



2021

ANNUAL REPORT



Nebraska
Water Center

Daugherty Water for Food Global Institute

The Nebraska Water Center

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:

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

NWC is part of the Daugherty Water for Food Global Institute (DWFI) 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 Water Sciences Laboratory comes from a combination of state, local and federal funding, as well as through partnerships with NGOs and industry.

For more information >>> watercenter.unl.edu



NWC 2021 SNAPSHOT



13

Undergraduate
Student
Interns



2

Postdoctoral
Researchers



\$95,700

in Grants to
Water Faculty
and Staff



27

Journal
Articles
Published



1,100

YouTube
Views



46

New
Facebook
Follows



32

Events
Hosted or
Co-Hosted



WSL Research Lab Manager Victoria Dey prepares a sample in the lab.

»» Water Sciences Lab Undergoes Challenges and Growth in 2021

Like many research operations affected by the COVID-19 pandemic, 2021 was a rebound year for the Water Sciences Laboratory (WSL). On the heels of a rocky 2020 that saw sharp declines in the number of samples analyzed, the lab corrected course last year, running more samples by the year's end than ever before.

The lab managed this despite significant staffing changes. In July, WSL bid farewell to Laboratory Manager Saptashati (Tania) Biswas and after a competitive search promoted Victoria Dey into that role. To keep up with sample loads, the lab added temporary research technicians Gabriel Casper and Jean David Bizimana and a roster of undergraduate student interns. Finally, the lab's visibility grew thanks to business and marketing interns Callie Svoboda and Rachel Williss who promoted WSL through articles, videos, photos and events.

The facility also had more to offer its community in 2021. A federal equipment loan program allowed for the addition of a Thermo ICS 5000+ Ion Chromatography System (ICS) and an Agilent 720 Inductively Coupled Plasma – Optical Emission Spectroscopy (ICP-OES) system. The new ICS replaced an obsolete Dionex ICS-90, while the ICP-OES supplanted a labor-intensive atomic absorption spectrophotometer. Both "new" instruments have been busy with increasing demands for anions and metals analysis. Meanwhile, WSL debuted a new course in the fall semester titled "Environmental Laboratory Instrumentation and Methods" to train students on lab equipment, procedures, housekeeping and safety.

WSL also participated in several in-person and virtual events, including the inaugural East Campus Discovery Days and Farmers Market, virtual educational events with Conservation Nebraska and a mass spectrometry workshop series hosted by Waters Corporation. Plans are developing for an open house in 2022 to showcase new equipment, renovations and staff.

A key part of NWC, the lab's mission is to provide technology, expertise, services, and training in advanced analytical science supporting today's water and natural resources students, researchers and stakeholders.

For more information >>>watercenter.unl.edu/water-sciences-laboratory2



NWC Director Chittaranjan Ray and NWC Assistant Director Rachael Herpel attend a nitrate working group meeting.

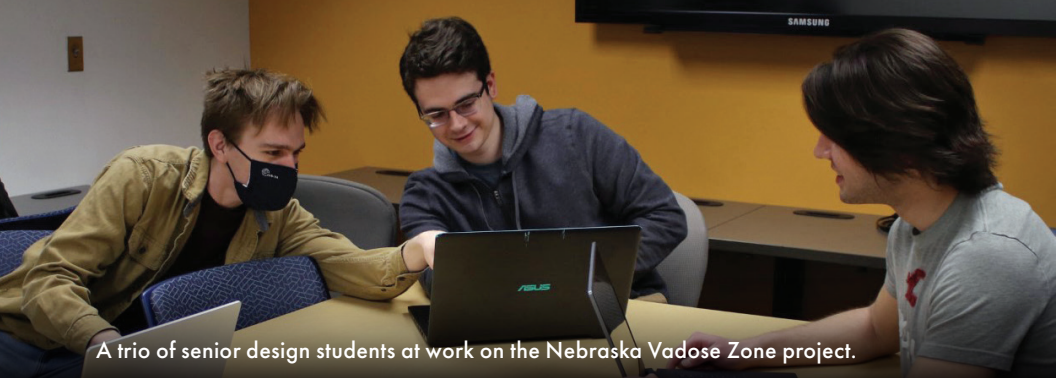
»» Nebraska Nitrate Working Groups Tackle Groundwater Contamination

Building on the previous year’s vision that “all Nebraskans will have access to safe water,” NWC and University of Nebraska Extension convened working groups throughout 2021 to address the statewide challenge of rising levels of agrichemicals in groundwater, particularly nitrates.

To achieve this goal, three topics were prioritized for multi-sector collaboration: awareness, education and policy. A systems thinking approach with facilitated ideation was used to propose actionable projects that can be implemented in three to five years and require cross-organizational support. In August, the working groups released a summary and call for action (go.unl.edu/nitrate-group).

Each group then went on to begin implementing their proposals throughout the fall. Initial outcomes include a focus on nitrate at Husker Harvest Days; multiple interactive training opportunities for growers to take fertilizer credits; continued policy discussions; and a public awareness campaign design workshop. These efforts have already impacted hundreds of citizens across Nebraska.

Throughout the year, 115 participants from 36 organizations were working together towards this vision for Nebraska. NWC will continue to lead this multi-sector collaboration as further projects are implemented in 2022.



A trio of senior design students at work on the Nebraska Vadose Zone project.

»» NWC and Computer Science Students Dive Into Nebraska's Groundwater

What's the vadose zone? That's the common response when anyone is asked about this feature of the earth. Indeed, it was the response a group of University of Nebraska–Lincoln (UNL) computer science students first had. Today, those students are part of the School of Computing's Senior Design capstone program, where industry and academic sponsors work with talented undergraduates who create professional-grade software, hardware and IoT applications.

By partnering with NWC on their senior design project, these students learned how the vadose zone acts as the earth's skin, regulating the storage, transport and transformation of agrichemicals between the crop root zone and water table. What happens to chemicals in this zone can impact the quality of Nebraska's most abundant yet precious natural resource — groundwater. With greater understanding of this zone, water managers can better predict groundwater contamination and how to implement interventions at the source.

This year, the students worked on revamping the Nebraska Vadose Zone website. The centerpiece is an interactive map where data on agrichemicals (like nitrate) is collected, processed, analyzed and shared for the general public. The group is increasing the site's user experience; enabling data uploading and verification; and sharing results through interactive mapping.

Working on the project revealed important connections between food and the environment. "You don't think about the fertilizer applications to grow your food. This is a nice window into what you don't see every day," said senior Cody Binder.

Will Swiston noted the geographic disconnect he felt as a native Chicagoan. "I had no idea about fertilizer getting into the water table," he said. "I learned a lot about the science from this project."

Senior Design Project Manager Bill Browning is interested in a different type of chemistry. "I'm always impressed by how five students who don't know each other come together to work for a common goal."

For more information »» nebraskavadose.unl.edu



The Austin Sailors Quintet serenades the evening banquet at the Legacy of the Plains Museum.

»» **NWC Heads West for Annual Conference, Online for Spring Seminars**

NWC trekked across the state to host its annual Nebraska Water Conference in 2021. Titled “The Shape of Water in Western Nebraska,” the conference was held August 16 at UNL’s Panhandle Research and Extension Center in Scottsbluff, Nebraska.

The daylong event attracted 90 participants and featured western Nebraska water leaders discussing water infrastructure in the panhandle; western Nebraska’s unique hydrogeology; and cutting-edge research in water and agricultural management. Attendees also enjoyed live jazz at an evening banquet at the Legacy of the Plains Museum with the Scotts Bluff National Monument as a charismatic backdrop.

August 17 and 18, NWC also participated in a post-conference water tour sponsored by the Scottsbluff/Gering United Chamber of Commerce. Approximately 50 participants traversed the North Platte River basin, making educational stops at fisheries, dams, ranches, potato processors and Lake McConaughy.

Due to the pandemic, NWC hosted its 2021 Spring Seminar Series virtually. The series, “Tributaries: Race, Justice and the Environment,” knit social justice and water issues together through speakers representing engineering, water chemistry, environmental studies, legal, public policy and tribal backgrounds.

Established in 1968, the series provides a forum to increase awareness and allow for meaningful conversation regarding water issues.

For more on the Nebraska Water Conferences »»
watercenter.unl.edu/conferences-and-events

For more on the Spring Seminar Series »»
watercenter.unl.edu/spring-seminar-series



Troy Gilmore, a UNL groundwater hydrologist and DWFI Faculty Fellow, was one of several USGS 104b recipients.

»» USGS Small Grants Support Big Ideas in Water

NWC awarded U.S. Geological Survey (USGS) 104b project funds to six Nebraska research teams in 2021:

- 1** *Examining Surface and Groundwater Contamination from Use of Byproducts Derived from Ethanol Processing of Pesticide-Treated Crop Seeds and the Potential Impacts on Biological Indicator Organisms*; PI: Judy Wu-Smart, UNL, Department of Entomology; Co-PIs: Shannon Bartelt-Hunt, Department of Civil Engineering; Dan Snow, Nebraska Water Center; **\$20,000**
- 2** *Advancing Groundwater/Surface Water Models using Geophysics-Derived Hydrostratigraphy*; PI: Jesse Korus, UNL, School of Natural Resources; Co-PI: Sorab Panday, Biological Systems Engineering; **\$20,000**
- 3** *A Data-Led Approach to Visualizing and Assessing Nitrate Contamination in Northeastern Nebraska*; PI: Erin Haacker, UNL, Earth and Atmospheric Sciences; Co-PI: Sorab Panday, Biological Systems Engineering; **\$19,000**
- 4** *Image-Based Streamflow and Water Quality Modeling*; PI: Troy Gilmore, UNL, School of Natural Resources; Co-PIs: Michael Forsberg, School of Natural Resources; Andrew Harms, Electrical and Computer Engineering; Mary Harner, UNK, Biology; **\$11,655**
- 5** *Evaluation of Nitrogen-based Redox Processes in the Vadose Zone*; PI: Michael Kaiser, UNL, Department of Agronomy and Horticulture; Co-PIs: Dan Snow and Arindam Malakar, Nebraska Water Center; Daniel Miller, USDA-ARS; Matteo D’Alessio, University of Mississippi, Civil Engineering; **\$9,982**
- 6** *Know Your Well – Northwest*; PI: Michael Leite, Chadron State College, Mathematical and Natural Sciences; Co-PIs: Tawny Tibbits, Chadron State College, Mathematical and Natural Sciences; Dan Snow, Nebraska Water Center; **\$3,120**



Installing lysimeters at the BGMA soil health demo site.

»» Partnering for a Clean Water Future in Northeast Nebraska

Northeast Nebraska is unique in many ways. One of those is the first groundwater-focused management plan in the nation to address nonpoint source pollution. The Bazile Groundwater Management Area (BGMA), as it's known, emerged from a partnership among four area Natural Resources Districts and the Nebraska Department of Environment and Energy who shared the goal of reducing rising nitrate levels in communities and domestic drinking wells. This is significant since BGMA residents rely on groundwater for drinking water and elevated nitrate levels can be harmful to human health and costly for small communities to treat.

In 2019, NWC, through funding from the Nebraska Environmental Trust, helped establish local demonstration farms that model different agricultural management practices to reduce nitrogen leaching. The three farms — diverse cropping rotations, soil health and nitrogen inhibitors — provided opportunities for educational outreach at the BGMA Field Day in September 2021. The in-person engagement was complemented by a virtual winter meeting series featuring Nebraska faculty, postdocs and external scholars.

Additionally, NWC is invigorating water quality research and education in this area. In the classroom, a citizen science project is empowering high school students with water quality awareness and science literacy through groundwater sampling and data collection. In the field, WSL Director Dr. Dan Snow and collaborators launched a project in spring 2021 titled “Novel Approaches for Controlling Nitrate Leaching and Protecting Nebraska Groundwater.” The research is injecting mulch into the subsoil to evaluate its potential to absorb and remove excess nitrate.

For more information »» bgma.nebraska.gov/



A UNL research team collects soil samples near Mead, Nebraska, in November 2021.

»» Research Monitors Impacts of AltEn Pesticide Contamination

With essential support from the NWC, a multi-university team is monitoring one of Nebraska's worst environmental disasters. In 2021, the University of Nebraska Medical Center and Creighton University partnered with UNL and NWC to explore the scope of contamination stemming from the AltEn ethanol plant near Mead, Nebraska.

When the plant opened in 2015, it represented an innovative way to generate ethanol from feedstocks consisting almost entirely of leftover seed corn treated with pesticides and fungicides. Treated seed is not unusual; but using it in large volumes to produce ethanol is. Over time, area residents became concerned as fish, bees and house pets fell ill or died. Residents reported strong odors in the air, burning eyes and breathing difficulties. In early 2021, the State of Nebraska shut down the plant after numerous violations and a burst pipe spilled waste into a nearby watershed.

The human health impacts are unknown. Measuring the extent of contamination within the surrounding land, air, water and animals is the first step and where NWC enters. WSL, part of NWC, is the primary destination for all water and soil samples collected through this research. A committed group of students and full-time technicians operate its high-precision equipment using sophisticated methods. Additionally, NWC awarded a USGS 104b grant (p.8) to an entomologist studying the impact on pollinators.

According to Shahab Karimifard, a UNL postdoctoral researcher collecting the project's data, the team will continue to monitor all aspects of the environment affected and have more decisive results in the near future.

What emerges from this collaborative investigation will help answer critical questions – for both the people of Mead and future communities exposed to pesticide contamination. *What's in our water? What does this mean for our health?*

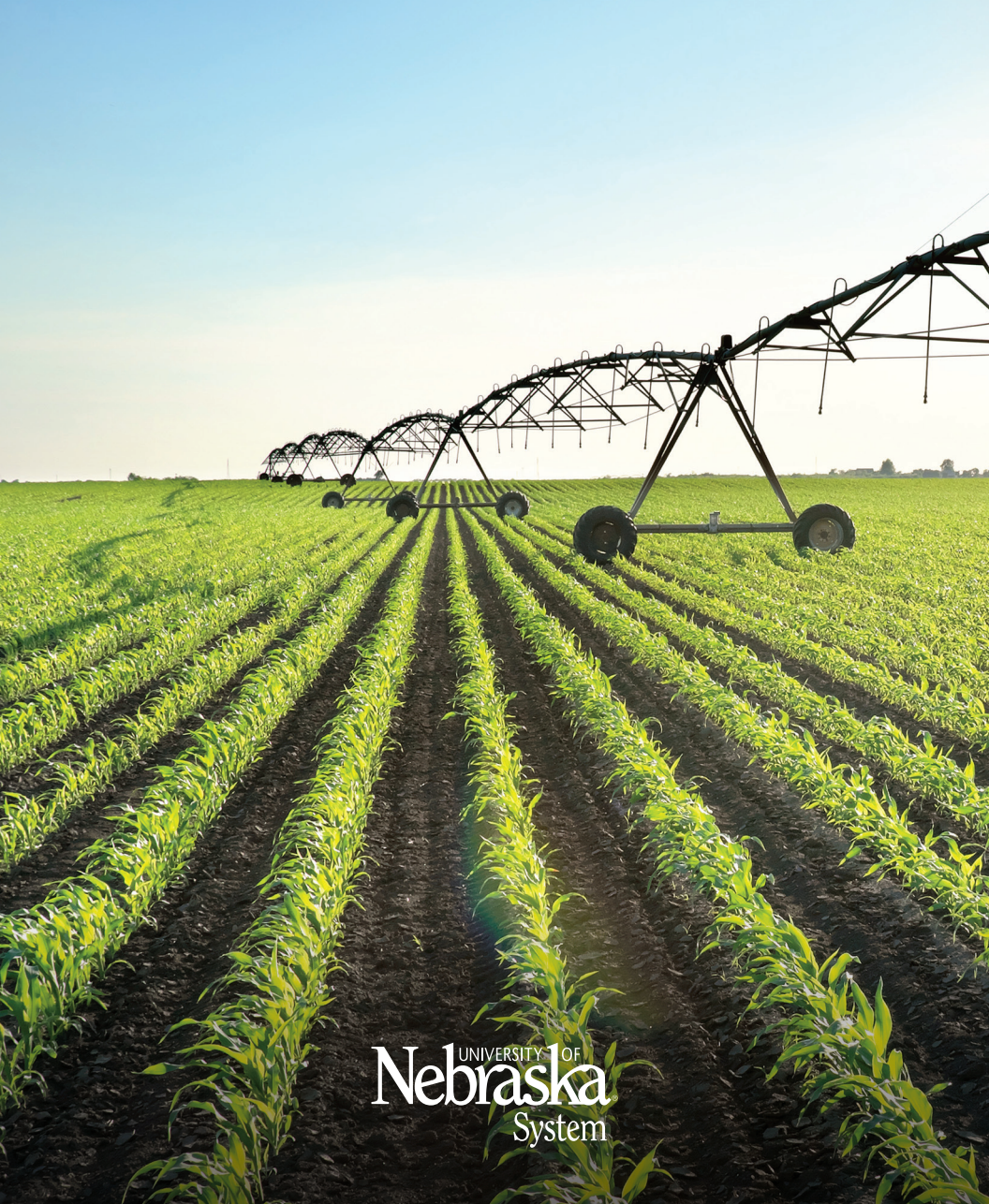
For more information about Nebraska's AltEn research »» go.unl.edu/mead



Our Impact

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