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WATER CURRENT

VOL. 39, No. 1

WINTER 2007



Future of Water Use in Agriculture Topic of Fourth Annual Water Law, Policy and Science Conference

by Steve Ress

The Future of Water Use in Agriculture” will cover topics from economics and policy to technology and biology and the fast-emerging biofuels market in a two-day March conference at the University of Nebraska—Lincoln.

UNL’s fourth annual Water Law, Policy and Science conference is Monday and

Tuesday, March 26 and 27 at Lincoln’s Embassy Suites.

Much of the conference will explore the economics and policy dimensions of agricultural water use.

“Increasing competition for water resources in Nebraska and the Great Plains is creating both exciting opportunities and stiff challenges,” said UNL Water Center director Kyle Hoagland.



**WATER LAW,
POLICY AND
SCIENCE
CONFERENCE**

“The purpose of this conference is to glean ideas for the future from some of the nation’s top experts.”

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June Water Tour to New Mexico Compares Republican and Pecos River Compacts

By Steve Ress

An early June tour to New Mexico will compare and contrast interstate water compacts on Nebraska’s Republican River and New Mexico’s Pecos River to see what can be learned from the latter’s compact with Texas.

The tour is June 4-7, beginning and ending in Albuquerque, N.M.

“There are so many similarities between these two river basins in terms of flow, agricultural usage, and importance to their respective states and in particular how interstate compacts and

lawsuits have effected their use by the compact states,” said tour co-organizer Michael Jess, associate director of the UNL Water Center.

“I think Nebraska legislators, irrigators, producers and those interested in state water issues can learn a great deal on how we might be able to resolve our challenges on the Republican River by hearing and observing what’s been done

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Eluid Martinez, former New Mexico state engineer and commissioner of reclamation; UNL Water Center associate director Mike Jess; and New Mexico water attorney Jay Stein gather in Stein’s Santa Fe, N.M. office to begin planning this summer’s tour to New Mexico’s Pecos River valley (photo by Steve Ress).

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Upcoming Activities Reflect a Quality Staff

from the DIRECTOR



Kyle D. Hoagland

The UNL Water Center is offering two major events this spring, both of which will be exceptional opportunities to learn more about Nebraska's water resources issues. First is the Fourth Annual Water Law, Policy and Science Conference, "The Future of Water Use in Agriculture" (March 26-27, 2007; see article in this issue). This conference has been the jewel in the educational outreach crown for the Water Resources Research Initiative (WRRI) over the past three years (hence the innovative "Fourth" in the title). Prior conferences have focused on water law, drought &

climate change, and last spring, adaptive management.

This year's conference includes sessions on the economics of water, technology of water delivery systems and biotechnology of drought-resistant crops, as well as a major session on water resources issues surrounding the fast-emerging biofuels arena.

As has been the case with past conferences, these events require a significant amount of planning, both for identifying and lining up speakers, the heart of the conference, and for the myriad logistics associated with offering an event of this scale. The former activity has been typically handled by a leader from the WRRI, such as Sandra Zellmer for the first conference (water law), in addition to an ad hoc committee of faculty and staff with expertise in the particular thematic area.

This year Lorrie Benson, a new addition to the Water Center staff and WRRI, is leading the effort. We also solicited input from faculty in agronomy/horticulture, agricultural economics, journalism, and biological systems engineering, to name a few. Then there's the challenge of landing high-profile, keynote speakers – this involves anyone who knows the "target", including friends, relatives, Vice Chancellors, professional acquaintances, cellmates, etc., i.e. *anyone* who can land the speaker!

Then there are the logistics....oy! These are handled by a team of exceptional people in the Water Center,

especially Steve Ress and Patricia Liedle, who handle everything from publicity and programs to venue and meal selections. We always approach this as a team effort, an approach that seems to work very well, again, because it involves outstanding players!

The second major event later this spring is the Annual Water Tour, June 4-6, 2007 (see this issue for more information about the tour). This year, a special tour is planned to New Mexico's Pecos River basin to learn about how they have dealt with water quantity and interstate compact issues similar to those in our Republican River basin, albeit with a 10-20 year head start! Every year, these trips are initially brainstormed and planned by the Nebraska Water Conference Council, then Mike Jess and Steve Ress from the Water Center and Tim Anderson and Jeff Buettner from Central Nebraska Public Power and Irrigation District take the lead in scoping the route, as well as lining up the speakers. Sara Rector of the Kearney Area Chamber of Commerce handles logistics. Again, this is a team effort by a group of highly talented and dedicated individuals!

While not a major spring event, Jessica Harder, another new addition to the Water Center team, has been in charge of ongoing liaison activities with the state legislature, NRD's, and the new external Water Resources Advisory Panel. Her efforts have included several outreach-related events such as retreats and legislative briefings.

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WATER CURRENT

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Meet the Faculty

Ayşe Irmak, Ph.D.

Ayşe Irmak is a research assistant professor in the Department of Biological Systems Engineering at the University of Nebraska–Lincoln. She specializes in water resources engineering (geologist, water specialist, research hydrologist, etc.) and has been a UNL faculty member since 2004.



Ayşe Irmak

Education:

Ph.D., Agricultural and Biological Engineering, University of Florida at Gainesville, FL, 2002.

M.E., Agricultural and Biological Engineering, University of Florida, Gainesville, FL, 1998.

M.E., Agricultural Structures and Irrigation Engineering, Mediterranean (Akdeniz) University, Antalya, Turkey, 1995.

B.E., Agricultural Structures and Irrigation Engineering, Cukurova University, Adama, Turkey, 1993.

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

- For a project funded by U.S. Bureau of Reclamation, I am working with computer simulation to determine

impacts of terraces and small reservoirs/ponds on streamflow depletion on the Republican River Basin. This is related to quantifying impact of terracing practices on water budgets and hydrological balances, in particular, impacts of terraces on deep percolation, runoff, and evapotranspiration (ET). I am using potential yield revised (POTYLD) model and subroutines from CROPSIM, and SWAT models to improve POTYLD to better account for effects of terraces and ponds on water balance.

- For the Nebraska Department of Natural Resources, we are using a combination of satellite-based ET techniques and in-situ flux and transpiration measurements (Eddy Correlation System and/or Bowen Ratio Energy Balance System, sap flow measurement, soil and ground

(continued on page 12)

David S. Hage, Ph.D.

David Hage is the Charles Bessey Professor in the UNL Department of Chemistry, Division of Analytical Chemistry. He joined UNL faculty in 1989 as an assistant professor and was promoted to associate and full professor in 1995 and 2000, respectively.

Education:

Ph.D., Analytical Chemistry, Iowa State University, Ames, IA, 1987.

B.S., Biology and Chemistry, University of Wisconsin, LaCrosse, WI, 1983

Examples of Current Research/Extension Programs:

- General interests are in the use of affinity-based separations for the analysis of environmental and biological compounds
- Examples of current environmentally-related projects include 1)

the creation of immunosorbents and molecular imprinted polymers for the analysis of tetracyclines by high-performance liquid chromatography and LC/MS/MS, 2) the use of field-portable devices for the detection of triazine herbicides, chlorophenoxy acetate-related compounds and explosives residues in environmental and forensic samples, 3) the use of chromatographic-based immunoassays for the detection of trace contaminants in water samples

Examples of Past Research/Extension Programs:

- Our lab was one of the first in the world to combine immunoextraction on-line with high-performance liquid chromatography for the detection of herbicides in water and environmental samples. Our group has also been quite active in development of new supports, detection methods and immobilization methods for use with selective binding agents such as

antibodies in chromatographic systems. Our group is also heavily involved in the use of affinity ligands in HPLC and capillary electrophoresis systems to perform the separation of chiral compounds and to study the binding that takes place between small molecules such as drugs and hormones with proteins and other biomacromolecules.

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David Hage

EPA Grant Helps Researchers Study Feedlot Waste Impacts

by Steve Ress

Seven University of Nebraska researchers, one from Iowa State University and a U.S. Department of Agriculture scientist in Idaho will spend the next three years studying environmental impacts from hormones excreted in cattle manure and what might be done to lessen their effects.

“We hope the data from this project will provide valuable information to both regulators and livestock producers in promoting a balance between agricultural production and environmental protection,” said University of Nebraska–Lincoln environmental analytical chemist and director of services of UNL’s Water Sciences Laboratory, Dan Snow. “The project will make full-use of our laboratory’s state of the art instrumentation and newly developed methods to measure very low levels of these contaminants in a variety of samples.”

Snow coordinates the team of nine researchers that are participating in the nearly \$700,000 U.S. Environmental Protection Agency-funded project. They are expected to complete their work by the end of 2010.

The project focuses on what happens to hormones excreted in cattle manure at concentrated animal feeding operations (CAFOs) and potential environmental impacts when that manure is used as fertilizer on crops.

Researchers will quantify hormones in manure as it passes through various stages of use, storage or containment throughout a feedlot, determine how different handling methods for animal waste effect it’s presence in feedlots, how different ways of applying manure as fertilizer effects its presence in the root-zone area of soils and to what extent grasses in field-edge conservation buffers absorb hormones from runoff water.



University of Nebraska, Iowa State University and U.S. Department of Agriculture scientists have received a nearly \$700,000 grant from the U.S. Environmental Protection Agency to study the environmental impacts from hormones excreted in cattle manure at confined animal feeding operations (IANR photo by Brett Hampton).

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Lawmakers Get Briefings on Top Water Issues

by Jessica Harder

More than 30 legislators and staff gathered December 5, 2006 for a University of Nebraska–Lincoln seminar on state water issues presented by the UNL Water Center.

With 22 new senators this session, due to newly imposed term limits, state leaders, new and old, were offered a short course on water issues from some of UNL’s top water experts.

Speakers briefed the audience on a wide range of issues including the ongoing drought and drought management tools, Nebraska water quality challenges, and the most talked about water issues in the state, such as the Platte River Cooperative Agreement, the Republican River Compact, and LB962 implementation.

First, Don Wilhite, director of UNL’s National Drought Mitigation Center spoke about the seriousness of drought and possibilities for better drought planning and response.

UNL Water Center associate director Mike Jess, former Director of the Nebraska Department of Water Resources, covered the history and current status of the Republican River Compact. Dave Aiken, water law specialist, presented informa-

tion on the status of the Platte River Cooperative agreement and LB962 implementation issues.

Agricultural economist Ray Supalla presented his “Water Optimizer” irrigation efficiency tool, both as a tool for better irrigation planning and as a policy tool to estimate the monetary value of irrigation on land.

Finally, Kyle Hoagland, director of the UNL Water Center, discussed the seriousness of water quality problems facing Nebraska including contaminants such as nitrates, arsenic and toxic algae, to name a few.

In addition to the information presented by the speakers, materials compiled by Jessica Harder, a water outreach associate with NU’s Rural Initiative and UNL Water Center was available as a reference by lawmakers and staff.

This water-related research in brief, white paper format resulted from the efforts of over 13 faculty members working to present their relevant water research, with lawmakers in mind.

The book contained brief pieces covering groundwater and surface water, law and policy topics, drought and drought mitigation, economic studies and more. Even if a legislator

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UNL Hosts Biofuels and Water Resources Retreat

By Steve Ress

Opportunities and challenges related to Nebraska's booming ethanol industry were examined in a morning retreat at Hardin Hall on the University of Nebraska–Lincoln East Campus, Friday, Jan. 19.

The event was primarily designed as a chance for UNL researchers and their staffs to explore possible research partnerships and funding opportunities in the rapidly expanding biofuels industry, but among nearly 80 attending the morning presentations were federal and state agency staff, natural resources district representatives, producers, agricultural consultants, students and interested members of the public.

"That cross-section among attendees in what we thought might be a largely faculty-centered event was very encouraging. It shows the level of interest in this topic from a wide degree of perspectives and potential involvements," said UNL Water Center director Kyle Hoagland.

The retreat was co-sponsored by UNL's Water Center, Water Resources Research Initiative, Nebraska Center for Energy Sciences Research and Department of Biological Systems Engineering.

Ken Cassman, who directs UNL's relatively new Nebraska Center for Energy Sciences Research, opened the retreat with a brief overview of emerging research and extension education opportunities in the expanding ethanol, biodiesel and related biofuels industries, emphasizing that this potential boom in Nebraska's farm economy carries a variety of corresponding research and education challenges for UNL faculty and staff in areas that include grain production, irrigation efficiency, water quality, livestock production, livestock waste utilization and many other fields.

Jim Cook, legal counsel for the Nebraska Department of Natural Resources, followed with a presentation on water supply challenges in supporting large-scale ethanol production at a time when much of Nebraska's surface and groundwater resources are already fully or over-appropriated.

University of Tennessee agricultural economist Burt English discussed advantages for cellulosic feedstock in biofuels production and was followed by UNL livestock bioenvironmental engineer Rick Koelsch and beef feedlot nutrition specialist Galen Erickson, with a joint presentation on water quality issues related to use of distillers grains in livestock production.

Later that morning, Adam Liska of UNL's Department of Agronomy and Horticulture talked about differences in energy efficiency and environmental quality of different



UNL center directors Ken Cassman and Kyle Hoagland at the start of a half-day faculty retreat in January on biofuels and water resources (photo by Steve Ress).

biofuels products and that same department's Dan Walters discussed how much corn stover can be removed for biofuel feedstock without compromising soil quality and risking erosion.

UNL agricultural economist Ray Supalla and water resources engineer Suat Irmak teamed for a final presentation on improving irrigation technology options for a high corn price market.

PowerPoint presentations from the retreat are available online at <http://wrrri.unl.edu/>.



Expanding ethanol and biofuels markets will have a ripple effect on agricultural and environmental issues across Nebraska and the Great Plains (IANR photo by Brett Hampton).

Fish and Wildlife Coop Supports Students, Lends Assistance

by Brent Atema

UNL's Cooperative Fish and Wildlife Research Unit is a multi-tasker in the world of natural resources research, teaching and management.

The recently formed unit, which operates as part of UNL's School of Natural Resources, trains graduate students for professional careers in natural resources research and management; conducts research aimed at thoughtful management of natural resources; and provides technical assistance to cooperators.

"Our predominant focus is understanding the impact of biological invasions ... especially those with a negative impact," said unit leader Craig Allen.

Biological invasions, he explained, are invasions by species that are not native to a given area. Two that are important to Nebraska and vicinity, he said, are zebra mussels and cedar trees. He said cedar trees change the prairie structure, making it unfavorable to prairie birds, and zebra mussels alter water chemistry and out-compete native mussels.

While the cooperative has three areas of focus, Allen said most of their work involves supporting graduate students. Currently, the cooperative supports and

advises nearly a dozen graduate students.

In December, the program graduated its first graduate student, Donald Wardwell, with a Master's GRA in Wildlife. Wardwell began his Master's program with the unit about two and a half years ago.

Another milestone, Allen said, was reached last year when the unit topped the \$1 million mark in external funding; the predominant form of funding the cooperative receives.

The fish and wildlife coop began in the summer of 2004 with two employees, Allen and Valerie Egger, cooperative administrative assistant. Recently, UNL fisheries ecologist Kevin Pope joined the cooperative as assistant unit leader.

Allen, a wildlife ecologist who formerly headed the South Carolina Cooperative Fish and Wildlife Research Unit, primarily focuses on interactions among species and landscapes, including non-indigenous species, declining species, invasive species, and landscape change.

Pope's principal focus is on freshwater ecology issues, such as using fish populations to better understand aquatic ecosystems, and how recreational fishing influences fish populations.

Currently, there are 12 research projects that the unit is working on. Some

examples of current research projects include: a project designed to monitor amphibian populations in Nebraska's wetlands and detect changes over time, one designed to understand how the diversity of grasslands affects ecological services, and one that documents the competition between white perch and other important fish species in two Nebraska lakes.

In the future, the cooperative hopes to investigate the restoration of prairies among agricultural land. The study would attempt to determine if "little patches of prairie among soybean and corn fields can export ecological services and features to adjacent crop lands and make the agricultural land more resilient to change," Allen said.

"The cooperative is an unusual partnership," Allen said. "Everyone puts up something and everyone gains something."

The unit was established through an arrangement between UNL's School of Natural Resources; U.S. Geological Survey, Biological Research Unit; Nebraska Game and Parks Commission; U.S. Fish and Wildlife Service; and The Wildlife Management Institute.

For more information on the unit, go online to <http://snrs.unl.edu/necoopunit/>

UNL Land Purchase Will Help Farmers and Ranchers Deal With Using Less Water

By Faye Colburn, UNL West Central Research and Extension Center and Sandi Alswager Karstens, IANR News Service

With its recent purchase of 1,280 acres of farmland in western Nebraska, the University of Nebraska-Lincoln will enhance its efforts to help farmers and ranchers adjust to limited water supplies.

The Keith County property consists of three parcels, one 640-acre parcel southwest of Brule and two 320 acre parcels northwest of Brule, said Don Adams, director of UNL's West Central Research and Extension Center at North Platte. The property consists of 800 acres of irrigated land with five pivots, 320 acres of dryland, and 160 acres of rangeland.

"Water research, education, and knowledge are absolutely critical to Nebraska's competitive advantage in crop and livestock production," said Institute of Agriculture and Natural

Resources Harlan Vice Chancellor and NU Vice President John Owens. "The university will focus this newly-acquired research and development capacity on practical applications that directly benefit our state and its citizens."

The university purchased the land because its soils are similar to soils covering a large area of southwest and south central Nebraska and its proximity to the Upper and Middle Republican Natural Resource Districts where farmers already face limits on water use, Adams said. Precipitation also is lower there than farther east in the state.

"When conducting irrigation research applicable to southwest Nebraska, precipitation representative of the area is critical," Adams said.

This purchase also means the first pivots owned by UNL in southwestern Nebraska, he said.

"This is a real commitment from the university to conduct research that will work with limited water supplies, whether

(continued on page 11)

Cooperative Ecosystem Studies Unit Begins Work on Great Plains Fire History

Researchers affiliated with the University of Nebraska–Lincoln’s School of Natural Resources are helping land managers piece together a history of fire on the Great Plains.

Fire brings many ecological benefits. In forests, it stops build-up of deadwood, preventing more devastating fires. On the prairie, it prevents colonizing woody vegetation and helps reinvigorate growth of grasses. In most protected areas, however, fire occurs so rarely they often have to be re-introduced by management decision.

Having a record of how fire once operated means it can be re-introduced in similar ways. In forested areas, studying tree rings gives evidence of fire’s frequency and extent in the past.

Fire burns the tree and leaves a scar on the annual growth ring, but in grasslands, where trees are rare, evidence like that is harder to find.

“The idea behind the project is that the Great Plains has been principally overlooked in examining fire history due to a lack of trees, but on the perimeter of the plains, there are trees,” said Gary Willson, research coordinator with UNL’s Great Plains Cooperative Ecosystems Studies Unit (GP-CESU).

Willson is coordinating a project to compile a record of fire on the prairie from before European settlement.

In addition to the prairie’s perimeter, researchers are interested in the history of fire in two other areas: the Niobrara River, which crosses northern Nebraska west to east, and parts of the Missouri River in northeast Nebraska.

“Those two areas might give us some history right in the middle of the Great Plains,” Willson said.

From the Director (continued from page 2)

The bottom line is that these events don’t just happen, but are the products of an enormous effort each year by a relatively small number of people. So, if you are able to take advantage of these unique and outstanding events, and I *highly* recommend that you do so, don’t forget to say thank you to those who actually made it happen (see above!). They did it because they care about the water resources in Nebraska and because they respect the stewards of those resources, like you. . . .

Another event on the horizon, as this was being written, and one that I’ve been charged with planning, is the annual

The collaborative effort includes the University of Missouri-Columbia’s Tree Ring Laboratory, the U.S. Geological Survey’s Missouri Cooperative Fish and Wildlife Research Unit and the National Park Service. Researchers will examine tree ring evidence from ponderosa pine and oak trees and feed the information into a fire model that will help fill gaps in fire history where trees are lacking.

During the project’s first full field season this past summer, Willson, a fire ecologist, and Richard Guyette, director of the tree ring lab, both worked in the Missouri River valley and Guyette in the Niobrara valley.

“Many resource managers of the national parks in the Great Plains use fire to manage vegetation and they often don’t have information about the occurrence of fire before European settlement, so they may be guessing about when to use it. This information is very valuable as they re-create a fire regime,”

Willson said.

“The idea behind the project is that the Great Plains has been principally overlooked in examining fire history due to a lack of trees, but on the perimeter of the plains, there are trees.”

Parks that use fire must have a management plan. The plans help managers assess the state of local and regional ecosystems, make management decisions, create restoration plans and assess national fire plans.

Fire histories also can be used by nongovernmental organizations managing grasslands, such as the Nature Conservancy, the Audubon Society and others.

GP-CESU is a partnership that includes a dozen universities and six federal agencies.

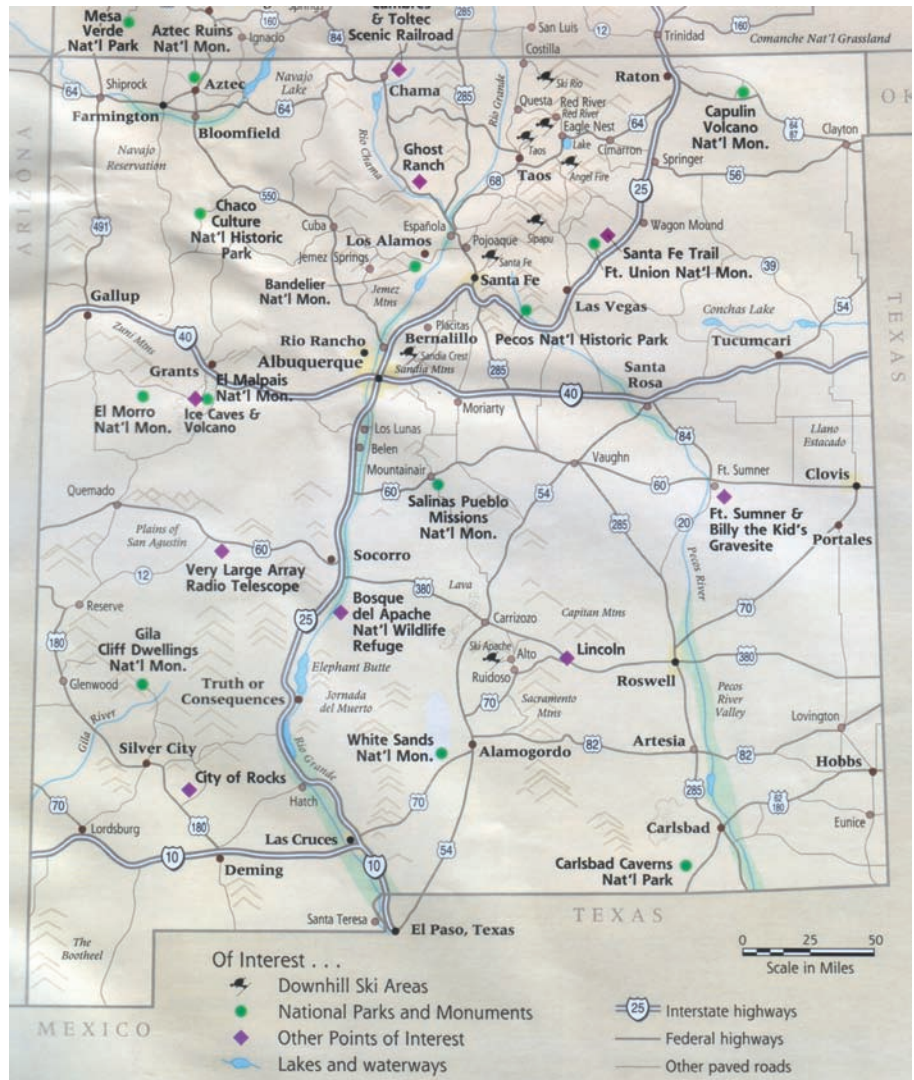
The project is funded by a \$250,000 grant from USGS.

Nationwide, the CESU system secures research, technical assistance and education by universities to support science-based management of federal lands.

National Institutes for Water Resources (NIWR) meeting in Washington DC, February 12-14, 2007.

This is THE annual event for the 54 water center directors from across the U.S. to meet and discuss how we can best serve water resources needs nationwide, including meetings with their state’s Congressional delegations. I’ll give you an update of what I learn and what it means for Nebraska in the next issue (this is not exactly edge-of-the-seat material, so I promise to keep it brief).

2007 Water Tour: Touring New Mexico and the Pecos River (comparisons and contrasts to Nebraska's Republican River compact) June 4-7, 2007



June's water tour will begin in Albuquerque, travel northeast to Santa Fe, then move south into the Pecos River valley, particularly in the Roswell, Artesia and Carlsbad areas.



Three local boys wet fishing lines in the Pecos River at Carlsbad on a relatively cold January afternoon.



CNPPID's Jeff Buettner dips a hand into a salty Pecos River, south of Carlsbad, New Mexico, near the Texas border. Much of the vegetation on the riverbank is Salt Cedar growth.



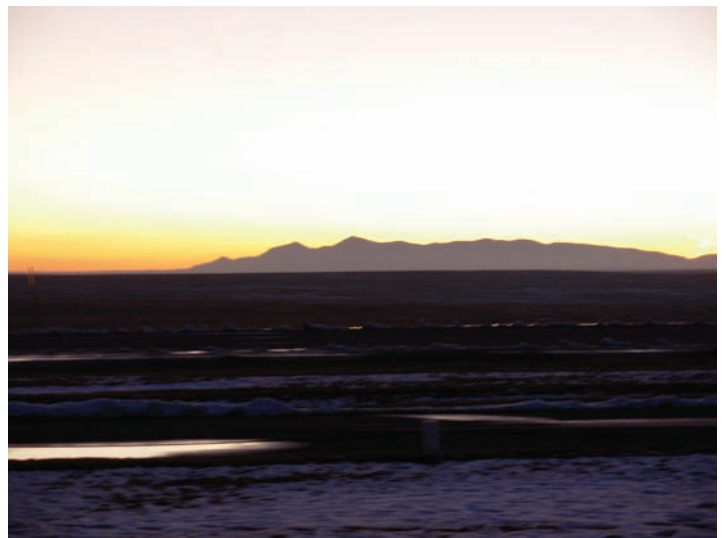
Estevan R. Lopez, lead engineer for New Mexico's Interstate Stream Commission. Lopez oversees much of the implementation and administration of New Mexico's compact with Texas on the Pecos River.



CNPPID's Jeff Buettner and UNL's Mike Jess discuss New Mexico geography and potential water tour topics with New Mexico Bureau of Geology and Mineral Resources karst hydrologist Lewis Land. Land co-authored a field guide on the Pecos River valley that will be given to tour participants.



Santa Fe, New Mexico water attorney Jay Stein and CNPPID's Jeff Buettner plan details for this summer's upcoming water tour to the Pecos River valley.



Sunset over the Capitan Mountains, near Roswell, N.M.

Co-sponsored by:

**Central Nebraska Public Power and
Irrigation District
Gateway Farm Expo
Kearney Area Chamber of Commerce
Nebraska Association of Resource Districts
Nebraska Public Power District
Nebraska Water Conference Council
UNL Water Center**

(photos by Steve Ress)

Groundbreaking Work on Natural Resources and Public Policy

Students looking to natural resources and public policy careers may be surprised at groundbreaking work happening right now in drought readiness at the University of Nebraska–Lincoln.

A national leader in this area at UNL's School of Natural Resources calls it "The move to a new paradigm in drought management." Don Wilhite, director of UNL's National Drought Mitigation Center (NDMC), said the message has been around since the birth of his drought research program in the early 1980s and formation of the NDMC in 1995.

Only in the last decade or so, working closely with leading scientific organizations and regional, state and local decision makers, have he and colleagues begun to get Congress' attention, however.

The unflagging effort by a relative few has led to funding needed to revamp national and even international, thinking about the most costly of natural hazards. Funding is now being directed toward analytical and decision-support tools made more sophisticated than ever and accessible to anyone with a computer.

For more than two decades Wilhite has been telling policymakers and anyone else who will listen the hazards of what he calls "The hydro-illogical cycle." The cycle starts with public apathy when rainfall is normal. When droughts begin and slowly build, awareness of its often far-reaching impacts grows.

This is typically followed by concern, then panic as people and governments see the magnitude of impacts and how poorly prepared most are to manage drought effectively.

When the rains return, so does apathy.

In contrast to other natural hazards, drought does not lead to loss of life or property in the U.S. Yet its economic, social, and environmental costs are estimated at more than \$6 to \$8 billion annually.

The solution is in viewing drought as a natural part of climate and pursue a risk-management approach. To that end, in cooperation with the Geological Society of America and others, Wilhite helped organize a national conference called

Managing Drought and Water Scarcity in Vulnerable Environments: Creating a Roadmap for Change in the United States.

"Going in, I didn't expect any grand revelations, but it was a participatory conference, not just speakers. We heard from many stakeholders groups, and what came out of it was more specific ideas from end users," Wilhite said.

One of these was for communities that had implemented drought plans... who could then promote themselves as "drought-ready" communities as a draw for visitors and business.

Relaying key issues emerging from the conference, held in Longmont, Colo. last September, Wilhite told Congress soon after that the U.S. must do a better job of preparing for drought.

Climate change creates the probability, especially in the Western U.S., that droughts will last longer than anything since record keeping began about 110 years ago. Population increases, urbanization and land use changes mean the effects of drought will be more acute, as well.

Wilhite and conference organizers are also drafting "The Roadmap for Change," to be ready this spring, in time for the next round of discussions on a national drought policy.

For his testimony, he condensed conference discussions into these messages:

- 1) Increase understanding of the "drought hazard" and how it may change in frequency, severity and duration. This involves better monitoring and understanding of droughts through studies of ancient climate and more projections of the possible effects of climate change.
- 2) Improve understanding of how social vulnerability to drought is changing.
- 3) Emphasize managing drought risks. Relief programs often support the traditional reactive cycle and reward lack of planning. Instead, agricultural producers, natural resource managers and planners should be encouraged to adopt measures to more proactively cope with moisture and water supply shortages.

- 4) Improve assessment of the broad range of drought impacts. We know that agriculture is only one of the sectors affected by drought, but its larger social, environmental and economic effects are not well documented.
- 5) Develop a national drought policy that outlines how to reduce social vulnerability to drought. It includes monitoring, risk assessment, planning and improved coordination among all levels of government. The Government Accounting Office recommended a national drought plan in 1980, but the traditional reactive, crisis-management approach predominates.
- 6) Create a new "National Water Culture" that would promote sustainable water-management practices.

Wilhite's testimony to the Congressional Hazards Caucus supported two pending pieces of legislation.

The first is the National Drought Preparedness Act, draft legislation created with the Western Governors' Association. It would create a national drought policy within a lead federal agency for drought, one that determines responsibilities for coordinating and integrating federal drought assistance.

The second would create the National Integrated Drought Information System, which would provide water users with the capacity to assess their drought risk in real time before its onset. NIDIS has passed both the House and Senate and is currently awaiting the President's signature, he said.

"We've continued to talk about the (fall) drought conference, and it's gotten a lot of play. We just need to motivate Congress and the administration to change," Wilhite said.

"I think there is movement there. I think these documents ('Roadmap to Change' and the summary for Congress) might help them latch onto something. You can't change the whole mindset of government quickly, but gradually you can begin to instill some new ideas."

Future of Water Use in Agriculture Topic of Fourth Annual Water Law, Policy and Science Conference *(continued from page 1)*

Key speakers in this first of three main conference topic areas are David Sunding, Department of Agricultural and Resource Economics, University of California-Berkeley; federal reserve and irrigated agriculture financial expert Jason Henderson of the U.S. Federal Reserve Bank, Omaha; Daryll E. Ray, Department of Agricultural Economics, University of Tennessee on policy effects on decisions in the agricultural economy; and Charleton Bonham, Trout Unlimited, on legal implications of competing water uses.

Syndicated agricultural columnist Alan Guebert will speak on water and ethanol connections at Monday's luncheon.

Afternoon discussions will shift to technical and biological issues related to agriculture and future water use.

Leading discussions on agricultural landscape evolution in an adaptive management framework is Christopher Lant, executive director of the Universities Council on Water Resources, Department of Geography at Southern Illinois University, Carbondale, Ill.

Vikram Mehta, Center for Research on the Changing Earth System, Columbia, Md., will speak on how climate variability and extreme climatic events impact water and agriculture; Pamela Nagler of the U.S. Geological Survey, Tucson, Ariz., will speak on evapotranspiration and riparian species and David Nielsen of the U.S. Department of Agriculture's Agricultural Research Service, Akron, Colo., addresses alternative crops and deficit irrigation.

Also Monday afternoon are presentations by UNL agricultural engineer Darrel Martin and Mark Lagrimini, head of UNL's Department of Agronomy and Horticulture on genetic improvements in drought tolerant crops.

Evening dinner speaker will be Colorado Supreme Court Justice Gregory Hobbs on the role of climate on western water institutions.

The focus on Tuesday will shift to the emerging biofuels arena.

"The rapid growth of the biofuels industry has tremendous economic potential, but also much broader impacts than many of us realize," said Lorrie Benson, UNL Water Resources Research Initiative senior program manager. "Our conference will examine impacts and ways to minimize impacts on communities, the livestock industry and, of course, on water and other environmental aspects."

Ken Cassman, director of UNL's Nebraska Center for Energy Sciences Research leads these talks with a discussion of the impacts of biofuels production on food crops.

Wallace Wilhelm of UNL and the U.S. Department of Agriculture's Agricultural Research Service follows with a look at opportunities and challenges in the ethanol industry.

Clarence Lehman of the University of Minnesota's Department of Ecology, Evolution and Behavior addresses the environmental, economic and energy costs of biodiesel and ethanol production and use. Predictions for improvements in water efficiency in the biofuels arena by Tom Sinclair, Department of Agronomy, University of Florida, Gainesville, Fl. follows.

Other speakers will address related topics such as biofuels impact on livestock and livestock markets and how this growing industry could affect agricultural sustainability.

Full conference registration is \$350 until March 7 and \$425 thereafter. Partial registration options are also available. Students can attend the conference free.

For more information or to register, contact Tricia Liedle, UNL Water Center at (402) 472-3305, e-mail pliedle2@unl.edu or go online to <http://snr.unl.edu/waterconference>.

Co-sponsoring the conference are the University's Water Resources Research Initiative, Institute of Agriculture and Natural Resources, Water Center, School of Natural Resources, Departments of Geosciences and Biological Systems Engineering, College of Law and College of Journalism and Mass Communications.

UNL Land Purchase Will Help Farmers and Ranchers Deal With Using Less Water *(continued from page 6)*

it be irrigation, pasture or crops," Adams said. "This also will be a long-term commitment to the state, and it will allow us to take small plot work typically done at the West Central Research and Extension Center and other locations in the state to the farm-sized scale."

In addition to continuing university research on limited-water and irrigation practices, the land also will offer a place to provide water-saving irrigation and cropping demonstrations for farmers, crop consultants and policy makers and for university field days.

"The site really met our specifications and really will help us meet the things we want to do," he said.

Adams anticipates a close association between the West Central and Panhandle Research and Extension faculty, the Departments of Agronomy, Animal Science and Biological Systems Engineering and the School of Natural Resources in designing and carrying out research on the property.

Graduate students will be able to conduct research on the land as part of their degree programs and the Nebraska Col-

lege of Technical Agriculture in Curtis will be able to use it as a teaching lab.

"This exciting addition to UNL's capability to conduct water management research and education could not have come at a better time or place," said Gary Cunningham, dean of UNL's Agricultural Research Division. "The work done at these Keith County properties will help Nebraska's farmers continue the wise use of the water that is essential for our state's economic future."

The property was purchased with funds from the sale of two other pieces of university land and from highway funds the university received when Highway 83 was rerouted. No tax dollars were used.

Final closing on the purchase from Ronald Grapes was Jan. 4, 2007.

"We are very happy that Ron Grapes was so supportive of the need to conduct this research and sold the land to support the university and eventually the farmers and ranchers of Nebraska," Adams said.

Meet the Faculty

Ayşe Irmak (continued from page 3)

water monitoring) to develop reliable estimates of ET from the riparian zones and to determine water use rates for typical and invasive species in the Republican River Basin. I am using physically based multi step Surface Energy Balance Algorithm for Land (SEBAL) and METRIC™ (Mapping Evapotranspiration at high Resolution using Internalized Calibration) models to calculate daily ET from satellite remote sensing data at different spatial scales in Great Plains. These technologies can be extremely viable for assessing different land use characteristics on planning and allocation of water resources and other environmental assessments.

- Another project is related to the assessment of the accuracy and adaptability of remote sensing technology to produce and utilize consumptive water use maps for different regions in Nebraska, including south central and panhandle. Both satellite-based ET techniques require parameterization of the energy balance and estimate surface energy fluxes based on spectral satellite measurements.

Examples of Past Research/Extension Programs:

- At the University of Florida, I worked with computer simulation of biological systems, including crop production, soil water processes and their interactions with each other and climate. My dissertation research included linking multiple layers of information to understand causes of soybean yield variability. I used field experimentation, crop models, artificial neural network and combined models to understand the mechanisms that can lead to spatial yield variation.

Teaching:

- Instructor, CIVE 898/BSEN 896 (<http://bse.unl.edu/airmak/giswr/2006/>), Fall 2006
- Instructor, BSEN 998, GIS application in watershed modeling, Spring, 2005.
- Guest Lecturer, AGEN 853, Irrigation and Drainage Systems, Spring, 2005.
- Instructor, BSEN/CIVE 130, Technical Drawing, Spring, 2004.

Lawmakers Get Briefings on Top Water Issues (continued from page 4)

did not attend the seminar, each legislator received a briefing book.

“With the serious and complicated water issues facing Nebraska, decisions these legislators make will impact the future management of our water and ultimately, help determine the long term sustainability of this state’s water resources. The University felt it was important to offer this seminar to sena-

Selected Publications:

- Sing, R., A. Irmak, S. Irmak, and D.L. Martin. 2007. Application of SEBAL for mapping evapotranspiration and estimating surface energy fluxes in south central Nebraska. *Journal of Irrigation and Drainage Engineering*, ASCE (in review).
- Sing, R., A. Irmak, S. Irmak, and D.L. Martin. Satellite remote sensing based estimation of land surface evapotranspiration in Great Plains. 2007. *World Environmental and Water Resources Congress*. Tampa, Florida.
- Irmak, A., J.W. Jones, W.D. Batchelor, S. Irmak, J.O. Paz and K.J. Boote. 2006. Analysis of spatial yield variability using a combined crop model-empirical approach. *Transactions of the ASABE*. Vol. 49(3): 811-818
- Irmak, S., A. Irmak, J.O. Payero, D.L. Martin, and T.A. Howell. 2006. Sensitivity analyses and sensitivity coefficients of the standardized ASCE-Penman-Monteith equation to climate variables. *J. Irrig. and Drain. Eng.*, ASCE. 132:6 (564).
- A. Irmak, J.W. Jones, W.D. Batchelor, S. Irmak, J.O. Paz and K.J. Boote. 2006. Use of Artificial Neural Network Model as a Data Analysis Tool in Precision Farming. *Transactions of the ASABE*. Vol. 49(6): 2027–2037.
- A. Irmak, D.E. Martin, and J.K. Koelliker and D. E. Eisenhauer. 2006. Modeling the effects of terracing on water supplies in the Republican River Basin. 2006 ASABE Annual International Meeting. Portland, Oregon. Paper #:062291
- A. Irmak, J.W. Jones and S. S. Jagtap. 2005. Evaluation of the CROPGRO-Soybean model for Assessing Climate Impacts on Regional Soybean Yields. *Transactions of the ASAE*. Vol. 48(6): 2343-2353.

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tors and their staff to help them transition more smoothly into their important roles as water-resources decision makers,” Harder said.

The seminar was part of a series of three UNL sponsored seminars for legislators; NU faculty also presented two other seminars on Criminal Justice and Health Care.

Meet the Faculty

David L. Hage (continued from page 3)

Examples of Outreach Programs:

- I am participant in both the Water Center and the University of Nebraska Center for Environmental Toxicology.

Teaching:

- Undergraduate and Graduate Courses in traditional methods for chemical analysis and instrumental methods of chemical analysis.
- Graduate-level courses in chromatography and chemical separation methods, for statistics.
- Methods, for statistics and data handling in chemical analysis, advanced chemical equilibria, and bioanalytical methods.

Selected Publications (Out of 133 total):

- Mary Anne Nelson, Arther Gates, Maud Dodlinger and David S. Hage*, "Development of a Portable Immunoextraction/RPLC System for Field Studies of Herbicide Residues", *Anal. Chem.*, 76 (2004) 805-813.
- Jianzhong Chen and David S. Hage*, "Quantitative Analysis of Allosteric Drug-Protein Binding by Biointeraction Chromatography", *Nature Biotechnol.*, 22 (2004) 1445-1448.
- David S. Hage (Editor), *Handbook of Affinity Chromatography*, CRC Press/Taylor & Francis, 2005.

- Mary Anne Nelson and David S. Hage*, "Environmental Analysis by Affinity Chromatography", In: *Handbook of Affinity Chromatography*, (D. S. Hage, Editor), CRC Press/Taylor & Francis, 2005, Chapter 19.
- Chad J. Briscoe, William Clarke and David S. Hage*, "Affinity Mass Spectrometry", In: *Handbook of Affinity Chromatography*, (D. S. Hage, Editor), CRC Press/Taylor & Francis, 2005, Chapter 27.
- Tao Jiang, Rangan Mallik and David S. Hage*, "Affinity Monoliths for Ultrafast Immunoextraction", *Anal. Chem.*, 77 (2005) 2362-2372.
- John E. Schiel, Rangan Mallik, Sony Soman, K.S. Joseph and David S. Hage*, "Applications of Silica Supports in Affinity Chromatography", *J. Sep. Sci.*, 29 (2006) 719-737.
- David S. Hage*, John G. Rollag and David H. Thomas, "Analysis of Atrazine and its Degradation Products in Water by Tandem High-Performance Immunoaffinity Chromatography and Reversed-Phase Liquid Chromatography", In: *Immunochemical Technology for Environmental Applications*, D. S. Aga and E. M. Thurman (Eds.). ACS Press, Washington, DC; 1997, Chap. 10.

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EPA Grant Helps Researchers Study Feedlot Waste Impacts (continued from page 4)

The EPA-funded project will including sampling and surveying existing CAFOs across Nebraska for presence of hormones throughout the feedlot handling process, how handling practices such as stockpiling, composting and containing runoff determines the presence of hormones in feedlots and what manure application strategies best help to contain hormone losses from a feedlot through water runoff and soil erosion.

Researchers will also look at the ability of different grasses, commonly found in conservation buffers to absorb hormones, as well as the potential for hormones to be leached through the soil profile.

Other researchers involved in the three-year study are environmental engineers Shannon Bartelt-Hunt and Tian Zhang, both in the Department of Civil Engineering at the University of Nebraska-Omaha; irrigation specialist Bill Kranz, soils specialist Charles Shapiro, agricultural engineer David Shelton and beef specialist Terry Mader, all of UNL's Northeast Research and Extension Center in Norfolk; veterinarian and toxicologist Steve Ensley of Iowa State University; and former UNL soil scientist David Tarkalson, now at the

USDA Agricultural Research Service laboratory in Kimberly, Idaho.

"Going in, we expect that the research will show measurable levels of hormones occur in cattle manure, and these compounds or their degradates can remain in soil for extended periods of time and may be found in runoff water from land receiving applications of cattle manure," Snow said.

Hormones are commonly used to help stimulate livestock growth, but a growing body of scientific evidence indicates their presence in the environment can alter the development of wildlife species and have other endocrine-disrupting health effects. Naturally produced hormones excreted by livestock may also contribute to these effects, Snow said.

These studies could have impacts on human health issues, as well.

"Project results will serve as a research base for future studies that will enable scientific and regulatory communities to better understand how animal waste management practices influence the outcome of hormones that are introduced into the environment from animal manures," Snow said.



Water News Briefs

Three Named GSA Fellows

UNL Water, Drought and Research Sites Worth a Look

hybridmaize.unl.edu/index.htm:

A computer program that simulates the growth of corn crop under non-limiting or water-limited conditions based on daily weather data.

marketjournal.unl.edu

A free, educational outreach effort from UNL's Extension Division. Market Journal provides a wide range of updates and analysis including current grain and livestock market commentary, weather, climate and soil moisture updates and risk management strategies.

real.unl.edu/h20

This is the download page for UNL's Water Optimizer program. Water Optimizer allows users to place data into a spreadsheet, including soil type and irrigation system options. Producers then fill in pertinent data to calculate crops that will be most profitable with the given cost and available water.

www.cropwatch.unl.edu

The Crop Watch web site covers many current topics on irrigation, water use and crop production.

www.drought.unl.edu/dm/index.html

Indices, outlooks and new that represents a consensus of federal and academic scientists to help producers and others cope with drought. The site includes current conditions, forecasts and drought management strategies.

www.hprcc.unl.edu

UNL's High Plains Regional Climate Center site, which contains climate data, climate products and publications related to water use.

www.ianrpubs.unl.edu

Research-based information in a wide range of topics written by Extension educators and specialists in UNL's Institute of Agriculture and Natural Resources (IANR).

bse.unl.edu/About/ExtEds.htm

Faculty and staff in UNL's Department of Biological Systems Engineering offer knowledge, perspective and research findings on a variety of agricultural engineering topics, many of them related to irrigation, water use and water quality.

<http://watercenter.unl.edu>

The UNL Water Center is at the center of many of UNL's efforts to implement water research, education and public outreach functions. There are also links on this site to a number of educational, non-profit and research sites pertaining to water.

<http://ppc.unl.edu/>

NU's Public Policy Center provides assistance to policymakers and researchers on a wide range of public policy issues. The Center works with policymakers in all three branches of government at local, state, and federal levels. The center works with University researchers from all campuses in the NU system.

<http://wrri.unl.edu/>

UNL's Water Resources Research Initiative promotes collaboration among research faculty in strength areas such as groundwater hydrology, water quality and emerging contaminants, non-point source pollution and best management practices, climate change, irrigation, drought prediction and mitigation, remote sensing and GIS, economics, and policy and law.

Three University of Nebraska—Lincoln faculty have been elected fellows in the Council of the Geological Society of America (GSA)

They were among a total of 40 new fellows elected in April 2006. Fellowship is an honor given annually by the society to geologists with a minimum of eight years experience in geology or related fields and who have made significant contributions to the science of geology through their research, teaching, administration, and/or service.

This years Fellows received their awards in an October 2006 ceremony at the society's annual meeting in Philadelphia, Penn. Awarded fellowships from UNL were:

Duane A. Eversoll, a professor in the School of Natural Resources and Conservation & Survey Division. Eversoll has been active and taken the lead in GSA, particularly in the Engineering Geology Division. He has made sustained contributions to both the profession and the public. UNL colleague Marvin P. Carlson nominated Eversoll.

F. Edwin Harvey, an associate professor in UNL's School of Natural Resources and Conservation & Survey Division was elected for his insightful study of the hydrogeology and hydrochemistry of regional groundwater aquifers. Harvey's work supports an understanding of groundwater resources and surface-water interactions within the context of climate change. His service to GSA has supported wide dissemination of the activities of the Hydrogeology Division, fostering a cohesive professional community. Janet S. Herman of the University of Virginia nominated Harvey.

Vitaly A. Zlotnik, a professor in UNL's Department of Geosciences has made fundamental contributions to understanding the hydraulics of subsurface fluid flow and well hydraulics, including analytical modeling of horizontal and vertical wells, stream depletion, borehole-flowmeter logging, single-well, dipole, and tracer tests. He has distinguished himself as an educator and member of the professional community of hydrogeologists. Robert W. Ritzi of Wright State University nominated Zlotnik.

June Water Tour to New Mexico Compares Republican and Pecos River Compacts *(continued from page 1)*

on the Pecos (river) in New Mexico over the past 20 years,” Jess said.

Both river basins have traditionally been plagued with over-appropriated stream flows and overcommitted groundwater supplies. Interstate compacts, both of which were adopted in the 1940's, and subsequent litigation, have limited consumptive water use by Nebraska on the Republican River and New Mexico, on the Pecos River.

Citing excessive water use, Kansas sued Nebraska and Colorado in 1998 over Republican River water and the three states negotiated a settlement in 2002. Texas similarly sued New Mexico in 1974 over a claimed deficit of 1.1 million acre-feet of Pecos River water and the U.S. Supreme Court ruled in Texas' favor in 1987.

An acre-foot is enough water to cover an acre of land with water one foot deep, or approximately 326,000 gallons.

The settlement, in Nebraska's case, and court ruling, in New Mexico's case have had major consequences for those state's water use from the two rivers, as well as multi-million dollar impacts to their respective state budgets, Jess said.

“Consequences here have included halting additional development and restricting surface water and groundwater use in much the Republican basin and yet so far, we have been unable to fully constrain our use of water from that basin,” Jess said.

The excess use of Republican River water has amounted to 200,000 acre-feet from 2003 to 2006 alone, according to remarks by Governor Dave Heineman at Nebraska Water Resources Association - Nebraska State Irrigation Association joint meetings in North Platte in November 2006.

“On the other hand, since the Supreme Court ruled against New Mexico, they have fulfilled all their water flow and other requirements to Texas,” Jess said.

To help meet those flow demands, New Mexico embarked on an aggressive program of buying land and water rights, from willing sellers, in key irrigation areas of the Pecos River and then retired irrigation to those lands. They also are designing and installing augmentation well fields on the river that will help maintain flows to Texas during periods of low river flows.

“Clearly, we have much to learn from New Mexico's experience and the particular models and methods they've developed to meet their interstate compact obligations,” said Jess.

June's four-day tour is one of the first outside Nebraska and contiguous states in many years.

“We're aware that most people have limited travel time and budgets, so that has been one of a number of reasons to keep the tours in or near Nebraska. In this case, however there's no other way to see the similarities and differences between these two basins and compacts then to go there and hear from those that have been involved in the litigation and the decision making processes,” Jess said.

The tour bus leaves Albuquerque for Santa Fe, N.M. on Monday morning, June 4. Afternoon briefings will give tour participants background on the physical, legal and institutional framework of New Mexico's Pecos River compact with

Texas. Talks will focus on the geography and hydrology of the Pecos basin, the 1948 compact with Texas, disputes between the two states and the roles played by the New Mexico engineer's office and interstate stream commission.

Speakers will include compact attorney Jay Stein of Stein and Brockmann, P.C., Santa Fe; former state engineer and commissioner of reclamation Eluid Martinez; interstate stream engineer Estevan Lopez; and karst hydrologist Lewis Land of the New Mexico Bureau of Geology and Mineral Resources.

Tour participants are on their own for Monday evening shopping and dining in Santa Fe.

On Tuesday, June 5, the tour leaves Santa Fe for Santa Rosa, on the northern end of the Pecos River basin, where in-depth discussions and observations of the Pecos River will continue. That afternoon, the tour continues south through the basin toward Ft. Sumner and Roswell and looks at irrigation district operations, as well as state-owned augmentation well fields.

Tuesday and Wednesday lodging will be in Roswell, where talks will focus on irrigated agriculture, including farming of chilies, pecans, hay, cotton and other crops.

On Wednesday, June 6, the tour heads south again to Artesia and Carlsbad for a close look at Carlsbad Irrigation District facilities at Bartley Reservoir, Lake McMillan, a district aqueduct over the Pecos River in Carlsbad and others.

There will also be discussion of efforts to control salt cedar growth, which has choked parts of the Pecos River, much as it has some rivers and streams in Nebraska.

Local irrigators and producers, state legislators and others will lead panel discussions of area challenges.

On Wednesday evening a lecture and visit to the UFO museum and research center in Roswell is planned. The museum is the most visited of any museum in New Mexico.

Inspection of locally grown crops, artesian wells, irrigation canals, operations of the Hagerman Irrigation Co. and New Mexico's augmentation well field continues on Thursday, June 7 near Roswell and Artesia.

The tour leaves Roswell for Albuquerque that afternoon.

“There is much to be learned in the New Mexico experience of interstate compact implementation that we here in Nebraska can benefit from in forming some possible solutions to our own challenges on the Republican River and on other river basins in Nebraska that are fully or over-appropriated,” Jess said.

Tour registration costs have not yet been set. Travel to and from Albuquerque is not included in the tour package, which otherwise covers all food, motel and motor coach expenses. To register, or for more information, contact Kearney Area Chamber of Commerce event coordinator Sara Rector at (800) 652-9435. Registration deadline is April 30 and participation is limited to the first 50 registrants.

Central Nebraska Public Power and Irrigation District, Gateway Farm Expo, Kearney Area Chamber of Commerce, Nebraska Water Conference Council, Nebraska Association of Resource Districts, Nebraska Public Power District and the UNL Water Center cosponsor the tour.

Groundwater Monitoring For Livestock Producers

Sponsored by the Nebraska Department of Environmental Quality and Nebraska Association of Resources Districts

Holdrege, Nebraska
City Council Chambers
502 East Avenue
Tuesday February 20, 2007
10:00 a.m. to 3:00 p.m.
Lunch on your own

Scottsbluff, Nebraska
Panhandle Research Center
4502 Avenue I
Thursday February 21, 2007
10:00 a.m. to 3:00 p.m. (MST)
Lunch on your own

Norfolk, Nebraska
Norfolk Public Library
308 Prospect Avenue
Tuesday February 27, 2007
10:00 a.m. to 3:00 p.m.
Lunch on your own

Lincoln, Nebraska
NDEQ Van Dorn Complex
2717 South 8th Street
Thursday March 1, 2007
10:00 a.m. to 3:00 p.m.
Lunch on your own

Purpose:

Installation and sampling of monitoring wells for wastewater lagoons represent a sizable investment for livestock facility owners. These wells are designed to measure substances that can affect the quality of ground water beneath your property. Training can help with proper and economical collection of samples for monitoring requirements. Even if someone else is collecting samples from these wells, the landowner is responsible for maintenance and ensuring that samples are properly collected and documented. Finally, learning how wells are installed and samples collected can help with understanding the test results and what this can mean for your facility.



Goals for the Workshop:

- Overview of monitoring well installation and maintenance
- Selection and use of groundwater monitoring field equipment
- Procedures for proper collection of groundwater samples
- Filling out the right paperwork
- What the sample results indicate

Questions:

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