

## 2018 water tour heads to Wyoming



Historic Pathfinder dam, the base of the USBR's North Platte irrigation project in Wyoming.

The University of Nebraska's water and natural resources tour will travel west along the Platte River basin in Nebraska and Wyoming this coming summer.

The tour will feature a visit to the U.S. Bureau of Reclamation's (USBR) North Platte and Kendrick irrigation projects in Wyoming—including Pathfinder and Seminole reservoirs—as well as many other points of interest in the two states.

The tour is June 26-29 beginning and ending in North Platte. It is being planned and supported by the University of Nebraska Water Center, Central Nebraska Public Power and Irrigation

District, Nebraska Public Power District, NU's Robert B. Daugherty Water for Food Global Institute and the **University of Nebraska's** Institute of Agriculture and Natural Resources.

"The Bureau of Reclamation's North Platte Project is one of the granddaddies of surface irrigation projects in the west and of major importance to irrigated agriculture in Nebraska," said tour co-organizer Steve Ress of the Nebraska Water Center.

*Continued on page 9*

## Reviving the Platte basin ecosystem symposium this June

Steve Ress

It was temporarily shelved, but never forgotten.

After a 15-year hiatus, the Crane Trust and Nebraska Water Center are reconvening the Platte River Basin Ecosystem Symposium this June.

"In celebrating 40 years of operating on the Platte River, the Crane Trust wanted to reconvene the symposium," said the Trust's lead biologist Andy Caven.

"Our goal is to provide a snapshot of ongoing research in the central Platte River valley, a broad assessment of the ecosystem's current conditions and to further clarify future conservation and research priorities," he said.

With those goals in mind, symposium abstracts are being solicited through April 15th for inclusion in the June 5 and 6 symposium's agenda.

"We are seeking applied science presentations from practitioners, academics, graduate students and others on all topics related to conservation efforts in the Central Platte River Valley and adjacent ecosystems.

"We welcome abstract submissions regarding fish and wildlife conservation and ecology, hydrology, water quality, vegetation ecology, wet meadows, prairie and wetland restoration, exotic species control and management, songbird,

*Continued on page 14*

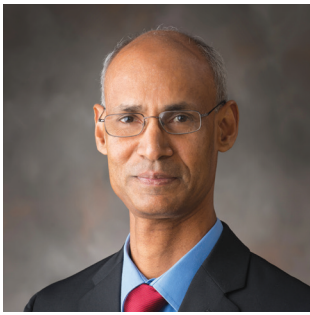
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Water Center**

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# Water Current celebrating 50 years; staff changes; full slate of activities on tap through 2018

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

Welcome to the 50th year of the *Water Current* newsletter.

For a print newsletter going to a rather targeted audience to survive, and thrive, for 50 years in this age of instant, cyber-based communications, we think is something of a milestone. Though we can't be absolutely sure, we are fairly confident that the *Water Current* is the oldest continually published newsletter amongst the more than 50 Water Resources Research Institutes nationwide.

The publication is nearly as old as the Nebraska Water Center itself, beginning in early 1969 as one of the first, major communications initiatives of the center's first permanent director, Warren "Bud" Viessman, Jr. The publication originally rolled off a mimeograph machine in the water center offices as *Water Resources News*. That changed to *Water Current* in 1974 and has remained so ever since.

The oldest surviving issue of the publication archived on DigitalCommons@University of Nebraska-Lincoln is from December 1969, when the water center was housed in the Agricultural Engineering Building on Nebraska's East Campus. Bud was compiling and editing the four-page typed newsletter himself, taking submissions from faculty, writing "research reviews" that announced various water-related happenings on campus and helping to circulate information on proposals and short courses. According to a research review in that issue, we were interested in "Evaluation of Methods for Improving Water Use Efficiency Through Simultaneous Determination of Field Evapotranspiration and Photosynthesis" at that time too.

Look deeper into this issue of the *Water Current* for some of its gems from the past and how we plan to use the publication's golden anniversary to look at where we were and how far we have come over the last 50 years in areas such as irrigation efficiency, best management practices, overall water use, water policy, water quality, water law and other areas.

We note also that for nearly 22 of the *Water Current*'s 50 years, or roughly a hundred issues, it has had one steadfast editor: our communicator Steve Ress. Steve has been a rather zealous guardian of the publication, especially during times of budget cutting or when conversations have drifted toward perhaps just publishing it electronically. Steve will be retiring from the University about the time you read this and we wish him well in retirement.

We also lost our outreach communications specialist Ben Beckman earlier this year. Ben saw an opportunity to move into an assistant educator's position with Nebraska Extension in Cedar County that is in his area of expertise and

understandably went after it. We think this will be an excellent fit for both Ben and for our University. At the time his issue went to press we were busy sorting through and interviewing candidates to fill this important liaison position that is shared equaled by the water center, Nebraska Extension and the Robert B. Daugherty Water for Food Global Institute.

We are also working with the managers and staff of the Upper Elkhorn, Lower Elkhorn, Lower Niobrara and Lewis and Clark Natural Resources Districts, all of them located in northeast Nebraska, to identify funding sources for a coordinator and for developing projects that would include University of Nebraska faculty in various demonstrations in consultation with producers, managers and NRD boards members to be implemented in producers' fields towards reducing nitrate impacts to groundwater in that area of the state.

We are entering one of the busiest stretches of the year here at the water center and have a good variety of activities upcoming.

On April 5 we are hosting a half-day water research faculty and stakeholders retreat at LI-COR Biosciences in Lincoln. These retreats have proven to be tremendously successful in getting our faculty better acquainted with one another and the work each of them are doing and in forging interdisciplinary partnerships that are increasingly successful in crafting proposals for funding. Emailing one another is a wonderful communications tool to have, but for forging professional relationships and cooperation, nothing beats face-to-face gatherings.

We are also helping the Crane Trust revive the Platte River Basin Ecosystem Symposium, which was a fixture of the University's now gone Platte Watershed Program in the 1990s and early 2000s. As before, the goal of the symposium is to give a forum to researchers and land stewards to help stay abreast of ongoing research in the central Platte River basin and develop shared goals for future inquiries.

This symposium, the first in the series since 2003, will be June 5 and 6. A call for presentation proposals is on our website at [watercenter.unl.edu](http://watercenter.unl.edu). This is an excellent opportunity for University staff, graduate students, Ph.D. candidates and post-docs, in addition to faculty, to present to a very broad audience of interested and involved attendees. Deadline for proposals is April 15.

Major planning and logistics for the water and natural resources tour are essentially complete. The June 26-29 tour will be examining North Platte River basin and surface irrigation issues in western Nebraska and eastern Wyoming.

A tour of the U.S. Bureau of Reclamation's North Platte and Kendrick irrigation projects near Casper, Wyo. will be a feature of the event. The tour will leave from North Platte.

Anytime the tour heads to the USBR's North Platte Project, which everyone in the water business wants to see, it fills very quickly, so if you are planning to go with us, keep a close eye on [watercenter.unl.edu](http://watercenter.unl.edu) for registration details, which should be available by late April.

Our annual water symposium will take-on a completely different flavor and expanded theme this year. Rather than focusing primarily on Nebraska water issues, we will host a nine-state regional symposium focused on the Great Plains. We are working with the directors of the Water Resources Research Institutes in Montana, North Dakota, South Dakota, Iowa, Kansas, Missouri, Oklahoma and Arkansas and the directors of the U.S. Geological Survey's water sciences centers in those states to develop a full program of topics and events and to invite speakers. We will hold this event right here at Nebraska Innovation Campus Oct. 24-26 and are greatly looking forward to it.

We are very pleased to note that our spring water and natural resources seminar series of public lectures is going very well this year. The lectures are keyed to irrigation management and technology and we invited a number of speakers from off the campus, most notably those directly employed in the irrigation industry, to be speakers. These lectures have proven to be extremely popular and attract a good number of registered students, as well. We especially appreciate the planning help and cooperation of the School of Natural Resources in keeping this lecture series vibrant and relevant and to Martha Rhoades and Pat Shea for teaching the classroom portion of the series. Over the past few years they have continued to add to the number of students taking the lectures for course credit.

We will likely add one lecture to the series in April as we have invited the eminent groundwater scientist Sorab Pandey of Midwest Geosciences to our campus for an opportunity for him to interact with our water faculty, staff and students.

Another noteworthy item is that our Water Sciences Laboratory's "Know Your Well" program has been very well received by participating high schools in the state and is



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entering its second year with the addition of six more schools. This is an opportunity for high school students to learn in a very hands-on way how to sample water wells, prepare those samples for lab analysis and then how to read and interpret the results from those samples. This program would not have been possible without funding assistance from the Nebraska Environmental Trust fund.

Our WARI program, conducted by the Water for Food Global Institute, is beginning its third year. WARI, or Water Advanced Research and Innovation, has announced its third wave of fellowships and internships. The joint initiative between the University of Nebraska and several of India's top academic institutions helps build capacity to address global water quality challenges. The 2017-2018 class includes eleven awardees, including one doctoral student from the University of Nebraska-Lincoln. See more about the program in this issue of the *Water Current*.

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## An Update from the Nebraska Water Sciences Laboratory

Daniel Snow

The past year has been a whirlwind of activity at the Nebraska Water Sciences Laboratory (WSL).

We have been able to implement many of the recommendations from our recent external review, including developing a business plan and hiring a laboratory research manager. This progress has led us to thinking more about the long term.

Conditional support from our University of Nebraska colleges that benefit from WSL expertise, equipment and services allowed us to think about a strategy to build on successes, learn from failures, and improve the way we operate.

Through a grant from the Nebraska Research Initiative, and cost shares from the University of Nebraska–Lincoln’s Institute of Agriculture and Natural Resources (IANR) and Daugherty Water for Food Global Institute, we were able to replace an outdated inductivity coupled plasma mass spectrometer (ICP-MS) that was no longer possible to repair or operate. In September 2017, we installed a Thermo ICAP RQ ICP-MS interfaced with a Dionex ICS5+ ion chromatograph (IC). This “IC-ICP-MS” is state of the art for measuring different forms of metals and metalloids such as arsenic that occur in Nebraska ground and surface water. Distinguishing forms of trace elements such as arsenic will help better understand the processes that lead to contamination of water supplies and, more importantly, what can be done to prevent or mitigate contamination.

Early this year we finished the complex and extremely time-consuming task of assembling and testing equipment for noble gas extraction and analysis of helium isotopes for groundwater

age dating. This complex and highly sensitive technique will permit estimation of groundwater age (up to 50 years post recharge) and will show where an aquifer is more rapidly recharged in Nebraska.

Pairing the groundwater age dating with our new nitrate isotope methods puts our laboratory and our university at the forefront of research needed for managing groundwater for multiple purposes in agriculturally intensive regions.

Over the course of 2017, we received almost 6,800 samples for more than 80 different testing methods. We developed several new methods for antibiotics, insecticides and stable isotopes. Though we offer routine testing for water chemistry and quality, our focus continues to emphasize specialized methods not available anywhere else.

These new methods now include a single rapid, high precision determination of nitrogen and oxygen isotopes in nitrate at a fraction of our previous cost for this service. Our new website provides information to better support researchers using the WSL and includes links for training, policies and a complete description of laboratory services and costs for analyses.

This year we will be formalizing our student training program and will be doing more promotion to help reach new users about all the equipment and resources that are available in our facility. I am grateful to our hard-working students and staff who help keep this operation running smoothly, and to the NU faculty and administration who understand the benefits of a state-of-the-art water laboratory in Nebraska.

## Kearney workshop connects groundwater quality to the surface

A March 7 workshop in Kearney took a half-day to explore the topics of “Connecting groundwater quality to the surface: models, monitoring and more.”

The event, held at Kearney’s Holiday Inn Conference Center, attracted nearly 50 participants and was cosponsored by the Lower Platte South Natural Resources District and Nebraska Water Center with support from a grant from the Nebraska Department of Environmental Quality.

Speakers were from the University of Nebraska and included Dan Snow, director of the Nebraska Water Sciences Laboratory;

Derek Heeren, assistant professor of irrigation engineering at the University of Nebraska–Lincoln; Aaron Mittlestet, assistant professor of watershed hydrology at the University of Nebraska–Lincoln and Mohana Sundaram Shanmugam, a postdoctoral researcher with the Nebraska Water Center.

One of the outcomes of the workshop was the Nebraska Water Center applying for four Continuing Education Units (CEUs) for appropriate categories of Nebraska Department of Health and Human Services water well licenses and certificates.

# With this issue, the *Water Current* reaches 50 years

Steve Ress

Congratulations. You are holding in your hand the 50th anniversary edition of the Nebraska Water Center's *Water Current* newsletter.

For a print newsletter that goes to a rather targeted audience to survive, and thrive, for 50 years in this age of instant, cyber-based communications and electronic social media, we think is a Golden Anniversary worthy of note.

We aren't absolutely sure but are nonetheless fairly confident that the *Water Current* is the oldest continually published newsletter amongst the more than 50 Water Resources Research Institutes nationwide.

It is the recurring communications piece most closely associated with the Water Center and nearly as old as the center itself, beginning less than five years after the center was established as part of the University's Conservation and Survey Division in 1964.

In late 1968 or early 1969 the center's first fulltime permanent director, Warren "Bud" Viessman, Jr. established it as the center's first, major communications initiative. It was originally targeted to University faculty and rolled off a mimeograph machine in the water center offices as *Water Resources News*. That changed to *Water Current* in 1974 and has remained so ever since.

The oldest surviving issue of the publication archived on DigitalCommons@University of Nebraska-Lincoln is Vol. 1, No. 8, December 1969, when the water center was housed in the Agricultural Engineering Building on the University's East Campus. Viessman was compiling and editing the four-page typed newsletter himself, taking submissions from faculty, writing "research reviews," announcing various water-related happenings on campus and helping to circulate information on proposals and short courses. According to a research review in that issue, "Evaluation of Methods for Improving Water Use Efficiency Through Simultaneous Determination of Field Evapotranspiration and Photosynthesis" was of interest then as it very much is now as well.

Ten years later the newsletter was still rolling off the mimeograph machine, but it was publishing annual reports and articles about irrigation scheduling, computer games to judge points of view on water usage, news of recent research grants and news of the center's annual water conference and water seminar lectures, both of which are still being held annually.

By the time the 1980's were drawing to a close the newsletter had gone to a three-column, newspaper-like print format of eight pages per issue and graphics and photographs were being published as part of the layout.

The annual water tour, still held today, had just visited the Sandhills, the effects of Acid Rain were very much in the news, and one of the burning front-page issues was whether the proper usage of groundwater was as one word or two, something this writer still wonders about today.

By the early 2000's, under this writer as the publication's editor, the *Water Current* had begun to take-on the basic layout that is still being used, though it has been tweaked three or four times in the intervening 15 years.

Slick, or gloss, paper was being used, as was colored ink. Feature articles on our water faculty and professional staff were being regularly featured, as they still are today, the 30th annual water conference (in 2001) was focused on groundwater monitoring and the year's upcoming water tour was focusing on challenges to water quality, quantity and demand as Nebraska's population shifted toward the eastern third of the state.

By then, the newsletter was publishing eight pages, every month. Later it would evolve to a quarterly of 16 to 24 pages per issue. This was cost saving measure to save on preparation expenses, printing and mailing fees.

We don't know how many copies of the first newsletter Viessman ran off his mimeograph machine, but today, each issue prints almost 3,000 copies, 90 percent of which go out as requested, free subscriptions. It is also published online at [watercenter.unl.edu](http://watercenter.unl.edu). Costs of the newsletter are covered by federal funding the water center receives annually via the U.S. Geological Survey.

As the year progresses, *Water Current* issues will use this Golden Anniversary year to take longer looks at where we were and how far we have come over the last 50 years in areas such as irrigation efficiency, best management practices, overall water use, water policy, water quality, water law and other issues.



# The Ebb and Flow: The Frustration of Research

**Ben Beckman**

Over many years of working in higher education as both a student and staff member, I often get asked questions along the lines of, “Why doesn’t the University have more information on ...”, or “The information we are being given is way behind the times.”

I firmly believe that scientific research and education are invaluable pursuits in today’s society. Just take a look around, from computers to medicine to agronomy, almost all of the practices and tools we use today are the result of decades of scientific research being compiled and refined by generation after generation. Still, when conducting research, there is a very easy temptation to get secluded in the ivory tower and forget that a particular focus is a part of the much larger world. When I’ve carried these critiques further and tried to understand where frustration stems from, it seems more often than not, these frustrations stem from one question: Why is science so infuriatingly non-committal?

If you’ve ever asked a scientist a point blank, yes or no, question you might notice that the answer is neither of the above options.

“Will this field treatment improve my crop yield?”

“It depends.”

“Can we say the cause of this pollution is due to over irrigation?”

“That definitely plays a major factor, but...”

Scientists don’t like absolutes. To say never or always goes against every fiber of their being. At its heart, science seeks to answer why. On the surface, that why might be simple: There was a wild fire and it started because of a carelessly tossed cigarette.

A non-scientist might leave it at that. We know what happened and what the cause was. Case closed. But as a scientist it’s only the beginning. Why was the cigarette not put out properly? Why was the area able to catch fire so easily? Why did the fire grow and spread, not peter out? Why was the individual smoking in the first place?

The list goes on and on. Each answer leads to more and more questions. Some of these questions might be easily answered, others might take years of dedicated research. Some results may simply answer the immediate problem they sought to solve, others open the door to fundamental changes about how we understand the universe, leading to even more whys to research. I’m guessing Sir Isaac Newton never imagined that the simple question of, “why did this apple hit me on the head?” would end up laying the groundwork for our modern understanding of physics.

And here is where the frustration with the scientific process lies. At what point are the whys enough? Where do we say, this is enough information to provide a solid answer to our question. There is no good answer. A researcher may never be satisfied with his questions, while a water manager was happy with the results about 10 questions ago. While the rest of the world moves on to the next issue, our researcher may be stuck, still pondering the answer to the initial question.

It is here that we can see the root of our problem. While I wish it were as simple as recognizing this dichotomy to make everything magically work, I’m afraid I can’t leave you with a nice simple solution. The wants and needs of both positions are never going to quite line up, managers will always want information sooner to act on, and researchers will always want to make sure there isn’t one more why that needs answered first. The key to making this relationship work despite this rub is good communication. And I think that is something we all can keep improving upon.

This is my final Ebb and Flow. In mid-January I took a position as an Extension Educator in northeast Nebraska’s Cedar County. While I’m still very much part of the University of Nebraska, my focus has shifted from water to beef production and forage systems. I am happy for this new opportunity but would be remiss if I didn’t share my sorrow of leaving the NWC. I have truly enjoyed the people I have been fortunate to meet and work alongside of while in this role and the unique challenges that working with water in Nebraska provides. To everyone who has made my work such a rewarding experience, Thank You!

## Beckman graduates Water Leaders Academy

Ben Beckman recently graduated from the seventh class of the Nebraska Water Leaders Academy, a one-year program that provides leadership training and educates participants about the vital role rivers, streams and aquifers play in the economic sustainability of the state.

For the past year and a half, Beckman was a research and extension communication specialist with the Nebraska Water Center/Daugherty Water for Food Global Institute and Nebraska Extension. He is a graduate of Elgin Public Schools and earned a bachelor's degree in Grassland Ecology and Management and a master's in Agronomy from the University of Nebraska–Lincoln.

Beckman recently accepted an assistant educator's position with Nebraska Extension in Cedar County in northeast Nebraska.

A project of the Water Futures Partnership-Nebraska, Academy sessions feature classroom as well as field trip experiences presented by acknowledged experts in leadership and natural resource topics held at locations across the state.

The Water Leaders Academy is partially funded through a grant from the Nebraska Environmental Trust and more than 25 other organizations and individuals.

More information can be found at [www.waterleadersacademy.org](http://www.waterleadersacademy.org).

## Great Plains water symposium comes to NIC in October

Steve Ress

The Nebraska Water Center at the University of Nebraska will host a nine-state regional water symposium, to look at shared challenges and opportunities, at Nebraska Innovation Campus in Lincoln in October.

The Oct. 25 and 26 event constitutes a significant break from the traditional state-driven Nebraska water symposium the NWC holds each fall, said NWC director Chittaranjan Ray.

"We think the timing is right for this sort of event and the endless possibilities for multi-state cooperation and collaborations it could bring," Ray said.

"The water resources of the region are under stress due to increasing demand for irrigation, industrial and municipal use as well as federal needs to maintain instream flows for fish and wildlife and to provide ecosystem services. Groundwater aquifers are also experiencing heavy pumping and in some regions, are losing their saturated thicknesses faster than they are being replenished by recharge," he said.

Participating states, in addition to Nebraska, are Montana, North Dakota, South Dakota, Iowa, Missouri, Kansas,

Oklahoma and Arkansas, an area Ray regards as a primary food basket not only for the United States, but also for the world.

To keep that bread basket producing, each of the nine states depends heavily on surface water from major river basins, as well as from groundwater sources such as the Ogallala Aquifer, Mississippi Embayment Aquifer in Arkansas and the Cambrian-Ordovician Aquifer system in Iowa and Missouri.

With heavy use of both surface and groundwater sources, each of the nine states are also experiencing similar groundwater contamination issues from natural and man-made sources, effects on water resources from climate change, flooding and leaching and runoff losses of farm applied chemicals and other challenges.

"Since we have similar water issues, a common platform to address water-related problems and to lay out potential solutions to mitigate them received wide support from the Water Resources Research Institute directors in each of the nine states when we talked about doing this symposium," Ray said.

The symposium will use presentations, posters and panels to cover major issues in the nine-state region, including supply shortages for irrigation, industrial or municipal use, technologies for dealing with groundwater contamination, use of high efficiency irrigation systems to reduce agricultural use, and exploitation of methods to use wastewater from food processing, animal operations or cities for crop use or groundwater recharge, among others.

Monitoring and modeling studies along with stakeholder driven research and educational activities will be showcased.

Issues will be highlighted in the regions' two major river basins: The Missouri River and Arkansas River.

Water quantity and water quality case studies in each of the nine states will also be presented, Ray said.

"The overall goal is to use the two days to address the current status of water resources in the region in the context of agricultural, public, industrial, and domestic use."



# WRAP meets at Ferguson House

Steve Ress

The University of Nebraska's Water Resources Advisory Panel, or WRAP, met at Lincoln's historic Ferguson House, just east of the State Capital, in early March.

It was an opportunity for members to catch up on the many happenings in the realm of water at the University, within state agencies, and in the current session of the state legislature.

Ron Yoder, associate vice chancellor of the University's Institute of Agriculture and Natural Resources, reviewed university plans for dealing with ongoing budget adjustments within the university but was quick to point out that water research projects, programming and teaching have been able to continue largely untouched by the threat of cuts. "It's not all doom and gloom. We have been able to continue doing what we need to do," he said.

What and where IANR will need to make cuts depends on how deep cuts in state funding assistance to the University turn out to be, he said.

Nebraska Water Center director Chittaranjan Ray reported on a number of upcoming projects, including the June 5-6 revival of the Platte River Basin Ecosystem Symposium by the Crane Trust and the June 26-29 water and natural resources tour, that will visit the U.S. Bureau of Reclamation's North Platte and Kendrick irrigation projects.

Ray also mentioned that the NWC will host a nine-state Great Plains regional water symposium at Nebraska Innovation Campus Oct. 24-26 in coordination with the water centers and USGS water sciences centers in Montana, North Dakota, South Dakota, Iowa, Kansas, Missouri, Oklahoma and Arkansas.

The NWC is working with the Upper Elkhorn, Lower Elkhorn, Lower Niobrara and Lewis and Clark Natural Resources Districts toward funding for a coordinator and for developing additional extension and demonstration projects in conjunction with local producers to reduce nitrate impacts to groundwater in Northeast Nebraska.

Peter McCornick, executive director of the Robert B. Daugherty Water for Food Global Institute, said DWFI will soon be publishing a water productivity atlas. He also caught panelists up on recent collaborative travels internationally including an upcoming conference in Brasilia, Brazil.

Jeff Fassett, director of the Nebraska Department of Natural Resources, told the group that much like the University, DNR is negotiating state budgeting issues. He noted that DNR already has a number of vacant positions, due in part to a booming commercial economy that can currently afford to pay better than the state.

He noted recent successes in the Republican River Basin in settling lingering disputes with neighboring Colorado and said there are currently no water-related lawsuits involving the state anywhere in Nebraska.

"The water factions in Nebraska have become far better at talking amongst themselves to find solutions to issues than 15 or 20 years ago," Fassett said.

After additional comments from other members of the WRAP, assistant extension educator Brian Krienke of the [University of Nebraska-Lincoln](#)'s Department of Agronomy and Horticulture gave a presentation on state-of-the-art "Sensor based nitrogen management: current nitrogen management methods that can increase nitrogen use efficiency."



The University of Nebraska's Water Resources Advisory Panel met at Lincoln's historic Ferguson mansion in early March.



Brian Krienke presented on "Sensor based nitrogen management: current nitrogen management methods that can increase nitrogen use efficiency" at the March WRAP meeting at the Ferguson mansion.



# 2018 water tour heads to Wyoming

Continued from page 1

The project extends more than 110 miles from Guernsey, WY, to Bridgeport, NE, where it irrigates nearly one-quarter of a million acres. It features about 2,000 miles of canals, laterals and drains and has five main storage dams, the first of which was completed in 1909 under then President Theodore Roosevelt.

“Water stored in the project’s reservoirs ultimately winds-up in Lake McConaughy, so touring the project is a natural follow-on to last year’s tour of irrigation facilities in western Nebraska,” Ress said. “Everyone who works in water and irrigated agriculture in Nebraska needs to see the upper reaches of the North Platte, but it is remote, which is part of the reason the tour periodically visits there.”

Tour planning is just beginning, but there is always much in the way of water topics to discuss and things to see along both the North and South branches of the Platte River.

“Nebraska, Wyoming and Colorado rely on the waters of the Platte Basin for irrigation, hydropower generation, recreation, wildlife habitat and groundwater recharge and the states are bound to share the water through interstate compacts and decrees,” said co-organizer Jeff Buettner of The Central Nebraska Public Power and Irrigation District in Holdrege. “Tour discussions will likely include topics such as water for wildlife habitat, effects on the rivers from invasive species, irrigation efficiency and generation of hydroelectric power.”

Those discussions could also include issues facing local irrigation districts, canal companies, and Natural Resources Districts and an overview of North Platte River operations, Buettner added.

The tour is expected to fill quickly. Registration will open later this spring and will be announced well ahead of time. Planning and registration updates will be posted at [watercenter.unl.edu](http://watercenter.unl.edu)

The tour last visited the North Platte and Kendrick Projects four years ago.



Seminoe dam.



Aerial view of Pathfinder dam and the North Platte River in Wyoming. The dam was completed more than a hundred years ago.



Lake McConaughy near Ogallala.





Daugherty Water for Food Global Institute visiting scholar Alka Rani presents at a lunch-and-learn for WARI participants last November.

## WARI moves into year three

Jesse Starita

The third wave of Water Advanced Research and Innovation (WARI) fellowship and internship awards have been announced. WARI is a joint initiative between the University of Nebraska and several of India's top academic institutions to help build capacity to address global water quality challenges. The 2017-2018 class includes eleven awardees, including one doctoral student from the University of Nebraska–Lincoln.

WARI program partners include the Indian Government and its Department of Science and Technology, the Indo-U.S. Science and Technology Forum, the University of Nebraska–Lincoln and the Robert B. Daugherty Water for Food Global Institute at the University of Nebraska.

Now in its third year, the program provides Indian students and scientists with advanced water research and mentorship opportunities at the University of Nebraska. New this year, WARI is launching a reciprocal exchange component that enables Nebraska students and early-career faculty to conduct water research in India. On Jan. 11, the first Nebraska WARI scholar will begin a five-month fellowship in India that includes stipends for air travel, research and housing.

The first Nebraska WARI scholar is:

- David Gosselin, Ph.D. student,

### University of Nebraska–Lincoln

Department of Political Science, for the project: *Water Governance and Community Based Organizations*. India host: Dr. Ashish Pandey, associate professor, Department of Water Resources Development & Management, Indian Institute of Technology – Roorkee.

Additionally, the 2017-2018 class includes seven doctoral student interns and three early-career research fellows from Indian universities and research laboratories. The ten awardees will be mentored by Nebraska water science faculty from across the university system, including the University of Nebraska Medical Center's College of Public Health, the Nebraska Water Center, National Drought Mitigation Center and **University of Nebraska–Lincoln's** School of Natural Resources, School of Biological Sciences, and Departments of Civil Engineering, Chemistry, and Biological Systems Engineering. WARI scholars will spend three to twelve months in Nebraska after arriving this spring.

The 2017-2018 WARI fellowship awardees include:

- Sandeep Kumar, assistant professor, Guru Jambheshwar University of Science & Technology, Hisar, for the project: *Utilization of Nanomaterials for Quick and Efficient Water Management*. Nebraska faculty mentors: Ashraf Aly Hassan and Yusong Li, **University of**

### Nebraska–Lincoln Civil Engineering.

- Raaj Ramsankaran, associate professor, Indian Institute of Technology – Bombay, for the project: *Operational Meteorological Drought Monitoring across India using Multi-Satellite High Resolution Grid*. Nebraska faculty mentor: Francisco Muñoz-Arriola, **University of Nebraska–Lincoln** Biological Systems Engineering.
- Hiren Dinkarray Raval, scientist, Central Salt & Marine Chemical Research Institute, Bhavnagar, for the project: *Exploring the Novel Hybrid Approach for Emerging Contaminants' Removal for Water Reuse*. Nebraska faculty mentors: Dan Snow, Nebraska Water Center; Yusong Li, **University of Nebraska–Lincoln** Civil Engineering.

The 2017-2018 WARI internship awardees include:

- Akarsh A, Ph.D. student, Indian Institute of Technology – Gandhinagar, for the project: *Groundwater Vegetation Linkage in India through Remote Sensing and Process Based Modeling*. Nebraska faculty mentors: Tsegaye Tadesse and Brian Wardlow, National Drought Mitigation Center.
- Pooja Devi, Ph.D. student, Central Scientific Instruments Organization, Chandigarh, for the project: *Development of Biosensor for Non-Conventional Pollutants Determination in Water*. Nebraska faculty mentors: Rebecca Lai, **University of Nebraska–Lincoln** Chemistry; Dan Snow, Nebraska Water Center.

• Ipsita Nandi, Ph.D. student, Banaras Hindu University, Varanasi, for the project: *Monitoring Water Quality for Turbidity Nutrients and Atrazine using Citizen Science in the U.S. and India*. Nebraska faculty mentors: Shannon Bartelt-Hunt, **University of Nebraska–Lincoln** Civil Engineering; Eleanor Rogan, UNMC College of Public Health.

• Banajarani Panda, Ph.D. student, Annamalai University, Chidambaram, for the project: *Influence of Vadose Zone on the Geochemistry of Recharging Groundwater*. Nebraska faculty mentors: Dan Snow, Nebraska Water Center; Karrie Weber, **University of Nebraska–Lincoln** School of Biological Sciences and Earth and Atmospheric Sciences.

• Veerababu Poliseti, Ph.D. student, Central Salt & Marine Chemical Research Institute, Bhavnagar, for the project: *Studies on the Development of High Flux Anti-Fouling Nanofiltration Membranes*

*Application in the Removal of Pesticides and Treatment of Industrial Waste Water*. Nebraska faculty mentor: Siamak Nejati, **University of Nebraska–Lincoln** Chemical & Biomolecular Engineering.

• Ashutosh Sharma, Ph.D. student, Indian Institute of Technology – Guwahati, for the project: *Analysis and Simulation of Relevant Water Quality Climate Scales using Global Climate Model and Remote Sensing*. Nebraska faculty mentor: Francisco Muñoz-Arriola, **University of Nebraska–Lincoln** Biological Systems Engineering.

• Priyanka Uddandaraao, Ph.D. student, National Institute of Technology Srinivasanagar Surathkal, Mangalore, for the project: *Inactivation of Drug Resistant Bacteria by Employing Biogenic ZnS Nanophotocatalysts*. Nebraska faculty mentors: Siamak Nejati, **University of Nebraska–Lincoln** Chemical & Biomolecular Engineering; Xu Li,

**University of Nebraska–Lincoln** Civil Engineering.

“We look forward to entering our third year of the WARI program, which is an important part of Nebraska’s efforts to collaborate with India on water quality challenges,” said Chittaranjan Ray, Nebraska Water Center director. “Together, we’re working to equip future leaders with the tools and expertise to tackle water issues that affect our ability to ensure water and food security in Nebraska and around the world.”

The WARI research program addresses shared water quality challenges in the U.S. and India, including the ecological and human health impacts caused by pollutants and contaminants, groundwater quality assessment and management, and remote sensors that monitor and measure water quality. For more information about WARI, visit <http://waterforfood.nebraska.edu/wari>

## New publication highlights state’s secondary aquifers

Shawna Richter-Ryerson and Dana Divine

Most Nebraskans likely are familiar with the High Plains aquifer, one of the largest aquifers in the world, and the primary source of water for many Nebraskans. But for those living in eastern Nebraska and in portions of the panhandle where the High Plains aquifer is absent, secondary aquifers are crucial sources of water for life.

A new publication by hydrogeologists with the Conservation and Survey Division at the University of Nebraska delves deep into Nebraska’s seven secondary aquifers and provides extensive detail about their characteristics, with a focus on water quantity, water quality, and water use. The educational circular, “An Overview of Secondary Aquifers in Nebraska”, is the first comprehensive analysis of its kind in the state.

“This publication is designed to answer questions commonly asked about these smaller aquifers,” said co-author Dana Divine, CSD hydrogeologist based at the School of Natural Resources.

Divine, co-author Steve Sibray, and cartographer Les Howard, compiled and analyzed data from more than 4,000 active wells in 30 counties in eastern and western Nebraska to summarize where and how each of the secondary aquifers are used. The secondary aquifers in eastern Nebraska are the Western Interior Plains, Dakota, Codell, and Niobrara aquifers, and in western Nebraska are the Chadron, Brule, and Upper Cretaceous aquifers. Maps for each of the seven secondary aquifers show the locations of individual wells.

“The maps in this publication are printed on transparent overlays so that the spatial relationship of the aquifers to each other is clear,” Divine said. “More than one secondary aquifer is used in some counties, and we would like people to

understand where it is possible to drill into a deeper aquifer and where it is not.”

In addition to showing the locations of the aquifers, the hydrogeologists also answered basic questions such as how deep the aquifers and available water are; how much yield the aquifers produce; where they recharge or discharge; and how the water is used. They also summarized water quality and highlighted potential problems associated with tapping into the aquifers. Secondary aquifers, they noted, typically yield less water that is poorer in quality and more difficult and costly to access than water in primary aquifers.

“People should find this publication helpful if they have concerns about their water quality or if they want to know if they have potential to install a well in an area where the High Plains aquifer is absent,” Sibray said. “They should get a good idea of how deep these aquifers are and what to expect in terms of well yield and water quality.”

Hard copies of the publication are \$24.99 each and are available at Nebraska Maps and More Store, in the Hardin Hall lobby, 3310 Holdrege St. They also can be purchased online or by phone at 402-472-3471. A free PDF is available to institutional university members at [digitalcommons.unl.edu](http://digitalcommons.unl.edu).

The Conservation and Survey Division is a multidisciplinary research, service and data-collection organization established by Nebraska state statute in 1921. The division also serves as the natural resource survey component of SNR.



# New staff at the Water Sciences Laboratory

A research laboratory manager, a post-doctoral researcher and a professional technician have recently joined the staff of the Nebraska Water Center's Water Sciences Laboratory on the University of Nebraska–Lincoln's East Campus.

## Saptashati (Tania) Biswas, Ph.D., Research Laboratory Manager:



Saptashati Biswas is the new research laboratory manager for the Water Sciences Laboratory at the University of Nebraska–Lincoln. In this capacity, Biswas is responsible for the day-to-day operation and management of the WSL in the following areas:

Managing day to day laboratory operations including monitoring sample workflow, client requirements, implementing data management and quality assurance plans, revise standard operating protocols and supervise proper use and maintenance of lab equipment

Developing and implementing formal staff and student training programs, overseeing undergraduate internship programs and providing workshops promoting capabilities of the WSL.

Monitoring WSL budgets and client pricing schedules, improving client interface, directing promotional efforts through workshops and conferences, updating core facility business plans, expand the scope of research and assisting with grant proposals.

Biswas received her Ph.D. in Environmental Science and Technology from the University of Maryland, College Park in 2014; an M.Sc. in Environmental Science from the University Kalyani, West Bengal, India in 2006; and a B.Sc. in Chemistry from the University of Calcutta, India in 2004.

Prior to coming to the WSL, she was a postdoctoral research associate at the National Centre for Water Quality Research at Heidelberg University and a postdoctoral research assistant and graduate research assistant in the Department of Environmental Science and Technology at the University of Maryland, College Park, Md.

Some of her most recent research interests have involved long-term trends in pesticide concentrations and loads in Lake Erie, method development measurement of glyphosate in Ohio rivers, method development for measuring acid herbicides in Lake Erie watersheds and effects of long-term trends in agricultural pesticides from tributaries to Lake Erie and the Ohio River, among others.

## Arindam Malakar, Ph.D., Post-Doctoral Research Associate:



Arindam Malakar is a post-doctoral research associate at the Water Sciences Laboratory on the University of Nebraska–Lincoln's East Campus. Malakar began his post-doctoral association with the WSL in May 2017, having received his Ph.D. in April 2017 at the Indian Association for the Cultivation of Sciences, Kolkata, under the University of Calcutta, India. He earned his postgraduate degree in Chemistry from Banaras Hindu University in Varanasi, India in

2010 and Bachelor's degree (Hons.) in Chemistry from Banwarilal Bhalotia College, Asansol under the University of Burdwan, Burdwan, India in 2008. In 2015, Malakar was selected for the prestigious "Water Advanced Research and Innovation (WARI)" Internship Program, supported by the Department of Science and Technology, Govt. of India, the University of Nebraska–Lincoln, the Daugherty Water for Food Institute (DWFI) and the Indo-US Science and Technology Forum (IUSSTF).

Malakar's research interests include:

- Understanding formation, mobility and different interaction of natural nanoparticles/minerals.
- Developing methods to study interaction and influence of synthetic nanoparticles on formation, stability and mobility of natural nanominerals.
- Synthesis of nanomaterials and their application in environmental remediation. Specifically, decontamination of water mimicking natural ways.
- Developing self-standing membrane for forward osmosis.

Currently at the [University of Nebraska–Lincoln](#), his main focus is understanding the formation and movement of natural nanoparticles in the environment. In that context, he is trying to understand the interaction of irrigated water and root zone soil chemistry.

"We are trying to analyze, how specific crop type and root-pore water interact, which may change the mobility and availability of uranium (U), arsenic (As) and selenium (Se) ions or nanoparticles," he said. "In another project, we are looking at the Vadose zone nitrate content and how this nitrate may affect the movement of contaminant ions. These projects are presently at nascent stage and we are continuously expanding our knowledge by designing new experiments. I am also the primary researcher overseeing the new IC-ICP-MS at the Water Sciences Lab."



**Victoria Wickham,  
Research Technician:**



Victoria Wickham has joined the staff of the Water Sciences Laboratory as a full-time research technician, having begun working with the lab more than a year ago, while still an undergraduate student at the University of Nebraska–Lincoln. Wickham received her Bachelor of Science degree in Water Science from the University of Nebraska–Lincoln in December 2017. At the lab, Wickham does water, soil and Polar Organic

Chemical Integrative Sampler (POCIS) sample preparation for liquid chromatography-mass spectrometry (LC-MS/MS) and gas chromatography-mass spectrometry (GC-MS) analysis. She also works closely with the laboratory's manager and other professional staff to help train students in laboratory analysis procedures and helps in maintaining laboratory equipment, disposing of samples, lab organization, administrative work and other duties.

## SNR's new limnologist: Water quality key

Alli Dickey

When Jessica Corman was in sixth grade, her godmother lent her a water quality testing kit to use on a stream in her backyard for a science project. That project sparked a curiosity about water that grew into a career at the University of Nebraska–Lincoln where she works as a limnologist researcher and professor at the School of Natural Resources.

“Water is this important thing because it combines all these big environmental issues we’re thinking about,” Corman said. “It’s so socially relevant because everyone needs clean drinking water.”

Corman likes to combine chemistry and ecology to understand water systems as a whole. She studies the different elements that come into water systems because of human disturbance and how this affects later human usage.

It has taken her across the globe to East Africa, Guatemala, and Northern Mexico where she has conducted research on water quality in lakes and how it affects human health. She currently is wrapping up a project in Kenya connecting water quality on Lake Victoria to human health.

At Nebraska, she plans to broaden her research to include water quality in streams across the state and examine whether they act as filters or pipes of nutrients to the larger rivers. Corman wants to know if the streams are healthy and whether they pass the nitrogen and phosphorus they collect into bigger water systems.

“I’m balancing these multiple processes of, ‘How do we use water for irrigation and return it back to the rivers in such a way that it doesn’t impair the other uses of that resource?’” she said.

In addition to taking on new local research projects, and continuing to build collaborations across the globe, Corman also teaches limnology, the study of fresh water’s biological, chemical and physical features, at Nebraska.

She wasn’t always interested in being a limnologist, though. As an undergraduate biology and science of earth systems major at Cornell University, Corman was interested in soils. After completing a National Science Foundation Research Experience for Undergraduates as a limnologist on Lake Tanganyika, she realized she would rather work with water systems.

For three years after she graduated, she worked for the National Science Foundation as a science administrator.

“That really got me excited about the bigger picture of science and how it is used in policy,” she said.

She then pursued her doctorate at Arizona State University, where she completed her dissertation on the calcium-carbonate deposits in the aquatic features in Cuatro Ciénegas, México. The dessert has many water systems, but there are limited nutrients.



Jessica Corman

“The big question there is how does life survive when there are not any nutrients around,” Corman said.

She also worked on the effects of volcanos on lakes and sustainable phosphorus.

For her post-doctoral research, she went to the University of Wisconsin-Madison where she looked at acid rain deposition on lakes.

In December, she came to SNR, and she already has big goals in mind.

“One of my big goals it to get people to think not in terms of water quantity, but in water quality,” she said. “It doesn’t matter how much water you have if the quality is poor.”

# Know Your Well project moves into second year

Christopher Olson

Our Nebraska Environmental Trust-funded “Know Your Well” project, led by Ashok Samal and coordinated through the Nebraska Water Sciences Laboratory (WSL) has just finished a successful first year.

Four Nebraska high schools, Waverly, Auburn, Newman Grove and Central City, led the way in getting this unique educational opportunity for high school students off the ground. Participating students have completed sampling local rural domestic water wells around their home town and area. Starting late last spring, high school students were trained in sampling and recording field observations from up to 20 domestic wells from a 20-mile radius surrounding their school.

Those participating completed testing for various analytes that might indicate a problem with well water quality. They have uploaded all of their data into a “Know Your Well” computer application developed by [University of Nebraska–Lincoln](#) Computer Science and Engineering graduate students that allows them to view their results on the “Know

Your Well” website.

Students will compare their test results to results from samples they collected and sent to the WSL. They can use the data to statistically evaluate the similarities and differences between their results and those from the WSL. Laboratory results are supplied to each well owner for participating with the “Know Your Well” project.

Year two of “Know Your Well” is now underway and four to six additional schools are planned to be included from across Nebraska. These presently include Freeman, Stuart, Cody-Kilgore, Madison and possibly Osmond and one other. The goal for this three-year project is to give a wide variety high school students in agriculture and science classes from across the state opportunities to learn about proper well sampling for potential

groundwater contaminants. They will also learn what to do if specific contaminants are found in drinking water.

For more information on the Know Your Well project, go online to [knowyourwell.unl.edu](http://knowyourwell.unl.edu)

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



Christopher Olson (right) coordinates the “Know Your Well” program for the Nebraska Water Sciences Laboratory.

## Reviving the Platte basin ecosystem symposium this June

*Continued from page 1*

shorebird, and crane ecology, endangered species topics, habitat mapping and modeling, insect conservation, natural history, herpetology, and all other topics relevant to the conservation of the Central Platte River Valley and adjacent ecosystems.”

Details of the request for presentation proposals can be found online at [watercenter.unl.edu](http://watercenter.unl.edu).

A draft schedule of symposium events calls for a bird walk to begin the first day on June 5, followed by a series of 15-minute presentations throughout the morning and afternoon. On June 6, workshops will focus on conservation needs in the central Platte River basin and knowledge gaps in the central Platte River basin, Caven said.

The symposium will close by Noon, June 6.

The Platte River Basin Ecosystem Symposium was originally held yearly then biannually from 1990 to 2003 with funding help from the U.S. Environmental Protection Agency. It was

coordinated by the University of Nebraska–Lincoln’s Platte Watershed Program which has since been inactive.

Its intent was to provide researchers and land stewards an opportunity to stay abreast of ongoing research within the Platte River basin and to develop shared goals for future study and inquiry.

Organizations such as the Audubon Society, Nature Conservancy, and Crane Trust have been actively conserving and studying habitat in the central Platte River valley for more than 40 years, cooperating with regional partners such as [the University of Nebraska–Lincoln](#), the University of Nebraska at Kearney, U.S. Fish and Wildlife Service, U.S. Geological Survey, Nebraska Game and Parks Commission, Central Platte Natural Resources District and others.

2007 witnessed initiation of a major management milestone in the basin with the beginnings of the Platte River Recovery and Implementation Program, which has focused on studying and improving habitat for federally threatened and endangered species.

In view of that 40-year history of conservation and management in the basin, Caven said the time was right to reconvene the symposium.



# Series focused on advances in irrigation management

Steve Ress

The Nebraska Water Center and the [University of Nebraska–Lincoln](#) School of Natural Resources spring semester water and natural resources seminar that is now in progress is featuring seven free public lectures focused on advances in irrigation management.

“Evolving and advancing irrigation management practices are at the very core of Nebraska’s powerful and productive agricultural economy. It is safe to say that without development of the irrigation technologies and management we have today, our state economy would be far different than it is,” said Chittaranjan Ray, director of the Nebraska Water Center.

“Irrigation is not without risk, responsibility and a clear focus on the future, however,” he said.

The seven speakers in this spring’s seminar are looking at advances in and management of this important technology from perspectives of both university experts and industry leaders.

According to the Nebraska Department of Agriculture, there were just under 2.2 million acres of crop and pastureland under irrigation in 1964. Fifty years later, in 2014, that number had increased to just under 8.3 million acres, representing just under half of the total cropland harvested in the state.

Cody Bailey of Reinke Manufacturing Co. opened the series on Wednesday, Jan. 17 with “A unique view of an advanced center pivot irrigation system.”

Xin Qiao, a water and irrigation management specialist at [Nebraska’s](#) Panhandle Research and Extension Center in Scottsbluff, closes the seminar on April 18 with a talk on “Irrigation management in western Nebraska and future opportunities.”

All of the lectures are 3:30 to 4:30 p.m. in the first-floor auditorium of Hardin Hall on [Nebraska’s](#) East Campus in Lincoln.

In addition to being offered free to the public, the seminar can be taken for student credit through the [university’s](#) School of Natural Resources.

Individual lecture videos and speaker PowerPoint presentation will be posted online at [watercenter.unl.edu](http://watercenter.unl.edu).



## Lectures in the seminar:

- Jan. 17 Cody Bailey, Reinke Manufacturing Co., Inc.  
*A Unique View of an Advanced Center Pivot Irrigation System*
- Jan. 31 Williams Memorial Lecture: Ken Quandt, McCrometer Corp.  
*McCrometer Flow Connect: Building on Irrigation Flow Meter Fundamentals*
- Feb. 14 Trenton Franz, [University of Nebraska–Lincoln](#): *Spatiotemporal Prediction of Soil Properties and States in Variably Saturated Landscapes*
- Feb. 28 Daran Rudnick, [University of Nebraska–Lincoln](#): *Performance of Tools and Technologies for Scheduling Irrigation and Fertigation in Western Nebraska*
- March 14 Kremer Memorial Lecture: Kurtis Charling, Lindsay Corp.: *Using Proven Science, Research, and Big Data to Simplify and Optimize Irrigation Management*
- March 21 No Seminar ([University of Nebraska–Lincoln](#) Spring Break)
- April 4 Derek Heeren, [University of Nebraska–Lincoln](#): *Variable Rate Irrigation (VRI): Potential Benefits, Limitations, and Management Practices*
- April 18 Xin Qiao, [University of Nebraska–Lincoln](#): *Irrigation Management in Western Nebraska and Future Opportunities*

## Nebraska continues to see modest groundwater declines

Shawna Richter-Ryerson

Unlike parts of Colorado and Kansas, Nebraska isn't in danger of running out of groundwater from the High Plains Aquifer anytime soon. But the largest source of usable water in the state is still on average below pre-pumping water levels, according to the 2017 Nebraska Statewide Groundwater-Level Monitoring Report.

The recently released annual report examines groundwater level changes, including increases and decreases measured in regional wells in spring 2017. In addition to current levels, it also looks at historical trends, comparing regional water levels over extended periods of time.

The report is available for \$7 from the Nebraska Maps and More Store, 3310 Holdrege St., and [here](#). Phone orders also are accepted at 402-472-3471.

"The reports coming out of Denver, Colorado, and Garden City, Kansas, are accurate for those regions, but they don't accurately portray conditions in Nebraska," said Aaron Young, survey geologist with [the University of Nebraska-Lincoln's](#) Conservation and Survey Division (CSD) and the report's lead author.

Nebraska has seen a slight decline in groundwater levels over the five-year period starting in the drought year 2012, with 71 percent of the 5,200 wells recorded showing water levels dropped by about 1.9 feet on average in that time period.

"From 2016 to 2017, groundwater levels in Nebraska haven't really changed," Young said. "Most of Nebraska received near-

average precipitation, which reduced the need for supplemental irrigation, leading to little change in average water levels."

About half of the wells in the state saw groundwater levels decline; the other half recorded increases from 2016 to 2017. Increases of 1 to 10 feet were recorded in northeast Nebraska, where above-average precipitation fell. Declines of 1 to 5 feet were recorded in areas along and to the south of the Platte River in south-central Nebraska, in correlation with below-average precipitation and increased irrigation pumping.

Problem areas in Chase, Box Butte, Perkins and Dundey counties in the far-west portion of the state continued to persist, due to irrigation use in regions with limited precipitation. Since about 1950, some of these counties have seen declines of up to 122 feet.

In-depth maps in the report give visual representations of these changes, conveying the information in one-year, five-year, 10-year and since-pre-irrigation (about 1950) increments. The maps are based on information collected by CSD, U.S. Geological Survey, U.S. Bureau of Reclamation, Nebraska Natural Resources Districts and Central Nebraska Public Power and Irrigation District. The reports and maps have been produced by CSD since the 1950s. Groundwater monitoring began in Nebraska in the 1930s.

Other report authors are Mark Burbach, environmental scientist; Leslie Howard, geographic information science and cartography manager; Michele Waszgis, research technician; Matt Joeckel, state geologist and CSD associate director; and Susan Lackey, research hydrogeologist.