

2009
WESTERN SOUTH DAKOTA
HYDROLOGY CONFERENCE
*with a Special Session on
Remote Sensing*

Program and Abstracts

**April 23, 2009
Rushmore Plaza Civic Center
Rapid City, South Dakota
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2009 Western South Dakota Hydrology Conference

with a Special Session on Remote Sensing

This program and abstracts book has been produced in conjunction with the 2009 Western South Dakota Hydrology Conference, held at the Rushmore Plaza Civic Center on April 23, 2009. The purpose of this book is to provide summaries of the presentations made during the conference.

The purpose of the 2009 Western South Dakota Hydrology Conference is to bring together researchers from Federal, State, University, local government, and private organizations and provide a forum to discuss topics dealing with hydrology in western South Dakota, including a special session on remote sensing. This conference provides an opportunity for hydrologists, geologists, engineers, scientists, geographers, students, and other interested individuals to meet and exchange ideas, discuss mutual problems, and summarize results of studies. The conference consists of four technical sessions and a keynote speaker. The topics of the technical sessions include science management issues, surface-water issues, remote sensing, ground-water issues, uranium and mining issues, floods, and biological issues.

ACKNOWLEDGMENTS

Many people have contributed to this conference. The many presenters are thanked for their contributions. The moderators are thanked for their help in streamlining the technical sessions. The help by many students from the South Dakota School of Mines and Technology with presentations and lights is greatly appreciated. The keynote speaker, Robert Glennon, is thanked for his time and perspectives. Registration help by Sheri Meier and Barbara Rowe (USGS) is greatly appreciated. Brenda Athow (USGS) provided computer support for the conference.

The sponsoring organizations are thanked for support: South Dakota Department of Environment and Natural Resources, South Dakota Engineering Society, South Dakota School of Mines and Technology, U.S. Geological Survey, and West Dakota Water Development District. The West Dakota Water Development District is thanked for sponsoring the refreshment breaks. The chairpersons for this conference were Derric Iles (South Dakota Department of Environment and Natural Resources), Jenifer Sorensen (South Dakota Engineering Society), Arden D. Davis (South Dakota School of Mines and Technology), Scott J. Kenner (South Dakota School of Mines and Technology), J. Foster Sawyer (South Dakota School of Mines and Technology), Mark T. Anderson (U.S. Geological Survey), Janet M. Carter (U.S. Geological Survey), Daniel G. Driscoll (U.S. Geological Survey), and Van A. Lindquist (West Dakota Water Development District). The following were co-chairs for the special session on remote sensing: Nancy Anderson-Smith (South Dakota School of Mines and Technology), William Capehart (South Dakota School of Mines and Technology), Ed Duke (South Dakota School of Mines and Technology), Donna Kliche (South Dakota School of Mines and Technology), Guy Meiron, (Fugro Horizons), and Rob Rombough (Fugro Horizons).

2009 WESTERN SOUTH DAKOTA HYDROLOGY CONFERENCE PROGRAM

Thursday, April 23, 2009

Alpine/Ponderosa Rooms and Rushmore G Room

Rushmore Plaza Civic Center

7:00 – 8:00 a.m.	REGISTRATION		
8:00 – 9:50 a.m.	Plenary Session 1 in Alpine and Ponderosa Rooms – Science Management Issues (1.5 PDH) Moderator – Mark Anderson , Director of the U.S. Geological Survey South Dakota Water Science Center, Rapid City, SD		
8:00 – 8:10 a.m.	Welcome, general information	Mark Anderson and Daniel Driscoll , U.S. Geological Survey	
8:10 – 8:30 a.m.	Record precipitation over western South Dakota during the spring of 2008	Jeffrey Schild and Melissa Smith , NOAA/National Weather Service	
8:30 – 8:50 a.m.	Sanford Underground Laboratory at Homestake: Progressing towards a DUSEL in South Dakota	Mike Headley , South Dakota Science and Technology Authority	
8:50 – 9:10 a.m.	Water-quality effects and characterization of indicators of onsite wastewater disposal systems in the east-central Black Hills area, South Dakota, 2006-08	Galen Hoogestraat , Larry Putnam , U.S. Geological Survey, and J. Foster Sawyer , South Dakota School of Mines and Technology	
9:10 – 9:30 a.m.	The Landsat mission and the free data distribution paradigm	Rachel Headley , U.S. Geological Survey, EROS Data Center	
9:30 – 9:50 a.m.	The geology of Jewel Cave: New pieces to an unexpected puzzle	Michael Wiles , Jewel Cave National Monument	
9:50 – 10:30 a.m.	REFRESHMENT BREAK		
10:30 a.m. – 12:30 p.m.	Concurrent Session 2A in Alpine Room – Uranium (2.0 PDH) Moderator – Dr. Arden Davis , South Dakota School of Mines and Technology	Concurrent Session 2P in Ponderosa Room – Surface-Water-Quality Issues (2.0 PDH) Moderator – Joyce Williamson , U.S. Geological Survey South Dakota Water Science Center	Concurrent Session 2G in Rushmore G Room – Remote Sensing (2.0 PDH) Moderator – Rachel Headley , U.S. Geological Survey, EROS Data Center
10:30 – 10:50 a.m.	<i>In situ recovery of uranium: Regulatory status and economic benefits – Mark Hollenbeck</i> , Powertech (USA), Inc.	<i>Monitoring stormwater quality in the Arrowhead watershed, Rapid City, South Dakota – Kevin Baker, John Stamm</i> , U.S. Geological Survey, and Scott Kenner , South Dakota School of Mines and Technology	<i>Remote sensing of precipitation – A look at radar now and in the future – Darren Clabo and Donna Kliche</i> , South Dakota School of Mines and Technology
10:50 – 11:10 a.m.	<i>Phase I groundwater modeling of the Dewey-Burdock uranium project, Fall River and Custer Counties, South Dakota – Crystal Hocking</i> , RESPEC, and Arden Davis , South Dakota School of Mines and Technology	<i>Treatment of water removed from the Sanford Underground Laboratory at Homestake – John Scheetz</i> , Sanford Underground Laboratory at Homestake, and William Roggenthen , South Dakota School of Mines and Technology	<i>Upcoming improvements to the NWS Doppler Radar: Hydrologic impacts – Matthew Bunkers, Melissa Smith</i> , and Paul Schlatter , NOAA/National Weather Service

11:10 – 11:30 a.m.	<i>Use of metal/thorium ratios and sequential chemical extractions to explain fate and transport of metals associated with abandoned uranium mines in Custer National Forest, Harding County, South Dakota – Gregory Kipp, James Stone, and Larry Stetler, South Dakota School of Mines and Technology</i>	<i>Infiltration, runoff, and sediment production from a mixed-grass prairie watershed in western South Dakota – Matthew Hubers, Pat Johnson, and Dave German, South Dakota State University</i>	<i>Impact of vegetation cover estimates on regional climate forecasts – William Capehart and P.A. Stauffer, South Dakota School of Mines and Technology</i>
11:30 – 11:50 a.m.	<i>A quantitative model for biogeochemical sequestration of uranium and associated metals in ground water: Implications for reclamation of in-situ leach mining – Gregory Kipp and Arden Davis, South Dakota School of Mines and Technology</i>	<i>Relationships between water quality and mercury fish tissue concentrations for natural lakes and impoundments in South Dakota – Cindie McCutcheon, James Stone, Larry Stetler, South Dakota School of Mines and Technology, and Steve Chipps, U.S. Geological Survey</i>	<i>Generating surface flow features from 1-meter Lidar-derived digital elevation models – Sandra Poppenga, U.S. Geological Survey</i>
11:50 a.m. – 12:10 p.m.	<i>Microbial diversity associated with Edgemont uranium mine as revealed by high-density 16S microarray – Gurdeep Rastogi, South Dakota School of Mines and Technology, Shariff Osman, Gary Andersen, Lawrence Berkeley National Laboratory, Larry Stetler, and Rajesh Sani, South Dakota School of Mines and Technology</i>	<i>Sediment mercury concentration profiles in South Dakota lakes and impoundments – H. Betemarian, James Stone, Larry Stetler, Cindie McCutcheon, South Dakota School of Mines and Technology, Steve Chipps, U.S. Geological Survey, T. Desutter, North Dakota State University, and M. Penn, University of Wisconsin-Platteville</i>	<i>Classifying catchments into broader physiographic regions: “A GIS Approach” – Don Belile, C.J. Tinant, and J. Sanovia, Oglala Lakota College</i>
12:10 – 12:30 p.m.	<i>Reoxidation and remobilization of uraninite—The current status – Jaysankar De, Rajesh Sani, South Dakota School of Mines and Technology, Brandy Stewart, Brent Peyton, Montana State University, Nicolas Spycher, Lawrence Berkeley National Laboratory, and Timothy Ginn, University of California-Davis</i>	<i>Nature versus nurture: Functional assessment of restoration effects on wetland services – P.V. Sundareshwar, South Dakota School of Mines and Technology, C.J. Richardson, Duke University Wetland Center, Robert Gleason, U.S. Geological Survey, Perry Pellechia, University of South Carolina, and Shawn Honomichl, South Dakota School of Mines and Technology</i>	<i>Geospatial data for South Dakota: The National Map and beyond – Stephen Shivers, U.S. Geological Survey</i>
12:30 – 2:00 p.m.	LUNCH with Keynote Speaker in Rushmore H Room – Robert Glennon (1.0 PDH) Rogers College of Law at the University of Arizona <i>Unquenchable: America’s Water Crisis and What We Can Do About It</i>		
2:00 – 3:20 p.m.	Concurrent Session 3A in Alpine Room – Ground Water (1.0 PDH) Moderator – Dr. J. Foster Sawyer, South Dakota School of Mines and Technology	Concurrent Session 3P in Ponderosa Room – Surface-Water Modeling (1.0 PDH) Moderator – Daniel Driscoll, U.S. Geological Survey South Dakota Water Science Center	Concurrent Session 3G in Rushmore G Room – Hydrology Potpourri (1.0 PDH) Moderator – Janet Carter, U.S. Geological Survey South Dakota Water Science Center
2:00 – 2:20 p.m.	<i>Radionuclides in the Deadwood aquifer – Perry Rahn, South Dakota School of Mines and Technology</i>	<i>Automatic watershed delineation/curve number tool – Colin Niehus, Natural Resources Conservation Service</i>	<i>Section 404 of the Clean Water Act permitting process – Jeffrey Breckenridge, U.S. Army Corps of Engineers</i>
2:20 – 2:40 p.m.	<i>Numerical ground-water flow model of the Minnelusa and Madison hydrogeologic units in the Rapid City area, South Dakota – Larry Putnam and Andrew Long, U.S. Geological Survey</i>	<i>Hydraulic model of the Belle Fourche Irrigation District North Canal using EPA SWMM 5.0 – Lacy Pomarleau, RESPEC, and Scott Kenner, South Dakota School of Mines and Technology</i>	<i>Ground motion studies at Homestake DUSEL – Larry Stetler, William Roggenthen, Jason VanBeek, South Dakota School of Mines and Technology, James Volk, Fermilab National Accelerator Laboratory, and Steve Glaser, University of California-Berkeley</i>
2:40 – 3:00 p.m.	<i>Heat-transport modeling of conduit and diffuse flow within the Madison aquifer – Andrew Long, U.S. Geological Survey, and Patrick Gilcrease, South Dakota School of Mines and Technology</i>	<i>Sediment source tracking of the Cheyenne River, South Dakota, using a multivariate statistical approach – Joshua Valder, U.S. Geological Survey, Arden Davis, Scott Kenner, South Dakota School of Mines and Technology, John Stamm, Andrew Long, U.S. Geological Survey, and Gregory Kipp, South Dakota School of Mines and Technology</i>	<i>Environmental implications associated with land application of antimicrobial-containing manure – Erin Dreis, James Stone, South Dakota School of Mines and Technology, Sharon Clay, South Dakota State University, and Garth Spellman, Black Hills State University</i>

3:00 – 3:20 p.m.	<i>Measurement and analysis of water reduction at the Homestake DUSEL – Larry Stetler, Arden Davis, Jason VanBeek, South Dakota School of Mines and Technology, and Rohit Salve, Lawrence Berkeley National Laboratory</i>	<i>Rapid Creek simulation of water quality for three dates – 06/06/07, 08/27/07, and 11/18/08 – Scott Kenner, South Dakota School of Mines and Technology, Joshua Valder, U.S. Geological Survey, and Gregory Kipp, South Dakota School of Mines and Technology</i>	<i>Determination of environmental and climate change impacts due to antimicrobial usage at swine CAFOs: A life cycle assessment approach – K. Aurand, James Stone, South Dakota School of Mines and Technology, and Sharon Clay, South Dakota State University</i>
3:20 – 3:50 p.m.	REFRESHMENT BREAK		
3:50 – 5:10 p.m.	Concurrent Session 4A in Alpine Room – Mining Impacts (1.0 PDH) Moderator – Dr. Larry Stetler, South Dakota School of Mines and Technology	Concurrent Session 4P in Ponderosa Room – Floods (1.0 PDH) Moderator – Melissa Smith, NOAA/National Weather Service	Concurrent Session 4G in Rushmore G Room – Biological Issues (1.0 PDH) Moderator – Jenifer Sorensen, South Dakota Engineering Society and FourFront Design
3:50 – 4:10 p.m.	<i>Identification of uncontaminated alluvial deposits of the lower Cheyenne River, South Dakota – John Stamm, Joshua Valder, U.S. Geological Survey, and Scott Kenner, South Dakota School of Mines and Technology</i>	<i>Updated peak-flow frequency estimates for South Dakota streams – Dan Driscoll, Steven Sando, and Charles Parrett, U.S. Geological Survey</i>	<i>Nematode parasite frequency relations to water quality and habitat characteristics and their distribution among Chironomidae subfamilies, functional feeding guilds and habit guilds – Andrew Kopp and Nels Troelstrup, South Dakota State University</i>
4:10 – 4:30 p.m.	<i>Metal contaminant concentrations at the abandoned Hilltop #1 and #2 uranium mine site, Slim Buttes, Harding County, South Dakota – Albrecht Schwalm, Al Eastman, Oglala Lakota College, and James Stone, South Dakota School of Mines and Technology</i>	<i>Design floods between the 100 year flood and the probable maximum flood – Thomas Fontaine, South Dakota School of Mines and Technology, Jason Lambert, and Cory Foreman, RESPEC</i>	<i>Black Hills fens: Preliminary investigations – Jessica Gould and Chelsea Vollmer, USDA Forest Service</i>
4:30 – 4:50 p.m.	<i>Surface water and sediment investigation concerning abandoned uranium mines within the Slim Buttes region, Harding County, South Dakota – Hannah Albertus-Benham, James Stone, Larry Stetler, South Dakota School of Mines and Technology, Albrecht Schwalm, and Al Eastman, Oglala Lakota College</i>	<i>Debris effects and floodplain analysis – Jason Lambert, RESPEC, Thomas Fontaine, South Dakota School of Mines and Technology, and Cory Foreman, RESPEC</i>	<i>Fluvial morphology and riparian communities – Devon Wilford and Charles Tinant, Oglala Lakota College</i>
4:50 – 5:10 p.m.	<i>Development of an arsenic and uranium fate and transport model for historical uranium mining impacts from Custer National Forest, Harding County, South Dakota – Lance Larson, James Stone, and Larry Stetler, South Dakota School of Mines and Technology</i>	<i>Non-invasive solution to prevent flooding in the North Platte River at North Platte, Nebraska, to allow for increased river flows during the migratory season – Rocky Keehn, Short Elliott Hendrickson, Inc.</i>	<i>Paleoclimate and expressions of climate change in the Missouri River Basin – John Stamm, U.S. Geological Survey</i>

THURSDAY, APRIL 23, 2009
SESSION 1
8:00 – 9:50 A.M.

SCIENCE MANAGEMENT ISSUES
(ALPINE/PONDEROSA ROOMS)

Record Precipitation over Western South Dakota During the Spring of 2008

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2008 began with drier than normal conditions; however, everything changed after the May 2nd blizzard. Snowfall amounts up to 48 inches were reported, with snow water equivalent values of three to five inches. Warm temperatures which followed, accompanied by heavy rain of one to two inches, quickly melted the snow and caused flooding from the northern Black Hills north to the North Dakota border. Creeks overflowed, several roads inundated, and several culverts were destroyed in Harding, Butte, Lawrence, western Meade, and northern Crook counties. Record precipitation amounts were reported in Newell, Rapid City, Opal, Ft. Meade/Sturgis, and Elm Springs. Several other cities reported significant monthly precipitation amounts.

The very wet conditions continued into June, with rainfall amounts averaging between four and five inches, or about 150% of normal. Flooding became widespread across western South Dakota. Several homes, state highways and secondary roads were inundated. Numerous stock dams failed and erosion was reported near the spillway on Newell Lake. Water levels in Belle Fourche Reservoir rose into the flood control pool, and water had to be released down Owl Creek. Several counties issued disaster declarations, and South Dakota declared a State Emergency Declaration because of the flooding. Damage estimates are ongoing; however, total damage has reached into the millions. This presentation will focus on the significant precipitation amounts received in May and June of 2008, and the meteorological pattern responsible.

Sanford Underground Laboratory at Homestake: Progressing Towards a DUSEL in South Dakota

Mike J. Headley

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The South Dakota Legislature established the South Dakota Science and Technology Authority (SDSTA) in 2004 to begin transforming the former Homestake gold mine into the Sanford Underground Laboratory at Homestake. Since then, the SDSTA has steadily increased activities to reopen Homestake -- both to prepare the Sanford Laboratory for early science and to prepare Homestake for consideration as the National Science Foundation's (NSF) proposed Deep Underground Science and Engineering Laboratory (DUSEL).

Four sites competed to become the NSF's preferred DUSEL site. On July 10, 2007, the NSF selected Homestake. In support of this decision, the NSF awarded \$15 million to the University of California Berkeley to begin planning a Homestake DUSEL. Berkeley issued sub-awards to the Lawrence Berkeley National Laboratory (LBNL) and the South Dakota School of Mines and Technology (SDSM&T) to create technical designs that could lead to DUSEL construction by late 2012.

Since March 2008, the SDSTA has focused on removing water from the Homestake mine and rehabilitating the underground infrastructure. The SDSTA recently upgraded pumping and water treatment systems to speed the de-watering of the mine and to speed removal of iron oxide from the water. The SDSTA also has supported the DUSEL Collaboration with site investigations and with development of designs.

In addition to de-watering Homestake, the SDSTA has established an early science program at the Sanford Laboratory. Experiments are under way. They include underground and surface experiments in seismology, hydrology, microbiology, gravitational studies and radiation background characterization. The Sanford Laboratory also has safety, environmental and education programs. In short, the SDSTA is developing the Sanford Laboratory as an interim DUSEL. More important, the SDSTA is working with the LBNL, SDMS&T and the rest of the DUSEL Collaboration to support the larger goal -- realization of a national underground laboratory in South Dakota.

Water-Quality Effects and Characterization of Indicators of Onsite Wastewater Disposal Systems in the East-Central Black Hills Area, South Dakota, 2006–08

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The potential effects of onsite wastewater disposal systems (OWDS, septic tanks with drain fields) on surface- and ground-water quality is an important water-resource concern for the Black Hills area of South Dakota. The hydrogeology of the area includes fractured or solution-enhanced bedrock, which is less effective at attenuating contaminants than other geologic units. In 2006, the U.S. Geological Survey, in cooperation with the South Dakota Department of Environment and Natural Resources and West Dakota Water Development District, initiated a study to characterize potential effects of onsite wastewater treatment systems. Study areas include developments overlying alluvium, terrace deposits and the underlying Spearfish Formation, the Minnekahta Limestone, and Precambrian rocks. A total of 111 samples from 61 wells and 26 stream sites grouped as either upgradient or downgradient from OWDS were analyzed for nitrate, chloride, bromide, boron, and fecal indicators. Nitrate concentrations at downgradient sites were higher than 5 milligrams per liter (mg/L) in 50 percent of samples and higher than 10 mg/L in 18 percent of samples. The $\delta^{15}\text{N}$ values in 78 percent of the 46 downgradient ground-water samples that were analyzed for nitrogen isotopes were greater than 8 per mil, indicating predominantly animal sources (including humans). The mean nitrate concentration in the Minnekahta setting (8.62 mg/L) was the highest of all four settings investigated. A positive correlation between downgradient nitrate concentration and OWDS density within the contributing area was observed. Water-quality maps of a small community show an upward trend of nitrate and chloride concentrations moving in the downgradient direction. Statistical tests on chloride, boron, fecal coliforms, and *E. coli* showed a significant difference between upstream and downstream surface-water sites; however, differences in nitrate concentrations were not significant.

The Landsat Mission and the Free Data Distribution Paradigm

Rachel M. K. Headley, PhD.

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Landsat 1 launched in February 1972. This began a more than 37-year mission to provide the world with mid-resolution satellite data coverage. Although data were always publically available, the cost of the data has always been prohibitive for either broad regional to global studies, or research requiring in high temporal frequency.

In June 2007, the U.S. Geological Survey launched a pilot that distributed Landsat data at no charge to the user. This pilot was limited to recently-acquired, cloud-free Landsat 7 data only. In September of 2008, the entire Landsat 7 archive became available for free ordering and FTP download. The entire Landsat archive, over 2.2 million scenes, was offered at the end of December 2008. In order to make such a large dataset freely available, all data are processed with the same parameters. Some researchers suggest this limits the usefulness for some applications.

In the first weeks of only the Landsat 7 data availability, all data distribution records were superseded by thousands of times the previous distribution paradigm. No-charge data has enabled new research, both more temporally dense and spatially expansive. An update to the mission, free data distribution, and new science applications will be discussed.

The Geology of Jewel Cave: New Pieces to an Unexpected Puzzle

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Over the last 20 years, exploration and mapping of Jewel Cave, as well as geological mapping of the Jewel Cave Quadrangle, have documented several unexpected relationships between cave features and surface geology; and also within and between the Pahasapa Limestone and Minnelusa Formations themselves. This paper presents several of these observations in order to encourage further study.

Geological mapping has identified six subunits within the Minnelusa: I) 40 feet of basal sandstone; II) 50 feet of thin-bedded limestone; III) 120 feet of sandstones; IV) 120 feet of dolomite with interbedded sandstones; V) 120 feet of medium-to-coarse grained sandstones, and VI) over 100 feet of brecciated sandstone layers.

Unit thicknesses were constant throughout the quadrangle, allowing the mapping of subtle faults and folds. The folds express themselves in extensive dip-slope topography and exhibit a strong correlation between synclines and surface valleys.

The most striking observation is the fact that Jewel Cave exists almost exclusively in limestone that is capped with the Minnelusa Formation. This relationship holds throughout the southern Black Hills to the point that, without exception, no cave over 200 feet in length is known to exist within uncapped limestone.

Furthermore, there is no mappable paleotopographical relief within the quadrangle. Rather, evidence within Jewel Cave strongly suggested that "paleofill" developed contemporaneously with the development of the cave – after lithification of the basal Minnelusa sandstone. Finally, the only known natural entrance to Jewel Cave is located precisely at the crest of a broad anticline.

There is a strong correlation between the passages of Jewel Cave and modern geological features. The evidence suggests that Jewel Cave formed as a result of the most recent processes that shaped the present-day stratigraphy, structure, and topography. There is virtually no evidence of a Mississippian paleokarst development. This gives pause for reevaluation of the origin of caves in the southern Black Hills.

THURSDAY, APRIL 23, 2009
SESSION 2A
10:30 A.M. – 12:30 P.M.

URANIUM
(ALPINE ROOM)

In Situ Recovery of Uranium: Regulatory Status and Economic Benefits

Mark Hollenbeck

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Aldo Leopold, the Father of the American Conservation Movement, opined about the two spiritual dangers of not owning a farm – “the danger in supposing that breakfast comes from the grocery; and that heat comes from the furnace.” Well, I don’t own a farm but I own an organic ranch about twelve miles northwest of Edgemont where I, my wife and four young kids reside and nearby about 400 feet below the surface lay uranium ore deposits amenable to in situ recovery (ISR). ISR recovers valuable uranium metals in place with minimal disturbance of vegetation, topsoil, overburden, or host rock. It recovers uranium by drilling water wells, adding oxygenated groundwater and pumping the dissolved metal to the surface. This ‘light touch’ process will provide clean fuel for nuclear energy production.

Powertech is nearly finished with the lengthy, expensive permitting and licensing application process, and, once completed, and NRC, EPA and DENR approval received, the company plans to begin operations within 18 months.

Benefits from the Dewey-Burdock Project will be plentiful – providing the fuel for energy which emits no greenhouse gases or chemical pollutants and economic vitality.

Local and state economies will strengthen from 84 full-time positions and 36 support ones positions. Additionally, Powertech anticipates investing more than \$300 million during the first 16 years of operations resulting in \$7 million in sales tax. Regional communities will benefit through increased business activity. Fall River and Custer Counties will receive significant amounts in property taxes as well as half of the estimated \$20 million in mineral severance taxes while the State receives a \$1.1 million conservation tax.

Like Leopold, as a rancher I know where my food and fuel comes from which helps explain why I find this project satisfying, worthwhile and valuable to Edgemont, the State and the Nation.

Phase I Groundwater Modeling of the Dewey-Burdock Uranium Project, Fall River and Custer Counties, South Dakota

Crystal M. Hocking

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Powertech (USA) Inc. proposed to conduct in situ solution mining within a uranium roll front deposit at the Dewey-Burdock site located in the southwestern Black Hills of South Dakota. During the mining process, a significant quantity of groundwater will be circulated into and out of the Inyan Kara aquifer, the host of the uranium deposits. In an effort to conceive a more comprehensive understanding of the hydrologic system, a regional groundwater flow model was developed using Visual MODFLOW. The two primary objectives of the Phase I groundwater model are to predict the maximum extent that mining operations might have on the groundwater flow system and to provide boundary conditions for the Phase II well field-scale groundwater modeling. The numerical model is considered conceptual in nature and thus provides semiquantitative estimates of the regional groundwater system's response to different stresses.

The model was constructed and calibrated in Visual MODFLOW to simulate existing, premining hydrogeologic conditions by matching to potentiometric surfaces and drawdown values from aquifer pumping tests. Based on the expected life of mining operations, a number of time steps were set up for the transient simulations, and pumping rates for operational wells varied over time.

Results of the model calibration and simulations indicate that the model provides reliable estimates of patterns of system response and magnitude of impact within the Inyan Kara aquifer. The model's predictive capability varies across the model domain with results reliable to within 10 to 20 feet. When model results are compared to actual data, the model generally overestimates drawdown, making the results conservative or overestimating potential impacts or mining activities. While the overall volume and areal extent of impact is dependent on how the mine operates, the maximum impact estimated from simulations performed is approximately 50 feet of drawdown at the permit boundaries.

Use of Metal/Thorium Ratios and Sequential Chemical Extractions to Explain Fate and Transport of Metals Associated with Abandoned Uranium Mines in Custer National Forest, Harding County, South Dakota

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Sediment samples were analyzed as part of ongoing environmental investigations of historical uranium mining impacts within Custer National Forest in Harding County, South Dakota. Correlations between metals content, grain size, and soil mineralogy were determined to identify contaminant fate and transport mechanisms. Soil samples were analyzed near the mining source zone and up to 61 km downgradient of the mine sites. Samples were homogenized and wet sieved through polymer screens, and metals concentrations were determined using inductively coupled mass spectrometry (ICP-MS). Powder X-ray diffraction (XRD) analysis identified quartz as the primary mineral for all size fractions, with varying amounts of analcime, indicative of volcanic origin. Selected samples were examined for trace mineral composition using scanning electron microscopy (SEM). The presence iron sulfides and iron(hydr)oxides indicate heterogeneity in redox potentials on a microscopic scale. Elevated metals concentrations were associated with the trace presence of iron sulfides indicating an influence on metal transport. Sequential chemical extractions (SCE) performed on source sediment fractions demonstrated that most As and U was adsorbed to Fe- and Mn- oxides and carbonates with lesser amounts bound by ion exchange, organics and iron sulfides. The insensitivity to redox conditions facilitated interpretation of hydrological and geochemical influences on metals concentrations in the fluvial system using U/Th and As/Th ratios. By using metal/Th ratios, four distinct geochemical regions were identified in this system: source materials, where chemical leaching dominates over physical transport; the active streambed, mostly dominated by hydrological transport processes; the backwater of the Bowman-Haley Reservoir, dominated by reducing conditions; and the outlet of Bowman-Haley Reservoir, dominated by re-oxidation of leaky alluvium flow passing beneath the dam. Thus, metal/Th ratios can provide a valuable tool to the environmental practitioner in identifying and understanding metals fate and transport within a fluvial system.

A Quantitative Model for Biogeochemical Sequestration of Uranium and Associated Metals in Ground Water: Implications for Reclamation of in-Situ Leach Mining

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Sulfur reducing bacteria have been sequestering uranium and associated trace metals in carbonate and sulfide minerals for millions of years through the formation of concretions. These organisms harvest energy from buried organic compounds during early lithification of sedimentary deposits. A substrate flux is sustained by ground water advection and molecular diffusion, governed by Darcian and Fickian processes respectively.

Using sulfate as the primary terminal electron acceptor, bacteria produce sulfide and bicarbonate as metabolic waste products. The buildup of metabolic wastes induces precipitation of various minerals as governed by microbial kinetics and crystal interface physiochemistry. Lithification advances in eccentric or concentric rings, depending on whether nutrient flux is dominated by advection or diffusion. Precipitation induces concentration gradients, attracting contaminant trace metals by diffusion and incorporating them to crystal matrices or to organic material which is subsequently entombed by the advancing concretion. Most literature is limited to qualitative descriptions of the concretion growth mechanisms.

Accordingly, a quantitative, steady-state model was developed by superimposing Darcian and Fickian flow fields using analytic elements. The model provides a reasonable estimate for concretion growth and trace metal sequestration at low Péclet values with versatility for the user to fix a maximum flux rate or calculate flux with prescribed nutrient concentrations. Quantification of biogeochemical metal sequestration has utility for in-situ leach mining operations by potentially improving cost, efficiency, and reliability of reclamation activities.

Microbial Diversity Associated with Edgemont Uranium Mine as Revealed by High-Density 16S Microarray

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Microorganisms indigenous to metal-contaminated soils/sediments are capable of catalyzing reactions that detoxify their environment, and thus constitute an important driving component in the biogeochemical cycles of toxic metals. Therefore, it is important to understand the total microbial diversity in metal-contaminated soils/sediments. Microbial diversity was characterized in mining-impacted soils collected from abandoned Edgemont uranium mine, the Edgemont, South Dakota by 16S microarray analysis. Major and trace elements characterization of soils by the X-ray fluorescence spectroscopy revealed higher metal-contamination including uranium in the soil. Phylogenetic analysis of microarray data demonstrated enormous microbial diversity and showed that lineages classified to Proteobacteria constituted the most abundant group. Several of the lineages retrieved in the microarray displayed similarities with yet-uncultured bacteria representing a hitherto unidentified diversity. Results from this study demonstrated that highly diverse microbial populations were present in the mining-impacted soils. Our results will be applicable in strategies to reduce environmental and human health risks from radionuclide contaminated sites.

Reoxidation and Remobilization of Uraninite—The Current Status

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Reduction of soluble uranium [U(VI)] to insoluble uraninite mineral U(IV), which has been viewed as a potential mechanism for sequestration of environmental uranium (U) contamination, faces a threat due to reoxidation and remobilization of the U(IV). After in situ bioremediation of U(VI) e.g., using various methods including nutrient addition in the subsurface, many factors including organic carbon, oxygen, nitrate and its reduced forms, metal oxides, pH, redox potential etc. control the rate and extent of biogenic U(IV) stability. It is important to understand the long-term stability of U(IV) when biostimulation is stopped and oxic conditions reoccurs either through groundwater transport or infiltration of oxygenated rainwater at a U-contaminated site. Several metal oxides, organic ligands, and many other physical and biogeochemical factors prevailing at the site would lead to reoxidation of the U(IV) and forfeit the bioremediation effort. In the past decade, it has been firmly established that a variety of combination of physical, chemical, and biological factors control this reoxidation of U(IV). We briefly address the research to identify specific factors for U(IV) reoxidation, competition between U and other electron acceptors, attempts to stimulate in situ reduction, and mechanisms of reoxidation of reduced U minerals.

THURSDAY, APRIL 23, 2009
SESSION 2P
10:30 A.M. – 12:30 P.M.

SURFACE-WATER QUALITY ISSUES
(PONDEROSA ROOM)

Monitoring Stormwater Quality in the Arrowhead Watershed, Rapid City, South Dakota

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The City of Rapid City implemented programs to improve stormwater quality in response to the "Phase II Final Rule" issued by the U.S. Environmental Protection Agency (USEPA). Rapid Creek is classified as having beneficial uses for coldwater permanent fish propagation and immersion recreation. Water-quality guidelines for total suspended solids (TSS) at sites used for coldwater permanent fish propagation include a maximum of 53 milligrams per liter (mg/L) in any one sample. Guidelines for fecal coliform at sites used for immersion recreation include a maximum of 400 colony forming units per 100 milliliters (CFU/100 mL) in any one sample. Water-quality monitoring was initiated in the Arrowhead watershed, a tributary of Rapid Creek which contains a mix of residential communities, forest and rangeland, active construction sites, and a high density of septic systems. Previous sampling efforts indicated counts of fecal coliform and TSS concentrations in this watershed, exceeding USEPA guidelines. A U.S. Geological Survey (USGS) gaging station was installed in early July 2008 in the main drainage channel, approximately 1 mile upstream from its junction with Rapid Creek. The gaging station allowed for automated water-quality sampling during storm events and continuous monitoring of stage and discharge. Precipitation data were collected at the USGS gaging station, and NEXRAD data have been obtained for selected storms. Four storm events were sampled during July through October. Storm runoff produced high fecal-coliform counts, commonly greater than 20,000 CFU/100 mL, and high TSS, ranging from 97 to 2,900 mg/L. Samples of spring-fed base flow were within USEPA guidelines with fecal coliform values of 0 to 66 CFU/100 mL and TSS concentrations of 0 to 5 mg/L. Point samples also were collected approximately 1 mile upstream from the USGS gaging station, with similar results to data measured at the USGS gaging station. Continuing efforts will include modeling of flow and water quality using USEPA's Storm Water Management Model (SWMM) and additional field sampling. SWMM will be used to simulate changes to the watershed and effects of extreme runoff events.

Treatment of Water Removed from the Sanford Underground Laboratory at Homestake

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The Sanford Underground Laboratory at Homestake is committed to good environmental stewardship. Removal of water from the Sanford Laboratory includes treatment to ensure that discharged water meets the permit requirements of the National Pollutant Discharge Elimination System. The parameters of treatment include suspended solids, ammonia and metals. As the water is pumped from underground, oxygen is added. That produces a precipitate of very fine iron hydroxide. Although the quantity of precipitate is small, in the range of 20 – 80 ppm, the iron must be removed prior to further treatment. The Sanford Lab is pilot testing two pre-treatment processes for iron removal: a system of coagulation, flocculation and sedimentation and a system of sand filters. After the removal of iron, the water from underground is blended with tailings water from the former Homestake mine. This water and the underground water contain small amounts (2- 15 mg/l) of ammonia. The combined waters pass through rotating biological contactors (RBCs). Bacteria in the RBCs break down the ammonia to nitrites and nitrates. The water is then conveyed to a clarifier then polished by sand filters before discharge to Gold Run Creek and Whitewood Creek. The treated water consistently meets all permit requirements. Sampling of the deeper waters in the mine, down to 6400 ft (1950 m) below the surface, shows that, based on current permit requirements, the temperature and chemical composition of the deeper water should not require new or additional treatment processes.

Infiltration, Runoff, and Sediment Production from a Mixed-Grass Grass Prairie Watershed in Western South Dakota

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In order to manage, evaluate, as well as identify conditions that contribute to, and exacerbate sediment loads originating from rangelands effectively, it is necessary that hydrology and associated biotic and edaphic factors be understood. Paucity of information of factors and mechanisms at the ecological site scale, hinder application and evaluation of management actions to mitigate soil loss. The objective of this study was to quantify differences between infiltration, runoff and sediment yield from dense clay and clayey ecological sites and to identify which vegetative communities on associated soils provide the greatest degree of load reduction, infiltration, and site sustainability in the Belle Fourche watershed using rainfall simulations during the summers of 2007 and 2008. On saturated sites, sediment production ranged from a high of 1116 kg/ha of suspended solids on a dense clay, western wheat dominated site with 728 kg/ha biomass and an infiltration rate of 0.08 cm/min to a low of 16.2 kg/ha on a clayey site dominated by downy brome with 2227.20 kg/ha biomass and an infiltration rate of 0.09 cm/min. Indications are that plant communities having relatively high biomass, high litter, and minimal bare ground result in the lowest sediment production and infiltration rates. Plant communities with the highest infiltration rates and relatively low sediment production occurred on sites with increased plant diversity, lower litter amounts, and a percentage of bare ground. Grazing management leading to maximization of these characteristics should increase range productivity, decrease sediment loading, and improve water quality.

Relationships between Water Quality and Mercury Fish Tissue Concentrations for Natural Lakes and Impoundments in South Dakota

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Currently nine lakes and reservoirs within South Dakota are EPA 303(d) listed as mercury impaired waterbodies. In cooperation with the South Dakota Department of Environment and Natural Resources (SD-DENR), a series of interdisciplinary studies commenced during Summer 2008 to better understand mercury loading and cycling processes within South Dakota air and watersheds, with the goal of providing information to complete a state-wide mercury TMDL for South Dakota waterbodies as mandated by EPA 303(d) requirements. The project approach includes an assessment of existing surface water quality, mercury fish tissue data, and watershed characteristics. Combined wet and dry atmospheric mercury deposition fluxes are being estimated through the deployment of passive bulk mercury deposition monitors at six locations throughout South Dakota. Lake and reservoir sediment cores have been collected and analyzed for mercury and lead-210 to provide quantitative estimates of current and historical mercury fluxes. Water quality data has been analyzed using regression analysis, box-plots, and Akaike's information criterion (AIC) to determine relationships between water quality and mercury fish tissue concentrations. Preliminary findings suggest positive correlation exists between Northern Pike mercury tissue concentrations and alkalinity, total dissolved solids, and total solids for natural lakes in South Dakota. For Walleye, a positive correlation exists between mercury tissue concentrations and alkalinity, total solids, pH, dissolved oxygen, and phosphorus for natural lakes.

Sediment Mercury Concentration Profiles in South Dakota Lakes and Impoundments

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Currently nine lakes and impoundments within South Dakota are EPA 303(d) listed as mercury impaired waterbodies where fish tissue concentrations have exceeded 1.0 mg/kg total mercury. In cooperation with the South Dakota Department of Environment and Natural Resources (SD-DENR), a series of interdisciplinary studies are currently underway to determine mercury loading and cycling processes within South Dakota air and watersheds, with a goal of providing information supporting the development of a state-wide mercury TMDL for South Dakota waterbodies. As part of this project, sediment mercury concentration profiles were determined for various South Dakota lakes and impoundments to determine whether relationships exist between mercury fish tissue concentrations and current and historical mercury sediment concentrations. Eleven South Dakota lake and impoundment sediment cores were collected early 2009 and were analyzed for total mercury, iron, phosphorous, sulfur, and water content, and quantitatively dated using Pb210 radiodating to determine current and historical mercury fluxes within these aquatic systems. The presentation will discuss the methodologies employed for sediment sampling and analysis, and preliminary results will be presented to better understand mercury fate and transport processes within mercury impaired waterbodies of South Dakota.

Nature Versus Nurture: Functional Assessment of Restoration Effects on Wetland Services

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Land-use change has altered the ability of wetlands to provide vital services such as nutrient retention. While compensatory practices attempt to restore degraded wetlands and their functions, it is difficult to evaluate the recovery of soil biogeochemical functions that are critical for restoration of ecosystem services. Using solution ^{31}P Nuclear Magnetic Resonance Spectroscopy, we examined the chemical forms of phosphorus (P) in soils from wetlands located across a land-use gradient. We report that soil P diversity, a functional attribute, was lowest in farmland, and greatest in native wetlands. Soil P diversity increased with age of restoration, indicating restoration of biogeochemical function. The trend in soil P diversity was similar to documented trends in soil bacterial taxonomic composition but opposite that of soil bacterial diversity at our study sites. These findings provide insights into links between ecosystem structure and function and provide a tool for evaluating the success of ecosystem restoration efforts.

THURSDAY, APRIL 23, 2009
SESSION 2G
10:30 A.M. – 12:30 P.M.

REMOTE SENSING
(RUSHMORE G ROOM)

Remote Sensing of Precipitation – A Look at Radar Now and in the Future

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It is well known that radar-rainfall products are crucial for immediate remote precipitation estimation, input to runoff and flood prediction models, for validation of satellite remote sensing algorithms, and for prediction of extreme rainfall frequency. These products, though still useful, have inherent limitations. The focus of this presentation will be the current issues involved in radar reflectivity based rainfall estimation and their uncertainty using current radar technology. Discussion will then shift to the new dual-polarimetric upgrades to the suite of National Weather Service Weather Surveillance Radars due in the near future. These upgrades are projected to vastly improve precipitation estimation through new algorithms and better precipitation identification. The impact of the new dual-polarimetric radar products to hydrologic models will also be briefly discussed.

Upcoming Improvements to the NWS Doppler Radar: Hydrologic Impacts

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One of the primary remote sensing tools utilized by the National Weather Service (NWS), the 10-cm wavelength Weather Service Radar-1988 Doppler (WSR-88D), will undergo significant upgrades in 2010–2012. The most notable upgrade will be the addition of dual-polarization capability to the transmitter/receiver system, which means the electromagnetic wave energy will be “split” into horizontal and vertical components with respect to the electric field. Dual-polarization of the NWS radars will facilitate much improved classification of hydrometeors (e.g., small rain drops, large rain drops, hail, snow) and non-meteorological targets (e.g., bugs, birds, anomalous propagation, chaff, “ground clutter”). Up to this point radar-derived precipitation estimation techniques have suffered because radar echo classification was very limited. Additionally, only one radar-derived precipitation estimation technique could be applied at a given time for a given environment. However, dual-polarization radar will afford the opportunity to apply more representative radar-derived precipitation estimation techniques based on the radar’s best guess at a hydrometeor type, thus rendering much improved rainfall-derived precipitation estimates. The focus of this presentation will be to describe the planned dual-polarization upgrade to the NWS WSR-88D, and discuss some of the potential benefits of this technology to the hydrologic community.

Impact of Vegetation Cover Estimates on Regional Climate Forecasts

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Numerical Weather Prediction and Regional Climate Models often rely on temporally averaged values of fractional vegetation cover. Over time, such data may no longer be representative due to land use change, drought or other forcing on the land surface. In regions such as the Northern Great Plains, which lies on the knife-edge between semiarid and more humid climate regimes this effects may become more noticeable. We shall demonstrate the impact of altering land cover (primarily, monthly fractional vegetation cover) on regional forecasts of weather and climate by comparing simulations using the “default” and remotely-observed vegetation cover over the Northern Great Plains.

Generating Surface Flow Features from 1-meter Lidar-Derived Digital Elevation Models

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The U.S. Geological Survey (USGS) has taken the lead in the creation of a valuable remote sensing product by incorporating Light Detection and Ranging (lidar)-derived digital elevation models (DEMs) into the National Elevation Dataset (NED), the elevation layer for The National Map. High-resolution lidar-derived DEMs provide the accuracy needed to systematically quantify and fully integrate surface flow including flow direction, flow accumulation, sinks, slope, and a dense drainage network. In 2008, one-meter resolution lidar data were acquired in Minnehaha County, South Dakota. The acquisition was a collaborative effort between Minnehaha County, City of Sioux Falls, and USGS Earth Resources Observation and Science (EROS) Center. With the newly acquired lidar data, USGS generated high-resolution DEMs and surface flow features that are precise, consistently integrated with elevation, and are important in understanding surface water movement to better detect surface water runoff, flood inundation, and erosion. Many topographic and hydrologic applications will benefit from the increased availability of accurate, high quality, and high-resolution surface water data. The remotely sensed data provides topographic information and data integration capabilities needed for meeting future human and environmental needs.

Classifying Catchments into Broader Physiographic Regions: “A GIS Approach”

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Reproduction of the native Great Plains Cottonwood (*Populus deltoides*) may be significantly declining within the boundaries of the Pine Ridge Reservation in southwestern South Dakota. Cottonwood is culturally significant to the Lakota people, and is ecologically important to Great Plains ecosystems (CRST; Ostler). Oglala Lakota College has initiated an environmental study of cottonwood regeneration across the Pine Ridge reservation through the use of geospatial technologies. The Great Riparian Protection Project (GRIPP) incorporates GIS remote sensing; dendrology; and geomorphology to better understand the distribution of woody riparian species across the Pine Ridge reservation. We will apply ArcView and ERDAS Imagine software to model and analyze field data and remotely sensed data to better understand the life history of cottonwoods on the Pine Ridge reservation (e.g. Tinant, pers. Comm.).

Catchment classification is a part of our larger study. We hypothesize we can identify potential cottonwood recruitment sites by integrating hydrologic models and available soils data using ArcView and ERDAS Imagine software (Luzio, et al). We have selected 15 - 20 physical, chemical, and habitat parameters. These parameters were used to group small catchments on the Pine Ridge reservation into broader physiographic regions using zonal statistics, principle component analysis, and unsupervised classification. This process yielded the following physiographic regions; White River Badlands, Alluvial, Pine Ridge Escarpment, Eolean Sands, Keya Paha Tablelands, Nebraska Sands Hills, River Breaks, and Escarpment Foothills. Generated map is remarkably similar to the portion of the South Dakota Geologic Map for the Pine Ridge Reservation. Overlaying the physiographic map with sample point layer will allow for further analysis of attribute data.

Geospatial Data for South Dakota: The National Map and Beyond

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The National Map (TNM) is a collaborative effort among the U.S. Geological Survey (USGS) and its partners to improve and deliver geospatial information for the Nation. Federal, state, local, Tribal, and private entities produce and maintain a vast array of current, accurate geospatial data. Contributions of data from public and private partners are essential to the success of TNM. USGS is building upon the initial accomplishments of TNM in a planned effort named TNM 2.0. This presentation will describe the enhancements currently being developed in TNM 2.0, and will explore TNM and other data available free of charge for use in Geographic Information Systems (GIS). Discovery tools that assist users in locating and downloading the data will be demonstrated. Future TNM developments will also be discussed.

THURSDAY, APRIL 23, 2009
LUNCHEON
12:30 P.M. – 2:00 P.M.

**UNQUENCHABLE: AMERICA'S WATER CRISIS AND WHAT WE CAN DO
ABOUT IT
(RUSHMORE H ROOM)**

THURSDAY, APRIL 23, 2009
SESSION 3A
2:00 – 3:20 P.M.

GROUND WATER
(ALPINE ROOM)

Radionuclides in the Deadwood Aquifer

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Ground water in the Deadwood Formation has high concentrations of dissolved radium and radon at some locations in the Black Hills. These two elements are daughter products from the radioactive decay of uranium, yet the dissolved uranium in the Deadwood Formation is low. Three hypotheses are examined to address the origin of these radionuclides:

- (1) The dissolved uranium may have originated from detrital uraninite in Cambrian paleoplacers in the basal Deadwood conglomerate. Major flaws of this hypothesis are that uraninite has not been found in the conglomerate, and that, because of the presence of atmospheric oxygen in Cambrian time, uraninite should not occur in paleoplacers.
- (2) A second hypothesis is that the uranium originated from Deadwood Formation paleoplacer minerals such as monazite and zircon.
- (3) A third hypothesis is that dissolved uranium was transported to the Precambrian/Cambrian unconformity where it accumulated due to geochemical change such as reducing environment.

Numerical Ground-Water Flow Model of the Minnelusa and Madison Hydrogeologic Units in the Rapid City Area, South Dakota

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A numerical ground-water flow model of the Minnelusa and Madison hydrogeologic units was constructed for a 1,000-square-mile study area surrounding Rapid City using the U.S. Geological Survey's Modflow-2000. The model consists of five layers: layer 1 represented the sandstone layers in the upper 250 feet of the Minnelusa hydrogeologic unit, and layer 2 represented the less permeable lower part of the Minnelusa hydrogeologic unit, layer 3 represented the upper 150 feet of the Madison hydrogeologic unit, layer 4 represented the less permeable lower part of the Madison hydrogeologic unit and layer 5 represented seepage from the underlying Deadwood aquifer. The finite-difference grid included 221 rows and 169 columns with a cell size of 492.1 feet in the Rapid City area and larger cell sizes toward the boundaries. Calibration of the model was accomplished with a steady-state simulation of average conditions for water years 1988–97 and transient simulations for 1988–97 divided into twenty 6-month stress periods. Total simulated transient streamflow recharge rates for the twenty 6-month stress periods ranged from 14.1 to 102.2 cubic feet per second (ft³/s), and areal recharge rates ranged from 1.1 to 98.4 ft³/s. Total simulated transient springflow ranged from 26.2 to 40.7 ft³/s. Water use rates ranged from 3.4 to 19 ft³/s. Outflows from the Minnelusa and Madison hydrogeologic units to the east were 13.5 and 13.6 ft³/s, respectively. Calibrated horizontal hydraulic conductivities for the three zones in model layer 1 ranged from 1.2 to 6.9 feet per day (ft/d) with an area-weighted average of 3.3 ft/d. Hydraulic conductivities for seven zones in model layer 3 ranged from 0.1 to 660 ft/d with an area-weighted average of 12.1 ft/d. Vertical hydraulic conductivity for layer 2, which generally impedes flow between the more permeable layers 1 and 3, ranged from 2.0E-1 to 1.0E-6 ft/d.

Heat-Transport Modeling of Conduit and Diffuse Flow Within the Madison Aquifer

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A one-dimensional heat-transport model for conduit and diffuse flow within the Madison aquifer near Rapid City, South Dakota is presented as an alternative to two or three-dimensional distributed-parameter models, which are data intensive and require knowledge of conduit locations. This model can be applied to karst studies where water temperature at a discharge point (well or spring) is influenced by a phreatic conduit. Heat transport in the conduit is simulated using a physically-based equation that accounts for diffuse inflow to the conduit from small openings and fissures during periods of low recharge. Additional diffuse flow that enters the well or spring directly without conduit interaction is then simulated by a binary mixing equation that also estimates the proportions of conduit and diffuse flow to the discharge point. This estimation is useful for the assessment of contaminant vulnerability and wellhead or spring protection. The model was applied to 7 months of continuous temperature data collected from April to October 2008 for a sinking stream and a pumped well. The stream recharges a conduit within the Madison aquifer that is hydraulically connected the well. The simulated conduit-flow fraction ranged from 0 to 32 percent of total flow to the well, and simulated water velocity within the conduit ranged from 0.0006 to 0.005 m/s.

Measurements and Analysis of Water Reduction at the Homestake DUSEL

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Reductions of water levels inside the former Homestake gold mine at Lead, SD, have been measured since Oct. 15, 2008, using a pressure sensor lowered into the water column through the #6 winze. The suspended bottom-hole instrument package includes a pressure sensor with specific conductance and water temperature probes on a 350' cable. Additional water temperature sensors have been placed 120' and 240' above the pressure sensor. Deployment of the instrument package has been from the #6 winze hoist room on the 4550-ft level. Air temperature, relative humidity and barometric pressure have been recorded at the datalogger inside the hoist room. Power supply consists of 110 VAC and a 12 VDC battery backup. Data are logged each minute and collected monthly using a notebook PC. Data accumulation occurs at approximately 650,000 points per month. Dewatering of the 4850-ft level will occur in spring 2009, and by early summer the entire system will be relocated and suspended from the 4850 station. Initial data analysis has focused on water reduction curves and the vertical water temperature profile. Specific conductance data have compared favorably to water quality sampling and indicate a highly mixed water column. Water reduction data analyzed with the pumping rate data will be used to determine aquifer characteristics of the Precambrian rocks at the site. Complementary future experiments will include measurements of pressure head in the bulk rock and the analytical ability to define aquifer parameters for the three primary hydrologic systems: drifts and shafts, sand-filled stopes and fractures.

THURSDAY, APRIL 23, 2009
SESSION 3P
2:00 – 3:20 P.M.

SURFACE-WATER MODELING
(PONDEROSA ROOM)

Hydraulic Model of the Belle Fourche Irrigation District North Canal Automatic Watershed Delineation/Curve Number Tool

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An automatic watershed delineation/Curve Number tool has been developed by the Natural Resources Conservation Service (NRCS) in South Dakota to help field engineers and technicians prepare input data for the Engineering Field Handbook, Chapter 2 Hydrology model, EFH2 program. The tool delineates the watershed drainage area and calculates runoff curve number, longest watershed flow length, and average watershed slope.

The watershed is delineated by using preprocessed Arc Hydro grids and the watershed tool in Arcmap (ArcGIS Desktop). Arc Hydro is a geospatial and temporal data model for water resources that operates within ArcGIS (Maidment, 2002). The U.S. Geological Survey's 30-meter DEM and the National Hydrography Dataset (NHD) data are used as input for Arc Hydro. South Dakota is divided up into 13 areas corresponding to the following watersheds: Bad River, Belle Fourche River, Big Sioux River, Upper Cheyenne River, Lower Cheyenne River, Grand and Moreau Rivers, Upper James River, Lower James Vermillion Rivers, Lewis and Clark Lake, Upper Missouri River, Lower Missouri River, Upper Red and Minnesota Rivers, and White River.

The watershed delineation is subdivided by the user into the land uses described in EFH2. Several forms with pre populated drop-downs are used to select the land use. The watershed delineation shapefile is intersected with pre-processed digital soils data to link the Hydrologic Soil Group with the land use. The tool then makes the appropriate calculations to arrive at a composite runoff curve number for the entire watershed. The output from the tool includes a delineated watershed shapefile and a text file that has the needed input data for the Engineering Field Handbook, Chapter 2 procedure.

This existing automatic watershed delineation/Curve Number tool should be valuable for developing input for EFH2. Additionally, there are plans to incorporate 10-meter DEM grids and/or IFSAR data into the tool in 2009. This should make the tool even better by increasing the accuracy of the watershed delineation part of the tool.

Using EPA SWMM 5.0

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The Belle Fourche River total suspended solids (TSS) total maximum daily load (TMDL) study, sponsored by the Belle Fourche River Watershed Partnership, found that irrigation return flows were one of several main contributors of TSS. It was determined that the TSS exceedance in the Belle Fourche River could be improved by reducing nonused irrigation return flows from the Belle Fourche Irrigation District (BFID), which contributed approximately 20 percent of the TSS loading in the Belle Fourche River. A set of best management practices was developed to bring the Belle Fourche River back into compliance; one of these includes the development and implementation of a hydraulic model of the BFID.

A model was developed using EPA SWMM for the entire 43 mile North Canal. The North Canal model was calibrated based on recorded water orders, field measurements collected during the 2007 and 2008 irrigation seasons, field dataloggers, and operational curves developed from field measurements. Various methods of simulating automated gates at check structures were investigated. Due to limited field data and time constraints, the North Canal model was not validated. The error between the simulated results and the measured values was minimized to ± 10 percent at a majority of the check structures. Differences between the observed data and the simulated results are estimated to be primarily due to uncertainty in water orders, water deliveries, insufficient physical characteristics of the canal, and assumptions pertaining to manual structure adjustments.

The model is fully capable of simulating the entire BFID irrigation system if the appropriate amount of data is collected. The BFID can use this model as a tool for ditch-rider training, for understanding the complexities of the North Canal, and as a decision-making tool concerning system operation and structure adjustments. By using the developed SWMM model, the BFID could reduce non-used irrigation return flows by improving the operational efficiency, which would in turn reduce the TSS in the Belle Fourche River.

Sediment Source Tracking of the Cheyenne River, South Dakota Using a Multivariate Statistical Approach

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The Cheyenne River watershed drains east central Wyoming and much of southwestern South Dakota, including the Black Hills, portions of the Badlands National Park, and east towards its confluence with the Missouri River. Some reaches of the Cheyenne River are characterized as impaired by the U.S. Environmental Protection Agency because water-quality standards are exceeded. Monthly grab and passive sediment samplers have been used to collect sediment and water-quality data from the Cheyenne River. In the second year of sampling (2008), sediment samples were collected from the channel's bed, bank, and floodplain from 20 sites within the Cheyenne River watershed. These samples have been analyzed at the South Dakota School of Mines and Technology's X-Ray Diffraction Laboratory to identify and quantify the mineralogy of the channel sediments. A multivariate statistical approach (including principal components, least squares, and maximum likelihood techniques) was applied to the mineral percentages at each site to identify contributing source areas that could be causing water-quality exceedances. Additionally, we plan to estimate the relative contribution of key source areas by applying a mixing model of Cheyenne River sediment sources.

Rapid Creek Simulation of Water Quality for Three Dates – 06/06/07, 08/27/07, and 11/18/08

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Rapid Creek was modeled from Pactola Reservoir to Canyon Lake using Qual2K for purposes of simulating hydraulics, temperature, nutrient parameters, and biological productivity. Past modeling efforts of Rapid Creek have included the characterization of water quality, physical habitat, algae, and basin characteristics by the U.S. Geological Survey and others. The model presented provides a foundation for determination of factors affecting stream habitat and growth factors of *Didymosphenia Gemenata*, commonly known as Didymo. Implications of the model will result in a better understanding of the inner relationships between physical and chemical characteristics that govern Didymo habitat which ultimately affects valuable trout fisheries. Rapid Creek is one of the most important cold water permanent fisheries in the region. As such it has significant environmental and recreational value, warranting special protection efforts. The Qual2K model provides a tool for evaluating management options for system responses to nutrient loading and physical stream characteristics. The model provides an economical means of testing management strategies before implementing field activities to maintain the best management practices set for Rapid Creek.

THURSDAY, APRIL 23, 2009
SESSION 3G
2:00 – 3:20 P.M.

HYDROLOGY POTPOURRI
(RUSHMORE G ROOM)

Section 404 of the Clean Water Act Permitting Process

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Section 404 of the Clean Water Act requires approval prior to discharging dredged or fill material into waters of the United States including wetlands. This presentation will be an overview of the Section 404 Permitting Process, including what types of waters are jurisdictional, the types of Nationwide Permits available, the Individual Permit process requirements, and Mitigation requirements for unavoidable impacts.

Ground Motion Studies at Homestake DUSEL

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Seismic-induced ground motion inside the former Homestake gold mine at Lead, SD, has been monitored and measured since spring 2008 using accelerometers and two types of tiltmeters. These instruments have been deployed at four locations on the 2000-ft level spanning a distance of approximately 3000 feet. Three-component accelerometers were placed 40 feet below grade in sand holes and cemented in place on top of inflatable packers. 0.1 \square radian resolution 2-axis tiltmeters were installed on the drift level beside the sand holes. Large tiltmeter arrays utilized Fermilab-designed Tevatron hydrostatic water level sensors (HLS) and have been installed in two arrays, each 1000 feet long. These sensors have a 5 \square m resolution and installation around a corner has provided tilt direction as well as tilt magnitude. Air temperature, relative humidity and barometric pressure sensors were included in each of the HLS arrays. Data were recorded through A/D cards and fed out of the mine real time utilizing a fiber optic backbone. These instruments have a combined frequency response of 1×10^3 Hz to less than 1×10^{-8} Hz and monitor the mine for evidence of local and regional seismic events in addition to long term trends associated with dewatering and excavation of new lab space. It is anticipated that the Homestake HLS will also provide data for evaluation of the three primary hydrological regimes in the mine, shafts and drifts, sand-filled stopes and fractures.

Environmental Implications Associated with Land Application of Antimicrobial-Containing Manure

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Antimicrobial and antibiotic compounds are used in therapeutic doses in the agricultural industry to prevent disease and at sub-therapeutic levels to enhance growth promotion and feed efficiency. In 2000, over 88% of swine producers administered antibiotics as growth promoters. Antibiotics and antimicrobials are specifically designed to be poorly adsorbed into the gut of the animal, and studies have shown that approximately 90% of the parent compounds can be excreted from the animal. The dominant pathway for antimicrobials to enter the environment is through the land application of antimicrobial containing manure from CAFOs. Land application of manure is a common agricultural practice enhancing the nutrient content of crop-lands. The purpose of this research was to determine the environmental implications during land application of tylosin and chlorotetracycline (CTC)-containing manure. Environmental effects were determined using a combination of soil columns and respirometry based experiments. Soil columns were constructed to simulate 'real-world' environmental conditions where antimicrobial-containing manure was applied at standard agronomic rates. Three different soil types common to the Brookings, SD region were used to study impacts on native soil microbial populations: Brandt (high sand), Brookings (high clay), and Vienna (high silt). Samples were analyzed for total phosphorous, %N, %C, pH, and moisture content. Changes in microbial populations were monitored using the T-RFLP analysis at Black Hills State University. Microbial respiration rates were monitored using a Micro-Oxymax respirometer to assess how tylosin and CTC affect CO₂ respiration rates by native soil microorganisms. Preliminary results from these on-going experiments will be discussed.

Determination of Environmental and Climate Change Impacts Due to Antimicrobial Usage at Swine CAFOs: A Life Cycle Assessment Approach

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Life Cycle Assessment (LCA) is a standardized method to quantify the environmental effects of industrial or manufacturing process from a cradle to grave perspective. In this study, the environmental effects of antimicrobial usage in swine production facilities were assessed. Tylosin and chlorotetracycline (CTC) are two of the most commonly administered antimicrobial compounds in the US, and both are excreted at high concentrations during swine production processes. The purpose of this study was to determine eutrophication, global warming, acidification, ozone depletion, and ecotoxicity potentials resulting from antimicrobial usage within a standard concentrated animal feeding operation (CAFO) swine facility. Environmental indices were determined using the SimaPro 7.1 LCA model. The LCA model simulation included inputs and outputs for common swine CAFO operations, including antimicrobial manufacturing and feed blending processes, feed production, transportation, metabolic emissions, and manure treatment and disposal. Three scenarios of swine production were compared: facilities using CTC, using tylosin, and not using antimicrobial compounds. Two distinct production models were developed for this study. The first model did not include the emissions generated from the production of antimicrobial compounds, while the second model included these emissions. Results from the first model showed that the no-antimicrobial scenario had the highest environmental impacts for every measured parameter. In the second model, the no-antimicrobial scenario had the lowest impacts for carbon dioxide equivalents and acidification, yet it still had the highest impacts for eutrophication, ozone depletion, and ecotoxicity. Antimicrobial usage generally decreased swine feed requirements and metabolic emissions. Although emissions were generated from production and shipping of antimicrobial compounds, those emissions were offset by the decrease in feed and metabolic emissions. In conclusion, the use of antimicrobials in swine production appeared to have fewer environmental impacts due to greater feed efficiency associated with antimicrobial usage.

THURSDAY, APRIL 23, 2009

SESSION 4A

3:50 – 5:10 P.M.

**MINING IMPACTS
(ALPINE ROOM)**

Identification of Uncontaminated Alluvial Deposits of the Lower Cheyenne River, South Dakota

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Sediments contaminated with various metals and metalloids from mining activities along Whitewood Creek have been deposited throughout downstream reaches of the Belle Fourche and Cheyenne Rivers in western South Dakota. The Water Resource Development Act of 1999 (amended in 2000) mandated a study of contaminated sediments within the Cheyenne River Basin, which is being conducted by the U.S. Geological Survey, in cooperation with the U.S. Army Corps of Engineers. The first phase of this study is to determine the concentrations of metals and metalloids in alluvial sediment deposited prior to the effects of mining and other anthropogenic sources of contamination in the watershed. Such data would provide estimates of concentrations in 'uncontaminated' sediment. The active channel and floodplain upstream from known sources of contamination (such as Whitewood Creek) may provide candidate sites for sampling the uncontaminated sediment. However, such sites are far from areas of primary interest and may not include the influence of important tributary streams on the chemical signature of sediment in the lower Cheyenne River. An alternative to sampling in the active channel is to sample alluvial terraces along the lower Cheyenne and Belle Fourche Rivers. Source areas of deposits can be determined through a principle-components and sediment-mixing model being developed by the South Dakota School of Mines & Technology. The chronology of terraces on the lower Cheyenne River is largely unresolved, but previous work indicates that terraces as much as 75 meters above the channel have been dated as young as late Pleistocene to early Holocene. We will discuss our proposed sampling plan and our current understanding of the history of the Cheyenne River as preserved in terraces.

Metal Contaminant Concentrations at the Abandoned Hilltop #1 and #2 Uranium Mine Site, Slim Buttes, Harding County, South Dakota

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Highwalls, mine benches, spoil piles, and surrounding drainage sediments of the abandoned Hilltop Mine in the Slim Buttes region of Custer National Forest, Harding County, South Dakota were analyzed in-situ at 135 locations with a field-portable x-ray fluorescence spectrometer (FPXRF) during a two-day field investigation in July 2008. The historic mining operation targeted uraniferous coals in the upper Ludlow Formation and resulted in an open cut with a large spoil pile of waste rock. The distribution of contaminant concentrations within and between different sample types demonstrated that elevated U, As, and Mo concentrations at the site were directly related to the mining operation, while elevated concentrations of Cr, Cd, V, and Zn were not. Median concentrations for U (20 ppm), As (12 ppm), and Mo (5 ppm) were low but reached as high as 3100 ppm for U, 1300 ppm for Mo, and 660 ppm for As. Detection limits of 5-15ppm for the three COCs and 5 other relevant contaminant metals (Cu, Hg, Pb, Se, Tl, Zn) were low enough to evaluate contaminant distributions and trends for determination of remediation goals. Higher detection limits for Cd (40 ppm), Cr (73 ppm), and V (125 ppm) resulted in a large number of non-detects and did not allow for sufficient geospatial analysis of these contaminants. COC concentrations were back to upstream levels at a maximum distance of 700 m downstream from the site. Correlation between in-situ FPXRF and EPA method 200.3 yielded R² values of 0.61 (Mo), 0.81 (U), and 0.84 (As), demonstrating only fair to reasonable predictive power between the two methods. Nevertheless, the results demonstrate that a mine site like the Hilltop and the surrounding drainages could be sufficiently characterized by FPXRF with a large volume of screening-type quality data in a short time and cost-effective manner.

Surface Water and Sediment Investigation Concerning Abandoned Uranium Mines Within the Slim Buttes Region, Harding County, South Dakota

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As part of ongoing environmental investigations of historical uranium mining impacts in Harding County, South Dakota, surface water and sediment samples were collected and analyzed to evaluate fate and transport of heavy metals and radionuclides emanating from the Slim Buttes region of Custer National Forest. Surface water and sediment samples were digested and analyzed by ICP-MS following EPA methods 200.2 and 200.7. In addition, field and laboratory hand-held X-ray fluorescence spectrometer (XRF) measurements were taken in collaboration with Oglala Lakota College. The Slim Buttes region was divided into five sampling quadrants: west-central, east-central, south-west, Antelope Creek south-east and Sheep Creek south-east, with the greatest number of historical uranium mine and exploration sites found in the west-central and Antelope Creek south-east regions. For the Antelope Creek south-east region, As and U surface water concentrations exceeded 4x background (>80 and 108 µg/L, respectively), while U sediment concentrations exceeded 4x background (>16 mg/kg) at several locations within Antelope Creek and its tributaries. All elevated samples were collected downgradient of the Hill Top and Square Top minesites. For the west-central Slim Buttes, surface water As was greater than 11x background (>220 µg/L) within an unnamed drainage downgradient of the Olesrud minesite. Sediment samples analyzed by synthetic precipitation leaching procedure (SPLP) and evaluated using element concentration pattern graphs (ECPG) suggest heavy metals and radionuclides were readily mobilized from mining impacted drainages.

Development of an Arsenic and Uranium Fate and Transport Model for Historical Uranium Mining Impacts from Custer National Forest, Harding County, South Dakota

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Historical uranium mining operations within the North Cave Hills region of Custer National Forest, Harding County South Dakota, have resulted in significant fluvial transport of heavy metals and radionuclides within the downgradient watersheds. Previous SDSM&T studies have shown anomalously elevated arsenic and uranium surface water and sediment concentrations within the North Fork Grand River deltaic deposition zones and downgradient of the Bowman-Haley reservoir outlet located in Bowman County, North Dakota. The goal of this project phase was to better understand contaminant fate and transport phenomena within various segments of the impacted watersheds using a combination of field investigations and contaminant transport modeling. EPA Water Quality Analysis Simulation Program (WASP 7.3.1) model will be used to ascertain changes in heavy metal-influenced sediment transport reactions under steady state and dynamic flow conditions, and will be calibrated using surface water and sediment results from previous SDSM&T field efforts. Sediment pore water behavior will be investigated through the deployment of in situ dialysis samplers (peepers) to understand contaminant cycling phenomena under various redox conditions. Peepers will be deployed at various locations within the impacted watershed, including the Bowman-Haley Reservoir backwaters where marshlands provide localized geochemically reduced microenvironments. Reservoir sediment core sample results collected early 2009 will be used to calibrate WASP modeling efforts to predict arsenic and uranium sediment cycling behavior within the reservoir.

THURSDAY, APRIL 23, 2009
SESSION 4P
3:50 – 5:10 P.M.

FLOODS
(PONDEROSA ROOM)

Updated Peak-Flow Frequency Estimates for South Dakota Streams

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The U.S. Geological Survey (USGS), in cooperation with the South Dakota Department of Transportation, recently completed a statewide update of at-site peak-flow frequency estimates for gaged sites along South Dakota streams. Results are reported in USGS Scientific Investigations Report 2008–5104, which is available in online-only format at <http://pubs.usgs.gov/sir/2008/5104/>.

Estimates of peak-flow magnitudes for 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year recurrence intervals are reported for 272 streamflow-gaging stations, which include most gaging stations in South Dakota with 10 or more years of systematic peak-flow records through water year 2001. Flood frequencies for all stations were initially analyzed by using standard “Bulletin 17B” default procedures for fitting the log-Pearson III distribution. The resulting preliminary frequency curves were then plotted on a log-probability scale, and fits of the curves with systematic data were evaluated. In many cases, results of the default Bulletin 17B analyses were determined to be satisfactory. In other cases, however, the results could be improved by using various alternative procedures for frequency analysis.

The most common alternative procedures involved several different methods to extend systematic records. This was done primarily to address biases resulting from non-representative climatic conditions during several specific periods of record and to reduce inconsistencies among multiple gaging stations along common stream channels with different periods of record. Other alternative procedures included adjustments to skew coefficients for some stations and use of user-defined low-outlier criteria. A regional mixed-population analysis was developed to address complications associated with many high outliers for the Black Hills region. Primary procedures and relevant findings will be presented.

Design Floods Between the 100 Year Flood and the Probable Maximum Flood

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Selecting the magnitude of a design flood usually involves risk based methods up to the 100-year flood, and then for structures where failure is expected to cause loss of life or very severe economic loss, the probable maximum flood (PMF) is often used. The PMF is the flood resulting from the probable maximum storm, which is the most severe rainfall that could theoretically occur. The PMF analysis uses a very conservative approach, so that the probability of the PMF occurring at a specific site is essentially zero. These two approaches are well understood and accepted; however, there are situations where the design flood is between the magnitudes of the 100-year flood and the PMF. Few methods exist to predict design floods for this intermediate scenario. Extrapolating the risk based method much beyond the 100 year event increases the level of uncertainty because the database is usually too limited. Using the PMF can result in a very expensive design, with the design cost being far more than is justified for the project objectives. We developed a method that uses both the 100-year flood and PMF, along with a hydraulic model that displays the floodplain zone for a given flood, to analyze flood risk from streamflows that could be in the 500 to 1000 year range. The method analyzes the incremental rise of water depth between the floodplains of the 100-year flood and an "extreme condition" flood that is based on 50% of the PMF. The method is illustrated using a stream in the Black Hills.

Debris Effects and Floodplain Analysis

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On July 18, 2008, a major flood occurred on Pass Creek in the southwestern Black Hills. Floodway high-water marks were gathered from a field investigation and compared to the floodway extents predicted by a HEC-RAS model application of runoff from a 100-year, 24-hour design storm. The measured high-water marks from the flood event on July 18 indicated greater floodplain inundation and surcharge than that of the design storm floodway map. However, meteorological data and anecdotal evidence gathered suggested the amount of precipitation that actually fell over the watershed was much less than the amount used in the design storm. During the field investigation, large amounts of debris were found in areas that would significantly constrict flow along Pass Creek. Five days after the flood, cross sections of the floodway were surveyed and roughness coefficients were estimated at two uniform reach locations. The Slope-Area Method and Manning's Equation were used to estimate the flow from the flood event at both locations. Results from the Slope-Area Method revealed a predicted flow rate at approximately 70 percent of the flow rate from the 100-year, 24-hour design storm. However, the actual floodway extents more closely resembled a flood resulting from a much greater amount of precipitation. The large amounts of debris accumulation at various points along Pass Creek indicated constricted flow at those points that resulted in increased floodway boundaries. From an investigation of the July 18, 2008, flood that occurred on Pass Creek, significant increases in floodway extents can result from considerable debris accumulation. Characteristics unique to the watershed can provide clues as to whether debris effects should be accounted for in floodplain modeling of that particular basin.

Non-Invasive Solution to Prevent Flooding in the North Platte River at North Platte, Nebraska to Allow for Increased River Flows During the Migratory Season

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In 2007 SEH began a project to increase flow rates through about two miles of the North Platte River in Nebraska north of North Platte, Nebraska for the Platte River Recovery Implementation Program (PRRIP). The PRRIP started in 1997 when the states of Colorado, Wyoming and Nebraska and the Department of Interior came together in a partnership to develop a shared approach to managing the Platte River. One of the Program elements is enhancing, restoring and protecting habitat lands which include doing a “pulse” flow which are a result of controlled flow releases from Kingsley Dam during the migratory season. During the initial reconnaissance stages of the final project it was discovered that the original proposed project proposed by others would not be able to be completed due to issues with the landowners and permit requirements. SEH then began a reevaluation of the project to determine if the goal for an increase flow in the river, could still be accomplished.

The project went from an engineered project (ditches) to one in which the problem was addressed through a better understanding of the river flow system and the removal of the main problem that was reducing the flow, phragmites (an invasive species that grows to over six feet tall and is as thick as a jungle and is blocking natural flow path over sandbars and in floodplains in several rivers in Nebraska). The presentation will focus on several areas including: discussion on correct data collection requirements, looking at non-invasive solutions to projects (phragmite project eradication by helicopter which started in the fall of 2007 verses re-digging a bunch of channels), cost savings of the project (final project will save about \$500,000) and impacts of invasive species on flow rates in rivers (very interesting results in HEC-RAS modeling in the reach).

THURSDAY, APRIL 23, 2009
SESSION 4G
3:50 – 5:10 P.M.

BIOLOGICAL ISSUES
(RUSHMORE G ROOM)

Nematode Parasite Frequency Relations to Water Quality and Habitat Characteristics and Their Distribution among Chironomidae Subfamilies, Functional Feeding Guilds and Habit Guilds

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Chironomidae occur in almost any conceivable freshwater habitat and can be useful in biological assessment due to their diverse ecological roles. Nematodes frequently parasitize Chironomidae, often leading to host mortality when the parasite exits the body cavity. Nematode parasites of Chironomidae have free-living and parasitic stages of their life. Hence, environmental conditions can influence the parasite directly or indirectly by affecting the host. Chironomidae were sampled 27 times during the summers of 2007 and 2008 from 9 sites following modified EMAP protocols within the Lower Cheyenne River Basin. Chironomidae were brought back to the laboratory, slide mounted, identified to genus and examined for nematode infection as indicated by a coiled mass in the body cavity. Water quality characteristics were measured using a Yellow Springs Instruments Multi-Parameter probe. Habitat data were acquired from Patceg (2006). Out of 5023 midges 0.62% were parasitized. Fifteen samples contained no parasitized midges. Within-sample infection rate varied from 0-14.3% with an average of 1.1%. Chironominae were the most commonly infected subfamily (0.82%) followed by Orthocladinae (0.54%) and Tanypodinae (0.16%). Collector filterers were the most commonly infected functional feeding guild (3.72%) followed by collector gatherers (0.81%), shredders (0.49%), and engulfers (0.22%). Climbers were the most commonly infected habit guild (2.34%) followed by burrowers (0.53%), clingers (0.47%), and sprawlers (0.31%). Percent parasitized Chironomidae was negatively correlated with substrate embeddedness, conductivity, turbidity and pH. Percent parasitized Chironomidae were positively correlated with mean substrate particle size, sinuosity, dissolved oxygen and temperature. Our infection values were lower than previously reported, suggesting that these communities may be less stressed than previously reported streams. Positive correlations with mean substrate size and dissolved oxygen and negative correlations to substrate embeddedness and turbidity indicate that parasitism may be more prevalent in riffle habitat.

Black Hills Fens: Preliminary Investigations

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Fens are geographically restricted wetlands where perennial groundwater discharge occurs on the time scale of millennia, creating near permanently saturated, anaerobic conditions which promote the deposition of peat. Fens are generally characterized by their stable presence on the landscape for thousands of years and often support unique and rare plant and animal communities. Worldwide, fens are most often found in landscapes associated with historic glaciation periods.

Black Hills fens are rare and unique from other fens worldwide, largely because they occur in a region that is widely accepted to be outside the limits of past periods of glaciation. Black Hills fens also differ from other fens in the Rocky Mountains because they occur at lower elevations which do not support winter-long snow packs that prevent freezing of the fens. Furthermore, Black Hills fens represent a broad range of characteristics due to the inherent variety of the underlying geology in the Black Hills region.

Arthur McIntosh is credited with the discovery and documentation of the first Black Hills fen – the McIntosh Fen adjacent to Castle Creek, near Deerfield Reservoir. Until recently, it was believed that this was the only fen on the Black Hills. However, preliminary investigations have identified over thirty confirmed fens, generally located along the geologic contact between the Limestone Plateau and the underlying Precambrian metamorphics. Additionally, many areas of “bog iron” documented in historic mining records are now believed to be fens. These iron-rich fens were mined for industrial uses such as paint pigment and have been significantly, and possibly irreversibly altered. Many calcareous (calcium rich) fens have also been impacted by ditches dug by early homesteaders to drain and expand hayfields.

As fens continue to be identified across the Black Hills region, their geomorphic position, vegetation, and unique groundwater chemistry will serve to identify their groundwater source areas and thus will help land managers to protect not only the fens, but source areas as well. Additionally, restoration of impacted fens will hinge upon understanding their unique, individual characteristics.

Fluvial Morphology and Riparian Communities

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The purpose of the study is to conduct statistical analysis to see if any geomorphologic data coincides with a specific kind of neighboring riparian communities. Currently, the study has provided us with a complete geomorphologic profile of Medicine Root Creek on the Pine Ridge Reservation. This includes Rosgen levels I, II, and III analysis, with a Zig-zag pebble count, channel profile, sinuosity, slope, and so on. Moving forward, I will take the information gathered from the field, and conduct a statistical analysis in order to ascertain if any fluvial characteristics are indicators for neighboring riparian communities.

Relevant conclusions are currently undefined. I will either conduct a principle component analysis, or cluster analysis in order to accomplish my objective. For the past few weeks, I have been correcting and verifying data to make sure everything is complete and correct, and compiling the averages for each site into a master spreadsheet for easy analysis. Once I get things moving on the analyzation, things will move relatively quickly. In any case, by the end of February, I will have completed my statistical analysis, and be nearly finished drawing conclusions from those results. In short, whether there is a correlation or not, this study will definitely benefit the scientific community.

Paleoclimate and Expressions of Climate Change in the Missouri River Basin

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Paleoclimatology is the study of climate in the geologic past, and can complement our understanding of the sensitivity of the Earth's climate system. Proxy, or indirect, estimates of paleoclimate are available from a variety of sources. Isotopes such as ^{18}O and ^2H in glacial ice, ocean sediment, lake sediment, and cave deposits have been particularly valuable as proxy indicators of climate. Other proxy indicators of climate include fossils in marine and lake sediment, plant macrofossils in packrat nests, tree-ring records, and regional landforms such as stream terraces and dune fields. Dune fields in the central Missouri River Basin, an area known as the Sand Hills, were active as recently as 800 years ago indicating a drier climate or periods of prolonged drought. Black Hills terraces reflect the adjustment of stream channels to climate change and associated secondary effects such as stream capture and redirection of flow. Expression of current climate can also be identified with historical data, such as long-term streamflow records. Streamflow records in the Missouri River Basin from 1950-2007 indicate increasing annual flows in the east and decreasing annual flows in the west. On longer time scales, global agricultural practices during the past 8,000 years may have affected climate and delayed the start of the next ice age. Ice ages during the past 2.6 million years (Ma) are thought to be in response to changes in the Earth's orbit, amplified by changes in carbon dioxide, among other feedback mechanisms. Warm climates that might be analogs to future climate have been identified at 55 Ma and 3 Ma. Isotopes studies indicate that the 55 Ma event (Palaeocene-Eocene Thermal Maximum) was the result of releases of large amounts of carbon into the atmosphere, possibly from volcanic activity or the release of methane hydrates, and produced an abrupt warming of 5 to 10°C and a decrease in ocean pH. This talk will provide an overview of these topics to help place estimates of future climate change into the context of changes in the geologic past.