WYOMING WATER RESEARCH PROGRAM
Current and Previously Funded Projects

Current (FY 2002) WRP Projects

Project Title : Erosion Potential Model Development and Channel Monitoring
Principal Investigator: Gregory V. Wilkerson
Abstract:

Coal bed methane (CBM) development in the Powder River (structural) Basin (PRB), located in northeast Wyoming, has been occurring at an increasing rate since about 1990. As of November 1999, 3,041 CBM wells had been drilled or spudded in the PRB. At that time the U.S. Bureau of Land Management approved a plan to develop 5,000 new coal bed methane wells and related production facilities. The process of extracting coal bed methane involves drilling a well into the coal seam and then pumping water out of the well to create a pressure gradient that causes the methane to flow towards the well. The gas and water separate in the well. The gas is sent to a pipeline and the water is reinjected, stored in a reservoir, discharged into surface drainages, or otherwise disposed of.

There is great potential for CBM produced water to cause sedimentation and erosion in affected stream channels and tributaries. Therefore, an analytical model is currently being developed, in ArcView (a geographic information system program), which will identify the erosion potential of channels carrying discharges from CBM wells. The proposed project will allow that effort to continue. The proposed project also involves continued monitoring of channel erosion in a drainage basin in which significant CBM development is expected. The channel monitoring effort has thus far provided baseline data that will be compared with data to be collected in the future. The channel monitoring data will also be used to evaluate the analytical model and study channel processes in general.

Project Title : Testing of Hydrologic Models for Estimating Streamflow in Mountainous Areas of Wyoming
Principal Investigators: Bruce Brinkman, Hugh Lowham, and Lawrence Ostresh
Abstract:

Streamflows in mountainous areas of Wyoming are receiving increased interest in their role as a source for allocation water. This is a major source of water for non-consumptive instream flow rights and numerous consumptive water rights located within and downstream of the high mountain basins of Wyoming. To properly plan for and manage this remote resource, there needs to be a way to determine the yearly cycle, of volume and time of year, that the water is available

The ideal situation for planning and management of this water resource is to have long-term data available from an existing gage for the stream in question. However, economic and physical constraints prevent the installation and operation of gages at many mountain sites especially in the winter. When a gage is not available, then streamflow estimates are used.

The primary purpose of this project is to determine and document the accuracy of the available methods for estimating streamflow values in the mountains of Wyoming. Of particular interest are winter flows, which are sometime difficult to obtain. The secondary purpose of this project is to review the possibilities of using emerging technologies such as remote analysis using Geographic Information Systems (GIS), that may help in the determination of the basin's properties. In the process of this research, all opportunities will be taken to provide training and practical experience to as many students and professionals as possible.

Project Title : Product Accessibility and Dissemination for the Water Research Program at the University of Wyoming

Principal Investigator: Jan Curtis

Abstract:

Problem: In the west, water is critical to survival. Data and information concerning this resource are very valuable. However, unless information developed from research is readily available, all of the effort and expense of collecting, analyzing, and reporting the information is of little use. Therefore, an accessible and reliable database is needed for the dissemination of the data and information (products) developed by the Water Research Program (the Program). In addition, in order to produce quality research, coordination is required for determination of research priorities, dissemination of information on research opportunities, and identification of research expertise.

Methods: Over the next year, we will continue to operate and maintain the Program web site and expand the site to disseminate the Program information, and research products. Additionally, research products, as they become available, will be incorporated into the WRDS Water Library. The Program web site is accessible at http://www.wrds.uwyo.edu/wwrp/wwrp.html

Another critical component of the Program is the coordination of research activities between researchers, agency personnel, and private interests. This coordination serves as an information transfer activity through meetings, conferences, and informal communications. An example is the service of the Director as liaison between the University of Wyoming and funding agencies.

Objectives: This project will ensure the accessibility of the products from the research conducted under the Program. By posting products on the Internet, and by housing records and documents in our Water Library, anyone will be able to access the data. Researchers with the Program can continue to direct interested individuals to one site where they can obtain these products. The project will also help ensure the coordination and management of the Program, both at the State and National levels.

To continue to meet the needs of this project, WRDS will:

maintain and enhance the Program web site,

make products available digitally over the worldwide web,

enter citations for all the Program reports into the WRDS on-line Water Bibliography, and

have all products stored and available for checkout at the Water Library.

Project Title : Combining Modern and Paleo-Climate Data to Enhance Drought Prediction and Response

Principal Investigators: Stephen Jackson, Stephen Gray, Christopher Fastie, and Kenneth Gerow

Abstract:

We propose to use data from a network of tree-ring sites in western Wyoming to determine the range of drought frequency, magnitude, duration and spatial extent in that region, along with the probability of experiencing severe conditions during a given drought cycle. We will also use these data to determine whether wet and dry periods occur in predictable cycles, and, if so, to determine the frequency and magnitude of those cycles. In addition, we will use our long term climate records to explore the relationship between drought and large-scale circulation patterns, and to asses the usefulness of indices such as the Standard Precipitation Index as drought predictors and mitigation trigger points. Overall, by using a combination of modern and paleo-records, this project will provide valuable information on climate dynamics in western Wyoming, and a unique way to test the effectiveness of several important drought prediction techniques.

Project Title : The Wyoming Climate Atlas
Principal Investigator: Jan Curtis
Abstract:

It has been more than 15 years since the last Wyoming State Climate Atlas was produced. During this period, the development and marketing of natural resources in Wyoming has accelerated in order to meet the rapidly increasing demands nationally and internationally. New Federal environmental regulations and interstate litigation over water usage and rights have also prompted the requirement for a new climate atlas. Additionally, since tourism and recreation are important economic revenue sources for the state, a new atlas that focuses on this market can only enhance the image of Wyoming in a more positive way.

Project Title: Real-Time Monitoring of E. coli Contamination in Wyoming Surface Waters
Principal Investigator: Dr. Paul E. Johnson
Abstract:

This project will demonstrate the feasibility of economical, real-time detection of *individual Escherichia coli* in surface water. The Clean Water Act requires states to monitor surface waters for fecal coliforms or specifically for *E. coli*. Fecal coliform monitoring is an indicator of the sanitary quality of the water and can determine the extent of fecal contamination in the water from warm-blooded animals. Fecal contamination is important from a public standpoint when the surface water's designated use includes contact recreation such as beach use, boating, or swimming. It has recently been shown that *E. coli* enumeration is more accurate than fecal coliform enumeration in assessing the potential of surface waters to transmit infectious diseases to humans via contact recreation. A low-cost, portable, highly sensitive, self-contained single cell detection system for *E. coli* enumeration is proposed for rapid monitoring of surface waters, including streams, rivers, and lakes. Funded by Phase I and II NSF STTR grants, the P-I and his team have demonstrated an innovative technique for detection of pathogenic microorganisms, economically and in real time. This technology is based on laser-induced fluorescence of antibody-labeled cells. The proposed project will demonstrate the detection of individual *E. coli*, after filter removal of background detritus. The suspended bacteria are then stained using an immunofluorescent antibody. The resulting aqueous sample is passed as a stream in front of an LED, which excites the fluorescent labels. The resulting fluorescence is measured with a CCD imager using an innovative integration scheme, giving a dramatically higher signal-to-noise ratio than conventional techniques.

The major tasks of this Phase I project will be to 1.) optimize fluorescent labeling of *E. coli*, 2.) perform laboratory measurements on quantified *E coli* samples to determine the detection efficiency and sensitivity of the monitoring system, 3.) test methods of filtering out background detritus, 4.) test methods of counting quantified samples of *E. coli* in a background matrix, 5.) enumerate *E. coli* in stream and lake water samples using both our proposed method and the standard method currently recommended by the US Environmental Protection Agency. Our goal is a detection limit of ≤ 5 *E. coli* cells per 100 ml of sample in less than 15 minutes of analysis time, with a minimum detection efficiency of 80%.

The result of this project will be the development of a prototype low-cost, portable testing system that will allow for water to be monitored in the field continuously and in real time. This system will eventually allow for remote field monitoring with little human intervention.

Title: Drought Prediction Model Development and Dissemination in Wyoming
Principal Investigators: Michael A. Smith, Thomas L. Thurow, and Philip A. Rosenlund
Abstract:

Drought is a recurring, albeit unpredictable, climatic phenomena that is a prime source of annual variation of rangeland productivity in Wyoming and most other semi-arid regions of the world. Most drought indices focus on characterizing current conditions. Such information are not as useful to managers as would be predictive tools. Time series analyses of data from a site in southeast Wyoming (Saratoga) suggests that winter/spring climate can be used to predict annual forage production. Development and refinement of this type of predictive tool for representative locales within Wyoming would equip land managers with insights that would enable them to develop proactive management strategies regarding stocking levels, grazing season length, alternative forage sources, marketing or other accommodations to compensate for forage production shortfalls or take advantage of additional forage production.

We propose to continue existing data collection near Saratoga, initiate forage production-precipitation relationship studies in other areas of Wyoming, and compile agency data sets that will allow the development of a predictive tool for each major land resource area across Wyoming. Cooperatively developed and maintained forage production sites will be established with PI's of this project, county-based UW cooperative extension service (CES) personnel, and with personnel at federal land management or other agencies that are able to participate. Data analysis will consist of time series analysis and multi-variate regression of winter/spring precipitation, temperature/elevation and soil variables relative to how they can be used to predict non-irrigated herbage production.

Project Title : Program Administration/Management
Principal Investigator: Larry Pochop
Abstract:

The Director was appointed in October 1999 and has implemented a cooperative water related research program with participation of University faculty and State and Federal Agencies. The Water Research Program is physically housed in the Civil and Architectural Engineering Department, with the Director reporting to the Vice President of Research. A Priority and Selection Committee, consisting of Agency personnel, serves to identify research priorities and select projects.

Coordination and management activities of the Director include, but are not limited to, the following tasks:

preparation of the program application, annual report, and procedure document,
assist in the development of the Program web site,
assist in the preparation of the request for proposal,
oversight of peer reviews,
organize Priority and Selection Committee and facilitate meetings.
attend funding, organizational and planning meetings,
identify potential researchers for the Program projects,
coordinate with the Federal NIWR program.

Previously Funded WRP Projects (Completed Prior to FY2002)

Project Title: Hydrologic Impacts of Improved Irrigation Efficiencies and Land Use Changes
Principal Investigators: Drew Johnson, Larry Pochop, Bruce Brinkman and John Barnes
Abstract:

Stream flows that originate in the mountainous areas of Wyoming are receiving increased interest in relation to allocation of water rights. The primary objective of this study is to examine hydrologic impacts, including changes in instream flows, resulting from changes in irrigation practices and land use. The study area is the Salt River drainage basin (Star Valley). The methodology used incorporates comparing flows in the Greys and Salt Rivers. The Greys River, due to lack of agriculture in it's drainage area, can be used as a control and flows in the Greys River can compared to flows in the Salt River where changes in land use and irrigation have occurred Comparing flows in the Greys and Salt Rivers allows effects due to changes in land use and irrigation practices to be quantified.

This is a continuing project. With previous funding, instream flow savings due to changes in irrigation practices have been quantified, changes in water quality have been investigated and information relating changes in irrigated acreages within the study area has been obtained. Continued funding is requested to complete on going and future work which includes characterizing changes in ground water levels and quality, relating observed instream flow savings to estimated savings from reduced evapotranspiration losses and report generation for proper dissemination of findings from this study

Project Title : Field Evaluation of the Fate of Wastewater Components from Septic Systems
Principal Investigators: Marjorie Bedessem and Thomas Edgar
Abstract:

Community subdivisions and rural areas are often characterized by a single community or individual water wells and individual septic sanitary systems. The proximity of the water supply to the community's septic tank leach fields creates a concern that contaminants may be transported from the waste disposal system to the water supply aquifer. Of particular concern is the fate of nitrogen compounds, such as ammonia and nitrates, and the fate of microorganisms, particularly pathogens.

In recent years, septic system modifications have been proposed to include reactive zones to minimize nitrate contamination of ground waters. The proposed study is expected to furnish an evaluation of the effectiveness of septic system reactive zones in controlling bacterial and nutrient contamination (nitrogen compounds) from leach fields. This study is already being supported through federal 319 funds, and only supplemental funding is requested here to address development of an additional monitored field site representative of the rural ranchette area in the vicinity of either Cheyenne or Laramie.