SDWRI
South Dakota State University, College of Agricultural and Biological Sciences
Water News
Volume 3 No. 4
Published Quarterly by
South Dakota
Water Resources Institute
Director: Van C. Kelley

Happy New Year!

SD WRI is pleased to feature a 2006 USGS 104b funded project, *"Permeable Reactive Bio-Barriers for Uranium Removal: Role of Iron Minerals on Uranium Fate and Transport."* The principal investigator for this project is Dr. Rajesh Sani from South Dakota School of Mines and Technology in Rapid City, SD.

By Rajesh Sani

Uranium is the most common radionuclide found within contaminated groundwater, soils, and sediments at many sites and is of particular concern due to its inherent toxicity and carcinogenicity characteristics. For example, in western South Dakota, historical uranium-mining operations have lead to extensive contamination of surface and groundwater, soils, and sediments. At the abandoned Edgemont Uranium Mill Site (located in downtown Edgemont, SD), regional sediment and groundwater sites were extensively impacted by uranium milling and mining operations. These were remediated as part of the uranium mill tailings program of the Department of Energy. However, other regional sites exist within many areas of western South Dakota, including Edgemont, still have high concentrations of uranium and other heavy metals. We recently collected water and sediment samples from the creek (see Figure) near the Edgemont Uranium Mill Site and found elevated concentrations of heavy metals and uranium.

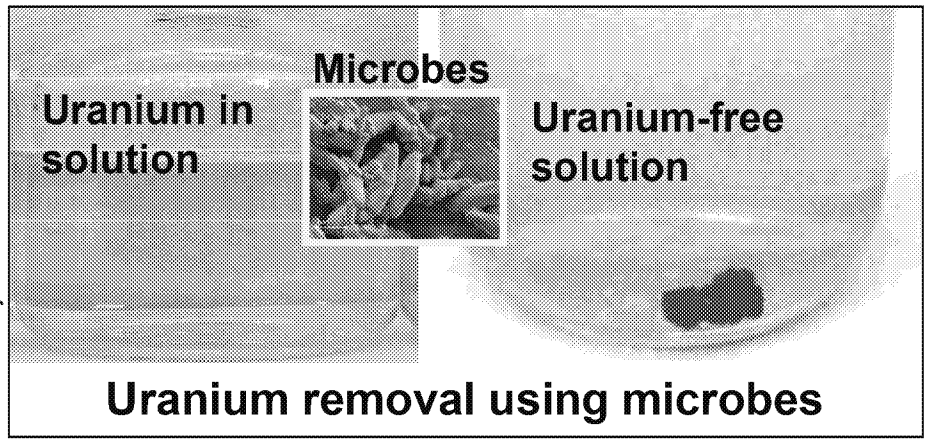
This uranium (the hexavalent form of uranium) has high solubility that can result its transport to sensitive receptors such as drinking water sources. One potential method of treating uranium contamination is by using natural dissimilatory metal reducing bacteria (DMRB) including sulfate reducing bacteria (SRB) to reduce soluble U(VI) to insoluble U(IV) (uraninite, UO_2), which can lead to

(Continued on page 2)

Sampling site near the Edgemont Uranium Mill Site (Edgemont, SD).

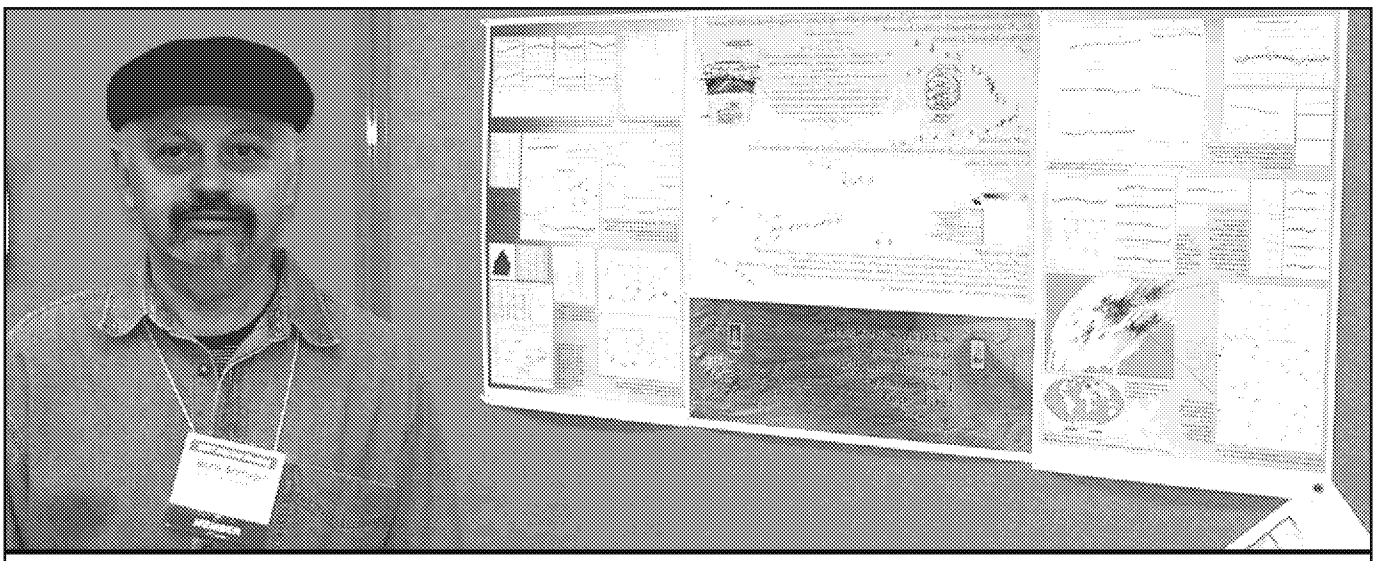
(Continued from page 1)

uranium immobilization (see figure). SRB are one group of such DMRB that are present in many contaminated sites. SRB can precipitate uranium by direct enzymatic mechanisms as well as indirectly by sulfide production. In addition, in the presence of iron-bearing minerals, biogenic sulfide can react to form iron sulfides, which can help maintain reducing environments important to uraninite stability.



The project is aimed at elucidating the transport and chemical stability of uraninite formed when uranium flows through a biologically reactive soil matrix containing U(VI)-reducing SRB. Specifically, construction of permeable reactive bio-barriers with the U(VI)-reducing SRB in bench-scale soil columns and quantify the removal of uranium across the barrier. In addition, quantification of the stability of uraninite immobilized in the bio-barrier will be carried out under oxidizing conditions. The research will provide data to enable evaluation of factors that may influence the long-term stability and bioremediation potential of sulfate-reducing bio-barriers under geochemical conditions that may be expected in natural environments. In addition, the data obtained can be used to develop mathematical models for predicting stability of bio-reduced uranium as a function of space and time, based on a mechanistic understanding of the complex interactions between iron minerals, microbes, and uranium.

Water Resources Sustainability Project



South Dakota Water Resources Institute Research Professor Boris Shmagin presented a poster at the AGU Fall meeting December 10-15 in San Francisco, CA. This project is through the University of Minnesota The goal of the Water Sustainability Project is to develop new, integrative tools to quantify the renewable water resources supply based on multiple scales at the regional, state, and county levels. For more information, current results, new maps and publications, please visit: https://wiki.umn.edu/view/Water_Sustainability/WebHome.

State Climate/Water Summary

Dr. Dennis Todey is South Dakota's State Climatologist.
http://climate.sdstate.edu/climate_site/climate.htm

By Dr. Dennis Todey
South Dakota State University

As we reach the end of the first full month of climatological winter, we look at what the rest of the winter may mean for temperature and precipitation and how that might impact water resources around the state. Several winter storms have affected the southern and eastern part of the state in December bringing some additional snowfall. This followed a near-record dry November, which in turn followed a record-wet October in some locations.

Much of the eastern part of the state received quite heavy precipitation during the fall (Fig. 1). There

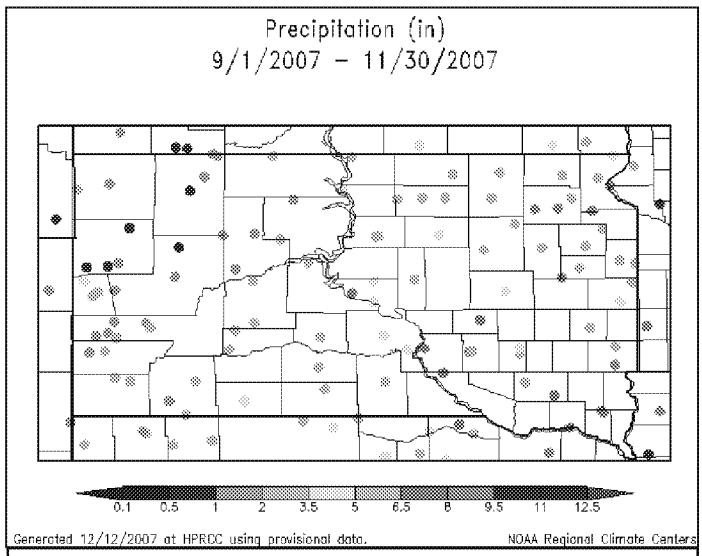


Fig. 1 September - November total precipitation.

was little flooding that occurred with these rainfalls because of the ample soil moisture availability after the dry summer. There was plenty of capacity for soil to take up the rainfall before producing excessive run-off.

There was remarkably few problems with harvest . A couple-week slow-down occurred during the rainfall period. While harvest was delayed, there seemed to be few long-term issues.

In the northwestern part of the state and the Black Hills, there was little precipitation during the fall, allowing for some resurgence of drought conditions as D2 drought levels were reintroduced in the northwest part in the state in an area from Perkins County arcing down to the northern Black Hills.

Snow cover from the recent storms is mainly over the eastern third of the state and parts of the Black Hills and southwest. Current snow maps can be found at: http://www.nohrsc.noaa.gov/interactive/html/map.html.

Of water resource interest for the state is the current snow pack in Montana and Wyoming and how that snow melt might impact run-off in the Missouri River. Reports from November indicated some good news on Oahe as the lake level was 8 ft. higher than at this time last year. Unfortunately, Garrison (3.6 ft) and Ft. Peck (2 ft) have seen lesser rises. Thus, the reservoir system still has a great need of snowfall for recovery. Current snow conditions are found at: ftp://ftp.wcc.nrcs.usda.gov/data/water/wcs/gis/maps/WestwideSWEPercent.pdf. The first run-off forecasts will come out in early January. But the snowpack as of late December was a little below average in the Missouri Basin. There is a mixed set of conditions; some areas a little above average and many well below average.

Outlook

Much of what we can say with confidence in long range outlooks occurs during El Nino or La Nina events, the two extremes of the sea surface temperature variation in the equatorial Pacific. As of December we are in a moderate La Nina. These events are characterized by colder than average sea surface temperatures in the eastern Pacific. Thus, there is some skill in the temperature and precipitation outlooks currently.

(Continued on page 4)

(Continued from page 3)

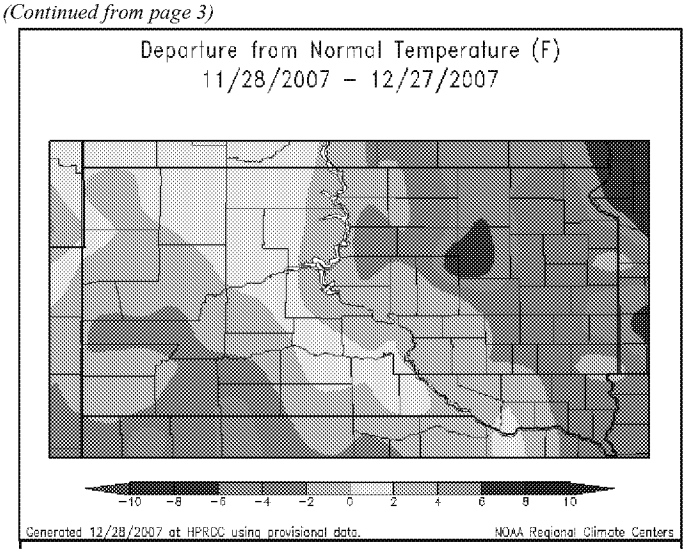


Fig. 2 Deviation from average temperatures for most of December.

La Nina events have good and bad impacts on winters in the northern Plains. Typically, colder than average temperatures would be expected during La Nina winters. So far we have seen a little bit of this in December (Fig. 2). But the temperatures have not been extremely cold, only slightly colder than average. Part of the issue countering the expected cold during La Nina events is the trend in warmer winters over the last 25 years. These two effects seem to be working against each other this winter.

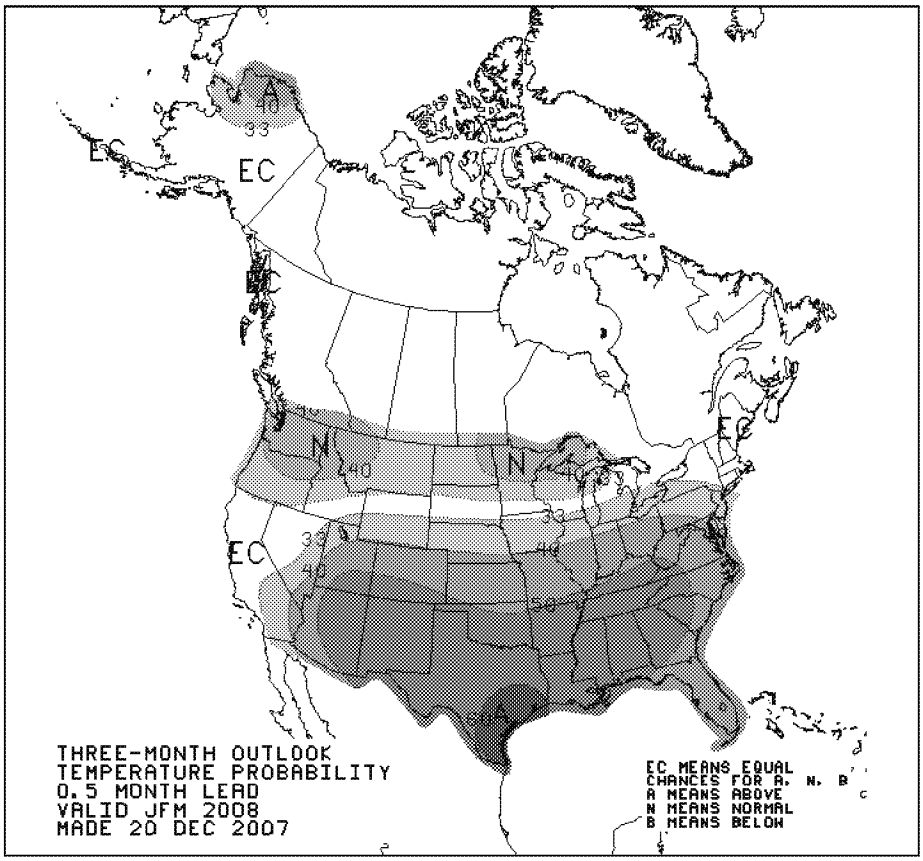
The likely outcome seems to be a colder winter than we have seen recently, but still possibly warmer than the 30-year average. The Climate Prediction Center outlooks bear this out for the late winter as the temperature outlook ranges from near average in the northern part of the state to a slight chance of warmer than average in the south (Fig. 3).

The biggest concern is the amount of precipitation. This also varies by your location in the state. The further southeast you are, the more likely conditions are to be drier than average in the later winter and early spring. While individual storms can drop significant precipitation, the overall outlook leans toward drier conditions.

In the western part of the state, chances are slightly better than average at being wetter than average. La Nina events have a tendency to produce more precipitation in the northern Rockies and northwestern states. This area extends into the

(Continued on page 5)

Fig. 3 January- December temperature outlook.



(Continued from page 4)

western part of South Dakota. This would be good news for water resources in the state as nearly all surface water sources are below to well–below average. Note that this area also includes the headwaters of the Missouri River in western Montana and northern Wyoming. Again this would be good news as the Missouri River reservoir system is at overall lows. Lake Oahe gained a little ground this year as less water was allowed downstream.

See the following outlook for precipitation in February – April (Fig. 4). Southeast South Dakota and the Midwest have slightly reduced chances for precipitation while the western part of the state into the Pacific Northwest do have increased chances for precipitation.

A heavy snowfall year would be very welcome to the system. But even with the increased chances for precipitation, the shortfalls of the last 7-8 years will not be corrected. In fact the main reason for the improvement on Oahe this year was because of a shortened navigation season and water being held back to reduce flooding issues downstream in the early summer.

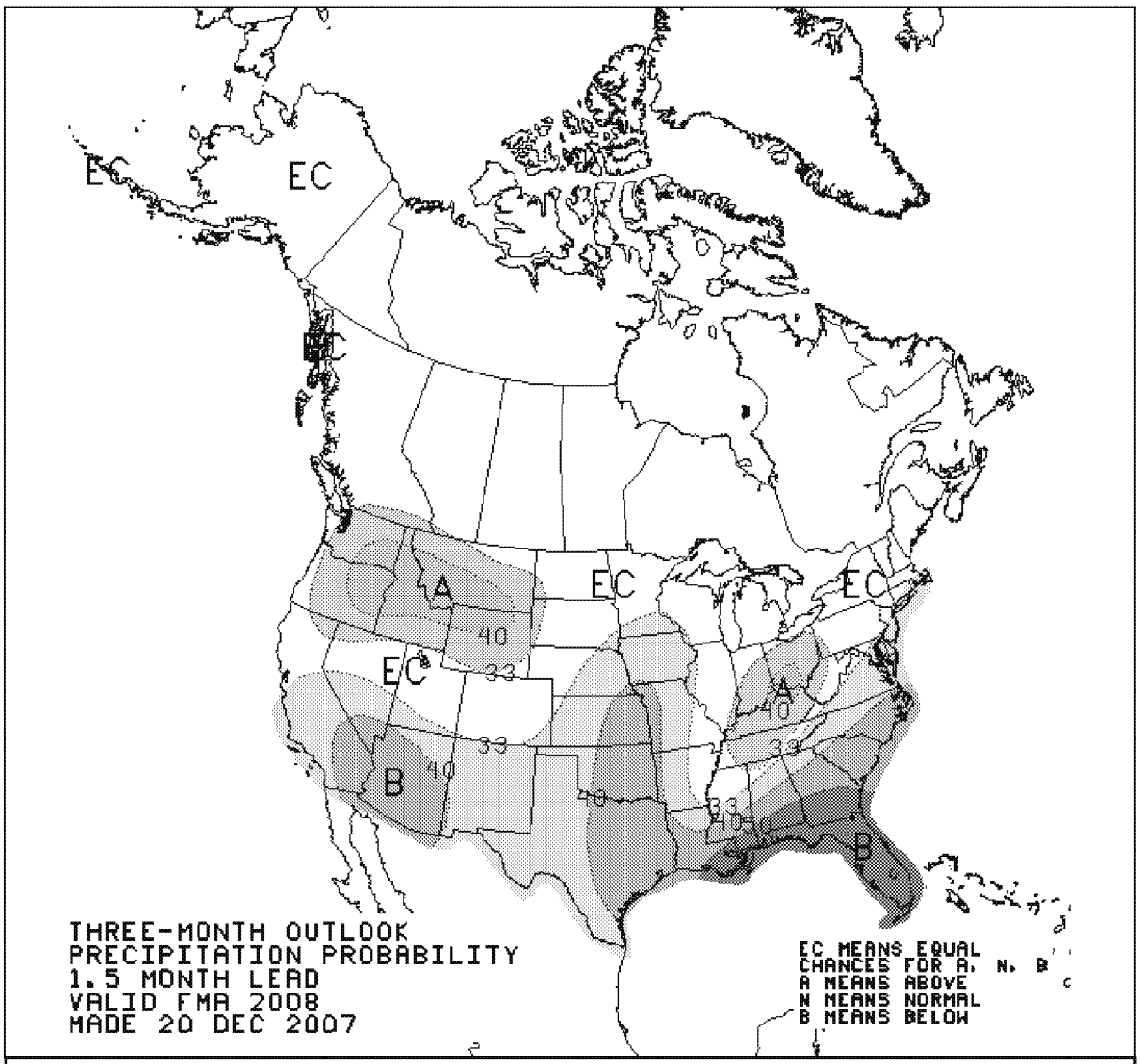
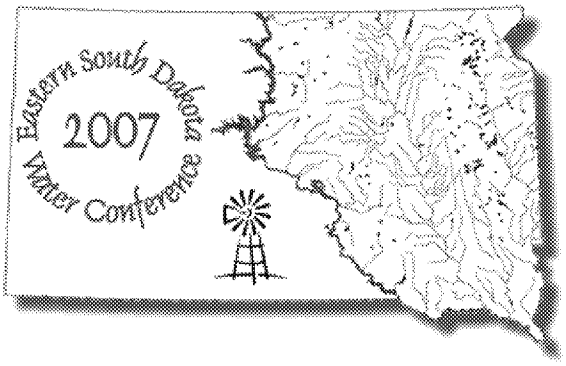
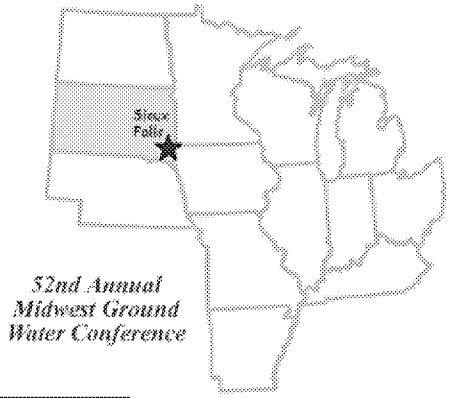


Fig. 4 February- April precipitation outlook.

2007 Eastern SD and 52nd Annual Midwest Groundwater Conference





By Jennifer Pickard
South Dakota Water Resources Institute

The 2007 Eastern South Dakota Water Conference was held in conjunction with the 52nd Annual Midwestern Groundwater Conference at the Sioux Falls Convention Center October 29-31, 2007. The steering committee was chaired by Derric Iles of the South Dakota Geological Survey and Van Kelley, Director of the South Dakota Water Resources Institute at South Dakota State University (SDSU). Other members included: David German and Jennifer Pickard (South Dakota Water Resources Institute--SDSU), Priscilla Young (South Dakota Geological Survey), Mike Crane (USGS-EROS Data Center), Jay Gilbertson and Patricia Hammond (East Dakota Water Development District), and Delvin DeBoer (Water & Environmental Engineering Research Center—SDSU).

The call for abstracts and speakers was released in May 2007. SDWRI staff member Jennifer Pickard designed a website (http://wri.sdstate.edu/esdwc) where participants could review the conference abstracts and pre-register and pay registration fees on-line for the conference.

A tour of the USGS Earth Resources Observation and Science (EROS) Data Center and the US Army Corps of Engineer's Gavins Point Dam and fish hatchery were held on October 29th. Concurrent sessions on October 30th focused on groundwater and surface water. Sessions on October 31st comprised information management and water quality and surface water and water supply.

Concurrent sessions throughout the conference offered information important to a wide array of stakeholders including engineers, industry, public officials, agricultural producers, hydrologists, geologists, planners, students and others studying the water resources of their respective states to meet and exchange ideas, discuss mutual problems, and summarize results of field and laboratory studies.

Thirty-nine oral and four poster presentations were made. SDWRI staff member David German gave presentations on manure management BMPs based on soil phosphorus and phosphorus runoff on a watershed scale.

Water is an important piece of the economic future of South Dakota, and this joint conference served as a mechanism to educate participants on this resource.

Plans are currently underway for the 2008 Eastern South Dakota Water Conference. The Midwest Groundwater Conference is an annual conference hosted by one of the 14-member Midwest states each fall. It is believed to be the longest-running conference dedicated to ground water. The 53rd Annual Midwest Groundwater Conference will be held September 29-October 2, 2008 at the Grand River Center in Dubuque, IA.

Links of Interest

- ★ South Dakota Water Resources Institute http://wri.sdstate.edu
- ★ Eastern South Dakota and Midwest Groundwater Conference http://wri.sdstate.edu/esdwc
- ★ Water & Environmental Engineering Research Center http://weerc.sdstate.edu/
- ★ South Dakota Climate and Weather http://climate.sdstate.edu/climate_site/current_weather.htm
- ★ South Dakota Section of the American Water Works Association http://pie.midco.net/hostsdawwa/index.htm
- ★ Missouri River Institute http://www.usd.edu/mri/
- ★ South Dakota Drought Task Force http://www.state.sd.us/applications/MV31DroughtTaskForce/index.htm
- ★ South Dakota Water and Wastewater Association http://pie.midco.net/sdwwa/index.htm
- ★ Missouri River Basin Association http://www.mrba-missouri-river.com/
- ★ South Dakota Department of Environment and Natural Resources http://www.state.sd.us/denr/denr.html

Water News

is published by the South Dakota Water Resources Institute at South Dakota State University, with the support and collaboration of the Department of the Interior, U.S. Geological Survey and South Dakota State University, Grant Agreement No. 01HQGR0100.

Van C. Kelley
Director
David R. German
Research Associate III
Boris A. Shmagin
Research Associate Professor
Jennifer L. Pickard
Senior Secretary

Water News features water-related topics, including SDWRI activities. Subscriptions are free. Please address requests to:

Water News Editor
AE 211 Box 2120
South Dakota State University
Brookings, SD 57007
jennifer.pickard@sdstate.edu

Phone (605) 688-4910
Fax (605) 688-4917

"Filthy water cannot be washed." —African Proverb