University of Wyoming
WATER RESEARCH PROGRAM
REQUEST FOR PROPOSALS
FY2003 Program

The Water Research Program (WRP) invites faculty members and affiliates of the University to submit research proposals under the National Institutes for Water Resources (NIWR) annual allotment program funded jointly through the U.S. Geological Survey and the State of Wyoming Water Development Commission. Proposals responding to the priority areas described below are sought. Total available funding for new projects for FY2003 could be approximately $200,000.

Proposals for research projects of one to three years in duration will be accepted, but can only be funded on a year-by-year basis. Thus, annual plans of activity and budgets must be submitted in addition to a total budget for all years. The Priority and Selection Committee will monitor progress and act on continuation annually. Annual and final reports on all projects are required. Also, results of research under the WRP are expected to be published in peer reviewed publications.

Proposals must include University faculty or affiliates as Principal Investigators. Student training is a high priority of the WRP, thus student participation is expected. In addition, most projects are expected to include personnel from a State Sponsoring Agency as a coordinator and/or participant.

Selection will be based on the results of peer reviews and the decision of the Priority and Selection Committee. Final approval must be obtained through the NIWR annual allotment program and through contract with the Wyoming Water Development Commission. All proposals must be submitted for review in hard copy. However, final submission of selected projects to the NIWR program will be in electronic format.

PROPOSAL DEADLINE: Tuesday, October 15, 2002.

Tentative Timeline for Project Selection and Start-up:

Proposal submission due date: Tuesday, October 15, 2002
Peer review completed: November 13, 2002
Project selection by Priority and Selection Committee: November 26, 2002
Submission of FY2003 application to USGS in electronic format: Early January, 2003
Tentative project start date, pending USGS and WWDC approvals: March 1, 2003.

All researchers interested in submitting proposals must contact the Director of the WRP for formatting requirements, budget preparation including an Excel template, submission guidelines, selection criteria, reporting requirements, and other information (this step is critical since it also serves notice that peer reviewers will be needed and thus allows the process of identifying peer reviewers to be initiated).

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WRP Research Priorities for FY2003

1. Coalbed Methane Issues

Coalbed methane development in the Powder River structural basin in northeastern Wyoming is occurring at a rapid pace as demand for natural gas has increased in the United States. Coalbed methane is removed from coal beds by pumping ground water (dewatering) from coalbed methane production wells installed in coal beds. Co-produced ground water is currently being discharged to the surface in the Tongue, Powder, Little Powder, Belle Fourche, and Cheyenne River watersheds in the Powder River structural basin, typically to ephemeral drainages and/or unlined evaporation/infiltration ponds. Because of the concerns associated with these discharges into the surface water environment, the State of Wyoming has identified research needs in these watersheds as high-priority.

The co-produced water discharged to the surface is managed and regulated by several State and Federal agencies under several programs. In order to effectively manage this water under the various regulatory programs, the fate and effect of the water discharged to the surface and shallow groundwater systems needs to be fully understood. Following are two projects of priority interest to the State:

a. Effect of Subsurface Infiltration.

Co-produced water discharged to the surface flows along ephemeral drainages to perennial streams in the area, is consumed by evaporation and evapotranspiration, and infiltrates and percolates to the subsurface in the study area. It has been observed that in many locations, much of the water discharged to ephemeral drainages does not flow to perennial streams – the water is lost to a combination of evaporation/evapotranspiration and infiltration to the subsurface. Also, much of this water may be held in reservoirs, where it evaporates or infiltrates.

Since evaporation/evapotranspiration can account for only a relatively small amount of the loss of water in ponds and ephemeral drainages, it is estimated that a large quantity of co-produced water is being lost by infiltration and percolation to the subsurface. The infiltration of large volumes of this water into the subsurface has the potential to affect water quality in shallow aquifers in the area and may interface with surface water. The potential impact is related not only to the water quality of the co-produced water, but also to the rate and volume of water that infiltrates and percolates to the water table.

A better understanding of the potential rates of infiltration and percolation of co-produced water under the ponds and ephemeral drainages is needed to evaluate the potential impact of co-produced waters on the water quality of shallow aquifers in the area of development. In addition, estimates of the quantity of water lost by infiltration as it flows away from the point of discharge to perennial streams have implications to regulatory programs such as NPDES and TMDLs.

Specific goals of a proposal may include:

aa. Estimate annual rate and volume of infiltration and percolation below an ephemeral and/or perennial stream in the Powder River structural basin

bb. Estimate annual rate and volume of infiltration and percolation below an evaporation/infiltration pond in the Powder River structural basin

cc. Estimate effect on groundwater quality from infiltration.

These results can be used to estimate potential ground-water recharge or interactions with surface waters from co-produced coalbed methane discharges to shallow aquifers in the Powder River structural basin.

b. Geochemistry Changes of Coalbed Methane Water

The University of Wyoming has done some preliminary analysis of the water in approximately fifteen coalbed methane produced-water retention ponds for gross

geochemistry and water quality. Concentrations of some constituents increased with time, and some decreased. There is need for additional research in this area.

Specifically, there is need to develop a better understanding of the chemistry changes that occur over time from the interaction of CBM discharge water to channel sediments and natural waters. This would include critical metals such as iron, barium and arsenic and the relationship of various dissolved salts.

This request would hopefully expand our knowledge of the chemical changes that occur in the quality of the surface water in downstream ponds and receiving main stems from the discharge of CBM water.

2. Theoretical and Empirical Approaches to Maintain and Improve Stream Physical Characteristics

A major effort is underway in Wyoming to protect and improve the quality of its streams. Numerous Federal, State and local agencies are working, sometimes in concert, to monitor, assess, and improve stream quality. These efforts represent millions of dollars of investments of taxpayer money. While stream quality is most commonly associated with natural chemical constituents dissolved in water or specific pollutant species, quality can also refer to biological or physical characteristics of the stream. Physical characteristics of streams, things like slope, channel width and sinuosity, bank angle, sediment transport capacity etc., are a function of physiography, geology, climate, land use and many other factors. Basic information relevant to Wyoming streams and the factors that control their physical characteristics are needed to help guide monitoring, assessment, and restoration efforts to ensure that taxpayer supported efforts are effective and efficient. This call requests proposals that address this basic information need. Successful proposals would employ field or laboratory simulation techniques to provide scientific insights regarding the physical characteristics and sediment transport capabilities of the types of streams found in Wyoming.

3. Drought Early Warning Technology Development.

Is there a way that the National Weather Service's Weather Precipitation Index (API – defined as an index of moisture stored within a drainage basin before a storm) could be modified for application for snow pack-based runoff estimations? What work, if any, has been done in Wyoming to develop predictive capabilities to assess what antecedent moisture conditions (AMC) will be on next year's inflow. Are there any other factors beyond antecedent moisture that would affect the amount of runoff? What data is necessary to make these determinations? What equipment would be necessary to collect the data and where should the data collection sites be located?

4. Conveyance Losses

Wyoming is a headwater state and most of the streams are regulated to meet downstream needs based on compacts and court decrees. It is necessary for Wyoming to know the conveyance losses in various stream segments to be able to properly administer its water rights. Currently there is a need to determine the conveyance losses between Woodruff Narrows Reservoir and Pixley Diversion Dam. A determination needs to be made as to how much storage water versus direct flow is in this stream segment so that each can be charged with the appropriate conveyance losses. This information would benefit Wyoming's interstate interest on the Bear River.

5. Wind River Basin Cloud Seeding Analysis.

The recent drought, covering much of the State and in particular the Wind River Drainage, has raised the question of the viability of supplemental water supply from cloud seeding. The weather patterns that typically bring moisture to the Wind River Drainage and Wyoming as a whole come from the West and move Eastward. Can storm systems moving through these patterns over several mountain ranges be stimulated and induced to deposit more precipitation in areas where it would be available to water users in the Wind River Drainage. The analysis should also address the probable impacts to both up-wind and down-wind areas.

Specific items to address are:

a. Can precipitation be enhanced in the Wind River Drainage.
b. Public acceptance of cloud seeding.
c. Cost of a production scale program.
d. Probable yield of a program.
e. Permitting needs

6. Effects of Suburbanization on Wyoming's Waters

Although Wyoming is a small state with a small population, various communities around Wyoming are experiencing tremendous growth in the suburban areas (outside the city limits). In many locations, this growth is occurring in the most scenic and environmentally sensitive areas. This extension of urban areas with individual wells, septic systems, curb, gutter, pavement or dirt roads and storm water runoff will probably transcend into changes to surface and groundwater resources. There is a need to begin to understand the positive and negative effects of this land use so that local and state governments can properly plan for this relatively new land use.

7. Subsurface Drip Irrigation Application Technology Demonstration and Efficacy Evaluation.

Subsurface drip irrigation is an irrigation application technology that is relatively new to the western region of the United States. Subsurface drip irrigation, often referred to as microirrigation, is used on only approximately 4% of irrigated farmland in the United States (Handbook of Water Use and Conservation by Vickers). Subsurface drip irrigation allows for frequent, low pressure applications of small quantities of water beneath the soil surface at or below the root zone. Small diameter plastic tubing equipped with low pressure emitters is buried at varying depths which provides for high water-use efficiency, increased yields, enhanced water penetration into problem soils, reduced weed growth and irrigation water to be applied to uneven terrain or irregular shaped fields. This application technology is highly adapted to automation and can reduce irrigation application operation and maintenance. As this is new technology to Wyoming, there is need for this technology to be installed for demonstration and efficacy evaluation in a controlled, experimental design with comparison to conventional flood irrigation application. The initial scope of this research would be to compare water use efficiency, measure crop yield, measure return flow and assess the quality of tail water. An 80 acre site that has homogeneous soils and is adjacent to Highways 133 and 134 is available on Midvale Irrigation District in the Pavillion area. This field is conducive to being split to accommodate a side-by-side trial of subsurface drip irrigation with conventional surface flood irrigation. Efforts are being made to attract a manufacture to provide the tubing at least at a cost reduction.

8. Evaluation of Increased Crop Production and Selenium (Se) Reduction as a Result of Improved Irrigation Application Efficiencies and Soil Profile Mining With Alfalfa.

The Kendrick Project, located on the North Platte River, developed water for irrigation and electric power generation. Within this project area is the Casper-Alcova Irrigation District (CAID) which uses water from Alcova Reservoir for irrigation of approximately 21,471 acres. Of that acreage, 91% is alfalfa of which 76.5% is furrow irrigated for a total of 18,114 acres. CAID water users can enhance water conservation, reduce irrigation diversion requirements, improve crop productivity, reduce return flows and potentially reduce soil profile Se by converting from furrow irrigation. Water-use efficiency can potentially be improved 40% to 50% by converting from surface applied to sprinkler applied irrigation. This could contribute to increased alfalfa productivity with the allocated water resource while significantly reducing return flow. Se in alkaline soils becomes oxidized to selenate which is water soluble, highly toxic, easily leached but readily available to some crop plants. Alfalfa is a secondary converter plant for Se. As such, alfalfa plant roots act like a pump bringing Se up in the soil profile and can accumulate fairly concentrated amounts. The scope of this project would be to evaluate increased crop production and Se reduction in the CAID area of the Kendrick Project as a result of improved irrigation application efficiencies and soil profile mining with alfalfa.

9. GIS Database of Paleozoic-Aquifer Water Supply Wells and Springs in Wyoming.

Graphic and interactive compilation of data associated with Paleozoic-age source supplies, including irrigation, municipal, industrial, and miscellaneous use (not including oil & gas development use, i.e. water flood supply). A single source from records in WWDC, SEO, WO&GCCC, USGS, WGS, etc. Would include a statistical gazette of information (yields, hydrostatic pressures, total depths, completion zones, etc.) based on formation. Features of outcrop exposures at mountain flank/basin margins and broad delineation of exploration potential in major basins. This would not be to the scale of an interactive database as being produced for the Powder River Basin or earlier for the Little Snake River Basin by the WGS, but could be a precursor to such an effort by utilizing similar select attributes. Since this work would not involve extensive research, it is imperative that proposals addressing this priority include student training.

10. Evaluations and Production Enhancement of the Brule Formation.

Several communities in Southeast Wyoming utilize the Brule formation for their public water supplies. Some wells in the Brule exhibit considerable secondary permeability, with resultant production, and others very nearby are tight and virtually non-productive. Research into methods to locate productive well locations and enhance the permeability in lower producing wells would be very useful.

The Town of Pine Bluffs has a number of Brule wells, and has been investing a considerable amount of time and money in recent years toward replacing some of their aging wells with varying success. In one case offset wells were drilled immediately around a high producing well without realizing similar yields.

This research project should analyze the potential to utilize geophysical, remote sensing, and other methods to locate areas with improved permeability, should compare alternative well completion methods, and should research ways to improve the permeability of existing wells. A contractor in the Pine Bluffs area has developed and used a down-hole formation saw on a few of the Town's wells with some success. The Water Development Commission and the Town of Pine Bluffs have developed a considerable information base that can be drawn upon toward this end.

11. Research Methods for Permittees to Analyze and Interpret Range Monitoring to Determine the Impacts on Water Quality

There is an immediate need to assist rangeland managers across the state in evaluating and determining actual range condition and trends on our public and private rangelands to improve water quality enhancement efforts. Currently, agricultural producers are collecting range monitoring data but do not understand what the data means in biological or water quality terms or how it can be used to drive management decisions. Methods are needed that will provide agricultural producers a way to evaluate range monitoring data in determining how various range management practices affect rangeland health and water quality. Basically two types of research are needed to include:

a) A model that can be used to analyze and interpret range monitoring data to provide public and private rangeland managers with information regarding rangeland health and trends
b) Evaluate the correlation between healthy rangelands and water quality.

Agricultural producers are becoming frustrated with not being able to analyze or interpret rangeland monitoring data they are collecting. Research is needed to qualify and quantify range monitoring data to determine range management impacts on water quality.

12. "Open" Category.

The Priority and Selection Committee welcomes research proposals related to other issues concerning Wyoming's water. As is the case for researchers intending to submit proposals under the above priority areas, those submitting proposals under this "open" category must contact the WRP Director indicating their intentions. Potential proposers will be provided information concerning formatting requirements, budget preparation (including an Excel template), submission guidelines, selection criteria, etc. Examples of possible proposals include, but are not limited to, the following topics.

a. Water conservation
b. Impacts of Reservoirs on Native Species.
c. Concentrations and Sources of Dissolved Uranium at Various Locations in the North Platte River Valley, Surface Water and Ground Water.
d. Comparison of Methods to Identify Canal Sections that would most Benefit from Lining or Placement in Pipe to Reduce Seepage.