REQUEST FOR PROPOSALS
University of Wyoming
Water Research Program
FY2010

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. It is also acceptable to address multiple research priorities within a single proposal. The available funds for new FY10 projects are estimated at approximately $250,000, dependent upon the level of the USGS appropriation.

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 WRP 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 WRP Priority and Selection Committee. Final approval must be obtained through the NIWR annual allotment program. All proposals must be submitted for review in both hard copy (10 copies required) and electronic format. Final submission of selected projects to the NIWR program will be in electronic format.

PROPOSAL DEADLINE: Tuesday, October 6, 2009, by 5:00 P.M.

Tentative Timeline for Project Selection and Start-up:

Proposal submission due date: Tuesday, October 6, 2009, by 5:00 P.M.

Project selection by Priority and Selection Committee: Friday November 20, 2009

Submission of FY10 application to USGS: Mid-January, 2010*

Tentative project start date, pending USGS approval: March 1, 2010*

*These dates, along with the dollar amount available for supporting new projects, are dependent upon approval of the FY10 Federal Interior Appropriations Bill

All researchers interested in submitting proposals must contact the Director of the WRP for formatting requirements (e.g., the narrative portion of the proposals is limited to 6 pages single spaced, Times New Roman 12 font, Microsoft Word), mandatory Excel template for preparing budgets, submission guidelines, reporting requirements, and other information. A minimum of 20% direct matching funds (e.g. PI time) is required on all proposals.

Greg Kerr
Director - Office of Water Programs
University of Wyoming
College of Engineering
1000 E. University Ave.
Department 3295
Laramie, WY 82071
Ph: (307) 766-6656
Fax: (307) 766-2221
Email: rrek@uwyo.edu

WRP Research Priorities for FY2010

The Water Research Program welcomes proposals that cover a wide range of areas involved in Wyoming's water resources. General areas include, but are not limited to the following:

- **Surface water hydrology**
- **Groundwater hydrology**
- **Water quality**
- **Biological/Social Sciences**
- **Climate/Hydrologic Processes**
- **Engineering**

In addition to the general areas that proposals may address, State and Federal agencies also provide more specific water related topics that are of direct concern as listed below.

Conveyance Losses on the Mainstem of the Green River

The flows in the Colorado River system have diminished with long-term regional drought. The water levels in Lake Powell sometimes approach the point where interstate regulation would be triggered. The State of Wyoming is gathering information to be able to regulate in the Green River Basin should interstate regulation be triggered. Regulation would cause a number of junior water rights to be shut off. These junior water rights may purchase water from senior direct flow users or stored water. Stored water may be mixed with natural flows leading to uncertainties as to the true quantities of each. Proper accounting of stored and natural flows becomes an important component in the administration and enforcement of Wyoming water laws and is vital to any regulation that may occur. Conveyance loss is an important quantity to measure in order to understand the distinction between natural and stored flows. Conveyance losses may be affected by length of reach, natural flow in the river, size of flow increase, bank storage, channel storage, precipitation, elevation and slope of the water table, stream channel characteristics, evaporation, evapotranspiration, hydraulic characteristics of the aquifer, irrigation return flows, inadvertent diversion and valley cross sections. Studies are requested involving conveyance losses on the mainstem of the Green River.

Irrigation Efficiency Improvements through Irrigation System Operations Management Opportunities

Improving the efficiencies of large canals to better match on farm efficiencies is desired. Most large irrigation projects in Wyoming were constructed by the Department of the Interior, Bureau of Reclamation. These canals were designed to accommodate flood irrigation practices. Due to labor savings, flood irrigation practices are yielding to the use of center-pivots, side-roll irrigation systems, gated pipe, installation of piped laterals and surge valves, which have drastically improved on-farm efficiencies. The purpose of the research project would be to determine whether delivery system efficiencies could be improved by using mechanical automated checks in combination with lower canal flows to discourage operational waste due to filling canals to an elevation needed to service farm turnouts and irrigation laterals. Other issues include seepage losses versus canal head and whether opportunities may exist within canal reaches to lower operating levels to discourage seep and to determine whether the "checked" canal may be used as a re-regulation facility. With respect to seep, this may require installation of pumped turnouts or laterals to service those facilities residing at a respective higher elevation with other similar facilities within a specified canal reach at a lower elevation with respect to the canal's surface water elevation. Economics (benefit vs. cost), quantitative impacts to groundwater recharge, effects on water quality and aquatic communities in associated streams, and other related issues also should be addressed.

Effects on Stream Flows from Irrigation Return Flows

Previous studies in the Salt River Basin indicate that significant quantities of water are stored during early summer irrigation and then slowly released back to riparian areas and streams during the following months, supplementing late summer flows. In addition to questions of hydrology, irrigation return flows have potential water quality impacts on receiving streams in some situations that can have significant negative effects on biotic communities in those waters. Impacts may include increases in temperature, sediment, nutrients, and salinity. In addition some return flows may carry elevated levels of pesticides and herbicides. Quantification and documentation of return flows are needed to assess the validity of these assumptions and to address potential impacts. Important questions to be answered include (1) what is the contribution of return flows to sustained late-season flow (baseflow) (2) what is the quality of the return-flow water, and how do changes to water quality affect riparian and aquatic communities receiving this water, and (3) how do return flows vary, in quantity, quality, and timing, among crop types?

Relationship between Watershed Management and Water Yield

Manipulation of forest vegetation for augmentation of water yield has been shown to locally increase stream flows, at least on a localized basis. Water yield improvement can be evident not only in stream flow increases but also in ground water increases. This results from a reduction of stand densities, conversion to a less water consuming cover type, creating openings that are conducive to concentrating snow fall, or establishing trees or artificial snow fences in treeless areas to initiate snow drifting. Recently, increases in beetle populations have lead to widespread die-offs of various tree species throughout the west, begging important questions such as (1) how does the extent and location of beetle killed conifer forests influence water yield (2) how do various treatments (fire, mechanical removal) influence water yield (3) how do changes to stand type and density, and altered hydrology, change relative to vegetative succession, and (4) what are the effects of beetle kill on forest hydrology related to water quality (sediment, recharge, erosion/runoff, temperature, DO, pH, others)? Potential research opportunities exist in the Medicine Bow National Forest related to proposed forest management activities in the Douglas Creek Basin.

Water quality effects of Aquifer Storage and Recovery projects on municipal water supplies

Many areas of the State utilize both surface and groundwater to meet their municipal water needs. Often, water levels decline due to drought and increased demand. As a result, investigations for the potential of utilizing Aquifer Storage and Recovery (ASR) to mitigate declining water levels may provide an opportunity to manage available supplies. A preliminary literature review of ASR projects indicated the potential to leach metals from aquifer host formations. Cases were identified where metal concentrations had increased initially as a result of injection but were later attenuated after several injection cycles. Research is needed on the processes that cause this reaction and laboratory testing procedures that represent real world conditions. More information is desired on the long term water quality effects of water supplies if an injection program is implemented. The City of Laramie is currently looking at using ASR by injecting surface water into the Casper aquifer. Recent laboratory tests using Casper formation samples and municipal water has shown an increase in arsenic and radionuclide levels. The City of Laramie project provides an immediate opportunity within the state to investigate ASR processes and associated water quality responses.

Enhanced Drought Prediction throughout Wyoming's Major River Basins

Building upon the recently completed study: "Predicting Drought in the Green River Basin" by Tootle, et al. additional information regarding drought prediction tools is desired to help water managers and water users in the Green River and Upper Wind River Basins judge by late fall what kind of water year may be coming and allow them to plan accordingly. The previous study pointed to reliable predictors, but also called for follow up investigations to further hone in and sharpen these predictive tools: specifically, investigations which extend existing records with more tree-ring reconstructions (i.e. streamflow, SWE, and temperature); that evaluate Pacific and Atlantic Ocean sea surface temperature influences; and/or that

expand on ongoing sediment records of climate, are desired. Similarly, investigations into Wyoming's other major river basins (Platte, Bighorn, etc.) with respect to determining drought prediction tools through tree ring reconstructions, lake sediments, and/or ice/snow cores by replicating the baseline work completed by Tootle, et al., and current work by Shuman et al., in these new basins is highly desirable. As before, identifying predictors that can help water users and managers in these additional basins know what kind of water year to expect with enough lead time to plan their activities for that year would be crucial.

Water and energy development

Information is desired on hydrologic relationships/constraints associated with energy development. Industry is focusing on "unconventional" targets including but not limited to tight gas, shale gas, oil shale and underground coal gasification, and more recently, surficial targets such as wind and solar. Water availability and quality will constrain future energy development in Wyoming. Studies to be considered should take a proactive approach to address the interdependence of water and energy development. This may include hydro-fracking effects on water quality, water quality and hydraulics of potential CO_2 injection targets, water quality and management associated with underground coal gasification, quantifying water needed for the development of oil shale resources, and water quality and runoff management related to surface disturbance.

Coalbed Methane

Continuing coalbed methane (CBM) development in Wyoming raises difficult issues associated with the disposal of the water pumped out of the coal seams to facilitate production of the gas.

Needed areas of research include:

- Methods of gas removal which require no (or reduced) water pumping.
- Enhanced and economically feasible methods for re-injection of CBM produced water.
- Water treatment technologies for reduction of total dissolved solids, sodium adsorption ratio, barium, iron, and whole effluent toxicity in CBM produced water surface discharges.
- Changes to native vegetation due to increased water flow from CBM produced water discharges.
- Changes to the hydrology and habitat of naturally intermittent and ephemeral streams by perennial CBM water discharges.
- Reclamation of CBM water holding ponds once they are abandoned.
- Surface water contamination caused by the subsurface horizontal movement of CBM water out of holding reservoirs into the downstream natural drainage.
- Water quality requirements for the irrigation of naturally occurring vegetation in NE Wyoming.
- The geochemistry and fate of CBM water discharged via subsurface drip irrigation systems.
- A determination, at the Wyoming/Montana state line, of the percentage of Tongue River flow and salt load that is being contributed by CBM discharges.

E. Coliform

Currently (2008), 62 stream reaches are listed on the DEQ's 303(d) list of impaired water bodies, with coliform bacteria as the impairment. Several groups are working to implement best management practices (BMPs) to reduce coliform counts in listed waters; however, it is not known to what extent the source of the coliform contamination is a predictor of human health effects. Areas of research needed include:

- Identification of the sources of e. coliform contamination in high altitude streams in Wyoming.
- Evaluation of various grazing and land management practices on e. coliform contamination of high altitude streams in Wyoming.
- Fate and transport of "x"–coliform bacteria in Wyoming streams. "X"–coliform bacteria appear to be over-wintering in Wyoming streams and showing up in samples collected during the spring runoff. This research would help in design of BMP's to reduce contamination levels in streams.

Guernsey Reservoir Silt Run

During mid-summer of each year the US Bureau of Reclamation conducts a rapid draw-down of Guernsey Reservoir on the North Platte River. This rapid draw-down results in large quantities of accumulated silt in the reservoir being sloughed into the river downstream. The purpose of this activity is to help seal irrigation canals and increase the efficiency of water delivery. However, this activity is disruptive to recreation on the reservoir during a high use period. In addition, there may be adverse environmental effects in the reservoir and on the down-stream stretch of the river. A special exemption in Wyoming's water quality standards allows for the silt run; however, an independent socio-economic/environmental analysis of the silt run would be beneficial to allow decision makers to determine whether the silt run benefits outweigh the costs.

Oxbow Storage Properties/Opportunities

Information is desired on the potential benefits/costs of diverting high river flows for storage in old river channel and oxbow features. Potential benefits to examine should include, but not be limited to: supplemental water supply, fish and wildlife habitat, recreation and flood control; while costs evaluated could include not simply the possible expense of the diversion and storage, but the impact of this new use on the functions the old channels and oxbow features already perform, including flood control. Ideally, the investigation should look at the use of old river channel and oxbow features on Wyoming rivers that include at least one river with a major dam or dams and one that has not been significantly dammed.

Consumptive Use of Water from Irrigated Lands

Accurate and detailed information on the consumptive use of water has been a long-standing need for water resources management. For state water resource managers, ET data are primarily needed from intentionally irrigated acres. This data gap is driven by intra- and interstate water rights regulation. However, due to the difficulties in measuring ET, large-scale estimates are typically the best state agencies currently obtain. There are several tools available to estimate ET from irrigated lands. One currently in use by the Wyoming State Engineer's Office (SEO) in the North Platte drainage is the "ET Calculator Spreadsheet Model" developed by the Natural Resource Conservation Service (NRCS). The SEO would like to see the NRCS model (or similar) and the inputs to the model refined and enhanced for application across Wyoming using localized climate and crop information. The information should be presented in a spatial or GIS format.