WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
PRODUCED WATER MANAGEMENT (PWM)

January 17, 2007

US EPA National Center for Environmental Innovation
EPA 2007 State Innovation Grant Program
Environmental Policy and Innovation Grants
CFDA - 66.940
RFP NO. EPA-AO-OPEI-07-01

WORK PLAN

1. **Project Summary**
   a. Project Title – PWM (Produced Water Management). Innovative Management of the Life Cycle of Coal Bed Methane (CBM) Produced Water Injection Wells and Fields using an Environment Management System in conjunction with an experience or knowledge base. The majority of the effort is capturing the current knowledge and then updating that knowledge with time. The life cycle experience base includes permitting, drilling, completions, performance monitoring, operations and plugging and abandonment. **Automation of permitting and performance monitoring are major goals of this effort.**
   b. Project Applicant - The applicant organization is the Wyoming Department of Environmental Quality (WDEQ). The primary component of the grant includes capturing the knowledge to develop a shared experience base for CBM produced water injection wells. DUNS Number 809915416.
   c. The State Project Manager for this Grant will be Glenn Breed, Department of Environmental Quality, Herschler Bldg. 4W, and Cheyenne, Wyoming 82002. Phone number 307-777-8580. Email: gbreed2@state.wy.us
   d. Project Period – The project period will start on receipt of the grant and will be completed within 24 months.
   e. Total Project Cost - *[Budgetary Information Withheld by U.S. EPA]*
   f. Summary Statement - The majority of CBM that has been developed in Wyoming to date is being produced from shallow coal formations and most of the produced water is relatively fresh and output to the surface. Over one million barrels per day (42 gallons per barrel) of water is now being produced in the Powder River Basin. A large number of future CBM wells are targeted at deeper coals, and it is anticipated that most of the produced water will be more saline and therefore re-injected. It is estimated that the number of injection wells for CBM produced water will increase from a few thousand to tens of thousands over the next ten years. This exponential increase in the number of injection wells and barrels of water produced will be difficult to manage without a shared knowledge base. The project will enable the stakeholders to share experiences via the Internet and intranet to improve decision making, reduce risks, improve permitting, drilling, completion, performance monitoring, operations, plugging and abandonment and reduce cost and time for all stakeholders.
   g. Project has no additional funding.
   h. The WDEQ contact is John Wagner, Administrator of Water Quality Division, Wyoming Department of Environmental Quality, is aware of this project and endorses it. Phone number 307-777-7072. Email: JWAGNE@state.wy.us
   i. All of the components of this grant take advantage of a coordinated strategy that the WDEQ has developed to capture, store and access data in a digital form, develop an Internet and intranet system to share and distribute the data and develop nodes for the flow of data to and between the WDEQ, EPA, USGS, State Engineers Office, Wyoming Oil and Gas Conservation Commission (WOGCC), owners/operators and other stakeholders.
   j. PWM will leverage a *[Budgetary Information Withheld by U.S. EPA]*investment in the Groundwater Environment Management (GEM) system or EMS that is used for the Underground Injection Control (UIC) and other groundwater pollution control functions.

2. **Pre-proposal Project Narrative**
    a. Project Description

        i. Case history example – while working at British Petroleum, Glenn Breed, the project manager for this project, managed an effort to capture the life cycle of an oil field. First the expertise from different disciplines was captured along the life cycle. The next step was to capture new experiences as a field was developed and produced. Several millions of dollars were saved and realized, by eliminating dry holes drilled and optimizing production. As experience is gained, a normal pattern is usually observed and this pattern can be used as a checklist of what and what not to do in a certain situation. In medicine, the analog would be a checklist of symptoms, which then leads to a diagnosis, which then leads to a prognosis and which then leads to a treatment regime. The greater the captured and shared knowledge the greater the mitigation of errors.

        ii. Functionality - PWM will provide the means for stakeholders to share experiences during the life cycle of CBM injection wells in a field, so injection wells will be optimally located in various aquifers, drilling and completion techniques improved, water quality enhanced through performance monitoring, operations improved and time and cost are reduced for all stakeholders. The life cycle includes, permitting, drilling, completion, performance monitoring, operations and plugging and abandonment of injection wells. As an example, for each injection well that is drilled in a specific aquifer in a specific geologic setting the knowledge associated with the life cycle of that particular well is captured and shared with others. The experience gained on each well will be codified and shared among all the stakeholders. As wells are drilled, the experience gained will be used to guide where new wells are permitted, drilled, and completed. There are several stakeholders including the EPA, WDEQ, WOGCC, owners/operators and others that will use WDEQ PWM to 1) automate the permitting process as much as possible, 2) capture the experience of the owner/operators and other stakeholders in the life cycle of a CBM injection well and gas field 3) share the experiences between the stakeholders, 4) continue to improve the knowledge base as new information becomes available 5) share all data, information and knowledge via the Internet and intranet between the stakeholders.

        iii. Statement of Need - The Water Quality Division's Underground Injection Control requires the means to be able to meet the demands of permitting, drilling, completing and monitoring tens of thousand of CBM produced water injection wells in the near future. WDEQ will leverage the investment in GEM to assist in PWM. GEM provides the data and information to assist in creating some of the experience base gained in the permitting, drilling, completion, performance monitoring, operations and plugging and abandonment of existing and historic wells. CBM development continues to increase in Wyoming, which will likely increase the number of injection wells. Re-injection solves

several environmental problems on the surface. Re-injection is done using geology and engineering methods to make sure the injected water is not being commingled for example with fresh water from other aquifers or hydrocarbons. There needs to be an in depth understanding of the aquifer i.e. an aquifer characterization to make sure the aquifer is capable of the injection and the in situ water is protected. A characterization includes porosity, permeability, structure, lithology, chemistry, tectonics, thickness, pressure, water quality and chemistry, geophysical well logs, seals, seismic, volume of rock, fracturing, (including apertures and orientations), and a myriad of additional information. The type and extent of information required is based on the local and regional geology. An experience base will be created for each CBM field.

iv. Objective - The objective is to capture and share knowledge for the life cycle of injection wells of produced water from CBM. This same methodology can be used for Class II wells for oil and gas injection wells. PWM will in general: 1) improve the efficiency of permitting, drilling, completion, performance monitoring, operation and plugging and abandonment, 2) improve decision making, 3) improve the sharing of experiences between the stakeholders, 4) enable knowledge transfer between organizations, 5) enable better technical understanding of complex geology, 6) improve efficiencies for EPA, WDEQ, WOGCC and owner/operators and other stakeholders 7)and free up time for inspecting sites, compliance and innovation.

v. Specific tasks that will be accomplished.
    1. Capture the knowledge of experts along the life cycle of an injection well and new experiences as they occur. Leverage the GEM role based database and applications for injection well permitting, drilling, completion, performance monitoring, operations and plugging and abandonment.
    2. Implement PWM.
    3. Continued training and change management for end users.
    4. Add experiences as available from stakeholder feedback.

vi. Milestones
    1. Form team of stakeholders – 1 month
    2. Capture knowledge of experts – 9 months
    3. Implement PWM – 6 months
    4. Training and change management – 24 months
    5. Add experience – ongoing

vii. Duration – 24 months from receipt of the grant.

b. **Program Guidelines, Eligibility Requirements, and Selection Criteria –** PWM meets the specific criteria as outlined. WDEQ is leveraging a $600,000 investment in a WDEQ Environmental Management System- GEM. PWM includes the life cycle of water injection wells for innovative permitting, drilling, completion, performance monitoring, operations and plugging and abandonment. The experience base will enable higher quality permitting, because WDEQ and the operator will understand the geology and the risk associated with injection of produced water into a particular aquifer. The volume of water produced is millions of barrels per day and increasing, which means a greater knowledge of the subsurface is required before injection can begin and, once started, has to carefully monitored to make sure the groundwater is being protected. The experience base will provide all stakeholders the opportunity to learn from one another, thus optimizing injection well locations, volume of fluids to be injected over what time period, and to protect the water. WDEQ is eligible to receive this grant as an agency of the State of Wyoming that is by statue authorized to protect the waters of the State of Wyoming. PWM is advancing the state of knowledge and is providing that knowledge to all stakeholders for produced water injection wells and fields. By addressing the entire life cycle of a produced water injection well or field a considerable amount of knowledge will be accumulated which can be used to improve how water is injected and stored for future use. The project is focused on water quality and how best to manage the produced water using environmentally sound methods. The experience base can be used by any organization where they are injecting large volumes of water. The geology may vary from area to area, but much of what has been learned in one area has value in another area.

c. **Environmental Outputs** – There will be several initial meetings with the stakeholders and then periodic meetings to make sure the knowledge is being captured and is useful. PWM is all electronic and the experiences can be addressed and shared by all those so authorized. The quality and number of permits issued will be monitored and more importantly the experience gained in the permitting process will be available to all stakeholders, thus making the process more efficient and cost effective. Permitting is one step in the total process of managing produced water and all experience will be captured for all stages of the process.

d. **Environmental Outcomes** – PWA will provide performance monitoring that will enable the stakeholders to better plan and mitigate environmental issues that will arises from such vast quantities of produced water. The WDEQ goal is to insure the produced water is re-injected in an environmentally responsible manner. By sharing experiences between the stakeholders each party will take a proactive approach in either anticipating problems or quickly solving problems when they arise. Quarterly monitoring reports will be used to monitor the existing wells and they will also be used for trend analysis to anticipate potential problem areas.

e. **Public Involvement** – The public are mainly farmers and ranchers who are very involved and concerned with what is going to happen with the produced water from CBM. There are several advocacy groups both pro and con to the development of CBM because of the environmental issues.

f. **Collaboration and Partnerships** – the primary stakeholders are the State of Wyoming with several state agencies being represented including WDEQ, engineers office and oil and gas commission, EPA, owners/operators and others that have an interest in sharing knowledge for re-injected produced water. PWM will gather knowledge from all these organization and make it accessible to all parties.

3. **Pre-proposal Budget Summary –** The majority of the funding will be used to capture knowledge from experts in various areas, e.g. geology, geophysics, drilling, completions, reservoir (aquifer) engineering, and operations specific to injection of produced water from CBM. The owners/operators have significant general knowledge and specific knowledge in the areas in which they operate.

State of Wyoming
Agency – Wyoming Department of Environmental Quality
Project Title – Produced Water Management (PWM)

(Estimated Budget)

[Budgetary Information Withheld by U.S. EPA]

Task or Activity	**Rate**	**Cost**
Form stakeholder team (EPA, WDEQ, WOGCC, SEO, Operators)		
Capture knowledge from experts along the life cycle		
Implement PWM		
Training and change management		
Add experiences in additional areas		
Subtotal:		
Contingency		

4. **Environmental Results Past Performance and Programmatic Capability -** Representative WDEQ projects funded by EPA.
   a. Environmental Management System named GEM (Groundwater Environment Management) utilizing EPA Network Exchange Node Grant Funding was developed for WDEQ under contract. GEM is a working system and the current stakeholders are EPA, WDEQ, SEO, WOGCC and owner/operators. The project has been done on time and within budget. Two rounds of funding for approximately *[Budgetary Information Withheld by U.S. EPA]*.

b. Former Casper Army Air Field – Preliminary Assessment and Site Inspection of seven areas of concern for firing berms, ordnance and chemical storage facilities, dry cleaners, landfills, storm water lines, incinerator and sewage plant. A PA/SI report was generated for all the areas of concern investigated. All projects have been done on time and within budget. Three rounds of funding for *[Budgetary Information Withheld by U.S. EPA]*.

c. F.E. Warren Missile Sites 1, 2, 4, and 6 were funded for site inspection. The projects were done on time and below budget. Final reports were delivered for the four missile sites. Two rounds of funding for *[Budgetary Information Withheld by U.S. EPA]*.

5. **State Agency Support –** John Corra, the Director of the WDEQ, is aware of this project and endorses it.

6. **Programmatic Resources and Key Personnel**

[Resumes Withheld by U.S. EPA]