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WATER CURRENT

VOL. 37, No. 4

FALL 2005

Missouri River Mainstem System is North America's Largest Reservoir System

By **Mary S. Roth, P.E.,**
U.S. Army Corps of Engineers

(Editor's Note: This is the first in a series of articles on issues facing the Missouri River Mainstem System and efforts by the Omaha District of the U.S. Army Corps of Engineers to address them. This series of articles will continue in the next issue of the Water Current. The UNL Water Center particularly wants to thank Rose Hargrave and Mary Roth at the Corps for their involvement in this project — SWR).

The Missouri River runs 2,321 miles from Three Forks, MT., where the Jefferson, Gallatin, and Madison Rivers converge. It drains one-sixth of the United States and is the nation's longest river.

The river's Mainstem Reservoir System (System) consists of six dams and reservoirs in Montana, North Dakota, South Dakota, and Nebraska. It can store 73.4 million acre-feet (af) of water, making it the largest reservoir system in North America.

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UNL, Well Drillers, NRD Team on York Well Demo

By **Steve Ress**

University of Nebraska-Lincoln water and geology experts teamed with the Nebraska Well Drillers Association, Upper Big Blue Natural Resources District (UBBNRD) and commercial well drillers for field well drilling demonstrations and seminars near York in August.

Seminars and corresponding well set up and drilling were conducted over two days in late August. UNL School of Natural Resources hydrogeologists Jim Goeke and Scott Summerside were part of the program.

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Getting Into Busy Fall and Winter Seasons; Planning for the Third Annual Water Law, Science and Policy Conference in Nebraska City

from the DIRECTOR



Kyle D. Hoagland

Kyle Hoagland

Sheri Fritz, Sandi Zellmer and I are making strides in planning the Third Annual Water Law, Science and Policy conference. Though we have yet to flesh-out the entire agenda and list of speakers, we know the conference will be May 4 and 5, 2006 at the Nebraska Arbor Day Foundation's Lied Conference Center in Nebraska City. The previous two years we held the conference at UNL facilities; at the College of Law on East Campus in 2004 and at the Nebraska Union on UNL's City Campus this year.

This year we've opted to move the event off-campus, to what may be the premier environmentally focused conference center in the area, boasting some of the finest scenery in all Nebraska.

The theme of the conference will be adaptive management of water resources, with focus on water challenges in the Great Plains, such as the High Plains Aquifer and the Missouri River.

Planning for the annual summer Water and Natural Resources Tour has also begun, even though it seems like we just got back from this summer's tour to the Sandhills and Pine Ridge. At present, the organizing committee is leaning heavily toward a tour of the Missouri River Basin from Omaha, north to Gavins Point Dam. There's a lot to see along this stretch of the river, including a vantage point at Ponca State Park where channelized and unchannelized stretches of the river can be viewed from the same overlook.

The tour will likely look at navigation, in-stream flows, threatened and endangered species issues, habitat restoration work being done by the U.S. Army Corps of Engineers, projects involving the Papio-Missouri NRD, tribal considerations and other issues. The tour is tentatively scheduled for July 18-20, 2006 and you will be receiving confirmation of dates and programming information by mail in the near future. Please make plans now to reserve the dates for this timely and interesting tour.

As something of a primer for the tour, the focus of this and the following issue of the *Water Current* will be Missouri River issues, using a series of articles penned by experts at the Omaha District office of the U.S. Army Corps of Engineers. These articles cover many of the basin use, threatened and endangered species, habitat restoration and tribal issues we will take a closer look at this summer.

I especially want to thank Missouri River Program Manager Rose Hargrave and Mary Roth at the Corps for helping to put these articles, photographs and graphics together for our use.

As part of our ongoing focus of getting water research faculty better teamed and in better positions to compete for large, external grant funding to help address a myriad of Nebraska water challenges and issues, we will also hold a daylong retreat at Wilderness Ridge in January. This will give key faculty a chance to get away from their desks, labs, classrooms and email for a day devoted strictly to working with colleagues to strategize on teaming individuals and expertise in ways to continue to lead in addressing surface and groundwater contamination issues, the continuing drought, water economics, climate modeling and a host of other challenges needing our attention.

As always, fall is a busy time. As Mike Jess, Steve Ress and I travel on behalf of

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WATER CURRENT

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Meet the Faculty

Patrick H. Dussault, Ph.D.

Pat Dussault has been a member of the faculty in the Department of Chemistry at the University of Nebraska–Lincoln since 1988. He was appointed professor and chair of the department in 2001.



Patrick H. Dussault

Education:

B.S., Chemistry, University of California at Irvine, 1982.

Ph.D., Organic Chemistry, California Institute of Technology, 1987.

Postdoctoral, Bioorganic Chemistry, Duke University, 1987–88.

Current Research:

Ozonolysis; organic oxidations; organic synthesis; fungal signaling.

Teaching Responsibilities:

Organic chemistry, portions of Toxicology 888 (UNL/UNMC)

Selected publications:

— Quorum sensing in *Candida albicans*: probing farnesol-receptor interactions with 40 natural and synthetic farnesol analogs² Roman Shchepin, Jacob M. Hornby, Erin

Burger, Timothy Niessen, Patrick Dussault, and Kenneth W. Nickerson. *Chemistry and Biology*, 2003, 10, 743–750.

- “Synthesis of (R)- and (S)-10,16-Dihydroxyhexadecanoic Acid: Cutin Stereochemistry and Fungal Activation² Aqeel Ahmed, Stephanie Cohen-Gould, Terry Crawford, Y.S. Ha, Monica Hollrah, Farhana Noor-E-Ain, Martin B. Dickman, and Patrick H. Dussault. *Phytochemistry*, 2003, 63, 47–52.
- Lewis acid-mediated reactions of carbonyl oxides: A new take on ozonolysis² P. H. Dussault and J. R. Raible. *Organic Letters*, 2000, 6478.

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Jeanette Thurston-Enriquez, Ph.D.

Jeanette Thurston-Enriquez is an environmental microbiologist for the United States Department of Agriculture–Agriculture Research Service (USDA-ARS), Soil and Water Conservation Research Unit. A position she has held since March 2001. She is an adjunct assistant professor in the Department of Agronomy and Horticulture and School of Biological Sciences at the University of Nebraska–Lincoln. She is a former research assistant, Soil, Water and Environmental Science Department, University of Arizona.

Education:

B.S. Microbiology and Chemistry, University of Arizona, 1995.
M.S. Environmental Science, University of Arizona, 1997.

Ph.D., Soil, Water and Environmental Science and Microbiology, University of Arizona, 2001.

Examples of Current Research:

Environmental water quality, pathogen fate and dissemination in the environment, water disinfection for pathogen reduction, bioaerosols, assessment of alternative manure management practices for health-related microbial reduction; methodology development for sensitive and specific detection of emerging pathogens in the environment.

Selected Publications:

— Thurston-Enriquez, J. A., Haas, C. N., Jacangelo, J., Riley, K., and Gerba, C. P. Inactivation of feline calicivirus and adenovirus type 40 by ultraviolet radiation. *Appl. Environ. Microbiol.* 69: 577–582. 2003.

- Thurston-Enriquez, J. A. Pathogen in water. *In: The Encyclopedia of Water Science*. B. A. Stewart and T. Howell (ed). 645–649. Marcel Dekker, Inc., New York, NY. 2003.
- Thurston-Enriquez, J. A., Haas, C. N., Jacangelo, J., and Gerba, C. P. Chlorine inactivation of adenovirus type 40 and feline calicivirus. *Appl. Environ. Microbiol.* 69: 3979–3985. 2003.

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Jeanette Thurston-Enriquez

August Four States Tour Looks at Front Range Water and Agriculture Issues

By Steve Ress

Four States Irrigation Council's biannual tour looked at a variety of water and agricultural issues on northern Colorado's eastern slope of the Rocky Mountains in a two-day late August bus tour organized by the Northern Colorado Water Conservancy District (NCWCD).

About 50 tour participants gathered from Nebraska, Kansas, Colorado and Wyoming to embark on the Aug. 29-31 tour based at Loveland, CO.

The tour began with a drive through Estes Park and Rocky Mountain National Park on the highest continuous paved highway in the United States to view water collection reservoirs, tunnels and related systems used to deliver water from the western slope of the Rocky Mountains to NCWCD users on the eastern slope, or front range, of the mountains.

NCWCD was created in 1937 under Colorado's Water Conservancy Act to contract with the U.S. Bureau of Reclamation to build the now famous trans-mountain Colorado-Big Thompson Project. The project delivers water from east slope collection points, across the Continental Divide, to about three-quarters of a million front range users in Loveland, Greeley, Fort Collins and other northern Colorado municipalities.

On the western slope, tour participants saw the west portal of the Adams Tunnel, Grand Lake and Windy Gap reservoir and pump plant. The return trip brought the tour to NCWCD's new headquarters in Berthoud, CO.

On the second day the tour stayed on the front range of the Rockies for a look at commercial carrot farming and packaging operations at Hungenberg Farms and Produce, and then to Fagerberg Farms, where onions and other

commercial produce are grown.

Some fields at Fagerberg Farms were recently converted to subsurface drip irrigation, where it was noted that onion yields have nearly doubled while using about two-thirds the water formerly delivered by furrow irrigation.

Lunch and presentations on row crop, tree and turfgrass research were at Colorado State University's agricultural research facility before a tour of the U.S. Department of Agriculture's National Center for Genetic Resources Preservation on the CSU campus in Fort Collins, CO. The facility is the core of a national seed banking and preservation system initiated in the late 1950s.

For more information on the Colorado-Big Thompson Project and NCWCD, go to www.ncwcd.org.



Brian Warner of Northern Colorado Water Conservancy District talks to Four States Irrigation Council tour participants at Lake Granby in Colorado's Estes Park (photo: Steve Ress).

UNL, Well Drillers, NRD Team on York Well Drilling Demo *(continued from page 1)*



Upper Big Blue Natural Resource District water manager Rod DeBuhr surveys the progress of demonstrations during a Nebraska Well Drillers Association two-day training event at Recharge Lake, near York (photo: Steve Ress).

First day seminar topics, included the basics of aquifers and well design including aquifer types, sieve analysis, filter pack selection and comparison, sample collection and principles of drilling fluids, mixing and handling drilling fluids, controlling artesian flow conditions and viewing of pack placement and grouting of the demonstration well.

The second day continued with well development, screening wells, specific capacity of wells before development,



UNL School of Natural Resources hydrogeologist Jim Goeke was a presenter during a two-day welling drilling and hands-on training event for the Nebraska Well Drillers Association at Recharge Lake near York in August (photo: Steve Ress).

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Understanding the Ins-and-Outs of LB 962

The Nebraska Farm Bureau Federation (NFB) has received inquiries from members regarding implementation of LB 962. The following question and answer piece addresses some of the more commonly asked questions. If you have additional questions, or want more information, call Jay Remppe, NFB State Director of Governmental Relations at (402) 421-4400.

What is LB 962? LB 962 was passed by the Legislature last year and contained the recommendations of the Water Policy Task Force and made several changes to Nebraska's water law. It was passed to address long-standing conflicts between surface and ground water users in certain areas of the state, to prevent conflicts from occurring in other parts of the state and provide an alternative to court involvement.

What changes were made with LB 962? LB 962 allows leases of surface water, changes administration of surface water rights, establishes a proactive approach to the integrated management of hydrologically connected groundwater and surface water and creates funds to direct money towards data gathering, research, conservation and implementation of integrated management plans in fully and over appropriated basins.

Describe the proactive approach for the management of hydrologically connected ground and surface water. The Nebraska Department of Natural Resources (DNR) is directed each year to examine river basins to determine if there is a sufficient supply of water over the long term to meet existing uses and allow for new uses. If not, the basins are determined to be fully appropriated. DNR's first report is due Jan. 1, 2006. In basins determined to be fully appropriated, immediate stays or moratoriums on new uses of surface water and ground water in the hydrologically connected area are implemented. The affected Natural Resource Districts (NRDs) and DNR are then required to develop integrated management plans within three to five years to protect existing uses and manage for new uses. The integrated management plans will determine whether or under what conditions new uses would be allowed.

When would a basin be considered fully appropriated? A basin would be considered fully appropriated if DNR determines the long term supply of hydrologically connected groundwater and surface water in the basin would not be sufficient to support new uses without negatively affecting existing uses. When making a determination, DNR will examine stream flows, existing groundwater and surface water uses and analyze the future lag effects of existing groundwater uses. The geographic area of the basin considered fully appropriated would be limited to the hydrologically connected area and would likely encompass portions of an NRD, not the full NRD.

How is hydrologically connected area defined? DNR has defined it as the geographic area within what is

known as the 10 percent/50-year line. For a well drilled on the line, 10 percent of the water pumped over 50 years would either come from the stream or would have gotten to the stream. DNR's report should contain information or a map on where the line would lie in basins determined to be fully appropriated.

Describe the moratorium on new uses. Determination that a basin is fully appropriated triggers a stay or moratorium on construction of new wells greater than 50 gallons per minute (gpm) and on the expansion of irrigated acres in the hydrologically connected area. The determination also triggers a moratorium on granting new surface water appropriations by DNR. The moratoriums on wells and new acres will remain in place until an integrated management plan is developed or they are lifted by an NRD. NRDs can grant a variance from the moratorium for good cause shown.

If a well were constructed, but not put to use prior to the effective date of the moratoriums, can those acres be irrigated? The decision lies with the local NRD. NRDs can permit increases in irrigated acres on wells constructed within nine months of the effective date of the moratorium but not used for irrigation prior to that date.

Can a well be constructed if a permit were issued by a NRD prior to the effective date of the moratorium but not constructed? Again, the decision lies with the local NRD. NRDs can allow construction of wells when a permit to construct was issued prior to the effective date of the moratorium.

Will the moratorium on new irrigated acres prevent the conversion from gravity flow systems to center pivot? What if the number of irrigated acres increases? Nothing would prohibit the conversion from a gravity flow system to a center pivot system if the number of acres irrigated does not increase. Whether or not the number of acres can increase will likely be discussed during development of the integrated management plans and may require offsets if the increase in irrigated acres is significant.

What actions should producers take if there is a possibility of their area being declared fully appropriated and a well moratorium implemented? Producers should make sure existing irrigation wells are properly registered with DNR. Producers can contact either their NRD or DNR for well registration information. Producers also should ask their NRD how it would certify irrigated acres make certain whatever records a NRD uses are correct. For example, some NRDs may use tax records from the county assessors' office to verify irrigated acres. In that instance it would behoove producers to check the irrigated acres listed at the county assessor's office before Jan. 1 to be sure they are correct. Finally, if a producer's business plan incorporates the

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Managing Australia's Great Artesian Basin

By Steve Ress,

In many ways, the challenges of managing Queensland Australia's Great Artesian Basin are not unlike the challenges of managing Nebraska's High Plains Aquifer. Both are vast yet diminishing natural resources.

"Much as with your own High Plains Aquifer, we're looking at best management practices, water mining, sustaining and restoring ecological processes, water use efficiency and a myriad of other issues to manage a finite natural resource of growing importance," said Robert G. Dick, senior policy and planning engineer for water management and use, Queensland Department of Natural Resources and Mines in Brisbane, Australia.

Dick spent six weeks investigating groundwater management and monitoring in the U.S. this summer. He was the Sept. 28 lecturer in the fall semester School of Natural Resources Seminar Series as part of his visit to the University of Nebraska-Lincoln.

Just as the High Plains aquifer is one of the greatest groundwater sources in the U.S., Queensland's Great Artesian Basin is vast, underlying two-thirds of Queensland, one-fifth of the Australian continent and one of the largest artesian basins in the world. It is about twice the size of the Ogallala Aquifer.

The basin currently supports 15,000 groundwater wells and another 2,700 naturally occurring artesian wells. Basin water is used for consumption and to support agriculture in some locales, but its largest use is in supporting livestock operations throughout northeastern Australia.

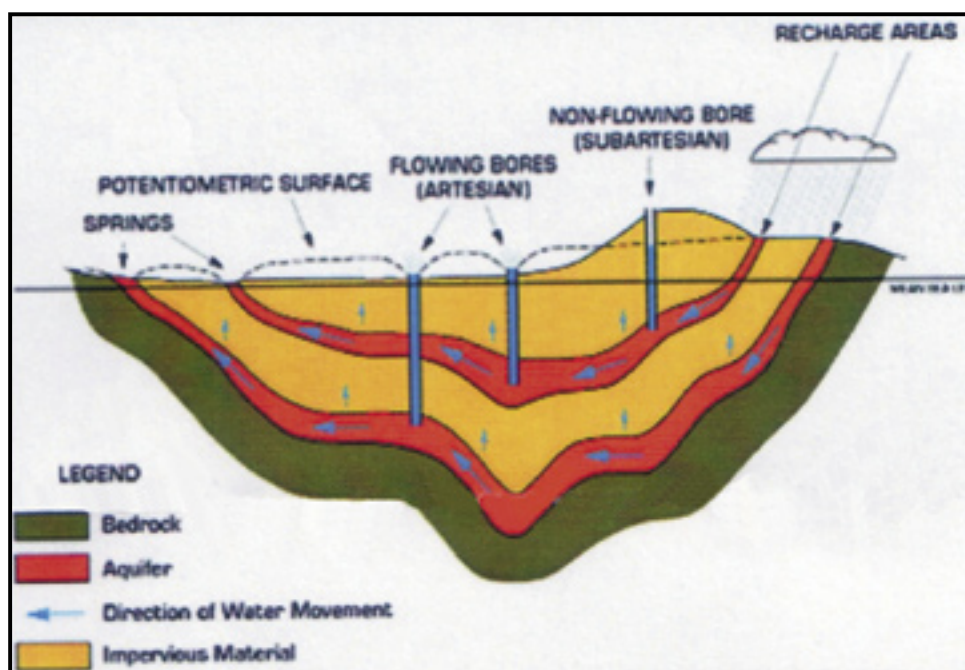
"Much of the water is lost to evaporation and seepage and uncontrolled boring (drilling) and flow, which contributes to salt deposits on the land and unwanted woody and weedy plant growth," Dick said.

Much of the basin's water is naturally brackish, or slightly salty. It typically flows to the surface from wells drilled from 2,000 to 6,000 feet in depth and at temperatures ranging from 30 to 100 degrees centigrade.

To help save and better use basin groundwater, the Queensland government has instituted a water resource plan for the Great Artesian Basin that includes massive well-capping and piping operations and which is designed to protect the basin's biodiversity, agricultural and human uses and future sustainability of the aquifer.

"What I'm hoping to learn in this trip to the United States is groundwater management and monitoring ideas that may help us better manage the Great Artesian Basin," Dick said. In addition to Nebraska, he visited California, Kansas and Ohio during the six-week trip.

Dick holds a bachelor's degree in agricultural engineering from the University of Southern Australia, did post-graduate study in groundwater management at Flinders University of Adelaide and is a chartered professional engineer in The Australian Institute of Engineers.



A representation of Australia's Great Artesian Basin.

From the Director *(continued from page 2)*

the Water Center, the Water Resources Research Initiative and UNL, we hope to see you either on campus, the Gateway Farm Expo, the NWRA/NSIA conference, NWRA water roundtable meetings or any of a number of other places we might rub shoulders.

As a final note I'm sure you have noticed the new "face" on

this issue of the *Water Current*, which places greater emphasis on the color red and the University of Nebraska. This reflects our commitment to meeting the new standards for all UNL publications that help reinforce our common ties to the University, but don't represent a change in content or flavor of the newsletter. Just think "The Power of Red!!"

Husker Harvest Days 2005



The Power of Red! Husker Harvest Days show goes to the Institute of Agriculture and Natural Resources red metal building at Husker Harvest Days near Grand Island. A record number of IANR units and departments participated in the annual September irrigated farm show, including the UNL Water Center and UNL's School of Natural Resources.



With UNL Market Journal host Doug Jose (left) are water panelists Dave Aiken of UNL's Department of Agricultural Economics, Lincoln attorney and former deputy director of the Nebraska Department of Water Resources Don Blankenau, and UNL Water Center associate director and former director of the Nebraska Department of Water Resources Mike Jess. The panel was one of several live Market Journal broadcasts originating from this year's Husker Harvest Days farm show near Grand Island.



NU president JB Milliken meets with Institute of Agriculture and Natural Resources faculty and staff at Husker Harvest Days near Grand Island. At left and right are Larry Schulze and Alan Blazek.



NU president JB Milliken (center) meets with members of UNL's Quarter-Scale Tractor Pull Team at Husker Harvest Days near Grand Island. At right is UNL's Larry Schulze, who coordinates Institute of Agriculture and Natural Resources participation in the annual irrigated farm show.



NU president JB Milliken meets with the media at September's Husker Harvest Days farm show near Grand Island. UNL Institute of Agriculture and Natural Resources show participation coordinator Larry Schulze is at right.

Photos by Steve Ress

Missouri River Mainstem System is North America's Largest Reservoir System

(continued from page 1)

The US Army Corps of Engineers (Corps) operates the System to serve Congressionally authorized project purposes of flood control, navigation, irrigation, hydropower generation, water supply, water quality, recreation, and fish and wildlife.

Runoff water from above the System is stored in the six reservoirs, where it serves several project purposes.

Water is released from the System as needed for downstream purposes. Released water from the lowest dam in the System, Gavins Point Dam, flows down the lower river, which includes the bank stabilization and navigation project from Sioux City, IA., to St. Louis, MO.



Reservoir Storage Zones

The **exclusive flood control zone** is the uppermost storage zone of the mainstem reservoirs. It is reserved to store extremely high floodwaters. Water is released from this zone as quickly as downstream channel conditions permit so sufficient space remains for capturing future floodwaters.

The **annual flood control and multiple use zone** is used to capture high spring and summer river runoff into the System. Later in the year, water stored in this zone is released for downstream uses so that this storage zone empties by the beginning of the next flood season on March 1. This zone provides benefits for flood

control, irrigation, navigation, water supply, hydropower, water quality control, recreation, and fish and wildlife. As with the exclusive flood control zone, most of the water is released from the reservoirs during the summer and fall navigation season.

The **carryover multiple use zone** is the largest zone of storage. It remains full most years but is gradually drawn down during droughts. Release of water from this zone is to serve project purposes during droughts.

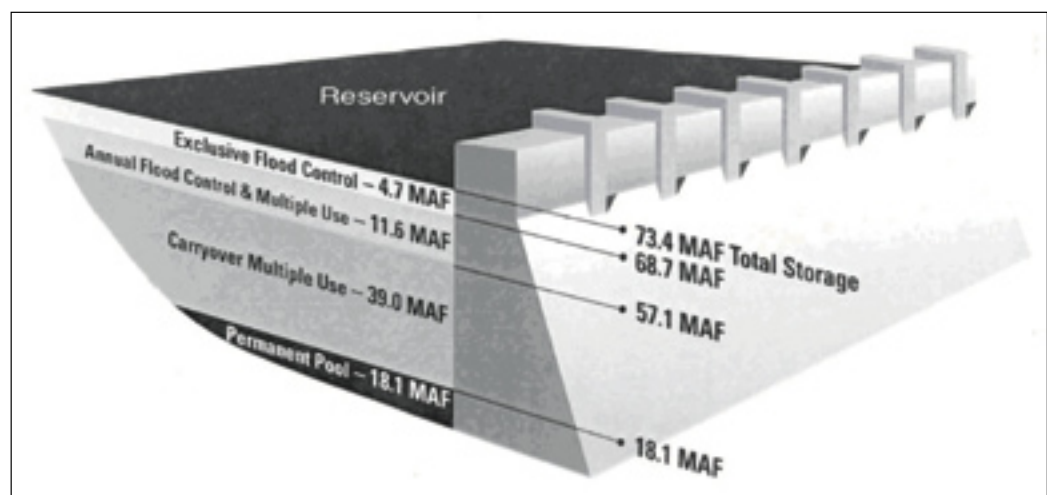
The **permanent pool** is the top of the remaining storage zone and represents the minimum water level necessary to operate hydropower plants at the dams. It also provides the minimum water necessary for recreation, fish and wildlife, and water supply for towns and irrigators located around the reservoirs, as well as storage for sediment.

How Dams Operate

The **spillway** is composed of a series of gates used to control lake levels and to make releases of water exceeding the capacity of the powerhouse and outlet works.

Powerhouses are located at the dams of each of the six mainstem projects. They are generally used to pass water from the reservoir through turbines that generate electricity.

Reservoirs are formed by dams that form barriers impeding river flow, which become artificial lakes, or reservoirs. The storage and release of water from reservoirs allows the Corps to serve many project purposes.



Master Manual Sees Changes Since First Adopted in 1961

By Roy F. McAllister, P.E.,
U.S. Army Corps of Engineers

After the U.S. Army Corps of Engineers (Corps) builds a dam and reservoir project, the project is operated following guidelines in a water control manual.

Multiple reservoirs within a single basin operated as an integrated system typically have a “master” water control manual providing guidelines for system operation.

One such master manual provides for operation of the six mainstem reservoir projects on the Missouri River.

Each of the projects – Fort Peck, Garrison, Oahe, Big Bend, Fort Randall and Gavins Point – has an individual water control manual, but the Missouri River Mainstem Reservoir System (System) operates following the Water Control Plan guidelines in the System’s Master Water Control Manual, or “master manual.”

The System was finished in the mid-1960’s and was first filled and operational in 1967.

Over the next 20 years the first master manual, published in 1961, operated it. Minor revisions were made to it in the 1970s and it continued meeting basin needs for the next 20 years.

An extremely dry 1988 in the upper Missouri River basin raised questions regarding adequacy of the existing Water Control Plan. This was the driest year in the upper basin since the reservoirs first filled. Water levels in the upper three reservoirs dropped about 20 feet that year.

A second consecutive dry year in 1989 saw water levels continuing to drop with the recreational use and access to the upper three reservoirs being impacted.

At the request of upper basin governors, the Corps agreed to review the existing Water Control Plan in the System’s master manual in November 1989 to determine if it was the

best plan for the Missouri River basin, considering the changes in the uses relying on the System that had occurred since 1961.

The review was completed using documentation and coordination processes required for an environmental impact statement (EIS) under the National Environmental Policy Act.

The public, federal and state agencies and basin tribes, were provided four consecutive drafts of the EIS from 1990 through 2001. To facilitate coordination requirements, numerous public workshops and meetings were held from Helena, MT. to New Orleans, LA.

The Final EIS was released in February 2004 and the draft revised master manual (with a new water control plan) was released the following month.

Operations have followed the new Water Control Plan since it was revised. It has provided greater reductions in releases from the System than the prior plan. This continues to be important to upper basin states, as the basin has been in another continuous drought since 2000.

The 2004 master manual was a major step toward addressing current needs of the Missouri River basin, but further revisions are needed.

Based on 2000 and 2003 biological opinions provided to the Corps by the U.S. Fish and Wildlife Service, additional Water Control Plan changes are needed to ensure threatened and endangered species won’t be adversely affected by System operations.

Beginning this year, the Corps has been working with basin stakeholders to develop a spring pulse plan to incorporate into the Water Control Plan and the master manual.

Further discussion between the Corps and the U.S. Fish and Wildlife Service this summer will result in developing a plan to follow next year.

Understanding the Ins-and-Outs of LB 962 *(continued from page 5)*

possibility of additional irrigation development, a visit with the local NRD and DNR can help assess the possibility of a well moratorium. An inquiry should be made about the size of area within the NRD if it is determined to be fully appropriated. This information should assist in making decisions about the long-term plans for the operation. Of course, the costs of capital financing and anticipated returns on investments should also be considered prior to making decisions regarding irrigation development.

What is an integrated management plan? IMPs must be developed jointly by a NRD and DNR and include clear goals and objectives with the purpose of sustaining a

balance between water uses and supplies. The plan will seek to protect existing groundwater and surface water uses, and manage new growth to assure existing uses are not harmed. The plan must include groundwater controls authorized for adoption by the NRD and surface water controls authorized for adoption by DNR. It could also provide for use of incentive programs to encourage water conservation. In fully appropriated areas, plans should merely require up-to-date well registration information and certification of irrigated acres and not require meters or allocations. LB 962 states that nothing in the plan shall require a NRD to regulate groundwater uses in place when a basin is determined to be fully appropriated.

Ponca State Park Habitat Restoration Project

By Luke Wallace
U.S. Army Corps of Engineers

Asandbar complex constructed by the U.S. Army Corps of Engineers (Corps) at Ponca State Park last year was one of the most successful breeding areas for interior least terns on the Missouri River in 2004.

Ponca State Park is located at the downstream end of the 59-mile segment of the Missouri National Recreational River near Ponca. This stretch of the river includes stretches of the Missouri River between Gavins Point Dam in South Dakota, and Ponca State Park. This is one of the last remaining unchannelized portions of the Missouri River.

In 1999, the Nebraska Game and Parks Commission (NGPC) asked for help from the Corps to study and construct a habitat restoration project at Ponca State Park on 295 acres of adjacent river bottomland that was donated to the park.

This land consisted of a series of side channels, a backwater and farmed wetlands that had degraded due to land-use practices and hydrology and sediment transport changes that have occurred in the Missouri River primarily as a result of building Gavins Point Dam.

The Corps hired Tetra Tech, Inc. to develop a restoration plan with an integrated environmental assessment and a 90 percent design for the proposed restoration alternative. This design was developed in cooperation with the NGPC, the National Park Service in O'Neill and the U.S. Fish and Wildlife Service (USFWS) in Grand Island.

The project goal was to restore degraded aquatic habitat areas. Plans and specifications were completed last March.

Final design included a series of backwaters and wetlands attached to the Missouri River, tall-grass prairie restoration in the formerly farmed areas and using dredged sandy spoil material from the backwaters to create emergent sandbar

habitat for endangered interior least terns, and threatened piping plovers.

A \$2.34 million construction contract went to Western Contracting Corp. last April and construction began in April. All major excavation work was completed in June 2004.

Spoil material was discharged into the Missouri River to create emergent sandbar habitat. About 533,240 cubic yards of sandy material was excavated to create wetlands and backwaters. This material was discharged into the river for this purpose.

In total, the project created 29 acres of backwater habitat, 17.5 acres of wetland, three emergent sandbars of 37 combined acres and 36 acres of tallgrass prairie.

Least terns began using the first constructed sandbar while it was still being built. Immediately after construction, waterfowl, shorebirds, five species of turtles and a variety of other wildlife were using the backwaters.

More than 3,900 fish representing 36 different species were collected from the backwaters last summer and fall.

Twenty-three piping plovers and 64 interior least terns hatched and were successfully fledged from the constructed emergent sandbar island complex, making them the most productive sandbar islands on the Missouri River for interior least terns last year.



Dredging of a backwater area along the banks of the Missouri River is part of the U.S. Army Corps of Engineers habitat construction programming (photo: U.S. Army Corps of Engineers).

Emergent Sandbar Habitat

**By Kelly Crane
U.S. Army Corps of Engineers**

The Missouri River looks very different today than it did before construction of six dams from Fort Peck, MT. to Yankton, SD.

Before the dams, there were no reservoirs to contain the spring influx of water from mountain snowmelt and plains runoff and the Missouri River would routinely wander out of its many meandering side channels, flowing through the plains, collecting and depositing sediment.

Sandbars were routinely washed away in some places and created in others. During the forming and reforming of these sandbars, much of the vegetation that grew on the bars from the year before was scoured away.

These newly created or scoured sandbars are thought to be desirable habitat for two species of birds, least terns and piping plovers. Both use the same habitat even though their feeding habits are different. Least terns eat small fish in shallow water surrounding the sandbars, while piping plovers forage along the shoreline for a variety of invertebrates.

After the dams were built, the annual grand scale sediment collecting and depositing cycle no longer occurred naturally. Flood or high water events such as in 1997 put large amounts of water and sediment into the Missouri River System because of near-record mountain and plains snowmelt and heavy spring rains.

Reservoirs swelled to near capacity and water was released—mimicking some of the pre-dam historic high flows. Hundreds of acres of new sandbars were created. Abundant habitat was available for a few years after the 1997 flood, but since then available habitat for terns and plovers has declined.

In November 2000 the U. S. Fish and Wildlife Service issued a biological opinion (BiOp) addressing interior least tern and piping plover habitat along with other threatened or endangered species that have been adversely affected because

of operation of the Missouri River mainstem system.

One BiOp recommendation was a habitat creation goal for each stretch of the river as well as for Lewis and Clark Reservoir just above Gavins Point Dam.

The river stretches, roughly stated, are below Fort Peck Dam, below Garrison Dam, below Fort Randall Dam, and below Gavins Point Dam.

Terns seem to prefer sandbars in the river stretches rather than reservoir shorelines, while plovers will use reservoir shorelines or sandbars in the river.

Responding to BiOp recommendations that upwards of 12,000 acres be available for use by terns and plovers by 2015, the Corps began creating what Missouri River flows no longer can.

Using dredges, bulldozers, backhoes and scrapers, the sand and sediment is piled onto a shallowly submerged sandbar to create one above water so the birds can use it.

Another way to create habitat is by removing vegetation from existing sandbars since both species of birds seem to prefer sparsely vegetated sandbars. When plant growth hinders their ability to see predators, the birds will not use the sandbar. Killing the vegetation with herbicides, then clearing the dead vegetation away is thought to be effective in creating barren sandbars.

But creating habitat is no guarantee the birds will use it, however.

Monitoring created habitat is crucial to understanding what meth-



Creating emergent sandbars in the Missouri River (photo: U.S. Army Corps of Engineers).

While the task sounds daunting, some of the habitat already exists. Aerial photos taken in June are being analyzed to determine how much habitat is currently available. The Corps' responsibility is to determine how much habitat currently exists compared to how much is recommended by the BiOp, and to create the rest.

Mechanical habitat creation can be done by several different methods. Redistributing sediment might be a better descriptive term for what actually happens during sandbar creation. In the river stretches and in Lewis & Clark Reservoir, there is plenty of deposited sediment—though most of it doesn't stick out of the water.

ods are effective for the birds. The U. S. Geological Society's Northern Prairie Research Center in Jamestown, ND is leading an interagency team that is currently creating a monitoring plan for all methodologies.

Over the past two years, the Corps has created more than 800 acres of emergent sandbar habitat. Most of this was created by vegetation removal and close to 150 acres was created by dredging and other mechanical equipment.

The Corps, U. S. Fish and Wildlife Service, state game and fish departments, National Park Service, and U. S. Geological Service are working together as an interagency team to determine habitat creation priorities on the Missouri River.

Interior Least Tern and Piping Plover

By Greg Pavelka
U.S. Army Corps of Engineers

In 1986, the interior least tern and the Northern Great Plains population of piping plovers were respectively listed as endangered and threatened by U.S. Fish & Wildlife Service. Both these shorebirds nest on Missouri River sandbars below dams operated by the U.S. Army Corps of Engineers (Corps) and on reservoir shorelines.

As part of a biological opinion by U.S. Fish & Wildlife Service, the Corps annually conducts adult census and productivity surveys throughout the nesting season to determine population trends, nesting success and chick success for the two species.

Surveys are conducted along 1,000 miles of river and reservoir shoreline from Fort Peck Lake in eastern Montana to Ponca State Park in northeastern Nebraska.

Permanent and seasonal Corps employees at project offices along the Missouri River do these surveys.

The surveys begin in late April as piping plovers arrive from wintering grounds along the South Atlantic coast, Gulf Coast and shores of Caribbean islands. Least terns begin arriving from wintering grounds along the shores of Central and South America about a month after the plovers.

After the birds arrive crews track them weekly through egg laying, egg hatching, chick rearing and chick fledging (when the birds are able to fly).

Generally, the last of the fledglings and adults of both species leave for wintering grounds by mid to late August. Before then, an adult census is conducted the last two weeks in June. By that time the two species have settled

down on nesting grounds and movement up and down the river is limited.

Tracking least terns and piping plovers is a high-tech operation. Crews carry a global positioning system (GPS) and data logger to survey sandbars and shoreline.

Finding nests isn't easy as the nest bowl is just a scrape in the sand and the eggs of both species are camouflaged to blend into the sand.

When a nest is found, crews record the location with GPS and document species, number of eggs, egg incubation stage and nest fate. In the office the data is downloaded via computer into the Corps' Threatened & Endangered Species Data Management System (DMS).



A piping plover nests on a sandbar (photo: U.S. Army Corps of Engineers).



An adult least tern feeds her chicks (photo: U.S. Army Corps of Engineers).

DMS is an Internet-based data depository. Once the data is in DMS, it undergoes a quality check and after approval, is available to users in a series of reports.

Users include the Corps, U.S. Fish & Wildlife Service and state game and fish departments. Reports include nest status, nest fate, adult census and chick productivity.

Throughout the nesting season the Corps' Threatened & Endangered Species Section closely coordinates bird monitoring with the Corps' Water Management Division.

The Water Management Division determines water releases from dams to meet project purposes such as flood control, hydropower generation, irrigation, fish and wildlife values and navigation.

Nests determined to be at risk from low sandbar elevation or rising lake levels are red-flagged by survey

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UNL, Well Drillers, NRD Team on York Well Drilling Demonstrations *(continued from page 4)*

viewing surging in the field and viewing and calculating differences in well development processes.

Recharge Lake, west of York at the UBBNRD's Bruce L. Anderson Recreation Area, was chosen for the seminars and drilling demonstration because of artesian conditions existing in the area. Artesian wells force water up by pressure from groundwater draining from higher ground. Geologic conditions sometimes, but not always, bring this groundwater to the surface naturally and can create unique problems for drilling, sealing and operating groundwater wells.

"Artesian wells are fairly common in our district and they require careful grout placement above the confining layer of the aquifer for proper sealing," said Rod DeBuhr, UBBNRD water department manager in York.

Grout placement thus was a focus of the event, with much of the actual drilling and demonstration of methods and grouting being done by Sargent Drilling of Geneva and

Downey Drilling Inc. of Lexington.

Lee Orton, director of the sponsoring Nebraska Well Drillers Association, said about 60 well drillers from across Nebraska attended the two-day seminar and demonstrations.

Helping teach seminar sessions and participating in the drilling and grouting demonstrations and techniques were UNL School of Natural Resources hydrogeologists Goeke and Summerside.

"There were a lot of entities that came together to offer this training and hands-on demonstrations, from the Upper Big Blue NRD, the University, the well drillers association, commercial well drilling companies, Nebraska Health and Human Services System, water well licensing board and others. This is exactly the kind of cooperative learning environment we want to offer the state's well drillers," Orton said of the two-day event.

Meet the Faculty

Jeanette Thurston-Enriquez *(continued from page 3)*

- Henry, C. and Thurston-Enriquez, J. A. Impact of a constructed low water stream crossing, an innovative BMP, on microbial water quality of a rangeland pasture stream. American Society for Agricultural Engineers Annual Meeting Paper #032313. 2003.
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Interior Least Tern and Piping Plover *(continued from page 12)*

crews and special attention is given these nests and subsequently to the chicks if the eggs hatch.

Actions taken to protect at-risk nests and chicks include delaying water increases out of the dams until after the eggs have hatched or the chicks have fledged, to raising up nests and moving nests and chicks to higher locations.

This year saw record number of piping plovers and least terns on the Missouri River. The 1,764 adult piping plovers represent an 11 percent increase over 2004 and the 904 least

terns represent a 25 percent increase over the number adult terns counted in 2004.

Productivity goals as set by the U.S. Fish & Wildlife Service in the biological opinion were also met for both species.

Data collected this year will continue to be analyzed for ways to improve bird survivability. DMS will also undergo a major overhaul as the Corps looks to improve data collection and analysis measures.



Water News Briefs

2006 Water Law, Science and Policy Conference To Nebraska City in May

Planning has begun for the Third Annual Water Law, Science and Policy conference that will be May 4 and 5, 2006 at Arbor Day Farm's Lied Lodge and Conference Center in Nebraska City. The event may include both a pre-conference golf outing at neighboring Arbor Links golf course and a tour of the Lied Lodge grounds and educational programs.

Conference programming is still being planned.

For more information on Arbor Day Farms or Lied Lodge, go to www.liedlodge.org. Information on the 2006 conference and on previous Water Law, Science and Policy conferences can be found at <http://snr.unl.edu/water/conference/>

The debut conference in 2004 was held at UNL's College of Law, while UNL's Nebraska Union hosted the 2005 conference.

Summer Tour Will Be July 18-20

The 2006 Water and Natural Resources summer tour, sponsored jointly by the Kearney Area Chamber of Commerce, Gateway Farm Expo, Central Nebraska Public Power and Irrigation District, Nebraska Public Power District, Nebraska Association of Resource Districts (NARD), UNL Water Center and others, will be July 18-20.

Earlier dates in June were changed to July so the tour won't conflict with an NARD director's tour in western Nebraska in mid-June.

Though planning for the July tour has just begun, it appears likely the tour will concentrate on Missouri River Basin

issues from approximately Omaha, north to Gavins Point Dam and Lewis and Clark reservoir.

Look for more tour information in the next *Water Current*.

Notes from the Water Sciences Laboratory

In filling a vacancy on its staff, the UNL Water Sciences Laboratory has hired Aaron Shultis as a research technologist, said WSL laboratory services manager Dan Snow.

Also, WSL research technologist Teyona Damon gave birth to an 8 lb., 13 oz. baby boy on June 15, who joins an older brother.

Professional journal articles published since the last update on the WSL in this publication, include the following:

Aga, D.S., S. O'Connor, S. Ensley, J.O. Payero, D. Snow, and D. Tarkalson. 2005. Determination of the Persistence of Tetracycline Antibiotics and Their Degradates in Manure-Amended Soil Using Enzyme-Linked Immunosorbent Assay and Liquid Chromatography-Mass Spectrometry. *Journal of Agricultural and Food Chemistry*. V. 53, n 18, pp 7165-7171.

Extension Continues Volunteer Lake Monitoring Program

Nebraska Cooperative Extension's water quality program continues its volunteer monitoring program to check lakes for blue-green algae. The program began in 2004 and continues this year.

Free test kits to detect toxic blue-green algae are available from University of Nebraska-Lincoln water resources specialist Tadd Barrow so lake owners, users and managers can check their lake for potential toxin-producing algae.

Kits contain instructions on proper sample collection, a sheet for recording measurements, a questionnaire about the lake and sample bottles for water and algae. Samples are returned to Barrow

for processing and those who submit samples are notified of results.

For more information or a test kit, call Hilary Hansen at (402) 472-8190.

Rapid algal growth is called an algae bloom. Blooms can appear and linger anywhere from days to weeks. They are most common in the warmer months from May to September, said UNL Water Center director Kyle Hoagland.

Some types of blue-green algae produce chemical toxins that harm people and animals, he said. "These colorless and odorless toxins may linger in the water for as long as two weeks after the bloom has disappeared."

Skin irritations and gastrointestinal problems are the main risks to people from these toxins. In rare cases, extremely high toxin levels can be fatal to people.

During a bloom, lake water becomes cloudy with a green or blue-green cast and blue-green streaks may be visible on the water's surface, Hoagland said.

"At this stage, the lake looks like pea soup or as if someone dumped a light-colored green paint in the water. It often develops a strong musty or fishy odor as the algae accumulate and begin to decompose," he said.

Winds can increase the danger of a toxic bloom by blowing algae to the leeward side of a lake where they concentrate in coves or along shorelines.

Blue-green algae, which are cyanobacteria, are microscopic organisms commonly found in lakes and ponds worldwide. Special characteristics of blue-green algae often allow them to multiply faster than other types of algae.

This summer, more than 150 free test kits were distributed to individuals in the following Nebraska communities: Ashland, Auburn, Ayr, Beatrice, Bellevue, Blair, Brady, Brainard, Burwell, Cedar Creek, Chadron, Clarks, Columbus, Crete, Dalton, Doniphan, Duncan, Fairbury, Firth, Fremont, Gothenburg, Grand Island, Gretna, Hastings, Humboldt, La Vista, Lincoln, Monroe, Morse Bluff, North Bend, Omaha, Papillion, Pilger, Plattsmouth, Ravenna, Rising City, Roca, Salem, South Bend, Stromsburg, Syracuse, Union, Verdigre, Waterloo, West Point, York and Yutan.

New Tool Monitors Drought's Impact Across U.S.

A new Web-based tool from the National Drought Mitigation Center (NDMC) is a first step toward providing long-needed information about the impact of far-reaching but difficult-to-quantify drought.

From an overtaxed private well in New York to cemeteries in Illinois that are so dry it's difficult to dig new graves, the Drought Impact Reporter aims to help policymakers identify and better respond to drought impacts.

"Drought impacts are inherently hard to quantify, and there is no comprehensive and consistent methodology for quantifying drought impacts and economic losses in the United States," said Don Wilhite, director of the University of Nebraska-Lincoln-based NDMC. "The Drought Impact Reporter is intended to be the initial step in creating such a methodology."

Mark Svoboda, climatologist with the drought center, compared the new tool with the drought center's widely used Drought Monitor, a Web-based map that tracks drought's severity across the country.

"The Drought Monitor was developed to assess the physical nature of drought, while this tool was designed to capture the human, or social, side of droughts," Svoboda said. "You can't ignore the social aspect of drought. The Drought Impact Reporter should enable us to better educate decision makers and others ... as they see impacts linger on the map well after the physical aspects of the drought itself are gone."

The Drought Impact Reporter also gives members of the public a chance to weigh in with details about how drought affects them, Svoboda said.

The site, which can be accessed through a link at the NDMC's Web site, <http://drought.unl.edu>, displays a U.S. map. Site visitors can drag the cursor across the U.S. map and get drought impact data for each state and can click on individual states and, from there, individual counties for more information about those impacts.

Impacts are categorized as agriculture, water/energy, environment, fire, social and other.

In Nebraska, for example, the map notes that drought has led authorities to end the navigation season on the Missouri River 48 days earlier than usual, on Oct. 15. A click on Red Willow County reveals that McCook has instituted new watering restrictions, while a click on Dawes County shows that the U.S. Forest Service has banned open fires in the region.

Data collected at the site ranges from general to very specific. Some examples:

- In Illinois, cemetery employees are having a difficult time digging graves in the dry ground.
- The Kennewich School District in Washington has closed 15 of 21 playfields; children can use playground equipment but can't go on the grass.

(continued on back page)

We're Updating!!

We are updating our mailing list. If you have a change of address, title and/or name, or would like to have your name added to or removed from the *Water Current* mailing list, please let us know. Also, if you know of anyone who might be interested in receiving our publications, please give us their names and we will be glad to add them to our mailing list.

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New Tool Monitors Drought's Impact Across U.S. (continued from page 15)

- Fishing has been prohibited from noon to midnight in the Jefferson River in Montana, in an effort to reduce stress on wild trout populations.
- The Lower Mississippi River Committee has implemented new rules on barge operations on the river.
- An Exeter, N.Y., resident reports, “we are no longer able to use our washing machine because it taxes the well too much.”

Information for the Drought Impact Reporter's database comes from a variety of sources, including online drought-related news stories and scientific publications; members of the public who submit drought-related impacts through the Web site; the media; and government agencies including the National Oceanic and Atmospheric Administration and U.S. Department of Agriculture.

NDMC staff reviews all impact reports submitted via the Web site; some reports have links to further information, such as online news stories. The NDMC is building the impact database, beginning with impacts from the past few months and planning to add older impacts over the next few months.

Visitors to the Drought Impact Reporter site can view reported impacts over a specified time, select various impacts to map, change the time frame of the map and more.

The tool is only a first step toward developing a consistent system for measuring drought impacts and economic losses, Wilhite said. It's imperfect and incomplete. In a caveat at the site, the NDMC notes, “The geographic coverage of these

submissions and reports may reflect personal/media perceptions or biases rather than actual drought conditions.”

It's critical to more effectively measure drought impact, Wilhite said. Drought losses average \$6 billion to \$8 billion a year, according to the Federal Emergency Management Agency. That's more than any other natural hazard. Some years it's even more -- in 1988, \$39 billion; in 2002, more than \$20 billion.

Because drought develops and plays out much more slowly than other natural disasters, its impact often is poorly understood, Wilhite said. Better information on its impact, however,

could help policy-makers identify what types of impacts occur, and where they happen. That could help officials develop policies to head off drought's devastation before it occurs, rather than incurring high expenditures on post-drought relief.

Previously, the NDMC

created the U.S. Drought Monitor through a partnership with the USDA and NOAA. The Drought Monitor is a weekly snapshot of drought severity across the nation and is widely used by USDA to determine eligibility for disaster programs. The drought mitigation center also created the Vegetation Drought Response Index, which measures vegetation stress from drought.

The NDMC, established in 1995, is based in UNL's School of Natural Resources.

(Editor's Note: From UNL's Institute of Agriculture and Natural Resources News Service).

“Because drought develops and plays out much more slowly than other natural disasters, its impact often is poorly understood.”



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