



WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Development of Erosion Potential Map

Focus Category: MOD, SW, SQN

Keywords: Channel erosion, Coal bed methane, stable channel thresholds

Duration: March/2000 – Feb/2001 (With extensions to be requested for two to three additional years)

FY 2000 Federal Funds: \$12,852

FY 2000 non-Federal Funds: \$48,676

Principal Investigator's Name(s) and University:

Gregory V. Wilkerson, Assistant Professor, University of Wyoming and Maggie Davidson, State Agency Project Coordinator, Wyoming Department of Environmental Quality.

Congressional District: 1st

Statement of critical regional or State water problems

Mineral production of coal, oil, and gas is the dominant economic activity in Campbell County, Wyoming, and is an important economic sector in Converse County, Wyoming (BLM, 1999a). More than 90% of the coal produced in Wyoming, the top coal producing state in the United States, comes from Campbell County (Campbell County Chamber of Commerce, 1998). According to the Wyoming Department of Employment (WDOE), in 1996 the mining sector accounted for 4,087 workers, or 25.6% of the total employment in Campbell County and for 656 workers, or 15.9% of the total employment in Converse County (WDOE, 1998). Based on Wyoming Department of Revenue (WDR) records, the taxable valuation of mineral production for fiscal year 1997 was 1.59 and 0.28 billion dollars for Campbell and Converse County, respectively (WDR, 1999). These figures demonstrate that mineral development is paramount to the economic well being of the State of Wyoming and its citizens.

At present there are plans for coal bed methane (CBM) development in an approximately 2,400-square-mile area encompassing central Campbell and northern Converse Counties. In the future, development will likely extend into the adjoining Counties of Sheridan and Johnson as well.

Methane is produced from CBM wells drilled into underlying coal seams. Peak gas production from the 3,000 proposed CBM wells and the 890 CBM wells currently in

production could average 486 million cubic feet per day (BLM, 1999a). The estimated productive life of the project is 10 to 20 years. Along with methane, water is extracted from CBM wells. On average, water from CBM wells is produced at a rate of 12 gpm per well. For the 3,890 anticipated CBM wells, surface water would be produced at an average rate of 46,680 gpm (104 cfs or 75,268 ac-ft/yr).

CBM produced water will be discharged at National Pollution Discharge Elimination System (NPDES) permitted points (BLM, 1999a). It is expected that produced water will be discharged from pipelines into existing surface drainages. There is great potential for produced water to cause sedimentation and erosion in affected stream channels and tributaries. The Wyoming Department of Environmental Quality (DEQ), in recognizing the need to manage CBM produced water, has asked the University of Wyoming to evaluate the erosion vulnerability of drainages in the project area.

Statement of results or benefits

The State of Wyoming, Department of Environmental Quality (DEQ) regulates increasing sedimentation, erosion, and other issues affecting the quality of water in Wyoming (BLM, 1999a [GVW1]). The DEQ is also responsible for granting NPDES permits for surface discharge of produced water. For this project a map will be developed which will identify the erosion potential of drainages that will receive water discharged from CBM wells. The map will be used by the DEQ to formulate appropriate management decisions associated with the NPDES permitting process.

Nature, scope, and objectives

The objective of this study is to develop a tool to help DEQ policy managers prevent excessive degradation of channels and tributaries as a result of CBM development. The project has three principal components. In the first component an analytical approach will be developed for predicting the vulnerability to erosion of existing drainages in areas where CBM development is proposed. Also, a geographic information system (GIS) will be prepared which will show the erosion vulnerability of a limited number of drainages.

In the second component of this study, the GIS will be expanded so that erosion vulnerability can be determined for all drainages in the area where CBM development is proposed. The expanded GIS will implement the analytical model developed earlier. The third component will serve to evaluate the accuracy of the analytic model. Field reconnaissance will be performed, and observations about channel stability and erosion will be recorded. Results from the field study will be compared to model predictions and adjustments to the model will be made if necessary. Additional work may be performed in this project to develop cost efficient channel stabilization techniques. This work will be required if drainages where CBM development occurs are found to be highly susceptible to erosion.

Methods, procedures, and facilities

The erosion vulnerability map is to be established from an assessment of available soil survey information, topographic relief maps, vegetation data, and other relevant watershed characteristics. The map will be made with ArcView GIS software and will identify the erosion potential of areas receiving and likely to receive coal bed methane well discharges. A report will be prepared which will describe how the erosion vulnerability map was developed and how it is to be applied.

Soil data for this study will be taken from soil surveys performed by the Natural Resources Conservation Service and the Spatial Visualization and Data Center at the University of Wyoming. Topographic data from U.S. Geological Survey topographic maps and aerial photographs will be used to characterize stream channels, tributaries, drainage areas, land use, and to broadly identify vegetation. Field trips will be made to verify data taken from the maps and to perform baseline surveys for a limited number of channels. All data used to develop the erosion vulnerability map will be incorporated into the ArcView GIS map developed for the DEQ.

Related Research

In response to CBM developer plans to expand operations in Campbell and Converse Counties, the BLM prepared a draft environmental impact statement (EIS) to document the potential effects of additional CBM wells and associated facilities (i.e., roads, pipelines, and CBM compressors). The report (BLM, 1999a) provides substantial information about the environment where the proposed CBM development is to occur. A final EIS has also been prepared by the BLM (1999b) and it incorporates new and additional information based on reviewer comments and improved models. Data from these reports will be used to assess the affected environment and estimate the likely surface discharges that will result from CBM development.

Several studies have been performed to evaluate stable channel morphology in the area where CBM development is proposed (Rathburn et al., 1993 and 1995; and Anderson et al., 1994). These studies report that important parameters for predicting channel stability include channel cross-sectional flow area, channel slope, hydraulic properties (top width, depth, velocity, shear stress, and stream power) for various discharges, and bed and bank sediment characteristics. Significant drainage basin properties include drainage area, main channel slope and Area Gradient Index (AGI; product of drainage basin area and mean basin slope). Data sets with information about stable channel morphology are presented in these studies and will be used in the proposed study.

Investigators qualifications: A summary resume of the principal investigator is attached to this proposal.

Training potential

This project is expected to provide support for three graduate students. Each of the graduate students will be expected to write a thesis on one component of this project. The graduate students will likely be Civil Engineering students although a graduate student in Geography may be sought. Three undergraduate students will participate in this project. Students with an interest in graduate school and a desire to gain research experience will be targeted.

Cost Estimate: An itemized budget is attached.

References

BLM. 1999a. Wyodak Coal Bed Methane Project Draft Environmental Impact statement. Buffalo, WY: Author.

BLM. 1999b. Wyodak Coal Bed Methane Project Final Environmental Impact statement. Buffalo, WY: Author.

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