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Spring 2008

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# WATER CURRENT

Vol. 40, No. 2

SPRING 2008



## UNL/OSU Researchers Try Promising Technique to Remove Groundwater Contamination

By Steve Ress

Researchers at the University of Nebraska—Lincoln and at Oklahoma State University have joined to test promising new methods of removing longstanding groundwater contamination at the former Nebraska Ordnance Plant near Mead.

The study includes pumping sodium permanganate into specially drilled injection wells, where it mixes with contaminants in the groundwater under the former ordnance plant, turning them into harmless carbon dioxide and water.

“Initial results show the permanganate was 75 to 80 percent effective in removing RDX from the groundwater contamination plume under the former (ordnance) plant,” said UNL environmental chemist Steve Comfort. Comfort specializes in soil and water remediation and oversees the Environmental

(continued on page 14)

University of Nebraska—Lincoln environmental chemist Steve Comfort (right) and environmental engineering graduate student Chanat Chokejaroenrat work on a project that injected sodium permanganate into specially drilled wells at the former Nebraska Ordnance Plant near Mead. The chemical mixes with explosives residues in the groundwater, turning them into harmless carbon dioxide and water. The experiments are being conducted in cooperation with researchers from Oklahoma State University and the Department of Defense (IANR photo by Brett Hampton).



## Water and Natural Resources Tour in June

By Steve Ress

An early June water and natural resources tour will visit the lower Republican River basin in Kansas and Nebraska to help answer water use questions in the basin.

The annual University of Nebraska—Lincoln and Kearney Area Chamber of Commerce water and natural resources tour is June 3-5, beginning and ending on UNL's East campus.

“With Kansas once again threatening Nebraska with alleged non-compliance issues under the three-state

(continued on page 15)



An ethanol plant at Cambridge was a stop on next June's water and natural resources tour (photo: Steve Ress).

### INSIDE

- |   |  |
|---|--|
| 2..... Director's Notes                 | 8..... Earthworm Study                 |
| 3..... Meet the Faculty                 | 9..... Switchgrass Costs               |
| 4..... Herpel Joins Staff               | 10-11 .... Water Conference            |
| 4..... Viessman Scholarship             | 12..... Water News Briefs              |
| 5..... Emergency Water Supplies         | 13..... Drinking Water Pharmaceuticals |
| 6-7 ..... Long-term Drought Perspective | 20..... Annual Reader Survey           |



# USGS Climate Change Research: a Critical Partnership in the Making

## from the DIRECTOR



Kyle D. Hoagland

Under its current director, Dr. Mark Myers, the United States Geological Survey (USGS) is currently undergoing major transformations, under two headings.

First, they are reorganizing themselves nationally, from a discipline-based organization to one that is more integrated across disciplines and regionally based. Nebraska is part of the North Central States region, with its new regional executive Dr. Max Ethridge, located in Eagan, Minn. ([mwthridge@usgs.gov](mailto:mwthridge@usgs.gov)).

Second, USGS has identified six *strategic science directions* to be addressed over the next ten years (2007-2017):

- Understanding Ecosystems and Predicting Ecosystem Change
- Climate Variability and Change
- Energy and Minerals for America's Future
- A National Hazards, Risk, and Resilience Assessment Program
- The Role of Environment and Wildlife in Human Health
- A Water Census of the United States

Recognizing that not all six can be undertaken or simultaneously funded, a decision was made to tackle global climate change as its first major push. To best address this significant challenge, USGS has recognized the need to establish a national ecological needs network and to form partnerships with academic institutions, acknowledging the fact that they cannot tackle the problem of global climate change alone.

The network will be comprised of six science nodes, strategically placed in locations representative of much larger regions. Formal decisions regarding locations of these nodes at specific universities have not yet been made, but the University of Nebraska-Lincoln is under consideration for one such node, which would represent the Great Plains region.

Two steps have already been

taken to begin development of this potential partnership: (1) a global change conference was held at UNL on October 12, 2007 to introduce the USGS delegation from Washington D.C., led by Dr. Tom Armstrong, to the cognizant researchers on global change at UNL, and; (2) from May 19-22, a far more extensive, in-depth climate change workshop was held in North Platte and surrounding environs.

This workshop was co-sponsored and jointly planned by UNL Vice Chancellor for Research Dr. Prem Paul's office and Armstrong's USGS office, via a combined planning committee lead by UNL Associate Vice Chancellor for Research, Kim Espy and Robert Swanson, who directs the USGS Water Science Center here in Lincoln. It included two days of field trips to various key research sites across western Nebraska, primarily in the Sand Hills, followed by a full day of formal presentations and panel discussion, culminating in several breakout sessions designed to explore research needs in global change specific to the Great Plains, but in particular the Sand Hills region (with its underlying aquifer) and the Platte River valley.

The amount of time and effort that went into the workshop not only made it an outstanding event, but it also demonstrated how well USGS and UNL can work together, now and into the future. Real collaborative ties and

*(continued on page 17)*

## WATER CURRENT

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# Meet the Faculty

## Gary L. Zoubek

Gary L. Zoubek is an Extension Educator in York County. He has been with University of Nebraska–Lincoln Extension in York County, Southeast Research and Extension Center for 34 years.

### Education:

M.S., Agriculture, University of Nebraska–Lincoln, 1973.

B.S., Agriculture, University of Nebraska–Lincoln, 1972.

### Examples of Current Research/Extension Programs (brief descriptions):

- Zoubek's Extension responsibilities include educational programming in irrigated agriculture. His goal is to get the research-based

information from the University to the people of the area.

- Most recently he has been involved with the Nebraska Agricultural Water Management Demonstration Network (NAWMDN). The goal of this effort is to: "Educate and inform agricultural professionals and irrigators about the use of newer technologies such as Evapotranspiration gages (ETgages) and Watermark soil moisture sensors through this Network which was established in early 2005 in a partnership between UNL Extension and Upper Big Blue Natural Resources District (UBBNRD). The network has expanded to more than 120 participants in 2007 with more planning to participate in 2008. Information about this effort can be found at: <http://york.unl.edu/Yorkag.htm>.

### Examples of Past Research/Extension Programs:

- Over the years, Zoubek's programming efforts have changed depending upon location or needs. He has been a member of several teams working on water quality

*(continued on page 16)*



**Gary L. Zoubek**

## Paul C. Hay

Paul Hay is a University of Nebraska–Lincoln extension educator and is unit leader of the Gage County Extension Office in Beatrice. He has been a UNL faculty member in the Southeast Research and Extension Center since 1975.



**Paul C. Hay**

### Examples of Current Programming:

- Cropping Systems Rotation Study
- Earthworm populations in tilled versus no-till fields
- Water infiltration on tilled versus no-till fields
- Home water wells and treatment systems
- Radon indoor air quality

### Examples of Past Programming:

- Eco-fallow Education
- No-till Cropping in Southeast Nebraska
- Central Blue Valley Hydrologic Unit Area
- Numerous Water and Conservation Cost-Share Programs
- Carbon sequestration education
- Gage County Farmers lead the nation with 141 carbon contracts

### Examples of Current Research/Extension Programs (brief descriptions):

- Dryland Cropping Systems: More than 60 percent of corn and milo, and 75 percent of soybeans and wheat are planted no-till in Gage County. The Extension effort to accomplish this feat has been one dedicated to protect our low intake rate silty clay loam soils from erosion and to improve the water quality in the Blue River system. Currently Gage County has 128 farmers with over 75,000 acres of no-till carbon contracts offered for sale on the Chicago Climate Exchange. Future efforts are focused on water quality cost share efforts targeting atrazine reduction in the Blue River system and unintended consequences of our ethanol and bio-fuel development in Nebraska. These will include,

*(continued on page 16)*



# Herpel Joins Water Center Staff as Outreach Specialist

By Steve Ress

**R**achael Herpel has joined UNL Water Center staff as a water education and outreach specialist.

"Rachael (Herpel) is well known throughout Nebraska, and nationally, for her 10 years of work as community programs director for the Lincoln-based Groundwater Foundation and we are very happy to have her bring her experience in water programming to the University of Nebraska—Lincoln." Said UNL Water Center director Kyle Hoagland.



Rachael Herpel

At the Groundwater Foundation, Herpel directed projects focused on source water protection, septic system maintenance, water policy education, private wells, proper disposal of pharmaceuticals and personal care products, waterborne pathogens, and wellhead protection area management.

At the Water Center, she replaces Jessica Harder, who left UNL for a lobbying position in Des Moines, Ia. last fall. Herpel will be working with Water Center student intern Kyle

Jackson and other UNL colleagues to extend the Water Center's educational and outreach efforts, particularly to those in state and local government, the state legislature, natural resources districts, state agencies, etc.

"With her wealth of experience at the Groundwater Foundation and professional credentials and interest in water and environmental issues, Rachael is an extremely good fit for the Water Center and for UNL's water education and outreach efforts," Hoagland said.

Herpel received a B.A. in Political Science and a Master's degree in Community and Regional Planning from UNL, where she specialized in environmental planning and water quality issues and previously worked for the UNL Water Center. She also has worked for the Papio-Missouri River NRD, the Nebraska Natural Resource Conservation Service and UNL Extension's Platte Watershed Program.

She is the author of *Consensus Building: A Primer for Local Leaders* and the Groundwater Foundation's various Groundwater Guardian and source water protection publications. She edited *Using Technology to Conduct a Contaminant Source Inventory: A Primer for Small Communities* and most recently *Protecting Our Water: A Primer for Preventing the Pathogenic Contamination of Drinking Water Sources*.

Since 1999 she has facilitated over 100 source water protection workshops in 32 states.

## Scholarship Honors Water Center's First Permanent Director

By Steve Ress

**W**ith the scholarship's namesake, her academic advisor and more than a hundred conference attendees looking on, Jesse Winter became the first recipient of the Warren "Bud" Viessman Memorial Scholarship at April's University of Nebraska—Lincoln Fifth Annual Water Law, Policy and Science Conference.

The scholarship was made possible by a donation to the University of Nebraska Foundation by UNL alumnus Isaac Yomtovian, owner and CEO of Cleveland, Ohio-based S.I. Land Development and Construction.

Yomtovian, who was on hand to present the scholarship and whose company is engaged in development, investment, construction and management of residential properties, retail centers and offices in New York and Ohio, said he had very fond memories of his years at UNL and his interactions with then UNL Water Center director Viessman and that he wanted to establish the scholarship as a way of giving something back to the university and encouraging current water science students.

The UNL Water Center, along with other Water Resources Research Institutes, was formed in 1964 as a provision of that



Viessman Scholarship recipient Jesse Winter is flanked by (from left) UNL Water Center director Kyle Hoagland, academic advisor Dean Eisenhauer, former UNL Water Center director and scholarship namesake Warren Viessman and scholarship benefactor and UNL alum Isaac Yomtovian (IANR photo by Brett Hampton).

year's Congressional passage of the Water Resources Research Act. The Water Center began as a program of UNL's Conservation and Survey Division under CSD director Eugene C. Reed.

(continued on page 15)

# Storing A Safe Emergency Drinking Water Supply

By Sharon Skipton,  
UNL Extension Water Quality Educator

**S**pring and summer in Nebraska can be a time of severe storms which can result in damage to homes and other property, loss of power, and in some cases an interruption in water supplies.

Having a safe emergency drinking water supply on hand is a good idea. If you do not have an emergency water supply, consider storing one.

The water you store should be free of disease causing organisms. Nebraska's public water supplies are suitable for storage. Private drinking water supplies suitable for drinking and cooking should also be suitable for storage. Use food-grade containers washed thoroughly with hot tap water and dish detergent and rinsed with hot tap water.

Bacteria can be introduced into the water during collection and storage. Therefore, it's a good idea to disinfect the water being stored to guarantee it will remain safe.

Some, but not all, public water supplies are disinfected with chlorine or chloramines. These water supplies may contain enough residual disinfectant to deactivate pathogens that might be introduced during the water storage process.

For private water supplies or public water supplies that are not disinfected with chlorine or chloramines, or for an additional safety margin, you can treat the water with chlorine (a disinfectant) to inactivate organisms that might be present in the storage containers, or that might be introduced as the water is collected.

Use liquid household chlorine bleach that contains five to six percent sodium hypochlorite. Do not use bleach containing fragrances, soaps, or other additives. Use fresh bleach, preferably not more than three months old. Add the bleach using a clean, uncontaminated medicine dropper at the rate of four drops per quart or 16 drops per gallon.

Stir the water, cover, and allow it to stand for 30 minutes. You should be able to smell chlorine after the 30 minute waiting period. If you cannot, add another dose and let the water stand covered another 15 minutes. Cap containers and label each with the contents and the preparation date. Water treated in this manner can be stored in one of two ways. Containers can be stored on a shelf in a cool, dry place away from direct sunlight.

For best quality, use or replace shelf-stored water every six months. Water can also be stored in a freezer. If you lose

electricity, the frozen water provides the added benefit of keeping foods frozen for a period of time. Leave two to three inches of air space in the top of containers before freezing to prevent the container from bursting as water expands during freezing. Some thin-walled containers may break regardless of the air space provided.

People sometimes ask if it is possible to can water. The answer is yes, although I do not hear of it being done often. It is possible to can water in food-grade glass fruit jars with flat metal lids and metal screw bands.

Jars should be manufactured and rated for canning of food. Fill clean quart fruit jars with water, leaving 1 inch of head space (air space) at the top of each jar. Place a flat metal lid and a metal screw band on each jar.

Fill a canner half full with water.

Preheat the water and lower the jars into the water. Add more boiling water, if needed, so the water level is at least 1 inch above the jar tops. Bring the water to a vigorous boil. Cover the canner with a lid and lower the heat to maintain a gentle boil.

Boil for 20 minutes adding more boiling water, if needed, to keep water level above the jars. When the jars have been boiled for 20 minutes, turn off the heat, remove the jars, and place them on a towel, leaving at least one-inch of space between jars during cooling. Contents contract as jars cool, pulling down the lid to form a high vacuum seal. If the lid is not sealed on cool jars, do not store the water. Store containers in a cool, dry place away from direct sunlight. Canned water can be stored for an indefinite period of time.

*(Editor's Note: This is the first in what we hope will become a regular feature in the Water Current on various water topics and issues by UNL extension educators and other water faculty and staff members with full or partial appointments in UNL's Extension Division).*



Sharon Skipton

# A Long-Term Perspective on Drought

By Sheri Fritz, Ph.D.

Department of Geosciences and School of Biological Sciences,  
University of Nebraska–Lincoln

The major droughts of the 20<sup>th</sup> century, such as those of the Dust Bowl period and 1950s, had profound environmental, economic, and social impacts in the Great Plains and are viewed by many as extreme events. Yet the 20<sup>th</sup> century provides a relatively short-term view of climate variability, and it is useful to extend our perspective to include longer periods of time. A longer term perspective gives us a better understanding of both the natural recurrence of drought for planning purposes and of whether recent trends may be a product of human impact on climate or are simply a manifestation of long-term natural variation.

In most parts of North America, the instrumental record of climate only extends back about a hundred years or less. This instrumental record can be augmented by the written accounts of early explorers and naturalists, such as Lewis and Clark or Fremont and Nicollet in the Great Plains. However, the diaries and notes of early explorers describe only short windows of time, may reflect subjective judgment, and still only extend the record of climate variation by a hundred years or so. To put recent climate variation in the context of hundreds or thousands of years, we can turn to geological or biological records of the history of climate change.

One of the best tools for reconstructing recent climate history is measuring growth rings of living, recently dead, or fossil trees. Annual rings of growth can be distinguished in trees that grow in a seasonal climate, and the width of each ring reflects how favorable the climate conditions were for growth. Because a ring is added each year, the age of each ring can be determined simply by counting from the newest growth back through the sequence of rings. Ring-width measurements from living trees can be compared with

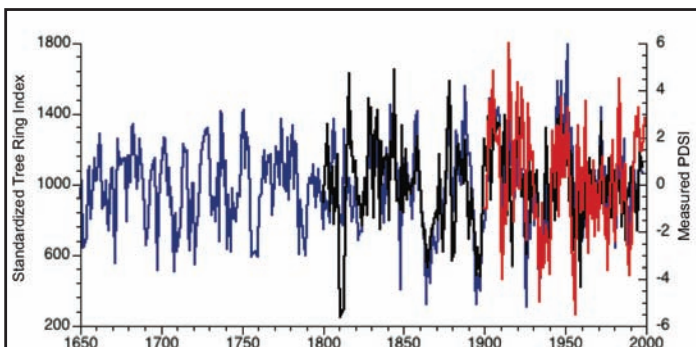
instrumental measurements of climate from those same years and used to derive a quantitative and predictive relationship between ring width and a specific climate parameter (such as growing-season temperature or precipitation). This relationship can then be applied to tree-ring sequences that formed in years prior to the instrumental record to reconstruct the climate of the past. The length of time covered by tree-ring sequences depends on the longevity of individual tree species and how well preserved fossil wood might be. Regardless, tree-ring records commonly extend back in time only a few hundred years.

Trees are infrequent in the grasslands of the Great Plains, but they do occur in river valleys, and these trees provide regional tree-ring records that give us an insight into the climate of the last few hundred years. Tree-ring sequences from Long Pine Creek and the Niobrara River Valley in north-central Nebraska (see Figure 1) show that major droughts equivalent in severity and length to those of the 20<sup>th</sup> century occurred in the late 19<sup>th</sup> century, whereas fewer major droughts occurred during the 18<sup>th</sup> century. The ring measurements also suggest that the first two decades of the 20<sup>th</sup> century were quite wet relative to the 300-year record, a pattern that is apparent in many trees from western North America, as well. In parts of western U.S., water policy was codified in these decades when the climate was unusually wet, thus the perception that rainfall was abundant likely biased policy formulations that were based on so-called average or “normal” water availability.

One limitation of tree-ring records is that they only extend back a few hundred years in most cases, which may not provide an adequate window into the full range of natural climate variability. This is particularly true, because the interval from ~ AD 1300-1850 was known as the Little Ice Age, and many parts of Europe and North America experienced cool conditions, which in turn may have affected regional water availability. Thus, it's possible that conditions during the Little Ice Age interval may not be characteristic of variability during slightly warmer time periods, such as in the 20<sup>th</sup> century and times prior to AD 1300.

Lakes, wetlands, dunes, and other landscape features often persist for centuries, or even millennia, and can be used to learn about climate even further back in time. My own research uses the bottom sediment of lakes as recorders of drought. Lake sediments are a product of material that forms in the lake itself, that is washed in from the watershed, and that falls in from the atmosphere. These materials enter the lake, fall to the lake bottom, and accumulate over time in a layer cake fashion. As you go deeper into the mud, you are going back in time. Fossils can be extracted from individual layers of the sediment and dated, and these fossils can be used to tell the history of the lake, watershed, and atmosphere back through time.

Precipitation history can be reconstructed from lake sediments, because lakes change in depth in response to increases and decreases in moisture. In some situations, they also change in salinity, because increased evaporation in a



Standardized tree-ring measurements from trees recovered from Long Pine Creek (black line) and Niobrara Valley Preserve (blue line) in the Nebraska Sand Hills. A comparison of the tree-ring measurements with the measured Palmer Drought Severity Index (PDSI) for the 20<sup>th</sup> century (red line) shows how tree-rings track local drought variation. Negative values of the PDSI indicate dry conditions, and positive values are wet. Data are from Connie Woodhouse and Tom Bragg and are available at the NOAA World Data Center for Climatology.



# History in the Great Plains

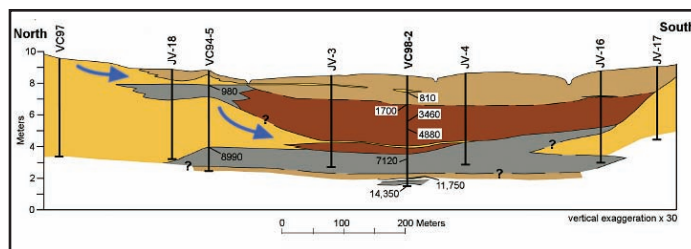
dry climate removes water and leaves behind dissolved salts, whereas increased precipitation dilutes the lake water and produces fresher conditions. These changes in lake depth and salinity influence the species composition of various organisms that live in the lake. Some of these species are resistant to degradation and thus are preserved in the sediments at the bottom of the lake after they die. Various chemical compounds also reflect changes in lake depth and salinity and can be analyzed in the sediments to reconstruct past moisture conditions.

Records from lakes in the northern Great Plains show that droughts the severity of the Dust Bowl period are a recurring part of natural climate variability (see Figure 2). At times, such as in the 16<sup>th</sup> century, major droughts occurred more frequently, whereas at other times, such as the early 1800s, major drought was rare. What is most striking about moisture records from the Great Plains is that drought was prolonged and persisted for multiple decades during some time periods within the last few thousand years. The most recent of these periods occurred between ~800 and 1000 years ago – also referred to as the Medieval Period, because it correlates with the European cultural period by the same name (much of northern Europe experienced unusually warm conditions during Medieval times). Some people refer to the Medieval drought in the Great Plains as a “megadrought”, because it was unusually severe and persistent.

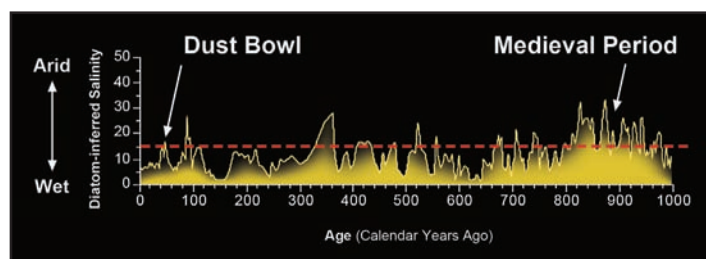
Evidence for major prolonged drought in the Great Plains during the Medieval Period is also present in the dunes and wetlands of the Nebraska Sand Hills. Some of the modern wetlands surrounded by grass-stabilized dunes have thin layers of sand at depth in their sediments (see Figure 3). These thin layers of sand suggest intervals of time when the grass cover of the dunes was destroyed by drought, and sand moved out across the dried wetland surface. Later, when precipitation increased again, these lenses of sand were buried by peat formed in the wetland. In Jumbo Valley Fen, a site in north-central Nebraska studied by University of Nebraska–Lincoln geologists, the most recent of these buried sand lenses dates from the Medieval Period. Dating of the

dune sand near the surface of the modern dunes also shows that, throughout many areas of the Sand Hills, the youngest sections of the dunes were deposited in Medieval times as winds moved sand across the land surface during a period of severe drought. Thus, there is widespread evidence from lakes, dunes, and wetlands in the northern and central Great Plains for major and persistent drought 800 to 1000 years ago that was much more prolonged than anything in human-recorded climate history.

Scientists commonly use the last one to two thousand years as a yardstick for evaluating natural patterns of climate variation, because the configuration of the Earth’s climate system over this interval is very similar to what it is today. Yet, drought even more severe than that of Medieval times was common in the Great Plains during other periods of the last 10,000 years, particularly within the so-called mid-Holocene, between approximately 9000 and 5000 years ago. During this interval, the Earth received more summer solar



A cross-section of what lies beneath the surface at Jumbo Valley Fen in the Nebraska Sand Hills. At this location, a wetland is bordered on each side by transverse dunes, which today are stabilized by grass cover. The composition of the subsurface below the modern dunes and the wetland was determined by taking cores at multiple locations, as shown by the labeled vertical lines. In the cross section, the yellow units represent sand and the tan, brown, and gray units are peat (decomposed wetland plants). The layers of sand embedded within the peat in the valley bottom were deposited when drought killed the dune grasses, and dune sand was blown across a dried wetland. The most recent of these events was 800 to 1000 years ago (the numbers within the cross-section are dates on various layers of sand or sediment). (Figure courtesy of Jim Swinehart, UNL).



A 1000-year reconstruction of drought in eastern North Dakota based on changes in lake salinity inferred from diatoms (fossil algae) in lake sediments. The dotted line, which shows the Dust Bowl period, serves as a point of reference. Note that drought was prevalent during most of the Medieval Period from ~1000 to 800 years ago. Data are from Kate Laird and Sheri Fritz and are available at the NOAA World Data Center for Climatology.

radiation (insolation) than it does presently, because of cyclic changes in the Earth’s orbit around the sun. Because the sun-Earth configuration was different, this interval is not a good model for natural drought variation under current conditions. Nonetheless the dominance of drought, as severe or more severe than observed in the Dust Bowl period, serves to reinforce the notion that major drought is a common and natural part of the climate variability of the Great Plains.

The geological record of drought recorded in tree rings, lake and wetland sediments, and sand dunes does not really allow us to predict the future occurrence of drought and whether or not drought severity will increase as a result of human impacts on climate. Yet, it does tell us that, even without human-induced climate change,

(continued on page 14)



# Water Center History Books Available

Copies of the *History of the UNL Water Center From 1964-2008* are available first-come, first-served while limited quantities remain.

This first-ever comprehensive history of the UNL Water Center dates from its inception as a program within the University of Nebraska–Lincoln Conservation and Survey Division to the present.

Copies of the book were available at last month's Fifth Annual Water Law, Policy and Science Conference in April and have been sent to Water Center con-

stituents, state senators, Nebraska's Congressional delegation and others.

The book was largely researched and written by former Water Center administrative assistant Karen Stork, who later retired from UNL's Conservation and Survey Division.

"Karen (Stork) did months of digging for information, writing, editing, reviewing hundreds of photographs and had personal contact with every living past director of the center," said UNL Water Center director Kyle Hoagland, who

commissioned Water Center communications coordinator Steve Ress and Stork to co-author the book last year.

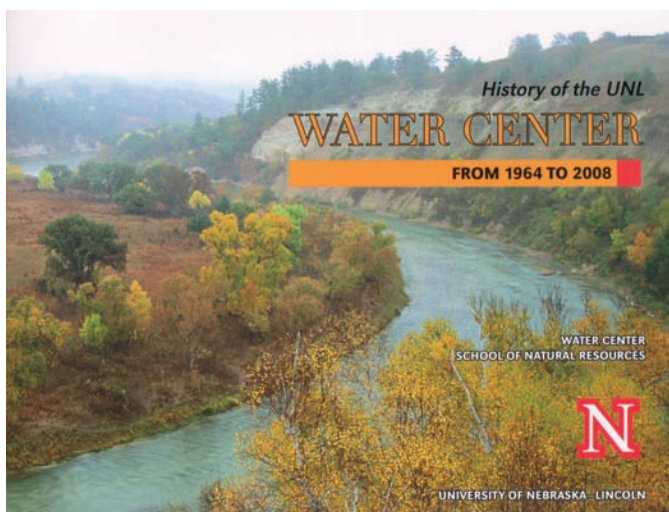
"Karen was the real force in keeping this project focused and moving along," said Ress. "She did the vast majority of the research and writing and I don't think there is anyone else who could have

captured both the history and the essence of the center over the last 40-plus years."

Sections of the book examine the early years of the Water Center, as well as the decades of the 1970's, 1980s, and 1990's and into the 21<sup>st</sup> century. Chapters also detail the Water Center's accomplishments in water resources planning and management, public service, drought management, hiring of water-related faculty, the Water Sciences Laboratory and special projects and programs such as conferences, water tours and seminars, the Burlington Northern study and many others. Recollections of past directors, in their own words, are included as separate chapters.

"The book highlights the center's contributions to Nebraska and the nation over the last 40-plus years, documenting why the now-established network of state water institutes was created and the unique accomplishments of our UNL Water Center from its beginnings," Stork said.

For a free copy, while they are available, contact the UNL Water Center at (402) 472-3305 or email [sress1@unl.edu](mailto:sress1@unl.edu).



## Earthworms Contain Chemicals from Households and Animal Manure

Earthworms studied in agricultural fields have been found to contain organic chemicals from household products and manure, indicating that such substances are entering the food chain, according to recent research by the U.S. Geological Survey.

Manure and biosolids, the solid byproduct of wastewater treatment, were applied to the fields as fertilizer. Earthworms continuously ingest soils for nourishment and can accumulate the chemicals present in the soil.

The chemicals investigated are considered indicators of human and animal waste sources and include a range of active ingredients in common household products such as detergents, antibacterial

soaps, fragrances, and pharmaceuticals. Some of the detected chemicals are naturally occurring such as plant and fecal sterols and fragrances. All of these chemicals tend to be concentrated in the municipal waste distribution and disposal process and are referred to as anthropogenic waste indicators (AWI).

USGS scientists and their colleagues from Colorado State University at Pueblo, Colo. recently published their findings in *Environmental Science and Technology*. The results demonstrate that organic chemicals introduced to the environment via land application of biosolids and manure are transferred to earthworms and enter the food chain.

Scientists found 28 AWIs in biosolids

being applied at a soybean field for the first time and 20 AWIs in earthworms from the same field. Similar results were found for the field where swine manure was applied. Several compounds were detected in earthworms collected both from the biosolids- and manure-applied fields, including phenol (disinfectant), tributylphosphate (antifoaming agent and flame retardant), benzophenone (fixative), trimethoprim (antibiotic), and the synthetic fragrances galaxolide, and tonalide. Detergent metabolites and the disinfectant triclosan were found in earthworms from the biosolids-applied field, but not the manure-applied field.

Biosolids are made from the sludge

(continued on page 17)

# UNL Researchers Determine Costs of Producing Switchgrass for Ethanol

By Sandi Alswager Karstens, IANR News Service

**O**n-farm cost of producing switchgrass for cellulosic ethanol averages about \$60 per ton, according to a new study by a University of Nebraska–Lincoln agricultural economist and others.

The study, which contracted 10 farmers in Nebraska, North Dakota and South Dakota to commercially grow switchgrass for five years, starting in 2000 and 2001, gives a real-life look to farmers interested in growing and contracting switchgrass, said Richard Perrin, the UNL agricultural economist who was the primary economic analyst for this study.

“This is the most comprehensive study to date on assessing the economic costs of producing switchgrass biomass in commercial fields,” he said.

The joint U.S. Department of Agriculture–Agricultural Research Service and Institute of Agriculture and Natural Resources study was recently published in *BioEnergy Research* and is available online at <http://dx.doi.org/10.1007/s12155-008-9005-y>.

In the study, two farmers with previous experience growing switchgrass had the lowest production costs of \$39 per ton. The five farmers with the lowest costs had production costs of less than \$50 per ton, which should be achievable by other farmers as they gain production experience, Perrin said.

The study does not include costs to transport the switchgrass to a biorefinery, or the costs to process it in the biorefinery.

“Cost beyond the farm gate is more speculative,” Perrin said. “Currently there is not an exact figure available on how much it actually costs to produce ethanol from switchgrass because that industry is not really born yet.”

Researchers offered a speculative scenario that factored in transportation and ethanol production costs. Estimating production cost at \$50 per ton and assuming a conversion efficiency of 80 to 90 gallons per ton, the cost of switchgrass feedstock delivered to the refinery would be equivalent to 58 cents to 66 cents per gallon of ethanol.

The Energy Independence and Security Act of 2007 mandates the use of 100 million gallons of cellulosic biofuel by 2010, possibly more than will be produced, Perrin said.

The technology to convert cellulosic materials to ethanol on a commercial scale has been difficult to develop. Cellulose first must be broken down into starch and sugar before it can be fermented into alcohol.

A number of cellulosic ethanol plants are in operation, including one in York, but most are pilot-scale plants. Six cellulosic biorefineries co-funded by the U.S. Department of Energy also are in the works across the U.S. and should be completed over the next few years. These plants are expected to produce more than 130 million gallons of cellulosic ethanol per year, according to the U.S. Department of Energy. The closest of these will be in Iowa and Kansas.

Perrin and the agronomists involved in the study expect production costs will decline further as farmers’ experience with switchgrass grows and new ethanol-friendly cultivars are developed. Increasing land rents will significantly increase production cost because they account for nearly half of all production costs.

The fields used in the study were in Nebraska near Atkinson, Crofton, Lawrence and Douglas; in South Dakota near Highmore, Bristol, Huron and Ethan; and in North Dakota near Streeter and Munich. Land was marginal cropland that would have qualified for the Conservation Reserve Program.

Farmers were paid for their work under contract with UNL and recorded all costs for producing switchgrass biomass start to finish, including machinery and labor, materials such as seed and fertilizer and land rent.

Total baled biomass yields were determined for each farm.

Other authors of the study were Ken Vogel, a USDA-ARS geneticist in UNL’s Department of Agronomy and Horticulture; Marty Schmer, USDA-ARS agricultural science research technician and UNL doctoral student; and Robert Mitchell, USDA-ARS agronomist at UNL. This study follows up on a net energy study published in the January Proceedings of the National Academy of Sciences (PNAS) which found switchgrass grown for biofuel production produced 540 percent more energy than needed to grow, harvest and process it into cellulosic ethanol.

That study also found greenhouse gas emissions from cellulosic ethanol made from switchgrass was 94 percent lower than estimated greenhouse gas emissions from gasoline production. For more information about this study, see the March 12 edition of *Cornhusker Economics* at <http://www.agecon.unl.edu/Cornhuskereconomics.html>.





# Water Quality Challenges In The Great Plains



Tricia Liedle and Pat Jarecke (center and right) register attendees at the Fifth Annual Water Law, Policy and Science Conference. Nearly 200 registered for the conference.



UNL alum Isaac Yomtovian (right) shares a moment with former UNL Water Center director Warren Viessman. Viessman became the first full-time, permanent director of the center in 1968.



Former *Wall Street Journal* editor Frank Edward Allen on journalism's duty in presenting environmental news.



Hydrologist Jennifer Stanton of the U.S. Geological Survey.



Former U.S. Secretary of the Interior and former Arizona Governor Bruce Babbitt talks with Nebraska Bostwick Irrigation District general manager Mike Delka.



Mike Klein of Holdrege's Anderson, Klein, Swan and Brewster, spoke as part of the conference's law track.



Steve Oltman of Olsson Associates and Dennis Grams of ASW Associates were joined by former Water Center director Warren Viessman and Prairie Fire newspaper publisher W. Don Nelson for a panel discussion on state water issues.



UNL Vice Chancellor for Research Prem Paul and former Secretary of the Interior Bruce Babbitt. Babbitt spoke to the Water, Law, Policy and Science Conference the morning after his E.N. Thompson lecture appearance at Lincoln's Lied Center.



Dick Ehrman of the Nebraska Association of Resources Districts (center) and UNL hydrogeologist Jim Goeke (right) talk at the conference.



U.S. Geological Survey hydrogeologist Herbert Buxton spoke on new ways of thinking about emerging environmental contaminants.



Purdue University agricultural economist Otto Doering speaking on the potential impacts of biofuels on water quality.



UNL College of Law professor Sandi Zellmer spoke to law track attendees on anti-speculation rules.

## 5th Annual Water Law, Policy and Science Conference

(Photos by Brett Hampton and Steve Ress)







# Water News Briefs

## October UNL Water Colloquium

The UNL Water Center and UNL School of Natural Resources will host a Fall Water Colloquium at Hardin Hall on UNL's East Campus, Thursday, Oct. 9.

The colloquium will showcase the latest water-related research by University of Nebraska faculty, as well as research from other agencies.

Colloquium details will be available in the next edition of the Water Current and on the UNL Water Center's web site by this summer.

## Where Does All the Water Go?

Nebraska's surface and groundwater resources are used for a wide range of purposes, but irrigation uses the most, by far.

Nearly 93 percent of the state's water resources are used for irrigation, with five other broad-category uses accounting for the other roughly seven percent, according to a U.S. Geological Survey circular.

Surface water is diverted and withdrawn from streams and reservoirs for off-stream uses, including generation of hydroelectric power, fish and wildlife, livestock and recreation. Groundwater is used for irrigation, human and livestock consumption and commercial and industrial uses.

In some cases, groundwater contributes to surface water flow, either as a deliberate or unintended result of the original use. Groundwater applied to fields for irrigation may infiltrate into aquifers or be discharged into rivers. Also, some groundwater used for public water supply is returned to streams via wastewater treatment plant discharge.

**Estimated total water use in Nebraska** (Mgd – Million gallons per day):

**Irrigation: 92.72 percent, 8,790,000 Mgd.**

**Public Supply: 3.48 percent, 330,000 Mgd.**

**Mining: 1.398 percent, 132,500 Mgd.**

**Livestock: 0.985 percent, 93,400 Mgd.**  
**Self-supplied Domestic: 0.51 percent, 48,400 Mgd.**

**Self-supplied Industrial: 0.40 percent, 38,100 Mgd.**

(Source: USGS Circular 1268, *Estimated Use of Water in the United States in 2000*).

## Bottled Water Drinkers

The countries with the highest share of the world's bottled water sales in 2006 were:

**United States, 17.6 percent**

**Mexico, 11.4 percent**

**China, 9.3 percent**

**Brazil, 7.0 percent**

**Italy, 1.6 percent**

(Source: U.S. Water News).

## Lake Mead Could Be Dry by 2021

Changes in climate and strong demand for Colorado River water could drain Lake Mead by 2021, triggering severe shortages across the region, scientists warn.

Researchers at San Diego's Scripps Institution of Oceanography said recently the West's largest storage reservoir faces increasing threats from human-induced climate change, growing populations and natural forces like drought and evaporation.

There is a 50 percent chance Lake Mead will run dry by 2021 and a 10 percent chance it will run out of usable water by 2014, if the region's drought deepens and water use climbs, the researchers said.

Currently, Lake Mead (located in Nevada and Arizona) is half full, as is Lake Powell. Both lakes help manage water resources for more than 25 million people in seven states.

(Source: Associated Press).

## Making Every Drop Count

Weather adjustments to an automatic irrigation system can conserve a lot of water. A system applying one-inch of water to an average size lawn (approximately 5,000 square feet) that has already received sufficient rain, wastes over 3,000 gallons of water, which is a year's supply of drinking water for 17 people.

1. In general, Kentucky bluegrass requires about 1 inch per week in April

and May, 1 ¼ inches in June, 1 ½ in July and August, 1 ¼ in September and 1 inch in October.

2. Consider allowing Kentucky bluegrass and buffalo grass lawns to go dormant. Irrigate only if no rain is received for three weeks. Tall fescue lawns do not recover well if allowed to go dormant in severe drought conditions.

3. Measure the amount of water applied in a 15-minute period using collection devices such as tuna or coffee cans. Adjust the runtime to deliver the required amount. Change the runtime seasonally and remember to subtract any rainfall.

4. Water to the bottom of the roots. Use a screwdriver or soil probe to determine how deep the roots are and how far the water has soaked in. Try to keep the soil moist about a half inch deeper than the deepest living roots, or to a depth of 8 to 9 inches if root depth is not known.

5. Water in the early morning (4 to 10 a.m.). Watering is more efficient in the morning due to less evaporation and low wind speed.

6. Observe your automatic sprinkler system once per month. Look for heads that don't turn, that spray the street or sidewalk, bent or damaged heads, clogged or worn nozzles or orifices, turf growth around heads, etc.

7. Return grass clippings to the lawn using a recycling type mower. Clippings are a good nutrient source, and help to conserve moisture.

8. Consider reducing the number of fertilizer applications, or reducing the amount of fertilizer applied to produce less growth and moisture loss.

9. Mow Kentucky bluegrass lawns 2 ½ to 3 inches; and tall fescue lawns in the 3-4 inch range to conserve moisture.

10. When watering on a slope, use delayed starts. Run sprinklers until you notice runoff, and then stop. Wait three hours, and then resume. Aerate in spring or fall to increase filtration.

11. When overseeding, irrigate lightly and frequently. The new turf plants have a shallow root system, so timing should be adjusted accordingly.

12. Adjust heads as landscape plants grow larger and begin to block the spray pattern. New installations of benches, decks, etc. can also decrease irrigation efficiency.

(Source: UNL Extension).

# Looking For Traces of Pharmaceuticals in Drinking Water

**By Daniel D. Snow, Ph.D.**  
**Director of Laboratory Services,**  
**UNL Water Sciences Laboratory**

**A** recent study by the Associated Press reported detecting traces of drugs in the public drinking water supplies of 24 major U.S. metropolitan areas. This has spurred further inquiries into the level and extent of pharmaceutical-based contamination in public water supplies and what should be done about them.

The presence of low concentrations of organic chemicals in drinking water supplies is not new, but the classes of contaminants being tested for are. Pharmaceuticals are of interest because they are biologically active and though their concentrations are usually very, very low – well below the part per billion levels we typically monitor other contaminants – their presence in water supplies is still of considerable interest.

Traces of many of chemicals we use daily end up in the environment and can ultimately wind up in water supplies. Municipal wastewater contains measurable levels of many over the counter and prescription drugs, steroid hormones, and other chemicals. Agricultural wastewater may contain steroid hormones as well as antimicrobial compounds used in the livestock industry. The relative importance of these contaminants to water supplies depends on their proximity to water sources, concentrations of the chemicals and their potential to persist in the

environment. Many questions remain regarding the occurrence and impacts of pharmaceuticals and other biologically active chemicals in the environment.

Several University of Nebraska research projects currently focus on improving our understanding of the occurrence and effects of steroids and pharmaceuticals in water.

For example, University of Nebraska, Omaha aquatic toxicologist Alan Kolok has been using a new sampling device along with genetic tools to study the occurrence and biological effects of natural and synthetic steroids from municipal and livestock waste. Natural estrogens are found in both types of wastewater and are known to affect the reproductive health of fish.

Because concentrations are quite low and vary over time, new devices for

sampling are being developed and tested to get a better understanding of these sources.

University of Nebraska–Lincoln civil engineer Shannon Bartelt-Hunt is developing and using new samplers to study occurrence of pharmaceuticals and steroid hormones in municipal and livestock waste to better understand their fate and transport in the environment. Bruce Dvorak, also in the UNL Civil Engineering Department, is also working on a new device for sampling drinking water systems for wastewater-derived contaminants such as caffeine.

These and other efforts in Nebraska will help better understand the sources of these “new” contaminants and ways to minimize their potential impacts on our public water supplies.

## State Senators Override Fluoridation Veto

Nebraska state senators overrode Governor Dave Heineman’s veto of LB 245, a water fluoridation bill, on April 17 with 31 “yes” votes, four “no” votes and 14 senators not voting.

LB 245, which took effect immediately because it contained an emergency clause, directs cities and towns with at least 1,000 residents to add fluoride to their drinking water, with a goal of reducing tooth decay. Medicaid dental programs cost as much as 50 percent less in fluoridated communities, according to the Centers for Disease Control and Prevention.

Fluoride is the single most effective measure to prevent tooth decay.

Towns and cities that don’t fluoridate their water could vote before June 1, 2010, to opt out. Those places where there is enough naturally occurring fluoride wouldn’t have to add any.

Many cities already have opted out of the current law requiring them to fluoridate water. Those that have opted out in the past would have to vote again to keep from adding fluoride.

Most of Nebraska’s population – more than 942,000 people – is served by 65 public water systems that add fluoride to water. Forty-one systems are naturally fluoridated. But 64 Nebraska communities with more than 1,000 people don’t add fluoride or have enough naturally occurring. That adds up to more than 297,000 people in cities such as North Platte, Grand Island and Norfolk.

*(Editor’s Note: From the Nebraska Section of the American Water Works Association).*

## UNL/OSU Researchers Try Promising Technique to Remove Groundwater Contamination *(continued from page 1)*

Restoration Science degree for UNL undergraduate students.

RDX, along with TNT and HMX were some of the explosive compounds used in producing bombs, boosters and shells at the Mead plant during World War II and the Korean War. The plant was active in producing munitions for the U.S. military for over 40 years.

Munitions producing load lines at the plant were routinely hosed-down to clean them and the resulting wastewater, containing high amounts of explosive residues, drained into sumps and ditches at the plant, where it later percolated into the groundwater.

"Complicating these groundwater contamination concerns was extensive use of trichloroethylene (TCE), which was used to degrease and clean pipelines at the plant in the 1960's," Comfort said.

The plume of RDX and TCE contamination in the groundwater beneath the Mead plant now covers several square miles.

With funding assistance from the U.S. Environmental Protection Agency's Region Seven Office in Kansas City, Kan. and the U.S. Department of Defense's Environmental Security Technology Certification Program, Comfort and fellow researchers from UNL and OSU are interested in seeing how efficient sodium permanganate may be in reducing the Mead plant's groundwater contamination problems and if the procedures they are using can be cost-effectively taught to and used by others at other similarly contaminated locations.

Mead's groundwater contamination problems are well known and are being treated. Comfort and his fellow researchers are using the location as an appropriate test-bed for their new technologies and treatment methods.

"Currently, the problems at Mead are being treated with an activated carbon method that is costing \$800,000 per year and could take as long as 125 years to totally eliminate the problems underneath the plant grounds," the UNL School of Natural Resources researcher said.

Before injecting permanganate into the groundwater to remove or reduce explosives-based contamination, OSU

researchers use a new technology, similar to ground-mapping radar, to characterize the subsurface area they will treat, which helps them better understand how and where to inject the chemical. The process is known as electrical resistivity imaging, or ERI.

"ERI helps us track the permanganate in the groundwater aquifer and shows zones of high concentrations of the chemical so that we can monitor destruction of the RDX," Comfort said.

It also shows the volume of groundwater impacted by the permanganate injections. Ultimately this helps researchers know where and how effective the permanganate is in reducing contamination within the treated area.

"So, with ERI as a monitoring tool, we can better identify sites that may be treatable with permanganate injections and know more precisely how effective the treatment is," Comfort said.

At Mead, researchers found that RDX decreased the most in monitoring wells closest to where the chemical was injected, but that makeup of subsurface soils, geology and groundwater flow paths in relation to the injection wells all had a bearing on how effective the treatment was.

"The chemistry works and if we had gotten better a distribution of the permanganate in the groundwater, the rates of RDX removal would have been even higher than the 75 to 80 percent we observed," he said.

Comfort and his team hope to use ERI again to improve permanganate delivery to the groundwater and determine the best locations for monitoring wells in future field trials.

"Permanganate is routinely used to treat groundwater with chlorinated solvents like TCE but is just now being considered for RDX and other explosives - maybe after a few more field trials, that will change," he said.

Sodium permanganate is much the same as *potassium permanganate*, a well-known chemical oxidant commonly used to treat problems as diverse as canker sores to getting rid of the rotten egg smell from hydrogen sulfide in water wells.

## A Long-Term Perspective on Drought History in the Great Plains *(continued from pages 6-7)*

major drought is recurrent and should be considered a natural part of the climate variability of the Great Plains. So, instead of adopting the common viewpoint that droughts are anomalies, we should manage our water resources to plan for severe droughts, such as those of the Dust Bowl period, the 1950s, and early decades of the 21<sup>st</sup> century. It may not be realistic to plan for the much less common but more persistent "megadroughts," such as during Medieval times - such a prolonged interval of drought certainly would have devastating social and economic impacts. Yet, we clearly can do a better job of water conservation, management, and planning to create a society and an economy that are less vulnerable to the natural fluctuations between wet and dry

that characterize the semi-arid climate of the Great Plains.

*Editor's Note: Sheri Fritz is a Willa Cather Professor at UNL with joint appointments in the Department of Geosciences and School of Biological Sciences. She co-directs the University-wide Water Resources Research Initiative. Fritz specializes in the reconstruction of past climate from lake sediments and presently has major projects in the Great Plains, the northern Rocky Mountains, and the tropical Andes of South America. She also studies modern lakes of the interior regions of North America. This article first appeared in the December 2007 edition (Vol. 1, No. 6) of "Prairie Fire" newspaper. The publication is online at [www.prairiefirenewspaper.com](http://www.prairiefirenewspaper.com)).*



## Water and Natural Resources Tour in June *continued from page 1*

Republican River compact, it will be a very opportune time for the tour to visit the basin,” said tour co-organizer Michael Jess, associate director of UNL’s Water Center.

“There are always questions to be answered regarding Nebraska’s and Kansas’ stances on compliance with the compact and with a new round of negotiations currently underway between the states and the possibility of legal action by Kansas against Nebraska, it’s a very pertinent time to look at some of these issues,” Jess said.

Kansas last initiated compact litigation against Nebraska 10 years ago. That lawsuit abruptly ended in 2002 when the two states negotiated a formal settlement. In 2003 Nebraska officials began efforts aimed at meeting obligations specified in the settlement, but in the 2003-2006 timeframe Nebraska’s water consumption exceeded agreed-upon limits. In referring to those deficiencies, Kansas threatened renewed court action against Nebraska last year.

Subsequent discussions among officials from both states have been aimed at avoiding further litigation, yet Kansas recently said it would like to collect more than \$70 million in damages from Nebraska for its over-use of Republican River water from 2003-2006.

Colorado is the third member of the three-state compact.

“Additionally, even though it’s not germane to the provisions of the compact, we always have people wondering why Kansas wants the water and how they utilize it,” Jess said.

The tour will explore answers to those questions, with part of the answer seeming to be increased urbanization and water use in and near Ft. Riley, Kansas that have supported military build-ups for the U.S.’s ongoing military commitments in Iraq

and Afghanistan.

Tour stops and presentations begin near the river’s mouth at Junction City, Kan. Other Kansas tour stops include Milford Reservoir, Kansas Bostwick Irrigation District and a site near Keith Sebelius Reservoir where Kansas State University and University of Nebraska researchers are investigating changes in overland runoff caused by terracing and other conservation measures.

The first of two overnights will be in Concordia, Kan., featuring dinner at the recently restored Brown Grand Theatre and a visit to the National Orphan Train Museum.

In Nebraska, the tour visits a recently completed ethanol

plant at Cambridge. Efforts to control salt cedar and other invasive species, using special funding provided by the state legislature will be examined below Harlan County Dam.

On the final day, Nebraska tour participants will join those taking part in a similar tour organized by the Kansas Geological Survey. Following lunch at Superior Estates Winery, legislative and executive branch officials from both states will discuss

water issues in the Republican River basin.

Tour registration deadline was May 9 and participation was limited to the first 50 participants. To inquire if seats are still available, contact Michelle Meyer at the Kearney Area Chamber of Commerce at (800) 652-9435.

Tour cosponsors are Central Nebraska Public Power and Irrigation District, Farm Credit Services of America, Gateway Farm Expo, The Flatwater Group, Kearney Area Chamber of Commerce, Nebraska Water Conference Council, Nebraska Association of Resource Districts, Nebraska Public Power District and UNL’s Water Center and School of Natural Resources.



**Homestead National Monument, near Beatrice, was a stop on June’s water and natural resources tour to the Republican River basin in Nebraska and Kansas (photo: Steve Ress).**

## Scholarship Honors Water Center’s First Permanent Director *(continued from page 4)*

Viessman became the first permanent director of the center as a stand-alone institute in 1968 and held the position until 1975.

It was clear at last month’s conference that Viessman and his family were proud to have the new scholarship named after him and to see the first of the scholarships awarded to Winter.

Winter is a junior Water Science major with a 3.92 grade point average. She selected Water Science from a desire to help protect and manage this vital natural resource to ensure that our society and future generations have safe, usable water for all purposes.

She plans to specialize in water policy and go on to graduate school to study in a related field before ultimately working for a state agency.

In summer 2007, she worked for UNL’s School of Natural Resources assisting with hydrologic research as part of a saline wetlands study. Her tasks included taking water samples from streams and wells around Lincoln, measuring salinity and electrical con-

ductivity of the streams and wells, and installing and collecting data from various sensors along stream banks and in wells.

At the end of the summer, she presented a poster about salinity variations related to precipitation for Rock Creek at the Geological Society of America’s annual meeting in Denver, Colo.

More recently she has been working with her advisor, Dean Eisenhauer in UNL’s Department of Biological Systems Engineering, testing the accuracy of rain gauges and water level loggers in addition to testing the hydraulic conductivity of soil samples.

This summer, Winter will work for the National Park Service at Valentine, on the Niobrara River. She is excited at the prospect of working in an area where water plays many different roles and where many agencies and groups cooperate to manage the resource. She plans on doing research for her senior project on some aspect of managing the Niobrara River and hopes to conduct most of the research this summer.



# Meet the Faculty

## Gary L. Zoubek *(continued from page 3)*

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and quantity issues (the Mid-Nebraska Water Quality Project), on-farm research (Greater Quad-County On-Farm Research Project), and a farm economics program (the Ten to Twenty farm profitability project). In addition, he has been involved in soil testing efforts to reduce nitrate leaching and on efforts to improve corn yields on sandy fields in Northeast Nebraska.

- While in Holt and Antelope Counties Zoubek worked on efforts to improve irrigation management and irrigation scheduling with the use of local weather data, soil moisture monitoring equipment and programs like the Penman equation. He installed a local weather station to gather needed climatic data.

### Examples of Outreach Programs:

- H<sub>2</sub>O Show – Youth Water Festival in past years
- Weekly Personal Columns in the York News Times – Extension Update
- Nitrate Testing Program @ the York and Nemaha County Fairs – 2007
- Turfgrass Demonstration Plot – York County Fairgrounds

### Selected Publications:

- Wortmann, C.S., Christiansen, A.P., Glewen, K.L., Hejny, T.A., Mulliken, J., Peterson, J.M., Varner, D.L., Wortmann, S., **Zoubek, G.L.** (2005, December). Farmer research: Conventional experiences and guidelines for alternative agriculture and multi-functional agro-ecosystems. *Renewable Agriculture and Food Systems*, 20, 243-251. Genre: Refereed Journal Article Category: Extension

## Paul C. Hay *(continued from page 3)*

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but not be limited to, land leasing options, forage diets for calf development, corn on corn cropping systems, meeting CSP guidelines, CRP conversion, etc.

- Gage County 4-H: There are 560 4-H members in 29 clubs and another 1500+ school enrichment contacts every year. Gage County 4-H features active and changing projects to meet youth needs like robotics, GPS training, conservancy breeds, corn rootworm surveys following UNL research guidelines, and 560 5<sup>th</sup> graders participating in an earth festival education program each year. This features seven half hour sessions on water and earth science education done in the natural setting of Camp Jefferson.

### Teaching:

- Last Year's Extension program efforts by Hay included 3729 student hours of direct teaching conducted in Gage

- Wortmann, C.W., A. P. Christiansen, K. L. Glewen, T.A. Hejny, J. Mulliken, J.M. Peterson, D. L. Varner, S. Wortmann, **G. L. Zoubek**, 2005. Farmer research: project evaluation and guidelines for implementation. *Renew Agric. Food Syst.* 20:243-251.

### EXTENSION and EDUCATIONAL PUBLICATIONS:

- Irmak, S., Jose O. Payero, Dean E. Eisenhauer, William L. Kranz, Derrel L. Martin, **Gary L. Zoubek**, Jennifer M. Rees, Andrew P. Christiansen, Dan Leininger. 2006. Watermark granular matrix sensor to measure soil matric potential for irrigation management. EC783 UNL Extension Division. <http://www.ianrpubs.unl.edu/epublic/live/ec783/build/ec783.pdf> Genre: Circular Category: Extension
- Roger A. Selley, Tina Barrett, and Robert Klein (Paul Hay, Tom Holman, Keith Jarvi, Ron Seymour, and **Gary Zoubek**) Nebraska Crop Budgets, 2006, EC872. <http://www.ianrpubs.unl.edu/epublic/live/ec872/build/ec872.pdf> Genre: Circular Category: Extension
- Ten Easy Ways to Boost Profits by \$10 per Acre. (2005-06). University of Nebraska–Lincoln, EC176. <http://www.ianrpubs.unl.edu/epublic/live/ec176/build/ec176.pdf> Genre: Circular Category: Extension

### Web/e-mail addresses:

<http://www.york.unl.edu/> or <http://york.unl.edu/Yorkag.htm>  
Email: gzoubek1@unl.edu

County, 18 other Nebraska Counties, and two other states. This includes 27 different presentation preparations. In addition Hay coordinated programs where other University of Nebraska staff and professionals presented 10,256 student hours of direct teaching.

### Selected Publications:

- Prepared 26 news columns for the Beatrice Daily Sun. These news columns placed on the gage.unl.edu website generated 10,291 contacts from across Nebraska and around the world.

### Web/e-mail addresses:

<http://gage.unl.edu>  
Email: phay1@unl.edu

## From the Director *(continued from page 2)*

genuine friendships were forged during this meeting, which also generated a plethora of specific research ideas that need to be jointly addressed by scientists at UNL and USGS.

Three parting observations regarding this workshop and its lasting effects on the way we “do business” in the future. First, a statement made by Armstrong during his plenary presentation, “The question that we are now facing is not whether or not climate change is occurring, rather what are we going to do about it?” is perhaps the most pertinent comment made at the entire workshop because it clearly demonstrated that the federal government is now behind the monumental effort of addressing what is unequivocally the most important environmental challenge of our time, global climate change.

The time to act is now and the degree of commitment must be unbridled by political concerns, something that came through loud and clear at this unique workshop.

Second, one couldn’t help not being very impressed by the breadth and depth of water expertise at UNL, based on the on-the-ground research being conducted at a variety of locations across the state, from the individual plant level to regional scale climate models, and based on existing infrastructure.

Finally, it was also clear by the exceptional attendance at the workshop that the entire Nebraska community of hydrologists, modelers, economists, sociologists, aquatic ecologists, agricultural producers, water law experts, educators, decision makers, etc. not only must work together but I believe that they are prepared to do so. Hopefully, UNL will be selected as a USGS science node so that our water faculty can fully engage in this critically important effort.

A few notes of additional interest before I close for this issue:

- The UNL Water Center and UNL School of Natural Resources will host a Fall Water Colloquium at Hardin Hall on UNL’s East Campus, Thursday, Oct. 9. This event will showcase the latest water-related research by University of Nebraska faculty, as well as research from other agencies. More details will be forthcoming later this summer.
- The UNL Water Center has been integrally involved in a major revamping of the Institute of Agriculture and Natural Resources and UNL Extension’s presence at the annual Husker Harvest Days ag show in Grand Island. Beginning this year, UNL efforts will be showcased along thematic lines, with this year’s theme being “Water” (what a coincidence!). This is the first major restructuring of UNL’s presence at Husker Harvest Days since the show debuted in 1978 and we are eager to bring you the changes.
- UNL Water Center assistant director Lorrie Benson has been diligently working with colleagues from UNL Extension and other departments to bring about a UNL water web site portal that will be a seamless window to all things water-related at UNL. By the time you read this, the beginnings of the site should be up and running at <http://water.unl.edu>
- Recent rains, especially in central and eastern Nebraska, have all but silenced drought talk of late, but they have come at the price of much severe weather, destruction of property and replanting of fields in some cases. They by no means should be taken as a cue not to keep our eye on the weather and to the greater challenges of climate variability and change.

## Earthworms Contain Chemicals from Households and Animal Manure

*(continued from page 8)*

generated by the treatment of sewage at wastewater treatment plants. Biosolids are used as fertilizer by farmers, landscapers, and homeowners when it satisfies U.S. Environmental Protection Agency and local regulations for nutrient, metal, and pathogen content. About half the eight million dry tons of biosolids produced in the U. S. each year are applied to the land.

Biosolids have been found to be rich in AWIs compared to levels in wastewater treatment plant effluent. In addition, the 1.3 million farms raising livestock in the U. S. generate an estimated 500 million tons of manure annually, much of which is also applied as crop fertilizer.

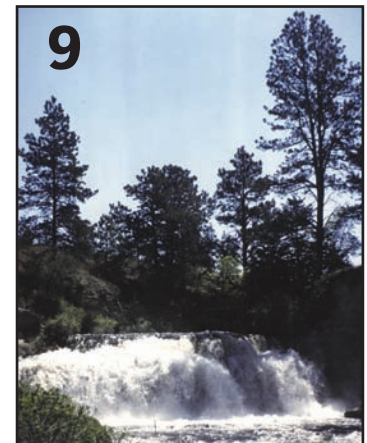
This study is part of a long-term effort by the USGS Toxic Substances Hydrology Program to determine the fate and effects of chemicals of emerging environmental concern in aquatic and terrestrial environments, and to provide water-resource managers with objective information that assists in the development of effective water management practices. It was funded in part by a Research Corporation Cottrell College Award and a faculty research grant from Eastern Washington University.

More information is online at <http://toxics.usgs.gov/highlights/earthworms.html>

# Can You Identify These Photos?

Most, but not all, of these photographs were taken somewhere in Nebraska. Those that come closest to identifying them all will win a free UNL Water Center shirt. Send your best guesses to: Steve Ress, Water Center, Hardin Hall, 3310 Holdrege St., P.O. Box 830979, University of Nebraska, Lincoln, NE 68583-0979 (UNL campus mail to: Steve Ress, 913 HarH, EC 0979). Write your answers under the respective picture and send this page (or a copy of it), along with your name, address and telephone number, to one of the preceding addresses.

Answers will be published in the Summer edition of the Water Current. Good luck !!





# Help Us Publish a Better *Water Current*

Help us publish a better *Water Current*.

Take a few moments to complete this questionnaire and return it to us. If you do, we will enter you in a drawing for one of three Water Center fishing lures and one of three Water Center umbrellas. To be eligible for these drawings, return your completed survey to Steve Ress, UNL Water Center, P.O. Box 830979, University of Nebraska, Lincoln, NE 68583-0979 or FAX it to (402) 472-3610 by Friday, June 27. UNL subscribers may return surveys via campus mail to 913 HarH, EC, 0979.

Mail or FAX the entire page (so we have your name and address for the drawings).

Survey responses and names of responders are confidential used only by the *Water Current's* editorial staff.

1. Rank, in order of importance, the usefulness of the following general areas of the *Water Current* (1 - most important to 7 - least important):

- ☐ News Briefs
- ☐ Meet the Faculty
- ☐ Reporting on upcoming events, seminars, conferences, tours, etc.
- ☐ Director's Notes
- ☐ Reporting on water and environmental research, survey and outreach activities
- ☐ Guest editorials/columns
- ☐ Information on what's happening with the Water Sciences Laboratory, Water Resources Research Initiative, etc.

2. What would you like to see in upcoming issues of the *Water Current*?

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3. What are your primary water and environmental interests?

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4. The *Water Current* provides timely and important information that I find useful.

☐ Strongly agree ☐ Mostly agree ☐ Mostly disagree ☐ Strongly disagree

5. The *Water Current* provides more information than I need.

☐ Strongly agree ☐ Mostly agree ☐ Mostly disagree ☐ Strongly disagree

6. Do you read each *Water Current* you receive? ☐ Yes ☐ No

7. Do you circulate your *Water Current* to anyone else? ☐ Yes (if so, how many others \_\_\_\_\_) ☐ No

8. Should the *Water Current* be distributed ☐ More often ☐ less often ☐ remain a quarterly ☐

over



9. Do you ever access the PDF copy of the *Water Current* that is on the Water Center’s web site at <http://watercenter.unl.edu>?  
\_\_\_ Yes \_\_\_ No

10. What can we do to improve the appearance and/or readability the *Water Current*?

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11. Additional comments (include address corrections or other updates to your mailing information):

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