaders in water science and management through educational programming, professional development, internships and fellowships

NWC is part of the Robert B. Daugherty Water for Food Global Institute at the University of Nebraska and part of the University of Nebraska–Lincoln’s Institute of Agriculture and Natural Resources.

Financial support for NWC and WSL comes from a combination of state, local and federal funding, as well as through partnerships with NGOs and industry.

For more information, visit: watercenter.unl.edu

2006

2012

2013

2014

2018

2019

2020

2012

NWC becomes a part of the Daugherty Water for Food Global Institute (DWFI)

2013

Chittaranjan Ray becomes NWC director

2014

NWC and DWFI move to Nebraska Innovation Campus offices

2018

In partnership with the National Institutes for Water Resources, NWC hosts regional symposium

2019

Water Tour travels to Wyoming and Montana; Water Conference hosted in Norfolk, Nebraska

2020

WSL celebrates 30th anniversary



IN MEMORIAM: Kyle Hoagland

April 24, 1951 – August 12, 2020

(Author's Note: This obituary is abbreviated from the original in the Aug. 26 Nebraska Today.)

Kyle Dean Hoagland, longtime professor in the School of Natural Resources, passed away Aug. 12 after a long battle with Parkinson's disease. He was 69.

Hoagland was born April 24, 1951, in Omaha, Nebraska, to Robert "Bob" and Eileene (Schultz) Hoagland and spent many summers on the family farm in Humboldt. His love of the outdoors led to an interest in aquatic ecology, water quality and the effect of herbicides on the microscopic algae that live in lakes and streams.

With degrees from Michigan State University, Eastern Michigan University and the University of Nebraska–Lincoln, Hoagland chose an academic career that took him to the University of Maine, Louisiana State University, Texas Christian University and ultimately back to the University of Nebraska–Lincoln, where he taught for more than 25 years. He served in a variety of administrative roles, including director of the Nebraska Water Center (2000-2009) and several stints as interim director of the School of Natural Resources. He was active in professional societies and published widely.

Hoagland was a popular professor, adviser and mentor to many students who went on to make contributions in academics, natural resource agencies and the environmental fields. His favorite class to teach was Limnology, the study of lakes and streams, which he taught in the summers at Cedar Point, the biological field station in Ogallala. He loved taking students to explore nearby aquatic wonders: the headwaters of Otter Creek, the Kingsley Dam toe drains and the Crescent Lake National Wildlife Refuge. He used these locations to demonstrate the infinite variety of ecological conditions and the resultant diversity of organisms.

Hoagland is survived by his significant other, Kristin Von Walz; his children, Aaron Z. Hoagland of Washington, D.C., and Sarah Z. Hoagland of Lincoln; his sisters, LeAnn (Neil) Merrifield of Pace, Florida, and Lori (Patrick) Umberger of Glenwood, Iowa; and nieces and nephews who remember him as the "fun" uncle: Megan Merrifield, Bryce Merrifield, Ben Umberger, Lydia Umberger, Samantha Umberger, Richard Barad, Sam Barad and Max Seiler. He was preceded in death by his parents.

RESEARCH



Nebraska is already a world leader in the intersection of water and food production, with much of that research centered in the Institute of Agriculture and Natural Resources and the Daugherty Water for Food Global Institute.



— Ronnie Green, Chancellor, University of Nebraska–Lincoln, 2021 State of the University Address

Water Sciences Lab Celebrates Memorable 30th Year

The Water Sciences Lab (WSL) had a landmark year in 2020.

The lab celebrated its 30th anniversary in style with new equipment, a renovated interior and commemorative publications. Then the global pandemic forced it to reconfigure operations. With numerous samples on deadline to be analyzed, WSL nimbly balanced new safety precautions with responsibilities to clients. The lab was among the first campus facilities to partially reopen following the COVID-19 shutdown.

The lab entered 2020 with a new Xevo TQS triple quadrupole mass spectrometer. The state-of-the-art mass spec is able to measure contaminants with 1,000 times the sensitivity of its older counterpart. In the fall, WSL co-hosted a technical workshop series with Waters Corporation — who makes the instrument — to train water scientists and professionals on its wide range of capabilities. The virtual workshops included presentations from a variety of institutions and countries and were attended by over 200 individuals representing universities, laboratories, government agencies, and private companies. Moreover, the facility has several current projects with Nebraska stakeholders, including Nebraska

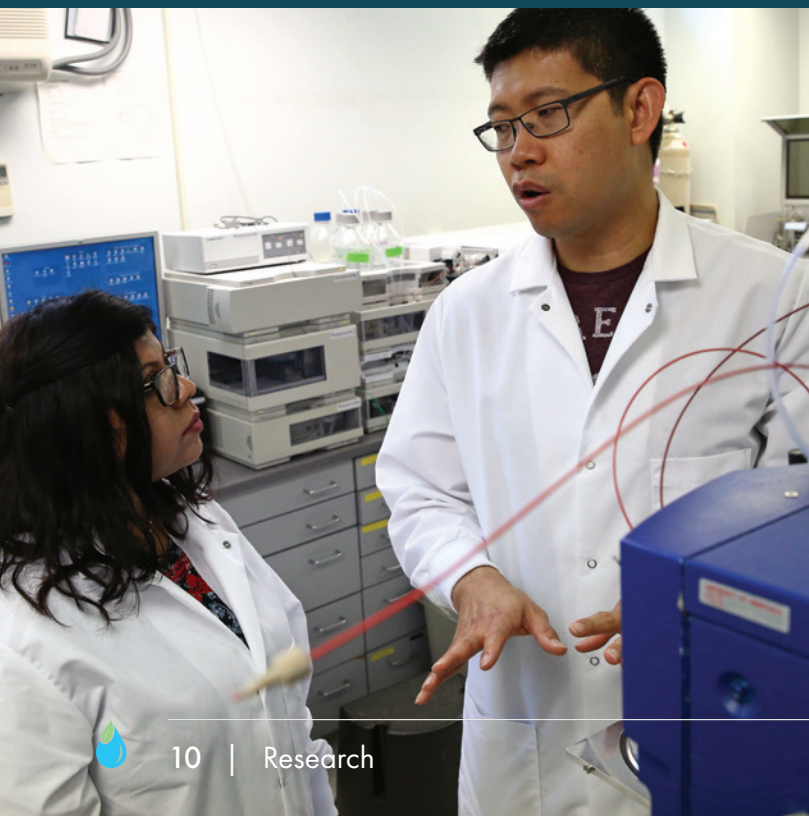
Lake Management; the Nemaha, Central Platte, Lower Platte South, Lower Platte North, Lower Loup and Upper Big Blue Natural Resources Districts; and Nebraska Game and Parks Commission, among others.

To grow awareness of the lab's capabilities, we developed a new brochure in partnership with University Communication. Additionally, a special edition of the Nebraska Water Current newsletter celebrated the lab's 30th anniversary through interviews with past and current lab members and leaders. Furthermore, the lab launched two new videos: a virtual tour of the facility and another on the Nebraska Vadose Zone project (see article on p. 12).

At the end of 2020, WSL took advantage of a federal surplus loan to educational institutions. This enabled it to add a relatively new inductively coupled plasma optical emission spectrometer (ICP-OES) and ion chromatography system from a Food and Drug Administration laboratory to its growing list of state-of-the-art equipment.

Looking ahead, WSL will launch a new environmental laboratory course (NRES 439/839) in fall 2021 for

WSL Research Technologist II Sathaporn (Tong) Onanong discusses lab equipment with visiting scholar Paromita Chakraborty



UNL Food Science graduate student Anamika Bagchi testing water at the lab.



WSL by the Numbers (2019-2020)

undergraduate and graduate students. Students wishing to pursue future laboratory positions, gain experiences to grow in academia or build stronger understandings of lab methods in environmental sciences will learn the analytical technologies and practices found in environmental laboratory testing. Environmental methods are unique in that they require a high level of measuring, quality control and management. Good laboratory practices ensure that results are consistent, reliable and reproducible at increasingly low concentrations.

Staff changes included the addition of Victoria Dey and Nathan Roddy. Victoria holds a B.S. in natural resource sciences from the University of Nebraska–Lincoln and serves as the lab’s research technician running the inductively coupled plasma mass spectrometer (ICP-MS) for trace elements. She also manages documentation, coordinates student training and organic contaminant methods. Nathan Roddy was recruited in fall 2020 to fill the isotope scientist position vacated by Aaron Shultis. He now runs the facility’s stable isotope and age dating instrumentation.

For more information on the lab, visit: watercenter.unl.edu/wsl



The Water Sciences Laboratory is another type of living lab and integral to keeping us competitive in state-of-the-art water research.

— Chittaranjan Ray



18,283

Samples Analyzed



38

NU Faculty
Clients Served



45

Non-NU
Clients Served



170

Analytical Methods Offered



1

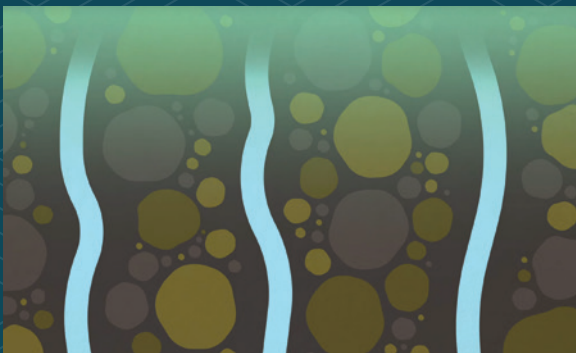
New Environmental Laboratory Course
to be Launched in Fall 2021

NWC Teams Up with Local Creative Company for Vadose Zone Video

For all its importance to Nebraska's water quality, the vadose zone is hard to grasp and harder to see. This zone — the interval between the crop root zone and the water table — is key to the storage, transport and transformation of chemicals that impact groundwater quality.

So in 2020, the Nebraska Water Center teamed up with local creative agency Redthread to give sight to the unseen. Several months and versions later, the team produced a two-minute video overview of the Nebraska Vadose Zone Program. The video features animations of water percolating through the zone (shown below) and highlights the project's importance to Nebraska's drinking water.

Watch the video and learn more about the program at: nebraskavadose.unl.edu/



A screenshot from the new video demonstrates the movement of water and particles through the vadose zone.



NWC Releases Vadose Zone Nitrate Report for City of Hastings

Several years ago, the City of Hastings tapped the University of Nebraska's Water Sciences Lab (WSL) to help better understand the quantity and movement of growing concentrations of nitrate and other agrichemicals stored underground near the city's wells. Specifically, the city wanted the lab's expertise in collecting and analyzing soil samples from the vadose zone — the layer between the land surface and groundwater table that acts as a skin of the earth and is key to regulating groundwater recharge and chemical movement. With more understanding of what's happening in this zone, the city can better predict groundwater contamination and how to implement interventions at the source.

Following years of study, the results are now in. In concert with the Nebraska Water Center and Hastings Utilities, the lab released its "Vadose Zone Nitrate-N Study: Final Report" in spring 2020. The 158-page report offers a detailed analysis of current masses of nitrate and pesticide in the vadose zone within the Hastings Wellhead Protection Area; estimated travel time from land surface to groundwater for various scenarios; and estimated potential for denitrification in the vadose zone and associated groundwater.

Hastings Utilities Environmental Supervisor Marty Stange has been a key partner throughout. He believes the report will be useful to help the city ensure current and future water quality.



WSL Director Dan Snow and University of Nebraska-Lincoln graduate student Craig Adams prepare a soil core from the vadose zone.



NWC, CSU Collaborate to Produce Water Current



To commemorate the final year of the Ogallala Water Coordinated Agriculture Project (OWCAP), NWC collaborated with Colorado State University to produce a special edition of the Water Current newsletter. The 32-page publication includes research briefs, graphics, pictures and in-depth articles on integrated hydrologic modeling, soil moisture monitoring, forage management and grazing, and the Testing Ag

Performance Solutions (TAPS) project.

The five-year research and outreach project — funded by the USDA’s National Institute of Food and Agriculture — involved nine institutions, including UNL (led by NWC). It focused on helping address groundwater declines and long-term agricultural sustainability in the region.

In February 2021, OWCAP hosted “Ogallala Aquifer Virtual Summit: Tackling Tough Questions.” The event built upon the momentum of the inaugural summit in 2018; increased networking and collaboration; encouraged momentum of activities; and identified common vision, practices, and opportunities that have potential to benefit the aquifer region over the short and long-term.

View the newsletter at: go.unl.edu/owcap
More on OWCAP available at: ogallalawater.org/

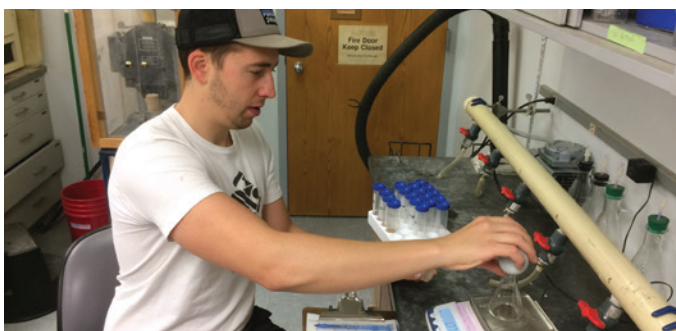


“This allows us to better understand where we need to implement best management practices. The future for us is to look at a contaminant’s rate of travel through that vadose zone and what we can do to control it,” Stange said.

In Nebraska, four out of every five residents get their drinking water from groundwater. At 25,000 residents, Hastings is one of the larger municipalities in Nebraska with nitrate contamination concerns. But it’s a concern shared by towns and cities across the state. This motivated NWC and WSL to create the Nebraska Vadose Zone Program — a one-of-a-kind agrichemical data repository to help manage and improve the state’s groundwater and drinking water quality. The Hastings sites are part of over 300 statewide whose data is available through the repository.

“The Nebraska Vadose website provides data directly to NRD managers and utilities managers who are determining land use and cropping management policies to reduce nitrate and agrichemical loading to the water table,” said Dan Snow, a co-author on the Hastings report and director of services at WSL.

In addition to Snow, the report’s authors include NWC Director Chittaranjan Ray, WSL Postdoctoral Research Associate Arindam Malakar, NWC Postdoctoral Research Associate Jahangeer, and UNL School of Natural Resources graduate student Craig Adams.



Craig Adams analyzes soil samples in the lab. His master’s thesis focused on the movement and storage of nitrate in the vadose zone in and around Hastings.

Platte River Resilience Fund



Jason Farnsworth

Jason Farnsworth remembers how it almost wasn't.

Farnsworth, Executive Director of the Platte River Recovery Implementation Program, remembered the challenges facing the Water for Agriculture project's Central Platte leadership team: "We were about one or

two meetings away from crashing and burning." The group struggled to coalesce around a subject until the idea of an endowment emerged.

"At that point," he noted, "our process was transformed into something that was very proactive and moved very quickly."

Ultimately, that endowment became the Platte River Resilience Fund. The Nebraska Community Foundation-managed fund seeks to "develop a source of funds for long-term support of activities that will ensure conveyance of water on the Platte River system in Nebraska." Activities to be funded will initially focus on control of invasive plant species — particularly Phragmites — but may include other actions necessary to support water conveyance. The fund's geographic focus will be the Platte River system from Kingsley Dam and the South Platte River at the Colorado border downstream to the Highway 81 bridge at Columbus.

Phragmites is an aggressive weed. Along parts of the Platte River, it forms dense strands over large areas, restricting water movement, trapping sediment and impacting irrigation, flooding, habitat and recreation. While a native variant exists, it was only recently discovered that a non-native species exists and is found over much of North America.

To contribute to the fund, visit: nebcommfound.org/give/platte-river-resilience-fund/



Phragmites

Water for Agriculture Project Hits Stride across Nebraska

A few years ago, as NWC Director Chittaranjan Ray and University of Nebraska scientists worked with other states on water-related projects, it became obvious one aspect of proposed research was missing: how to best engage and communicate with stakeholders to ensure successful mitigation of their water challenges.

Mark Burbach, an environmental scientist with the University of Nebraska—Lincoln's School of Natural Resources, explained: "The biophysical piece is only one component. What can make the biggest difference is knowing what's important to water users — respecting their values and interests and creating grassroots community-driven solutions."

In 2017, the USDA's National Institute of Food and Agriculture awarded \$5 million for a four-year, multistate project to bridge this divide. The research team includes six UNL researchers, with Burbach leading the Nebraska contingent, plus 12 colleagues from Penn State University, Arizona State University, and the USDA's Agricultural Research Service (ARS). The overall project is led by Penn State rural sociologist Kathryn Brasier.

One of the most powerful aspects of the Water for Agriculture project is its diverse case-study locations representing different water issues and settings. Burbach said, "The end game ultimately is a new model of stakeholder engagement that recognizes water and ag issues are most important to people affected and leads to improved water quality and quantity in their own communities." The team eventually will make the model available internationally.

In the past two years, following extensive interviews with local stakeholders, local leadership teams formed in the Central and North Platte River valleys. While the former identified conveyance of water along the Platte River with a focus on invasive species, the latter team focused on water infrastructure following the July 2019 collapse of the Goshen/Gering-Fort Laramie canal. (See sidebars on local leadership team projects.) Several members of the research team participated in NWC's August 2020 Mini-Conference (p. 21).





In addition to the tangible outcomes, the process of teams identifying a mutual water problem and formulating a resolution yielded important findings. “We are gaining great insights on what changes within individuals as a consequence of community-led engagement,” Burbach noted. In 2021, the researchers are planning to release interactive story maps to visualize the issues that gave rise to each team’s final product.

Originally set to conclude this summer, a one-year no-cost extension is anticipated from USDA-NIFA until June 30, 2022.

In addition to Burbach and Ray, other participants from the University of Nebraska–Lincoln include agricultural economists Lilyan Fulginiti and Richard Perrin, Department of Agricultural Economics; crops-economic risk management Extension educator Jessica Grosskopf and entrepreneurship/business development Extension specialist Cheryl Burkhart-Kriesel, Panhandle Research and Extension Center, Scottsbluff; and Daran Rudnick, irrigation management specialist, Department of Biological Systems Engineering.

For more information, visit: water4ag.psu.edu/



The Water for Agriculture project’s North Platte Leadership Team convenes for a brainstorming session.

Yonts Water Conference

In some ways, the Water for Agriculture North Platte leadership team’s decision was made easy. On July 17, 2019, the collapse of the 103-year-old Gering-Ft. Laramie canal — which transports water from the North Platte River to irrigate 100,000 acres in eastern Wyoming and western Nebraska — created turmoil for farmers precisely when they most needed water. While the collapse triggered a six-week stoppage in water delivery, it also generated an opportunity for the team.

“It actually caused our local leadership team to really have a purpose,” explained Jessica Grosskopf, the team’s facilitator and UNL crops-economic risk management Extension educator.

With the clock ticking, the group went to work. They convened U.S. Bureau of Reclamation representatives, the local Natural Resource District, irrigation districts, area state senators and farmers to talk through what the collapse really meant — both now and to the future. Ultimately, this culminated in the Yonts Water Conference: a comprehensive, day-long virtual event about water and infrastructure in the North Platte valley. The presentations have attracted nearly 400 views since being posted. The North Platte team is planning another conference in April 2021 pending University approval to hold an in-person conference.

For winter 2021, the Water for Agriculture team is also preparing a survey of ag producers and non-farm residents on water and ag issues in the North and Central Platte regions.

Watch the Yonts Water Conference at: extension.unl.edu/statewide/panhandle/yonts-water-conference/



A still image from one of the Yonts Water Conference’s many video presentations.



Nebraska Water Center Director Receives Prestigious National Award

Chittaranjan Ray

NWC Director Chittaranjan Ray received the 2020 Samuel Arnold Greeley Award, one of the highest research paper awards from the American Society of Civil Engineers (ASCE). The paper, “Decay Kinetics of Chlorite under Simulated Distribution System Conditions,” was co-authored by Ray’s former student Mongkolaya Rungvetvuthivitaya, at the University of Hawaii; collaborators at Louisville Water Company; and Tian Zhang, professor in UNL’s civil and environmental engineering department. Co-authors included Louisville Water’s Director of Water Quality Rengao Song, Senior Scientist Mark Campbell, and Manager of Water Research Eric Zhu. Instituted in 1968, the Greeley Award is given annually to the authors of a recent paper published in an ASCE journal that “makes the most valuable contribution to the environmental engineering profession.” The paper was published in the *Journal of Environmental Engineering* in April 2019.

The research paper outlines a model that can be used to help combat nitrification in municipal water distribution systems using chloramines for wastewater disinfection. During summer months, nitrifying bacteria can breakdown chloramine, reduce the effectiveness of the disinfectant present and allow the growth of other bacteria in tanks and pipes. The study showed that chlorite ions (not the chloride ions present in common salt) added at low concentrations can reduce the decay of chloramines. From a set of experiments simulating ambient conditions with chloramines present, a model was developed to show the decay of chlorite as a function of chloramine concentration and other environmental conditions. Utilities can use the model as a guide for chlorite feed concentration and in estimating chlorite decay in the distribution system.

The award is usually presented at the annual Environmental & Water Resources Institute Congress, but the 2020 meeting was cancelled due to COVID-19 concerns. The ASCE started this award in 1968 in honor of Greeley, who was a past director. According to the ASCE, the Greeley Award is open to original papers, “dealing with the design, construction, operation or financing of water supply, pollution control, storm drainage or solid waste collection and disposal facilities.”



NWC Distributes U.S. Geological Survey 104b Funds to Address Water Quality and Quantity

Every year, the Nebraska Water Center (NWC) awards United States Geological Survey (USGS) funding for projects intended to address water challenges in Nebraska. The competitive selection process includes reviews by a panel of fellow colleagues. In 2020, four projects were chosen and each focused on contaminated water in Nebraska. NWC assembled research briefs to provide an overview of the projects and researchers behind them.

Selected Projects Awarded Funding from March 1, 2020, through February 28, 2021:

1. *Setting Nitrogen Surplus Benchmarks to Control Nitrate Pollution of Groundwater in Northeast Nebraska*; PI: Mesfin Mekonnen, Research Assistant Professor, Daugherty Water for Food Global Institute (Mekonnen is now an Assistant Professor at the University of Alabama)
2. *Monitoring of Nitrate Leaching At and Below Crops Rooting Depth*; PI: Javed Iqbal, Assistant Professor, Department of Agronomy and Horticulture, University of Nebraska–Lincoln
3. *PFAS Exposure from WWTPs to Surface Waters and Agricultural Fields*; PI: Tiffany Messer, Water Quality Engineer and Assistant Professor, Department of Biological Systems Engineering, University of Nebraska–Lincoln (Messer is now an Assistant Professor at the University of Kentucky)
4. *Bank Filtration: An Efficient and Economical Water Treatment Technology for Cyanotoxins Removal*; PI's: Matteo D'Alessio and Saptashati (Tania) Biswas, University of Nebraska–Lincoln (D'Alessio is now an Assistant Professor at the University of Mississippi)



Mesfin Mekonnen

Setting Nitrogen Surplus Benchmarks to Control Nitrate Pollution of Groundwater in Northeast Nebraska

By Gabrielle Boucher, NWC student intern

With the high volume of farming in Nebraska, nitrate levels in groundwater have been an issue for quite some time as agriculture has contributed high concentrations of this contaminant. Even with efforts to control concentrations from various organizations, including Natural Resource Districts (NRDs) and Nebraska's Department of Environment and Energy (NDEE), nitrate levels are still on the rise. This is perplexing because multiple policies and technologies to reduce contamination have so far been unsuccessful. Mesfin Mekonnen believes it is vital to conduct research on sources of contamination in order to create improvements concerning the control of nitrate concentrations in Nebraska.

Mekonnen is a research assistant professor with the Daugherty Water for Food Global Institute. He is originally from Ethiopia and has been in Nebraska for four years. He is excited to lead a USGS 104b project titled "Setting Nitrogen Surplus Benchmarks to Control Nitrate Pollution of Groundwater in Northeast Nebraska." The project's focus is to evaluate sources of nitrogen aside from fertilizer. Mekonnen noticed a gap between the amount of research on fertilizer-based nitrogen and non-fertilizer sources, so he is seeking to answer whether significant nitrogen contamination comes from sources other than fertilizer. The research completed for this project will estimate nitrogen input and output from various sources in four northeast Nebraska NRDs.

So how does he propose to measure this surplus? For context, Mekonnen defines nitrogen surplus as the difference between the amount of nitrogen coming in and going out. In some places that surplus could be negative, but here in Nebraska, it is typically

Continued on next page...

Setting Nitrogen Surplus Benchmarks to Control Nitrate Pollution of Groundwater in Northeast Nebraska (Cont'd)

positive. For this research, nitrogen surplus will be evaluated in rural areas by determining the input of nitrogen from fertilizers, manures, deposition, fixation, and irrigation water, as well as outputs from harvested crops and grass, crop residues, and gases. This contrasts with other research that focuses only on fertilizers. The novelty of this study will hopefully broaden ideas of where nitrogen contamination comes from in Nebraska.

Mekonnen expects results to show “nitrogen fertilizer application will be the major problem, but he can also see an input from manure plus what we don’t consider in most cases — rural places that use septic tanks.” This will hopefully extend beyond meeting research objectives and deliver information that can be used to conserve resources and protect Nebraska. Ultimately, this project may inspire other researchers to look into these ideas.

This project began on March 1, 2020, and results are expected within one year. Mekonnen will be working alongside Dan Snow, director of the University of Nebraska–Lincoln’s Water Sciences Laboratory and Dan Miller, USDA-ARS research microbiologist.

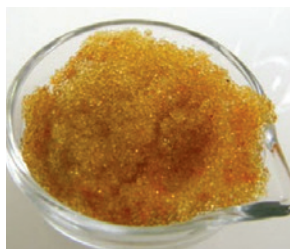


Javed Iqbal

Monitoring of Nitrate Leaching at and Below Crops Rooting Depth

By Gabrielle Boucher, NWC student intern

Javed Iqbal is an assistant professor in the University of Nebraska–Lincoln's Department of Agronomy and Horticulture, with expertise in soil and water sciences. Through a USGS 104b grant, Iqbal is leading a project named “Monitoring of Nitrate Leaching at and Below Crops Rooting Depth.” This project will examine different methods of measuring nitrate (NO_3) in soil profiles. Nitrate, the most prevalent and concerning water contaminant in Nebraska, can lead to negative health effects. However, there is currently no standard method for estimating nitrate leaching rates into the subsurface. The project’s goal is to evaluate two well-known methods and determine which one most accurately predicts concentrations of nitrate while accounting for cost, reliability and time.



Ion Exchange Resin

The two methods Iqbal and his team will evaluate are lysimeters and ion exchange resins. There are pros and cons to each method. Lysimeters provide highly accurate measurements compared to other methods. However, this method is laborious and requires visiting the site twice to get one measurement. Ion exchange resins also give good estimates and take less time than lysimeters, but have been known to over or underestimate concentrations. Iqbal describes ion exchange resins as “the materials that could absorb different ions, [such as] nitrate and ammonium that have both positive and negative charges.” These ions are absorbed as water moves through them and then the materials can be analyzed in the lab. While there are other methods to estimate concentrations, he has chosen these methods because they are widespread and some methods cannot be compared.

Iqbal’s first objective is to determine which method is best. His team will also take samples from fields using different farming management practices to see how they affect the results. The project will collect samples from an easily accessible site in Northeast Nebraska’s Bazile Groundwater Management Area. Through this project, Iqbal will directly address two of Nebraska’s top ten water challenges: nitrate contamination and emerging contaminants.

The project began in April 2020 and concluded in the fall, in line with the growing season. Intervals between sampling will be between two weeks to a month, depending on rainfall and time of season. Iqbal will lead the project with assistance from Dan Snow, director of UNL’s Water Sciences Laboratory, and a graduate student. He expects ion exchange resins to be easiest to install and



collect samples from. The team hopes to identify the method that is the most efficient and accurate and use that in future projects to evaluate the effect of different management practices. This will provide data to support best management practices to reduce the concentration of nitrate leaching in soils.

This project is intended to discover valuable information about measuring nitrate leaching concentrations in soils for future projects. Iqbal and his team are looking forward to this project and to continuing to improve the state of Nebraska's groundwater.



Tiffany Messer

PFAS Exposure from WWTPs to Surface Waters and Agricultural Fields

By Gabrielle Boucher, NWC student intern

Polyfluoroalkyl Substances, or PFAS, are emerging contaminants that can stem from many different sources — the main two being manufacturing and household products such as non-stick pans, water repellent fabrics, and some cleaning supplies. Researchers note the likely source of PFAS in biosolids from Wastewater Treatment Plants (WWTPs) come from household cleaning products. Biosolids are leftover organic materials from domestic sewage treatment and are often applied to agricultural farms. Furthermore, PFAS found in these biosolids are persistent and quite difficult to degrade and remove. PFAS are a known carcinogen that can cause various health issues, such as increased cholesterol levels.

Tiffany Messer is a water quality engineer and assistant professor in the University of Nebraska–Lincoln's Department of Biological Systems Engineering. Through USGS 104b funding, she is leading a project named “PFAS Exposure from WWTPs to Surface Waters and Agricultural Fields.” Her team will focus on determining movement and fate of PFAS from WWTPs to agroecosystems receiving biosolids as well as quantifying PFAS in these agroecosystems. Messer is doing this research to fill significant knowledge gaps on PFAS in agriculture and how they move in agroecosystems, noting “there have, to our knowledge, been no studies looking at fate and transport of PFAS in agricultural settings.” She intends for this project to serve as seed data. This is likely the first study of its kind and will address one of Nebraska's top 10 water challenges.

The project will consist of applying biosolids from Lincoln's Wastewater System to nearby Rogers Farm along with some controls, and assessing how much PFAS is lost from runoff when it rains. By removing and analyzing soil cores, Messer's team will evaluate PFAS' persistence and how it moves in the soil. The last part of the project is assessing sites upstream and downstream of a WWTP to see how PFAS concentrations vary. To analyze samples, the team will use the Water Sciences Laboratory, and specifically its new mass-spectrometer (p. 10).

Based on previous studies in manufacturing, Messer expects “we will see PFAS in the biosolids because we anticipate it coming into the treatment plant and there isn't much degradation or removal in processes currently.” She also expects the PFAS to be leaving the field through water runoff. However, it's difficult to say whether the levels are toxic since this is the first study of its kind. This project will provide valuable information about PFAS in agroecosystems so communities can move forward to address this emerging contaminant.

This project raises a crucial question: what to do if levels are toxic? Messer has already been brainstorming ways to address this outcome with another UNL researcher, Steve Comfort. He recently submitted a proposal to the EPA on a method he is developing to remove PFAS from WWTPs. To gain more data from agroecosystems, she also plans to submit proposals for similar but larger scale projects.

Messer and her team started this project in early April 2020 and finished in October in line with the growing season. They planned to deliver results by winter. She will be working alongside two undergraduates who will help lead the project, as well as with Shannon Bartelt-Hunt, department chair of civil and environmental engineering at UNL, and Dan Snow, director of the UNL Water Sciences Laboratory. The team is excited to get started and see the impact this study will have on Nebraska.

EXTENSION & OUTREACH



The Water and Integrated Cropping Systems (WICS) Hub is leveraging the knowledge gained from our Extension team faculty who are driving the innovations in this space.



— Michael Boehm, Vice Chancellor, Institute of Agriculture and Natural Resources, University of Nebraska–Lincoln, IANR All Hands Meeting, January 2021

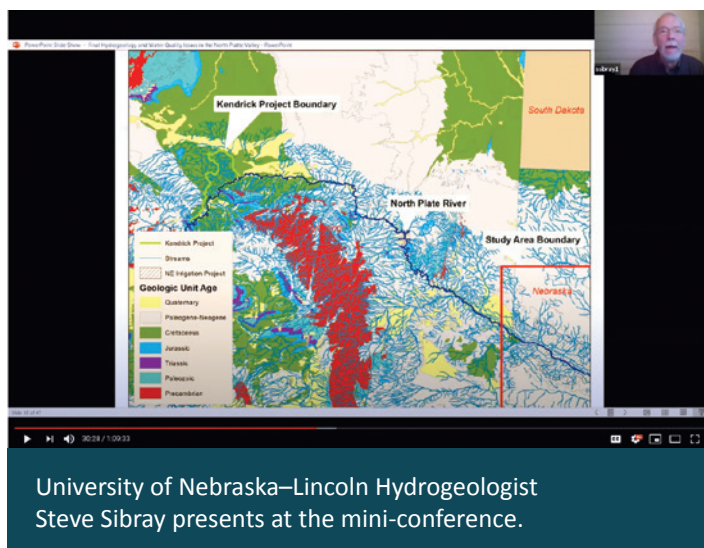


NWC Hosts August 2020 Mini-Conference

The Nebraska Water Center (NWC) hosted a virtual mini-conference on August 3, 2020, for and featuring stakeholders around the state. The event was held on the same day that its annual in-person water conference would have occurred in Scottsbluff. That conference — a partnership between UNL’s Panhandle Research and Extension Center and the North Platte Natural Resources District — is tentatively scheduled to return in summer 2021.

The mini-conference featured two sessions on western Nebraska’s water resources. The first included Nebraska researchers Steve Sibray and Troy Gilmore who presented western Nebraska’s unique hydrogeology. The second one featured the Water for Agriculture Project, a USDA-NIFA-funded effort focused on stakeholder engagement for addressing critical issues at the nexus of water and agriculture. Presenters included Nebraska team members Mark Burbach and Jessica Groskopf, and collaborators Weston Eaton, Penn State University; Jason Farnsworth, Platte River Recovery and Implementation Program; and Janeene Brown, Dines Irrigation.

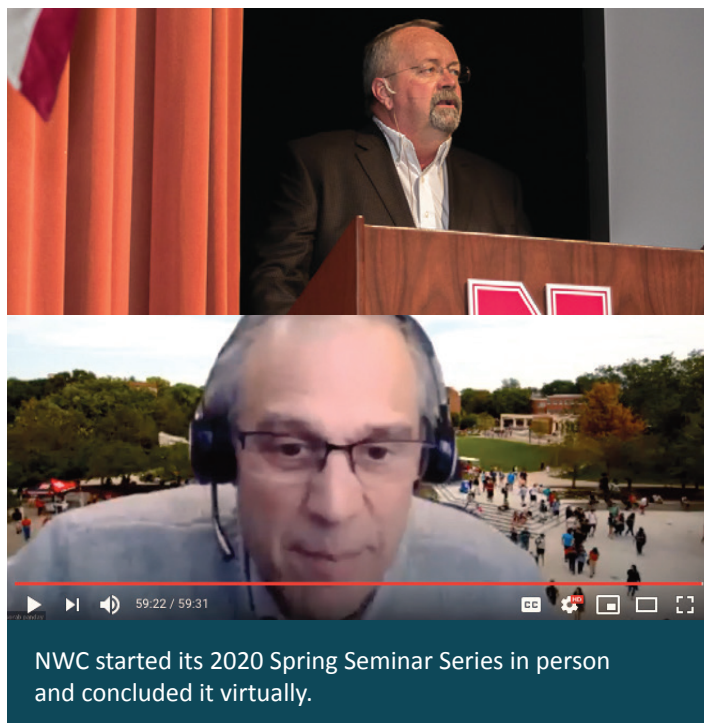
Both sessions are available on NWC’s YouTube channel.



2020 Spring Water Seminars

Every spring since 1968, NWC has hosted its spring seminar series. 2020, however, was the first to be transformed by a global pandemic. With a theme of “Current Issues in Nebraska Water,” the first four seminars were held in-person at Hardin Hall on the University of Nebraska–Lincoln’s East Campus. On March 4, Nebraska producer Roric Paulman presented the final in-person seminar and was honored with the Maurice Kremer Groundwater Achievement Award. Following the cancellation of one seminar, the final two shifted online to Zoom. The April 8 seminar featured the Know Your Well project while the finale on April 22 focused on groundwater modeling.

While in-person seminars were well attended, their virtual counterparts did slightly better with an average of 50 participants. The theme of the 2021 series is “Tributaries: Race, Justice and the Environment” and will run from early February to early May.



NWC takes 2019 Conference on the Road

Nearly 200 water managers, conservationists, policymakers, students, researchers, community members and producers gathered in Norfolk for the 2019 Nebraska Water Conference, held Oct. 9 and 10, at the Divots Conference Center. The conference, entitled “Building a Clean Water Future in Northeast Nebraska,” was the first in over 10 years to be held outside of Lincoln.

The event focused on three core pillars: water quality and public health, innovative solutions to current problems and community engagement. The latter topic included presentations by students from Newman Grove and Madison Senior High Schools who analyzed the water quality in their local watersheds. Both presentations drew rave reviews from conference attendees.

For more information, visit: watercenter.unl.edu/2019-nebraska-water-conference



Marty Link (L), former Nebraska Department of Environment and Energy water quality division administrator, visits over a break at the conference.



Members of the local media, including News Channel Nebraska, reported from the conference.

2019 Water and Natural Resources Tour

For the first time in its 48-year history, the Nebraska Water and Natural Resources Tour traveled to Montana’s “Big Sky Country.” Organized yearly by the Nebraska Water Center and Central Nebraska Public Power and Irrigation District, the 2019 tour blended Native American history, the Lewis and Clark Expedition and a daytrip to Yellowstone National Park with contemporary issues in agricultural, municipal and recreational water use in Montana and Wyoming. Forty-six participants from across Nebraska joined the tour, which was held September 15-19.

For more information, visit: watercenter.unl.edu/2019-water-natural-resources-tour



Local sage Paul Clifford shares stories about the Missouri River at its headwaters in Three Forks, Montana.



One of the 10,000 thermal features spread across majestic Yellowstone National Park.



Nebraska Water Center, UNL Extension Convene Nitrate Workshops



January 2020's initial nitrate strategy meeting was held just before the pandemic arrived.



Though different in look and feel, nitrate working groups continued to meet throughout the fall of 2020.

Throughout 2020's countless twists and turns, working to address nitrate challenges in Nebraska proved to be a constant.

Well before the pandemic, NWC and partners in Nebraska Extension began convening leaders from across the state to explore new ways to approach an old water challenge. When nitrate from excess fertilizer applications enters groundwater, they can contaminate municipal and domestic water supplies and lead to a range of human health hazards.

In January 2020, 40-plus participants from diverse backgrounds gathered for the initial nitrate strategy meeting. The group zeroed in on four major categories: building trust and promoting pride and awareness in Nebraska's water resources; education; policy; and development of alternative markets for low-nitrogen cropping systems.

Facilitated by NWC's Research and Extension Communications Specialist Crystal Powers and Nebraska Extension's Associate Extension Educator Katie Pekarek, the meeting sparked the development of short-term, cross-sector priorities to improve nitrate-water quality issues. Furthermore, they identified working groups to achieve these priorities and committed to the goal of ensuring that all Nebraskans have access to safe drinking water.

"The Nitrate Working Group has provided valuable input to better understand the concerns and level of knowledge of various stakeholders. One of the significant benefits has been our understanding of the importance of communicating with non-traditional stakeholders as they have an important role in implementing Best Management Practices to protect our groundwater," said Hastings Utilities Environmental Director Marty Stange.

Following a pandemic-induced hiatus, the nitrate meetings rebooted in September with working group meetings focused on policy, producer education and awareness. These groups are working on specific multi-sector collaborative proposals. These proposals will be brought back to the leadership of the organizations involved by summer 2021, with a goal of beginning implementation in the fall.

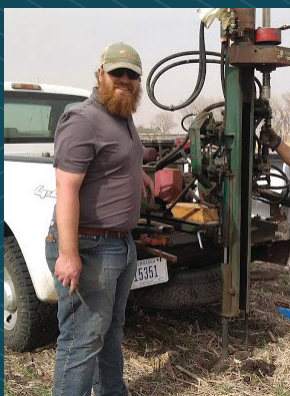
Overall, more than 65 individuals have participated in the nitrate meetings, including representatives from NWC, DWFI, Natural Resources Districts, the Nebraska Association of Resources Districts, Nebraska Farm Bureau, Nebraska Corn Board, Nebraska Agri-Business Association, Nebraska Game and Parks Commission, U.S. Geological Survey, National Resources Conservation Service, UNL Administration, Nebraska Department of Environment and Energy, University of Nebraska Foundation, Shell Creek Watershed Group, GC Resolve, Nature Conservancy of Nebraska, Nebraska Sierra Club, Nebraska Department of Health and Human Services, Groundwater Foundation, and growers.

Bazile Groundwater Management Area Extension Educator

Note: This article was originally written in 2019 by Bill Kranz, then associate director of the University of Nebraska–Lincoln’s Northeast Extension District, for the website water.unl.edu.

Please welcome Jeremy Milander to Nebraska Extension. Jeremy will assume his new role as an Assistant Extension Educator in mid-April and will have specific responsibilities in the Bazile Water Management Area in northeast Nebraska. He will work with four Natural Resources Districts to develop an educational program aimed at stabilizing the nitrate concentration in ground water. Jeremy will also work with a stakeholder group to implement field demonstrations funded by a Nebraska Environmental Trust grant.

Jeremy grew up near Coleridge, Nebraska, and earned his bachelor and master of science degrees in agronomy at UNL. His master’s work included assessing the impact of management practices on the yield components of corn. He has worked with the soil science program at the Haskell Ag Lab for the past two years where he assisted with a cover crop study and a long-term tillage and crop rotation study.



Jeremy Milander

Jeremy’s office will be located at the Lower Elkhorn NRD Office in Norfolk located at 1508 Square Turn Blvd. He can be reached at 402-371-7313 and jeremy.milander@unl.edu.

Bazile Groundwater Management Area Makes Big Strides

The Bazile Groundwater Management Area (BGMA) is a 756-square mile area with high groundwater nitrate levels in three northeast Nebraska counties. For the past several years, the Nebraska Water Center and UNL Extension have partnered with four area Natural Resources Districts (NRDs) and state and federal agencies to innovatively address these high nitrate levels on multiple fronts.

BGMA — About Us



The Bazile Groundwater Management Area is comprised of land located within four Natural Resources Districts (NRDs) including the **Lewis and Clark NRD**, **Lower Elkhorn NRD**, **Lower Niobrara NRD** and the **Upper Elkhorn NRD**.



The BGMA recently launched a new website, pictured here.



In 2019, NWC submitted a Nebraska Environmental Trust (NET) grant that helped establish local demonstration farms that model different management practices to reduce nitrogen leaching. The three demonstration farms planted in 2020 include diverse cropping rotations at the Lower Elkhorn NRD, nitrogen inhibitors at the Upper Elkhorn NRD, and soil health at the Lewis & Clark NRD. Advanced technologies like Variable Rate Irrigation (VRI) and soil moisture probes will augment the evaluation of nitrate leaching. NWC played a lead role in establishing an Extension educator position that oversees the on-farm demonstrations and educational programs. *(See sidebar on UNL Extension Educator Jeremy Milander.)*

In September 2020, UNL helped organize a Demo Farm Field Day with university speakers, industry experts and producers focused on cover crops, no-till farming and VRI. Fifty-two attendees — from a local Future Farmers of America chapter to current farmers and agriculture industry professionals — gained several takeaways, including how practices that promote soil health are economically viable and how cover crops preserve soil integrity.

Complementing these efforts is a new NET-funded citizen science project. Named “Project Citizen Science: A Valuable Approach for Monitoring Groundwater Quality in the Bazile Groundwater Management Area,” the project includes five area high schools: Wausa, Orchard, Creighton, Plainview, and Osmond. The project will help each school sample 30 rural wells through science classes, clubs and Future Farmers of America (FFA) chapters. Former UNL Research Assistant Professor Matteo D’Alessio and civil engineering graduate student Luke Walkenhorst are leading the project. The duo intends to improve upon the methodology of the Know Your Well project.

Lastly, in winter 2021, the BGMA held a series of one-hour virtual meetings with distinguished guest lecturers and UNL water and soil science faculty. Created in 2016, the BGMA plan developed by the local NRDs and Nebraska Department of Environment and Energy was the first federally recognized groundwater-focused plan to address nonpoint source pollution in the nation.

For more information, visit: bgma.nebraska.gov/

Soil sampling at the BGMA demonstration farm in November 2020.



NWC, IANR Partner to Lead Water and Integrated Cropping Systems (WICS) Hub

It started on the back of the proverbial envelope.

That is where Ron Yoder, senior associate vice chancellor with the University of Nebraska–Lincoln’s Institute of Agriculture and Natural Resources (IANR), began to sketch two overlapping circles. A few years ago, Yoder was tasked with bringing together the university’s dispersed water community — starting within IANR.

“I spent a lot of time doodling with circles, arrows and clusters,” he recalled. “Ultimately, I realized the Venn diagram which has crops in one circle and water in another and where they intersect — that’s a pretty large intersection.”

One of the recurring themes during his exploration was water quality.

“You can’t really talk about addressing water quality over a large geographic part of Nebraska without talking about crops.”

Fast forward to fall 2020. That’s when the etched circles began to be filled in. On October 27, over 120 Nebraska faculty, staff, administrators, and Extension educators joined the inaugural meeting of the Water and Integrated Cropping Systems (WICS) team. Organized by Yoder and a new leadership team, including Crystal Powers, NWC’s research and Extension communications specialist, the virtual meet-up was a springboard for future collaborations.

“Our goals for the meeting tracked our initial goals for the team: celebrate the depth of expertise we have and gain feedback on how we can strengthen communication, connections, and collaboration, with the overall intent of enhancing our reach and impacts across Nebraska,” said Powers.

Following the meeting, Powers developed several key ingredients to enable faculty collaborators to come together, including:

- Virtual collaboration space for WICS Hub to facilitate communication between members
- Team directory that includes edit access for members to update their information
- Team map to visualize members and their connections. The clickable map includes three preset views which can be changed according to topics, departments and teams. A publicly available website with the map is forthcoming.
- Inventory of existing small teams (i.e., projects).

In addition to Powers, Yoder assembled a leadership team steered by Chittaranjan Ray, NWC director; Water Program Leader Daran Rudnick, assistant professor, Department of Biological Systems Engineering, UNL; Cropping Program Leader Daren Redfearn, associate professor, Department of Agronomy and Horticulture, UNL; and Economics Program Leader John Westra, associate research and extension director, Nebraska Extension.

As the team continues to come together, these resources will be shared with partners across the state. If you would like to learn more, or be added to the team, contact Crystal Powers at cpowers@nebraska.edu.



The Water and Integrated Cropping Systems Hub is bringing together water experts from across the university.



Nebraska State Legislature Designates Funding for Water Research

Water is the lifeblood of Nebraska. It supports the state's \$25 billion agricultural economy, sustains wildlife and the environment, and provides the water needed for healthy daily living.

Improving water management can make a tremendous difference in Nebraska's economy and quality of life for its citizens — a fact recognized when Governor Pete Ricketts signed Nebraska's 2021 state budget bill in August 2020. The bill designates \$500,000 annually to the Daugherty Water for Food Global Institute (DWFI) at the University of Nebraska — which includes the Nebraska Water Center — for water research in the state.

This state funding will help advance the institute's work in Nebraska — from drought and flood prediction and mitigation, to water quality improvement and innovative technology development that will maximize agricultural production while sustaining our valuable water resources.

With this budget allocation, the people of Nebraska have entrusted DWFI and the University of Nebraska to keep a strong water future flowing for the next generation. DWFI joins the leaders of the University of Nebraska system in thanking Governor Ricketts for signing the budget package, Senator John Stinner and the Appropriations Committee for their work on the budget, and Senator Kate Bolz for leading the effort to invest in water research at the university.

The Nebraska State Capitol in Lincoln



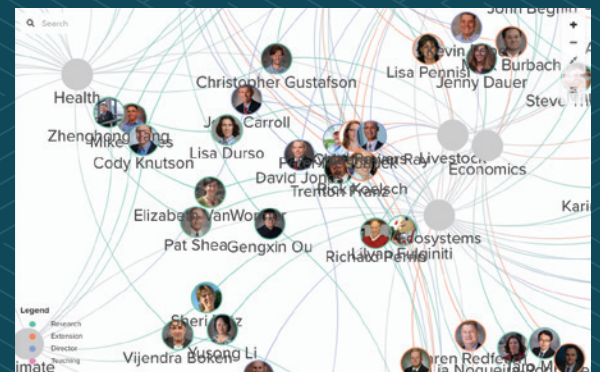
NWC Creates Interactive Water Faculty Directory

Connecting faculty from across the state with each other and stakeholders is a key part of the Nebraska Water Center's mission. Several years ago, the center published a printed directory that included faculty contact information, publications and research interests. But as time passed the dated directory needed a fresh start.

In summer 2019, NWC Research and Extension Communications Specialist Crystal Powers took on this task. Through Kumo, a network mapping software, Powers gathered faculty and sorted them based on their research interests and appointments, including research, teaching, extension and administration. The clickable, searchable map, available on NWC's website, looks somewhat like the route map of a major airline. The ability to quickly update the directory is a big advantage over its print predecessor.

Moreover, the new version visualizes connections between NWC faculty on various broad water topics. Ultimately, the goal is for the directory to be a valuable resource for collaborations both within academia and partners throughout Nebraska.

See the directory at: watercenter.unl.edu/directory



The new interactive water faculty directory.

2019-2020 WRAP Members

- **Mark Brohman**
Nebraska Environmental Trust
- **Tom Riley**
Nebraska Department of Natural Resources
- **Jason Farnsworth**
Platte River Recovery Implementation Program
- **Eugene Glock**
Cedar Bell Farms
- **Mace Hack**
The Nature Conservancy, Nebraska
- **Senator Steve Halloran**
Chair, Agriculture Committee, District 33, Nebraska Legislature
- **Senator Dan Hughes**
Chair, Executive Board, District 44, Nebraska Legislature
- **Michelle Koch**
Nebraska Game and Parks Commission
- **Matt Lukasiewicz**
Farwell Irrigation District
- **Jim Macy**
Nebraska Department of Environment and Energy
- **Mike Sousek**
Lower Elkhorn NRD
- **Lee Orton**
Nebraska Well Drillers Association
- **Jay Rempe**
Nebraska Farm Bureau Federation
- **Marty Stange**
Hastings Utilities
- **Dayle Williamson (retired)**
Offices of Senator Ben Nelson and Nebraska Natural Resources Commission

Water Resources Advisory Panel

Editor's Note: The article below was originally written by Linda Ulrich Miller, publications editor in the IANR vice chancellor's office. It was featured in the fall 2018 issue of IANR's Growing Magazine.

The University of Nebraska formed the Water Resources Advisory Panel (WRAP) in 2006 during a severe statewide drought. WRAP comprised representatives of state agencies, NGOs (nongovernmental organizations), and constituency groups with interest in addressing the best management of water resources in Nebraska, because the state was facing increased pressure to address water issues resulting from interstate compacts, the ongoing drought, and other factors.

Collaboration among the groups represented in WRAP, adoption of technology, and implementation of university research have played a big role in addressing the concerns that led to the original formation of the group. Currently, water quality, particularly the high nitrate levels in groundwater, has emerged as a focus, said Rachael Herpel, assistant director for DWF and NWC. Herpel coordinates WRAP activities.

WRAP is made up of 15 individuals representing a cross section of Nebraska's water decision-makers, including agricultural producers, representatives of many of the state's water-related agencies, and others who serve as the "voices of Nebraska" for water issues, Herpel said. The goal is to better connect the university with the wisdom of outside experts and those who often rely on the university's water-related research, education, and outreach to make decisions that affect Nebraska's water resources.

Panel members agree the university should support technologies and efforts that make water conservation easier and water safer, but producers need to know what technologies are worth their investment, particularly in the current economy. Stakeholders also want the university to model the sustainable behavior it believes in. Those are just a couple of the many water issues the panel has identified, Herpel said.

WRAP helps the university learn about stakeholder concerns, work on those issues, and be responsive to their needs, she said. "The panel takes this responsibility very seriously."



WRAP members gather for a meeting in December 2019.



TEACHING



This program helps water users understand what's going on in their own communities without preaching to them. That means people are more likely to understand the problems and help implement treatment — it gives everyone an opportunity to contribute.



— Christopher Olson, Know Your Well program manager

Teacher Spotlight: Laura Goracke



Laura Goracke

For many science educators, getting students outside the classroom and into the field is one of the most rewarding aspects of teaching. This was true for Seward High School Science Teacher Laura Goracke.

In 2019, Goracke was teaching at a small high school in Sterling, Nebraska. When the opportunity to participate in the Know Your Well program emerged, she jumped at it. The 35 students in her class started by surveying local well owners and in short order fielded 30 positive responses.

“Our community had had a lot of water quality issues,” Goracke shared. “I wanted the kids to know more than just science content.”

Students eventually selected six local wells to test. They became engaged in their community in a way that wouldn’t have been possible in a traditional class. That engagement — with school board members, administrators and community members — had a definite impact on the students.

“So they were really starting to think ‘This isn’t just something where we fill up our water bottles every day, this is really something that’s quite meaningful to us,’” Goracke said.

In 2020, she relocated to Seward and parlayed her Know Your Well experience to design a new course. The class — entitled Water and Society — has become popular with students and helped her shift from teaching kids to “know” science to having them “do” science.



The project has really changed my approach to environmental science.



— Laura Goracke

Know Your Well: Trickledown Effects of Hands-On Water Education

Eighty-five percent of Nebraskans rely on groundwater as their source of drinking water. Furthermore, one in five residents gets drinking water from private wells that are seldom tested for contaminants. So how does one know what comes out of the tap and if it’s healthy? For the past three years, the Water Sciences Laboratory’s Know Your Well program offered one answer: train hundreds of Nebraska high schoolers to become groundwater quality sleuths.

From 2017 to 2020, the Nebraska Environmental Trust-funded program empowered these young citizen scientists to sample and test well water quality in their communities. In all, 18 Nebraska high schools participated — from Crawford in the Sandhills to Auburn in the extreme southeast — collecting analytes like pH, conductivity, ammonia, atrazine, calcium, E. coli, iron and nitrate. Students collected and analyzed water and then compared results with duplicate samples sent to WSL water scientists. The results were then shared with well owners for their benefit.

As the program’s manager, Christopher Olson drove roughly twenty thousand miles to meet students and teachers in participating schools and help them understand and share in the science of groundwater and drinking water. According to Olson, while citizen science projects like this help scientists collect data in higher quantities than they could on their own, the benefits transcend testing and student education.



Christopher Olson gives a Know Your Well training at Madison High School.



Renowned Engineer Assists UNL, State Water Experts



Sorab Panday

In 2017, Sorab Panday was inducted into the National Academy of Engineering for “the development of computer codes for solving complex groundwater problems.”

Two years later, the veteran engineer joined the faculty of the University of Nebraska–Lincoln’s Department of Biological Systems Engineering (BSE) to share some of his specialized knowledge and advance approaches to analysis of environmental and water problems in the state.

Sorab lives and works in Herndon, Virginia, where he is a principal engineer with GSI Environmental. He brings more than 30 years of experience in developing and applying flow and transport models for subsurface contamination evaluations and water resource management.

Before the pandemic, he had been spending one week every other month in Lincoln working with BSE and civil and environmental engineering faculty; advising staff at the Nebraska Department of Natural Resources and USGS Nebraska Water Science Center on water models used in state water planning; assisting faculty in developing collaborations nationally and internationally; and leveraging efforts with industry and other organizations to enhance UNL’s ability to impact important issues related to water management and research across the region.

NWC Director Chittaranjan Ray played a pivotal role in recruiting Panday to campus and in introducing him to the significant issues and entities within UNL and the State of Nebraska. In April 2020, he presented “Understand Your Water Resource with Groundwater Modeling” as part of NWC’s Spring Seminar Series, which is available here: go.unl.edu/sorab.

Born in Mumbai, India, Sorab received his Ph.D. in civil and environmental engineering from Washington State University; M.S. in civil engineering from the University of Delaware; and B. Tech. in civil engineering from the Indian Institute of Technology, Mumbai.

“This program helps water users understand what’s going on in their own communities without preaching to them,” Olson explained. “That means people are more likely to understand the problems and help implement treatment — it gives everyone an opportunity to contribute.”

A side-effect of the program is the cultivation of important life skills. Faith Santana, a McCool Junction, Nebraska, native, participated in the program as a high school senior. She’s now a sophomore political science major at UNL. “It really played an important role in my high school career,” Santana said. “It helped me develop critical thinking skills and the idea that we have to be lifelong learners.”

Know Your Well expanded to include 10 Nebraska communities in 2019 - the final year of its first phase. The program is now sprouting in different directions, including a second phase in the Bazile Groundwater Management Area (see p. 25) and possible extensions with NRDs across Nebraska. Ultimately, Olson said testing drinking water is not just a skill needed in Nebraska. “Everyone needs water,” he explained. “From those who drink it to those in agriculture who rely on it to grow our food.” He believes the Know Your Well program and lessons learned could be expanded to communities anywhere.

For more information, visit: knowyourwell.unl.edu/



UNL student Nicole Schumacher works with a Madison High School student.

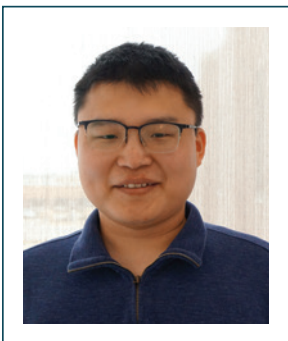
NWC Postdoctoral Profiles

Three new postdoctoral researchers joined the Nebraska Water Center (NWC) in 2019 and 2020. Training the next generation of water researchers is a cornerstone of the center's mission. Additionally, each project has relevance for agricultural water management in Nebraska. Check out the postdoc profiles below to learn more about them and their projects.



Rajneesh Singh

Rajneesh Singh joined NWC in April 2019 after earning his Ph.D. in civil engineering from the Indian Institute of Technology, Bhubaneswar. He earned his M. Tech. in agricultural engineering from the Indian Institute of Technology, Kharagpur. He works on facilitating natural, sustainable and affordable technologies, focusing on the treatment of agricultural and industrial wastewaters. Raised between the cities of Varanasi and Allahabad in northern India, he frequently visited the sacred Ganga River ghats in his early days. Witnessing the degradation of the Ganga River due to the discharge of domestic and industrial effluents, Singh took up research on wastewater treatment as his career. He began working on it at IIT Kharagpur, where he researched remediation of aquacultural wastewaters by improving trickling filters to offer higher denitrification. During his Ph.D., he worked on another green and affordable wastewater treatment technology named “vermifiltration,” which involves using a biological reactor and earthworms to filter organic material from wastewater. He soon encountered the limitations of taking vermifilters from the lab to the field. Therefore, he worked on increasing the lifespan of vermifilters and facilitation of a mathematical tool for the design and scaling up of vermifiltration-based treatment plants. At NWC, Singh works to deliver solutions on emitter clogging of subsurface drip irrigation systems using wastewaters from agricultural farms.



Wenguang Sun

Wenguang Sun joined NWC in March 2020 as a postdoctoral research associate. Sun is based at the USDA's Agricultural Research Center in Beltsville, Maryland. Previously, Sun was a doctoral student in soil physics at Louisiana State University, earning his Ph.D. in 2019. Sun completed a three-year master's program in environmental science at the Chinese Academy of Sciences in 2015. He earned his bachelor's degree in agronomy from China Agricultural University in 2012. His expertise is in the fate of nutrients and heavy metals in the soil-water systems. Additionally, Sun has strong computer programming skills, particularly in Fortran and Java. His work includes experimental and theoretical research towards understanding processes that govern the interaction of nutrients and heavy metals under different conditions. At NWC, he focuses on improving and testing existing code to simulate photosynthesis, leaf and root growth, and reproductive organ development under different water, CO₂ and temperature conditions. In addition, he works on modifying and assisting with the development of a root growth model.



Sahila Beegum

Sahila Beegum joined NWC in September 2020 as a postdoctoral research associate. Her research is in collaboration with the Adaptive Cropping Systems Laboratory at the USDA's Agricultural Research Center in Beltsville, Maryland. The study primarily focuses on testing and modification of existing plant models. She is working to improve mathematical representations of plant processes, numerical analysis, and to develop a simulation model using computer programming. The updated and modified plant codes will be further integrated with existing efficient simulation models for water, solute, and plant root dynamics in the soil. The desired outcome is a comprehensive simulation model for analysing soil-plant-atmosphere interactions. She is one of the developers of “HYDRUS Package for MODFLOW-version 2018,” an integrated simulation model for water flow and solute transport in soil and groundwater. Beegum is the recipient of a Fulbright fellowship, DAAD fellowship, and Berkner fellowship and served as a visiting researcher at the University of California, Riverside, and Forchzentrum Jülich, Germany. She received her doctoral degree from the Hydraulics and Water Resources Engineering Division, Indian Institute of Technology, Madras.



NWC Student Intern Profiles



Gabrielle Boucher

Gabrielle Boucher joined the Nebraska Water Center in August 2019 as a student intern. Gabrielle is a senior at the University of Nebraska–Lincoln majoring in civil engineering with an emphasis on water resources. At NWC, Gabrielle has assisted in numerous projects. For the 2019 Nebraska Water Conference, she designed graphics and profiled some of the researchers involved in the conference. She also writes articles for the Water Current newsletter and recently helped in marketing and promoting both the 2020 and 2021 Water Seminar Series.

Her interest to “meet people in the field and get a sense of what a career path would look like” is one of the things that drew her to the internship. In general, she hopes to gain more knowledge about the world of water.

A native of Lenexa, Kansas, Gabrielle is active on and off campus. She runs on the university’s varsity cross country and track team and is the community service chair of her sorority. She is a repeat Academic All-Big Ten and Dean’s List awardee.



Kelsey Jameson

Kelsey Jameson joined the Nebraska Water Center in February 2020 as its events intern. In December, she graduated from the University of Nebraska–Lincoln with a degree in hospitality, restaurant, and tourism management. Despite the pandemic, Kelsey maintained her internship and helped produce several high-profile events and publications. She came to the position with experience in wedding coordination, banquet supervising, and, most recently, as an agriculture office intern. Outside the classroom, Kelsey was treasurer of the Hospitality Student Development Organization, which provides a way for hospitality students to collaborate formally and informally over classes, internships, and professional opportunities. In addition, she kept busy with fundraising efforts for her sorority that contributed to St. Jude Children’s Research Hospital.

A native of Kearney, her agriculture background sparked an interest in the position. At NWC, she led the development of a new Water Sciences Laboratory brochure and assisted in the planning, coordination and execution of the Nebraska Water Center’s August Mini-Conference. These experiences helped equip her with skills to benefit her professional career after college.

Water Advanced Research and Innovation Fellowship

The Water Advanced Research and Innovation (WARI) Fellowship Program provides high-performing Indian students and scientists with opportunities to learn cutting-edge water science at the University of Nebraska–Lincoln.

To date, 40 Indian doctoral students and early-career faculty have completed WARI fellowships. 2019 marked the program’s fourth year and included seven Ph.D. students and nine Nebraska water faculty mentors representing the departments of biological systems engineering, chemical engineering, civil and environmental engineering, food science and technology, and school of natural resources. Overall, the program’s goal is to build capacity and long-term linkages between Nebraska and India to improve water quality.

In 2020, the program was poised to expand to three partner institutions — Texas Tech University, Purdue University and the University of Idaho. However, due to the pandemic the program was postponed until 2021.

For more information, visit: waterforfood.nebraska.edu/our-work/education/wari-program

OUR PEOPLE

Nebraska Water Center Advisory Board

The Advisory Board's purpose is to advise and strengthen the Nebraska Water Center as it carries out its mission of supporting water-related research, education and outreach, and to share information with constituent groups. This Advisory Board combines many existing advisory functions into one board. Members provide feedback on issues, including 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 of the board are:

Shannon Bartelt-Hunt, UNL Department of Civil Engineering

John Berge, North Platte Natural Resources District

Russ Callan, Lower Loup Natural Resources District

Ashley Dere, UNO Department of Geography/Geology

Bruce Dvorak, UNL Department of Civil Engineering

Tom Franti, UNL Department of Biological Systems Engineering

Rick Holland, Nebraska Game and Parks Commission

Suat Irmak, UNL Department of Biological Systems Engineering

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

Aaron Young, UNL School of Natural Resources



Nebraska Water Center Staff

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Rachael Herpel, assistant director
Sahila Beegum, postdoctoral research associate
Matteo D'Alessio, research assistant professor (until December 2019)
Craig Eiting, web developer and graphic design specialist
Erin Haacker, research associate (until August 2019)
Jahangeer, research associate (until January 2020)
Sushil Kanel, Ph.D., adjunct professor
Patricia Liedle, program assistant
Sekhar Muddu, Ph.D., adjunct professor
Sorab Panday, Ph.D., research professor
Crystal Powers, research and extension communications specialist
Rajneesh Singh, postdoctoral fellow
Jesse Starita, public relations and engagement coordinator
Wenguang Sun, postdoctoral research associate

Water Sciences Laboratory

Daniel D. Snow, Ph.D., director of services
Saptashati (Tania) Biswas, Ph.D., research lab manager
David Cassada, separations chemist and network administrator
Arindam Malakar, research associate
Sathaporn (Tong) Onanong, research technologist II – LC/MS
Nathan Roddy, research technologist III
Aaron Shultis, isotope scientist (until April 2020)
Victoria Wickham, research technician III

Nebraska Water Center Undergraduate Interns

Bassey Arikpo, University of Nebraska–Lincoln broadcasting major
Gabrielle Boucher, University of Nebraska–Lincoln civil engineering major
Kelsey Jameson, University of Nebraska–Lincoln hospitality major
Varun Vidyashankar, University of Nebraska–Lincoln business major

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A wide-angle photograph of a vast green field under a dramatic sunset sky. The sun is low on the horizon, casting a warm, golden glow across the clouds and the field. The field is filled with lush green crops, likely corn, stretching towards the horizon. In the distance, a few trees and utility poles are visible against the bright sky.

watercenter.unl.edu

