Wyoming Hydrogram

May 1992 Wyoming Water Resources Center Newsletter Vol. 4, No. 2

Water Center sponsors projects with federal funds

The Wyoming Water Resources Center (WWRC) administers several research grant programs each year. These include the state grants program and the Water Resources Research Institute program. The latter program is federally sponsored under the Water Research Act with funds provided through the U.S. Geological Survey (USGS).

The WWRC cooperates with its counterpart institutes and centers in the other Missouri River Basin states to develop priority research areas. These research areas are subsequently tailored to Wyoming needs through consultation with Wyoming state agencies and the WWRC's Research Review and Priorities Committee (RRPC). The WWRC then issues a request for proposals to the University of Wyoming and all community colleges in the state.

Proposals received by the WWRC are sent to three out-of-state universities as well as two or three state or federal agencies in Wyoming for "peer review" by faculty. Reviewers are selected on the basis of their knowledge of a particular subject matter area and must assert that they have no conflict of interest in reviewing the proposal. Based upon these external reviews plus review by the WWRC director and associate director for research, proposals are selected for funding recommendation to the USGS.

The USGS funds require a 2:1 match with non-federal funds. These matching funds are usually provided by the University of Wyoming and on-going state-funded projects from the WWRC. Individual projects are then integrated into a comprehensive "program" proposal to the USGS in Reston, Virginia. The proposal includes funds for information transfer and some administrative costs.

(Continued on page 7)

WWRC technicians install groundwater wells for studying riparian vegetation/water relationships at the south fork of Middle Crow Creek research watershed as part of the project directed by Tom Wesche.

Anna Krzyszowska, post-doctoral scientist, is analyzing pesticides under the direction of George Vance, assistant professor of soil chemistry, as part of research on the movement of pesticides.

Weather station records transferred to WWRC

In April, the National Weather Service Office in Cheyenne, Wyoming, transferred records of Wyoming Cooperative Weather Stations to the Wyoming Water Resources Center. These records from the Cooperative Weather Stations operated by volunteers include daily, monthly and annual climatological data collected in Wyoming and sent to the national climatic data center in Asheville, North Carolina. Some of the historical documents date back to the 1890s.

"These hard copy records can be an invaluable research tool for a lot of people. For example, the records show observers' comments that may not have been entered into any data system anywhere. We will catalog the collection and make it available to requesters," says Barry Lawrence, the Water Resources Data System (WRDS) coordinator.

Ray Kowrach, National Weather Service Cooperative Program manager for the state of Wyoming will continue to transfer Wyoming weather station records except for the most current records of the last three years. There are 174 weather stations in Wyoming, supported by a vast corps of volunteers who report daily, weekly and monthly to the National Weather Service on data such as daily temperature, precipitation, snowfall, evaporation, and soil temperature. For more information, contact Barry Lawrence or Cath Harris, WRDS, at 766-2143.

DEQ/WQD reports on Wyoming surface water quality

The Wyoming Department of Environmental Quality Water Quality Division released its 1990 draft interim water quality assessment report last fall. Required by the U.S. Environmental Protection Agency under section 305(b) of the Clean Water Act, the report provides an overview of surface water quality in 14 river basins throughout Wyoming.

"Wyoming's overall water quality is good."

The assessment was based on the designated use classification of water bodies in Wyoming and associated water quality standards. Water bodies are categorized into four classes based on the use for that water. For example, Class 1 and 2 water uses include game fishery, primary contact recreation (swimming), livestock and wildlife. The water quality standards associated with each use classification form the basis for determining whether the designated use for a particular body of water is supported.

Point source pollution

The report concludes that, based on available information, Wyoming's overall water quality appears to be good. Point sources of pollution are being addressed. Nearly all the municipal and industrial dischargers meet their National Pollutant Discharge Elimination System (NPDES) permit requirements. Although relatively few problem areas have been identified in the report, each river basin has its most important water quality problems identified.

Nonpoint source pollution

While Wyoming is in good shape in controlling point source pollution, nonpoint sources (NPS) continue to affect water quality. NPS are diffuse in nature and are not regulated through the NPDES permit program of the Clean Water Act.

The assessment reports water quality impacts in terms of river miles and lake acres affected. A total of 4,669 river miles and 101,322 lake acres was assessed. This is only a fraction of total river miles and lake area in Wyoming. Of the 2,146 waterbodies with designated use classification (37 lakes and 2109 rivers), only 11.3% have been evaluated for this report; 1,783 (83%) of classified waterbodies were not assessed. This means that when this report notes that 329 miles of streams were impacted by high nutrient levels, the number accounts for 23% of the total assessed miles, not 23% of the total stream miles in Wyoming.

Table 1

Pollutant Sources (point & NPS) Impacting Wyoming Surface Water Quality

	Lake acres affected*	River miles affected*
Range land	39,129	1,550
Irrigated crops	29,500	976
Pasture land	120	859
Municipal point sources	29,400	23
Highway/Road/Bridge Const.	9,476	791
Petroleum Activity	0	354
Surface mining	9,420	64

*Not fully supporting designated uses

Table 2

Pollutant Impacts in Wyoming Surface Waters (Point and NPS):

Pollutant/Activity	Lake acres affected*	River miles affected*
Org. Enrichmentt/Dissolved Oxygen	55,259	219
Sediment	9,633	2,249
Nutrients	39,209	329
Salinity/total dissolved solids	100	561
Other inorganics	28,480	42
Habitat alteration	0	433
Metals	25,730	401

*Not fully supporting designated uses

River basin summary

The report lists some of the major pollutants/polluting activities and sources for each of the 14 basins. Here are a few examples.

River basin	NPS pollutant/ activity	NPS source
Big Horn/ Wind River	Sediments, salinity	Natural geologic erosion, highway/road/bridge constr., irrigated crop production, range lands
Cheyenne River	Sediments, metals, flow alteration	Natural, range land highway/road/bridge constr.
Green River	Sediments, habitat alteration, nutrients, salinity	Natural geologic erosion, pasture and range land, streambank modification
North Platte	Sediment, salinity, metals	Range, pasture and irrigated crop lands
Powder River	Sediment, nutrients, organic enrichment	Range land, natural erosion, industrial point sources

For further information or to obtain a copy of the report, contact Wyoming Department of Environmental Quality Water Quality Division in Cheyenne at 777-7781.

The *Wyoming Hydrogram* is published bi-monthly by the Wyoming Water Resources Center with funds provided in part by the U.S. Geological Survey, Department of the Interior, as authorized by the Water Resources Research Act of 1984.
Director: Steve Gloss
Associate Directors:
Donald Brosz, Special Projects
Victor Hasfurther, Research
Ari Michelsen, Information Transfer
Contributors:
Kirk Faught
Barry Lawrence
Editor: Maija Devine
Layout: Mary Bower

Wyoming Water Resources Center
Box 3067, University Station
Laramie, WY 82071-3067
Phone (307) 766-2143

Printed on recycled paper.

Ocean Lake reaps water quality improvement results

Until the mid 1960s, Ocean Lake, near Riverton, produced 43 tons of harvested sport fish, primarily crappie and ling, every year. In 1971, 101 tons of carp were harvested. In just one decade, Ocean Lake had changed from being a nationally recognized black crappie fishery to murky water with high sedimentation, suspended solids and nutrients. It was classified as eutrophic, a body of water with an environment more favorable to plant than animal life. Carp and blue-green algae flourished.

The problem was this: Ocean Lake was originally created by irrigation return flow waters. The land area consists of 41,000 acres of irrigated crop lands that drain into 6,100-acre Ocean Lake. Over time, excessive erosion of granitic surface soils and in drainage ditches contributed to increased sedimentation of the lake. The problem was exacerbated when more easily erodible volcanic materials from the subsurface began to erode. As the granitic soils and volcanic materials were carried to the lake, they fell out rapidly and built deltas around the drain mouths. The volcanic materials suspended in water caused poor habitat for aquatic organisms including fish.

Several approaches are being taken to help correct these problems. Projects are underway to stabilize the drainage ditches and slow the runoff water that erodes ditches and carries silt. Farmers are taking other steps such as fencing livestock out of the drainage areas to promote vegetation that stabilizes the stream banks and using more efficient irrigation methods to reduce return flows.

Several agencies have been working cooperatively towards common goals of increasing water use efficiency, elimination of the NPS pollution and improving water quality in the Ocean Lake Hydrologic Unit Area. The Soil Conservation Service (SCS) has provided the technical assistance and conservation planning. The Agricultural Stabilization and Conservation Service (ASCS) has assisted landowners in the financial aspects of federal cost-sharing for water management. And, the University of Wyoming Cooperative Extension Service (UWCES) has provided community education and assistance in all aspects of the Ocean Lake HUA project.

John Brenner (left), USDA SCS Area One project engineer in Riverton, watches Hurley Dockham, an area farmer, program the surge valve's solar-powered computer. Dockham is programming the timing of the irrigation surges.

In 1986, a group of federal, state, local and district officials formed the Save Ocean Lake (SOL) Committee. The Midvale Irrigation District, Bureau of Reclamation, Wyoming Game and Fish Department, Riverton Conservation District, Fremont County Recreation Board, Department of Environmental Quality Nonpoint Source Program and Wyoming Water Development Commission all joined SOL to achieve the committee's water quality improvement goals, with each agency contributing funds and services.

According to a report in "Clean Water Ways," Wyoming's Nonpoint Source Pollution newsletter, to date, the following work has been accomplished:

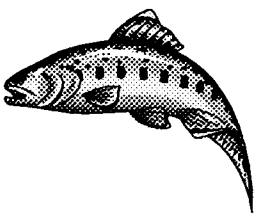
- 23 drop structures have been built to reduce the velocity of water in the irrigation return water drains;
- 19,800 feet of fence (with 7 water gaps in stable areas) have been installed to prevent livestock from damaging drain banks;
- 16 inlet pipes have been installed to control the flow of water from fields to drains;
- Reseeding of properly designed slopes has stabilized banks and helped slow water velocity.

The SCS and UWCES have been working together with SOL to provide water management recommendations and promote farm practices designed to help improve water quality and aid area producers in realizing increased productivity. For example, gated pipes and surge valves have been introduced on several farms to reduce erosion and nutrient leaching while improving water application efficiency and uniformity. These systems regulate water flows to save water and time while more evenly watering fields, keeping water in root zones and boosting yields.

Kirk Faught, UWCES agent, has been helping area producers with their surge flow irrigation. Not all data are in, but several Pavillion-area farmers have seen production and efficiency advantages in surge flow irrigation, using computer-equipped surge valves. "I'm really impressed with what this has done here, I really am," said Hearley Dockham, one of the Pavillion farmers who have been involved with the SOL irrigation project.

The various measures the SOL group has been taking for Ocean Lake are expected to improve the environmental quality of the area as well as benefit a great number of citizens including farmers, ranchers and recreationists.

For more information, contact Kirk Faught at 857-3918, or Joe Hiller at 766-2196.



Water resources exhibit available for loan

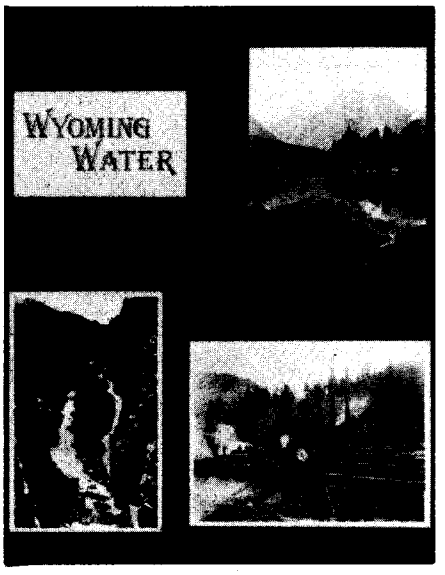
An educational and historical exhibit on Wyoming water resources has been developed by the University of Wyoming's American Heritage Center (AHC) and is available for loan to any interested organization.

The exhibit consists of three historical photographic displays with distinctly different themes. Exhibit 1, "Wyoming Water: A Working Partner," focuses on the partnership of Wyomingites and water to create a unique Western lifestyle. In much of the West, the average rainfall is under 20 inches per year, and the streams and rivers are inadequate to irrigate all the land. The exhibit shows early water development projects and how abuse and waste of water are synonymous with failure in this land.

Exhibit 2, "Wyoming Water: The Search for Enough," concentrates on how both Indian and emigrant trails in Wyoming followed the watercourses. In 1870-1871, the official expedition of the United States Geological Survey under Ferdinand Hayden spent considerable time assessing the water resources of the country. In the 20th century, the United States Bureau of Reclamation undertook a massive dam building program in the West. The photographs in this exhibit depict the route of the Oregon-California Trail through Wyoming, the Hayden Survey and the construction of some of Wyoming's dams and reservoirs.

Exhibit 3, "Wyoming Water: A Companion in Sport," shows water as it is celebrated for its beauty and for its contribution to the pleasure of our leisure hours. Fishing, boating or just having water as a pleasant backdrop for picnicking are some of the pleasures water affords us. In many places in the West, notably in Yellowstone National Park, water takes on truly spectacular forms creating geysers, soda springs and boiling mud flats as well as picturesque waterfalls and mountain lakes.

Underwritten by the American Heritage Center, the exhibits are available for loan, free of charge. However, the exhibitor needs to pay for insurance and the cost of shipping to the next exhibitor's site. The total weight of the three displays is about 180 pounds. For more information, contact the Center at (307)745-4114.



The AHC exhibits on Wyoming water resources contain 87 photographs depicting various aspects of the importance of water in Wyoming.

USGS ADAPS access available at WWRC

In April, the United States Geological Survey made Automated Data Processing System (ADAPS) access available to the Wyoming Water Resources Center's Water Resources Data System (WRDS). ADAPS provides up-to-date water resource information including water flow and levels at 52 observation points throughout the state. The data include real-time information as well as historical daily records. Water flow and levels are recorded every 15 minutes. These real-time data are then reported and made available to users every four hours.

"Real-time data can be extremely valuable to a lot of people including irrigators and people involved in recreational use of water. Those wanting to go rafting can check the real-time report and know the water condition of the hour, not just that of the day or week," Barry Lawrence, WRDS coordinator, notes. "The system also provides access to historical daily records of non-automated stations. The records include water quality sampling as well as flow information. We are happy to provide this service to users right here at the university." Contact Lawrence, WRDS, at 766-2143 for more information.

Regarding Sheridan and Powell Seminars

The names of several participants and contributing agencies and groups were inadvertently omitted from the article in the March issue of the Hydrogram dealing with the seminars held in Sheridan and Powell. The omitted names include those representing Sheridan College, Wyoming Association of Conservation districts, the Buffalo mayor's office and University of Wyoming's Research and Extension Center in Powell. The article was not meant to give an all-inclusive list of the participants and their affiliated organizations. Each and every participant and the group he/she represented contributed to the success of the seminars, and organizers deeply appreciate their valuable contributions.

Great Plains region water study booklet published

An agricultural task force has published its study results and recommendations on improving water quality in the Great Plains region. The 24-page booklet, "Agriculture and Water Quality in the Great Plains: Status and Recommendations," was prepared by the Great Plains Agricultural Council's (GPAC's) Water Quality Task Force. The region's eight states are Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas and Wyoming. "Agriculture and Water Quality in the Great Plains" is now available in limited quantities free from the Wyoming Water Resources Center (WWRC) at the University of Wyoming.

Ari Michelsen, WWRC associate director, represented Wyoming on the 16-member task force which studied the status of water quality as related to agricultural activities in the Great Plains region. Michelsen says the task force addresses eight major water issues in the booklet, which gives an overview rather than a detailed report. The issues and recommendations in the report include:

-- the unique characteristics of the Great Plains as a climatically transitional zone, between sub-humid and arid areas of the United States, need to be recognized and all measures including research, education, technical and financial assistance programs should be customized to meet the specific needs of the region;

-- many state and federal agencies' efforts on water resource issues need to be coordinated, and the creation of a water quality coordination group is recommended;

-- quantifiable relationships between agricultural activities and water quality must be established through increased monitoring of ground water, and research on chemical movement in the soil and vadoze zone should be established;

-- application of computer models should be increased to define and document relationships between agricultural production systems and associated water quality impacts;

-- funding of water quality research, extension, and technical assistance activities should be adjusted to provide flexibility in addressing emerging issues while retaining long-term funding to address basic concepts and relationships;

-- more professionals are needed to train people on water issues;

-- the voluntary nature of nonpoint source pollution program needs to be reviewed and possibly adjusted.

For a free copy of "Agriculture and Water Quality in the Great Plains" write to: Wyoming Water Resources Center, P.O. Box 3067, Laramie, WY, 82071; or call (307)766-2143.

Water supply outlook

With spring snow melt in full swing, every drainage basin except for the Belle Fourche, Upper North Platte and the Little Snake River showed decreases in the winter snowpack. Best snowpack in the state remains in the northwest corner of the state where snowpacks are in the upper seventy and eighty percent of normal for this time of year. The Shoshone River tops the list with 81 percent, closely followed by the Bighorn Basin with 80 percent. The lowest snowpack is shown in the Upper Bear River with only 22 percent of normal for this time of year.

Snow surveyors taking their last measurements of the year during the last week of April had a tough time finding enough to measure. Water users appear to be facing the long hot summer without a full water supply over much of the state. (from Monday Morning Snow Report, April 27, 1992, USDA, Soil Conservation Service; Casper, Wyoming)

Small community handbook gives overview of EPA rules

"Everything You Wanted to Know About Environmental Regulations...But Were Afraid to Ask" is the title of a new handbook written specifically for very small communities (population under 1,000). It provides an overview of the U.S. Environmental Protection Agency's (EPA) regulatory and non-regulatory programs. Created by the EPA Region VIII Small Community Workshop, which consists of representatives from 16 organizations, the 1991 publication has sections dealing with:

- water programs, including drinking water, wellhead protection, wastewater, and water and wetlands protection;
- the air program, specifically the Clean Air Act Amendments;
- land programs, including hazardous waste, solid waste landfill criteria and underground storage tanks;
- cross-media programs, including information about pollution prevention, public-private partnerships, asbestos and indoor radon;
- definitions; and
- Region VIII contacts.

Each section describes regulations, lists actions a community should be taking and provides references for more information.

More than 40 pages are dedicated to drinking water issues, including information about inorganic, synthetic organic and volatile organic chemicals; coliform bacteria monitoring; the Surface Water Treatment Rule; radionuclides; public notification; and disinfection and its byproducts.

The handbook (Item #: P000353) may be obtained for free from the Region VIII USEPA office, (303)283-1456, or from the National Drinking Water Clearinghouse, 1-800-624-8301 for $6 plus shipping charges. (from "On Tap," Vol. 1, Issue 1, March 1992, p. 9)

Sheridan water project to supply quality water

In order to more effectively meet the multi-faceted water needs of the area, Sheridan, Wyoming, has undertaken a $55-million water supply, treatment and distribution system project. The overall project involves construction of a treatment plant, dam enlargement and distribution system improvement to provide new and expanded water service to Sheridan and surrounding area users. Once the project is completed in 1995, it will provide many important benefits.

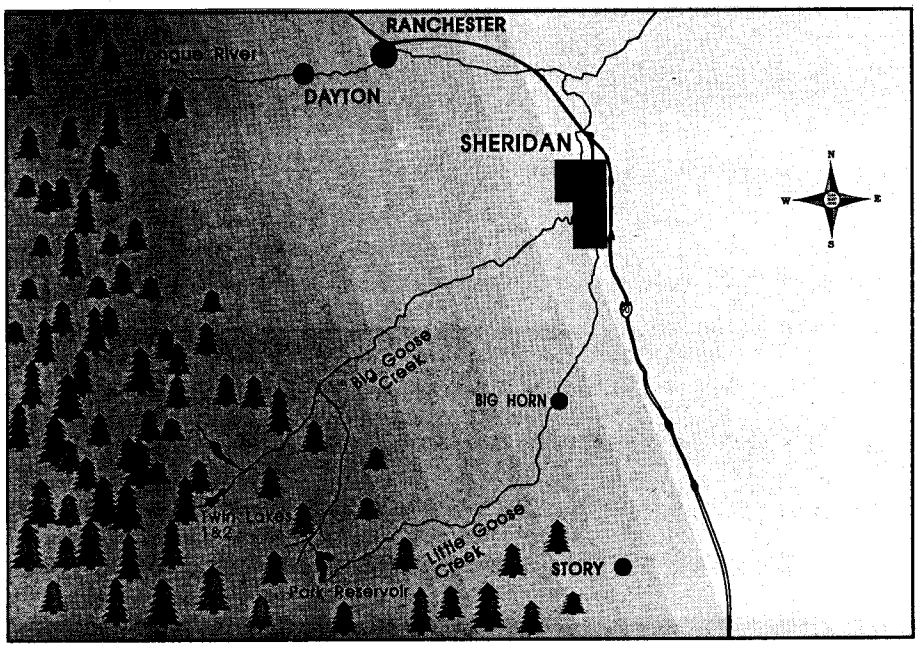
A five-million-gallon per day treatment plant will be constructed at the top of the Big Goose Creek Valley. This facility will serve the valley and the Little Goose Creek Valley and augment the city's treatment capacity. Distribution systems will also be constructed as part of the project and will serve approximately 1000 existing residences in the Big Goose Creek and Little Goose Creek Valleys. These residences have been relying on individual private water wells of insufficient quality and/or quantity.

Another part of the project will involve enlargement of Sheridan's Twin Lakes water supply facilities. Because of the failure of these facilities to meet current dam safety standards, substantial rehabilitation is needed. Once completed, the enlarged facilities will be able to supply residences with treated water service as well as to provide for future growth.

New distribution systems will also be constructed within the City of Sheridan to provide water service where none previously existed and where current service is inadequate. A new untreated water transmission main will be constructed in the Big Goose Creek Valley to carry water from Sheridan's existing intake to its water treatment facility. Two existing transmission mains, which were constructed in the early 1900s, have caused significant water loss and maintenance problems.

Initial studies for the project were conducted in early 1980s, but with the creation of the Sheridan Area Water Supply Joint Powers Board between the city and the county in 1988, the mechanism needed to proceed with the project was finally established. Funding for the project comes from Wyoming Water Development Commission grants and loans ($32 million), a local capital facilities tax ($19 million), Farm Loan Board grants ($4 million), Farmers Home Administration grants ($2 million) and a Wyoming Permanent Mineral Trust Fund loan ($6.75 million).

According to David Engels, project manager for the Sheridan Area Water Project, local citizen support for the project is high. He further notes, "The project provides an opportunity for rural residents to receive a public water supply and provides the opportunity for the City of Sheridan to grow."



The map shows the Sheridan Area Water Project sites.

WPCF, NWWA have new names

Two water organizations recently changed their names to better reflect the scope and nature of today's environmental issues.

The Water Pollution Control Federation (WPCF) and the National Water Well Association (NWWA) changed their names last fall to Water Environment Federation (WEF) and National Ground Water Association (NGWA), respectively.

According to "On Tap," a publication of the National Drinking Water Clearinghouse at West Virginia University, WEF's president, Roger Dolan, commented, "...the word 'control' just isn't good enough. We don't control pollution any more; we eliminate it." The not-for-profit technical and educational WEF membership consists of water quality and treatment specialists.

"On Tap" also reports that NGWA president, Ron Hiddleston, noted, "We have a new name, a new executive director, and a new beginning." NGWA is a not-for-profit professional membership society and trade association, representing all segments of the groundwater industry. Phone numbers and addresses for both organizations remain the same. The WEF is located at 601 Wythe Street, Alexandria, Virginia, 22314-1994; the phone number is (703)684-2400. The address for NGWA is 6374 Riverside Drive, Dublin, Ohio, 43017; the phone number is (614)761-1711.

SUMMER CALENDAR 1992

June 15-17 **A water law conference, "Uncovering the Hidden Resource: Groundwater Law, Hydrology and Policy in the 1990s,"** will be held at the University of Colorado at Boulder. For information, contact Katherine Taylor, (303)492-1288.

June 15-19 **Platte River Tour No. 1, No. 2 (July 13-17) and No. 3 (Aug. 10-14)** will take participants from the headwaters of the North Platte River in Colorado and Wyoming and down along the mainstem of the river into Nebraska. For more information, contact Janet Lee Montera at Colorado State University, (303)491-7425

July 6-17 & July 20-31 **Water Institutes for Teachers (WIT)** will be held in Laramie (July 6-17) and in Casper (July 20-31). At WIT, teachers earn two credit hours and learn about Wyoming water resources and issues through classroom sessions, hands-onactivities and field trips. WIT also provides many water resource concepts and activities that can be incorporated into a curriculum. Contact Jeanne Unruh at the Wyoming Institute for the Development of Teaching, (307)766-6381, or Ari Michelsen at WWRC, (307)766-2143, for more information.

July 20-31 **"Constructed Wetlands for Wastewater Treatment" seminar** will be held at Fort Collins, Colorado. For information, contact Maurice Albertson, Department of Civil Engineering, Colorado State University, (303)491-5753.

Sept. 1-3 "Settlement of Indian Reserved Water Rights Claims," 2nd Symposium,will be held at the Hyatt Regency Hotel in Albuquerque, New Mexico. An agenda and registration materials will be available soon. The Western States Water Council and Native American Rights Fund are organizing this event.

Oct. 2-3 Western Regional Instream Flow Conference II: "Tools and strategies for the enhancement and maintenance of instream flow" will be held in Jackson Hole, Wyoming. Contact: Western Regional Instream Flow Conference II, (307)733-9678

Water Center funds *(Continued from page 1)*

Four research projects were selected for funding this year and include the following:

Project title: **"Comparison of Depth-to-Groundwater Suitability Curves for Important Riparian Plant Species in the Subalpine and Montane Zones"**

Principal investigators: Thomas A. Wesche, Quentin D. Skinner and Robert J. Henszey

Grant total:* $63,190 (*Amount includes federal and non-federal funds.)

Project objectives:
Development of fundamental principles to characterize water requirements of riparian wetlands and the instream flow necessary to maintain wetland conditions in subalpine and montane areas. Surface water/groundwater stage relations and depth-to-groundwater duration curves for important plant communities will be developed.

Project title: **"Monitoring Dicamba and Picloram Movement in the Vadose Zone for Groundwater Quality Protection in Wyoming"**

Principal investigator:
George F. Vance

Grant total: $28,154

Project objectives:
Wyoming agricultural and rangeland areas will be examined to determine the movement and fate of two pesticides, dicamba and picloram, by analyzing soil/ substrata, soil solutions and shallow groundwaters. Results of this research should provide insight into these pesticides' potential to contaminate groundwater and help develop best management practices to prevent possible contamination resulting from these pesticides.

Project title: **"Severe Drought and Water Shortages in the Upper Green River Basin: Modeling Economic Impacts and Institutional Alternatives for Water Management"**

Principal investigators: Ari M. Michelsen and James F. Booker

Grant total: $55,246

Project objectives: The project addresses economic impacts and analyzes water management alternatives when problems, such as severe and sustained drought, climate change and transbasin diversions, occur. The research will provide fundamental empirical information on the magnitude of both direct and indirect economic impacts of water supply shortages in the upper basin areas of the Colorado River Basin.

Project title: **"Assessment of the Potential Environmental Fate and Effects of Oil-Field Discharge Waters Containing ^{226}Radium"**

Principal investigators: Harold Bergman and Sheryl Hill

Grant total: $63,896

Project objective(s): A field investigation will be conducted to determine the concentrations of radium in surface waters and sediments affected by oil production waters which are discharged to skim ponds, watercourses and wetlands. The results of this project will be useful in evaluating the effectiveness of current discharge limits for protecting the quality of surface waters and groundwater receiving these types of discharges.

The next issue of the Hydrogram will contain a summary of all WWRC state-sponsored projects. If you have any questions, please contact WWRC at 766-2143.

Safe Drinking Water (SDW) hotline gives free information

A toll-free telephone number, **1-(800)426-4791**, is available to help people get answers to drinking water questions. A service of the U.S. Environmental Protection Agency (EPA), the Safe Drinking Water Hotline is staffed by information specialists that have completed a comprehensive training program.

Started in 1987 to help public water systems, state regulatory agencies, outreach workers, environmental organizations, consultants and the public to understand federal drinking water regulations and programs, the Safe Drinking Water Hotline is operated by Geo/Resource Consultants, Inc., under contract to EPA's Office of Ground Water and Drinking Water. Callers from anywhere in the United States, Puerto Rico and the Virgin Islands can use the service Monday through Friday, 8:30 a.m. to 5 p.m. Eastern Standard Time, except on federal holidays.

According to Judy Lebowich, EPA project officer for the hotline, the questions asked "run the gamut" and peak around major implementation dates and after a proposed or final drinking water regulation is published. Recently, the hotline has received a lot of calls about lead in drinking water, she said.

In addition to answering regulatory questions, information specialists also answer questions on such topics as drinking water health effects, tap water testing, home water treatment units and bottled water, and provide referral to other federal, state, and local organizations as appropriate. The hotline also provides information about the availability of EPA's drinking water publications, public education materials and other documents. (--"On Tap," Volume 1, Issue 1, March 1992, p. 9)

Non-Profit Organization
U.S. Postage
Paid
Laramie, Wyoming 82071
Permit No. 1

UNIVERSITY OF WYOMING

Wyoming Water Resources Center
P O Box 3067, University Station
Laramie, WY 82071-3067

Wyoming Hydrogram
Vol. 4, No. 2

RESEARCH BRIEFS

Wyoming Water Resources Center

Technical RB92-02

DEVELOPMENT OF A CHEMICAL AND BIOLOGICAL METHOD TO RECLAIM ALKALINE SOLID WASTES

Investigators K. J. Reddy, Wyoming Water Resources Center and S.E. Williams, Department of Plant, Soil, and Insect Sciences, University of Wyoming.

Purpose Although petroleum reserves are finite and perhaps shrinking, solid fossil fuels such as coal and oil shale, are abundant and increasing in importance in Colorado, Utah, and Wyoming. Coal combustion and oil retorting of shale both produce alkaline solid wastes (e.g., fly ash and spent shale), which are potential causative agents for environmental pollution of soil, surface water, and groundwater. Revegetation of these wastes is hampered by high pH, increased solubility of some chemical constituents, and very low biological activity. The objectives of this study are to (A) develop a method to lower the pH of alkaline solid wastes by CO_2 exposure under pressure in the presence of moisture, and to (B) determine the effect of CO_2 pressure treatment on solubility and availability of various elements and on biological activity.

Methods Two fly ash samples, #1 and #2, were collected from power plants in Wyoming. Two spent shale samples, PPP6 (Paraho Pilot Process) and Lurgi, were collected from Western Research Institute, Laramie, WY. Objective A was met by preliminary experiments and optimization of treatment variables. Subsequent experiments were designed with a 2-level, 3-variable factorial design for optimization of treatment variables. After optimization studies, approximately 1 kg of each sample was reacted in the vessel with 20% moisture for 5 days at 40 psi. Samples were mixed well to ensure complete recarbonation. After treatment, samples were transferred into plastic bottles for subsequent experiments. To meet objective B, treated and untreated samples were subjected to chemical studies (X-ray diffraction, AB-DTPA extractable, and $CaCO_3$ analysis) and biological studies. For biological studies, treated and untreated samples were plated on several media specific to general groups of soil microorganisms. Media used were glucose nutrient agar (for fast growing bacteria), potato dextrose agar (for fungi), Lingappa and Lockwood medium (for actinomycetes) and modified mineral salt medium (for slow growing bacteria). In addition, yellow blossom sweet clover was grown in dilutions of each material (undiluted, 1:5, 1:10, and 1:100). Plant health, nodule number, and infection by vesicular-arbuscular mycorrhizae were recorded.

Results Fly ash and spent shale samples were alkaline (Table 1). Combustion of coal and oil shale at high temperatures causes decomposition of carbonate minerals and production of oxides and silicate phases. Rapid reaction of oxide and silicate phases with water caused a high pH of untreated samples. Reacting samples at 40 psi with 20% moisture for 5 days lowered pH to around 9.0 as a result of calcite precipitation. The data presented in Table 1 further suggest that fly ash and spent shale samples are effective absorbents for CO_2. Fly ash and spent shale samples had significant concentrations of environmentally

Table 1. The effects of CO_2 pressure treatment on pH and $CaCO_3$ content[a].

Sample	Treatment Status	pH	% $CaCO_3$	% CO_2 Absorbed
Fly ash 1	Untreated	12.27	4.8	4.0
	Treated	9.71	15.0	
Fly ash 2	Untreated	12.79	10.7	15.0
	Treated	9.14	47.3	
PPP6	Untreated	12.38	17.6	8.0
	Treated	8.76	33.7	
Lurgi	Untreated	12.29	39.4	4.0
	Treated	8.91	53.4	

[a] mean of duplicate analyses.

deleterious elements before treatment (Table 2). The CO_2 treatment effectively reduced these concentrations (Table 2).

Plate counts of the microbial populations in the fly ash and spent shale were dominated by bacteria. However, absolute numbers of bacteria strongly suggest that these materials, both treated and untreated, are very low in biological activity. Very few fungi were recorded and almost no actinomycetes were observed.

Conclusions

Reacting fly ash and spent shale samples at 40 psi for 5 days with 20% moisture lowered the pH from 12.0 to 9.0 by the precipitation of calcite. The yellow blossom sweet clover bioassay demonstrated that this plant could survive in most of the materials, treated or untreated. However, these data require further analysis. CO_2 pressure treatment effectively decreases the release of various elements from alkaline solid wastes. The significant aspect of this process is the use of CO_2, which is obtained either from the combustion process itself or from another source. Another potential benefit of the process is that it may help to reduce emissions of CO_2 into the atmosphere. However, further research is needed to examine the long term stability of treated samples.

Table 2. The effects of CO_2 pressure treatment on AB-DTPA extractable elements[a].

Element	Fly ash 1		Fly ash 2		PPP6		Lurgi	
	BT	AT	BT	AT	BT	AT	BT	AT
Cd	0.2	0.1	3.60	0.6	0.1	0.1	0.1	0.1
Pb	BD	BD	38.00	5.8	1.7	0.5	BD	BD
Zn	1.7	0.6	79.00	10.2	3.8	5.2	9.2	5.6
Mn	4.5	1.6	31.00	5.4	24.0	2.6	40.0	4.4
Ni	0.5	0.2	11.00	1.9	0.7	1.0	1.2	1.2
Cu	2.7	1.2	62.00	18.0	0.8	4.0	2.8	3.1
As	BD	BD	BD	BD	BD	BD	2.1	BD
Se	BD	BD	0.78	0.2	BD	BD	BD	BD

[a] units mg/Kg and mean of duplicate analyses.
BT = before treatment; AT = after treatment, BD = below detection limit of 0.1 mg/L.

Publications

Reddy, K.J., J.I. Drever, and V.R. Hasfurther. 1991. Effects of a CO_2 pressure process on the solubilities of major and trace elements in oil shale solid wastes. Envir. Sci. and Tech. 25:1466-1469.

Reddy, K.J. 1991. Immobilization of toxic elements in alkaline solid wastes. Fourth annual meetings of Amer. Water Resourc. Assoc., Wyoming section, Laramie. p10-12.

Clark, R.A., K.J. Reddy and L. Wang. 1991. Utilization of CO_2 to minimize the solubilities of toxic elements in alkaline solid wastes. Envir. Qual. Div. Agron. Abst., Madison, Wisconsin. p38.

Reddy, K.J. and S.E. Williams. 1991. Development of a chemical and biological method to reclaim alkaline solid wastes. Final Rep., U.S.G.S., Section 104.

For further information on this or other research projects or for a list of WWRC publications, telephone or write:

Wyoming Water Resources Center
P.O. Box 3067, University of Wyoming
Laramie WY 82071-3067
(307) 766-2143; FAX (307) 766-3718

WWRC RESEARCH BRIEFS are published by the Wyoming Water Resources Center with funds provided in part by the US Geological Survey, Department of Interior, as authorized by the Water Resources Research Act of 1984. The research on which this report is based was financed in part by the US Geological Survey, Department of Interior and Wyoming Water Resources Center. The views expressed do not necessarily represent those of the Department of Interior or the WWRC. Persons seeking admission, employment, or access to programs at the University of Wyoming shall be considered without regard to race, color, national origin, sex, age, religion, political belief, handicap, or veteran status.

UNIVERSITY OF WYOMING

Technical RB92-02