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Water Policy Interim Committee

61st Montana Legislature

Dec. 28, 2009

To: WPIC members
From: Joe Kolman
Re: CBM information from Montana Bureau of Mines and Geology

The attached pages were provided by the MBMG for your examination prior to the January WPIC meeting. The information will be covered in more detail by John Wheaton at the meeting.

Prepared by John Wheaton, Elizabeth Meredith and Andy Bobst, Montana Bureau of Mines and Geology.

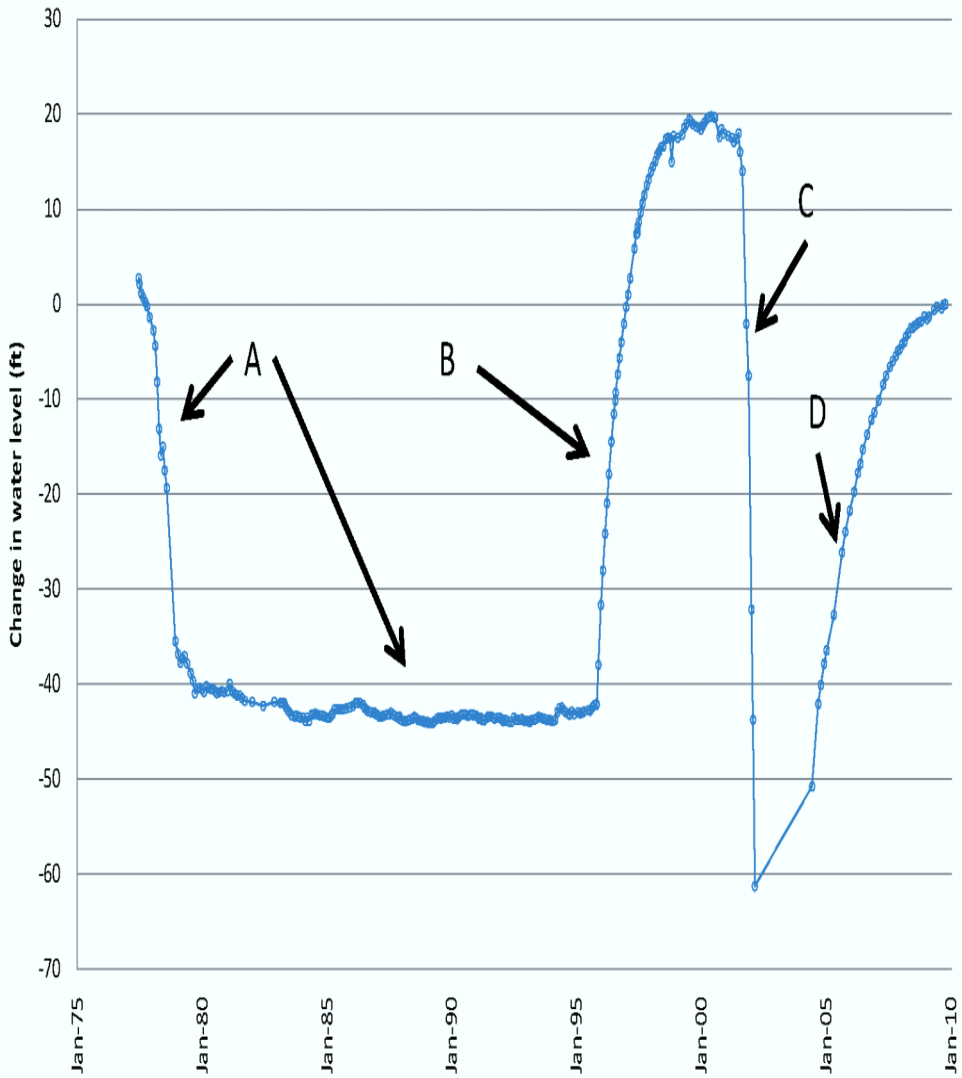
The associated file presents five figures that demonstrate lessons learned and data gathered in regard to coalbed methane (CBM) development in Montana and that portion of Wyoming adjacent to the Montana state line. These figures are based primarily upon the work that is presented each year in the hydrogeologic reports prepared each year by MBMG: Annual coalbed methane regional ground-water monitoring report: Northern portion of the Powder River Basin. The most recent includes all data through September, 2009 and is nearing completion and public release. A copy will be provided to the WPIC at that time.

Each figure has a caption and can be used independent of the others. Included here is a summary. The first figure shows groundwater level trends from 30 years of regular monitoring. Water levels were impacted by a small coal mine, recovered and subsequently impacted by CBM. The groundwater systems are dynamic, they respond to stresses and, given sufficient time, will recover.

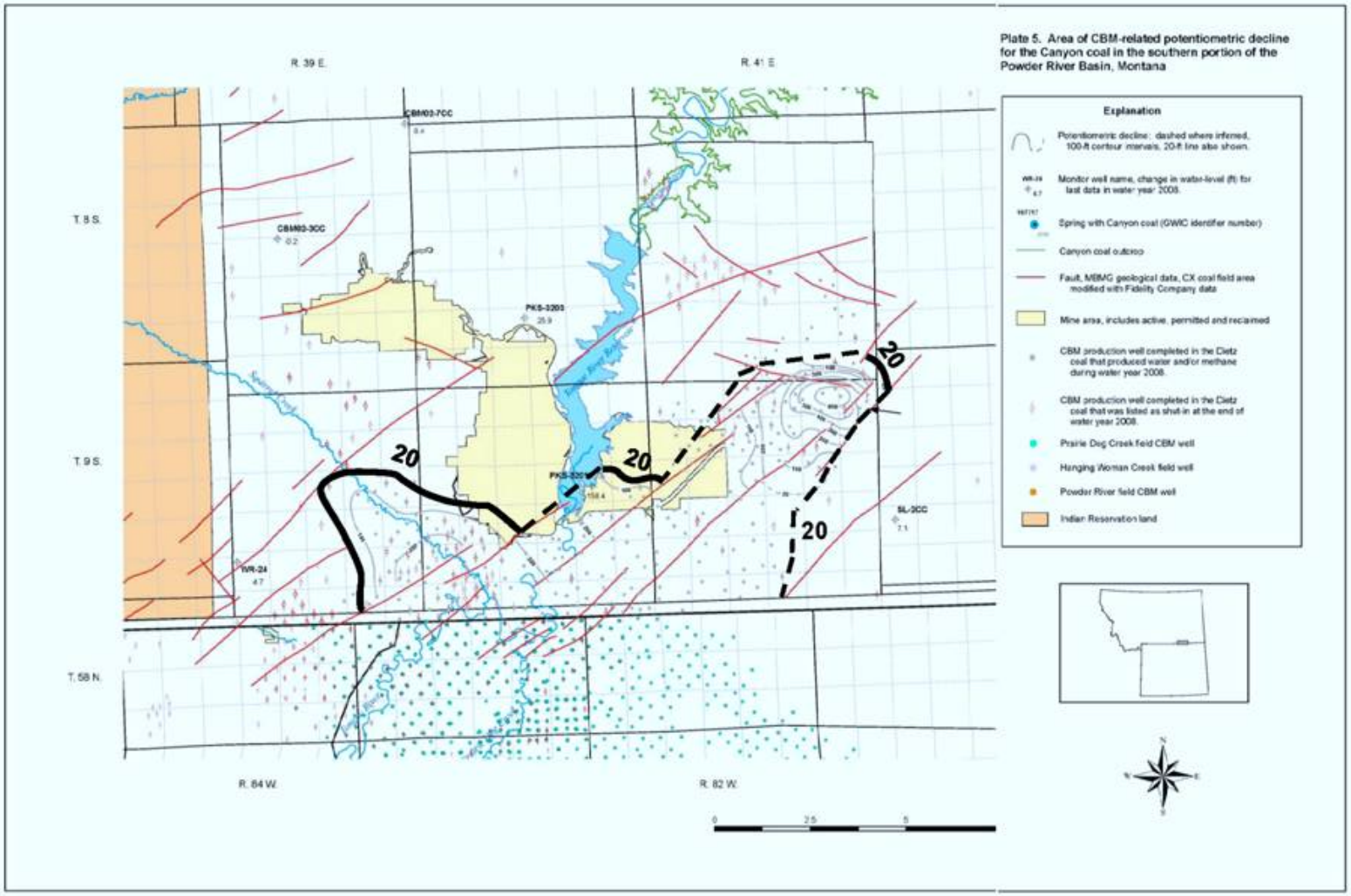
The second figure shows the area of measured groundwater drawdown near the CX CBM field in Montana. Drawdown occurs in response to coal mines in the area and CBM production in Wyoming, as well as the Montana CBM production. Production has been ongoing in the area since 1999 and has created a cone of depression in the groundwater potentiometric surface. The maximum distance from the edge of CBM fields to the 20-foot drawdown contour is approximately 1.5 miles. This is consistent with drawdown model results of John Metesh early in CBM production. Other models have been less successful.

The third figure shows water (green) and gas (orange) production averages for Montana. Average water production per CBM well in Montana is significantly below the value used in the EIS for Montana during the first 6 years, when water production is highest. During the later times, when fewer wells are producing and at generally lower rates, the actual trend is somewhat higher than predicted. Overall, far less water has been produced than was anticipated. This is further demonstrated in the fourth figure. Water production was calculated for each CBM well using the pumping rates anticipated in the EIS. The results are plotted against actual production rates and show how much less total water has been produced than would have been expected for the number of wells which have been installed.

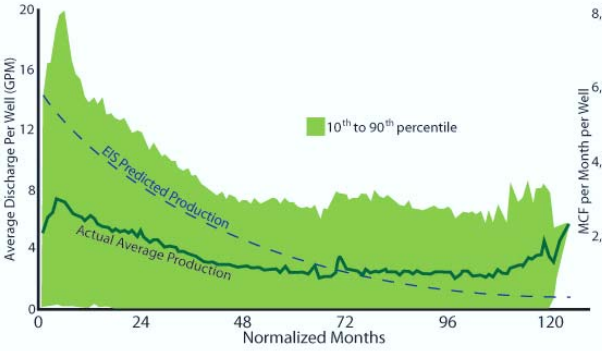
The fifth and final figure shows water and gas production rates in the northern most two townships of Wyoming. Since this portion of Wyoming is nearest Montana, it is most likely to impact Montana groundwater resources. Production is holding steady in the western areas and generally increasing on the eastern side of the Powder River Basin near the state line.



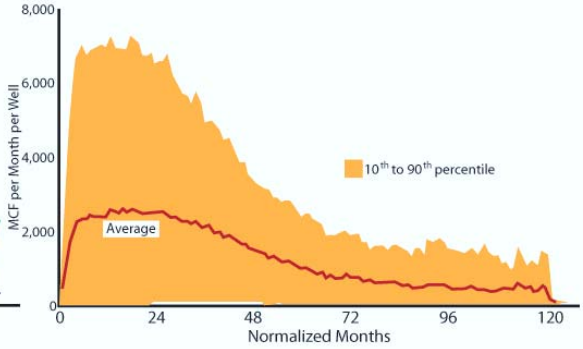
Water level drawdown has slowed or reversed in several wells in the western part of the CX field and near Decker, MT. At this monitoring well (WR-38), several stress periods and recovery trends are evident. A.) drawdown from a small coal mine; B.) recovery as the mine pit is backfilled; C.) drawdown from coalbed methane production; D.) recovery as CBM wells in this area have been shut-in.



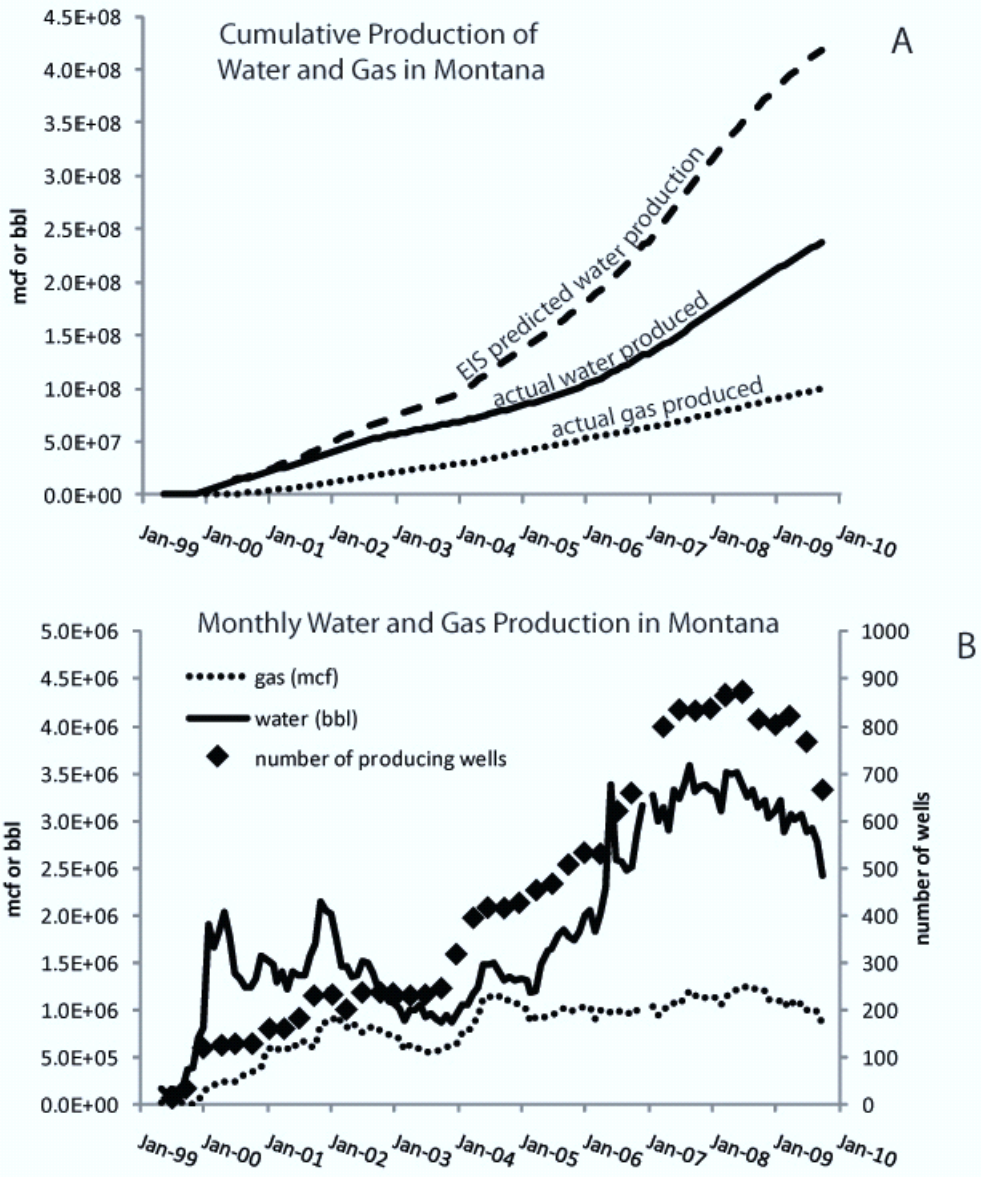
Drawdown around the CX CBM field in Montana as of 2008. CBM production began in this field in 1999. The 20-foot drawdown contour is highlighted in black for emphasis. Modified from: MBMG 2008 Annual coalbed methane regional ground-water monitoring report: Northern portion of the Powder River Basin



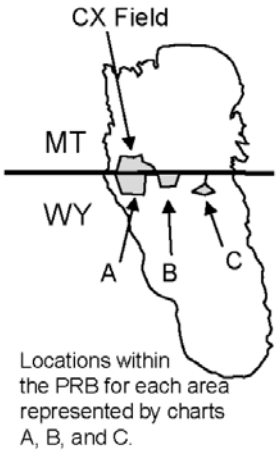
Normalized CBM production in gallons per minute (GPM) in the Montana portion of the Powder River Basin (data from the MT BOGC website). The actual production (solid line) falls below the EIS predicted production (dashed line: y = 14.661 e^(-0.0242x); US BLM, 2003) for the first 6 years of production. After 6 years the production is greater than anticipated. The difference between the predicted and actual production is the amount of water anticipated but never produced. The range of production from individual wells varies greatly. The 10th to 90th percentile encompasses the production predicted by the EIS.



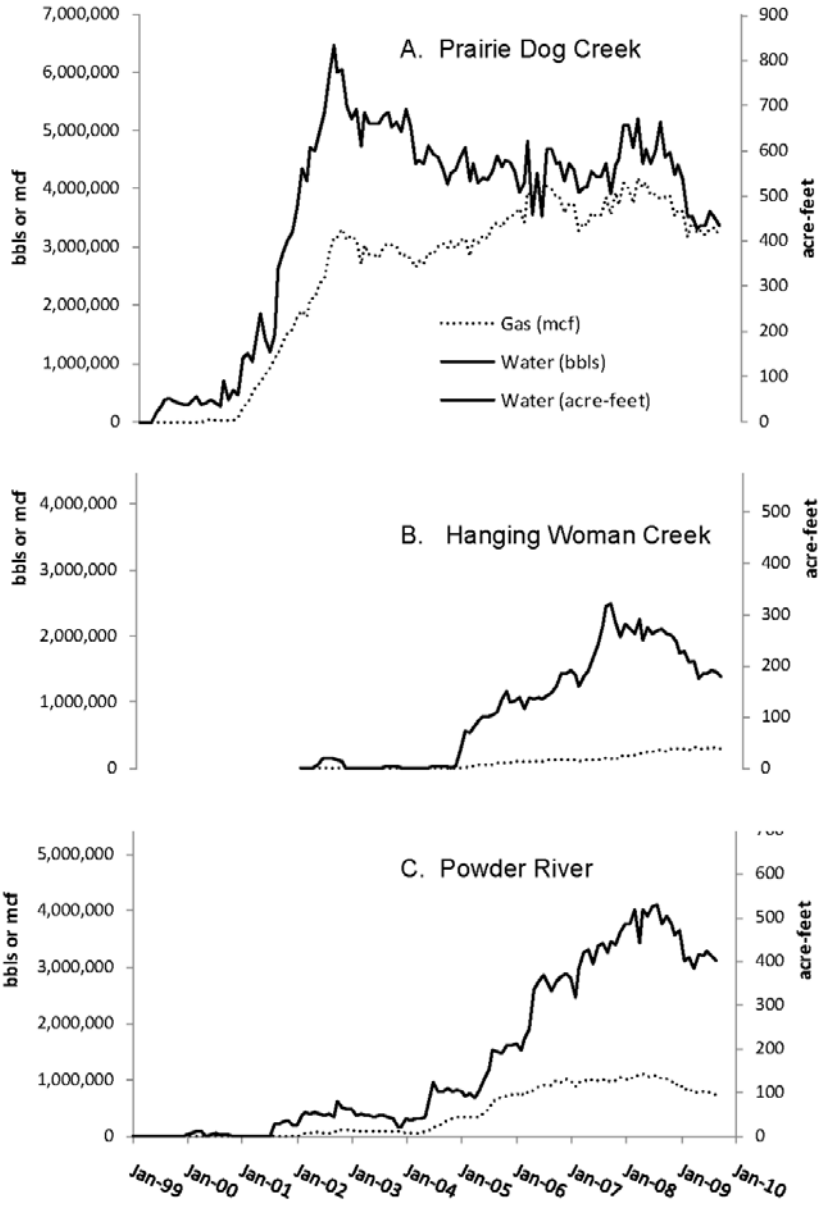
Normalized gas production (MCF) per month for individual CBM wells in the Montana portion of the Powder River Basin (data from MT BOGC web site). Solid line represents the average gas production per well per month. The 10th to 90th percentile provides perspective on the variability of gas production.



A. Cumulative water and gas produced in Montana since CBM production began in the spring of 1999. The dashed line indicates the amount of water that was predicted to be produced based on the EIS rate and the actual number of wells and months produced. **B.** Monthly totals of water and gas produced from Montana CBM wells and total number of active CBM wells. Water and gas production decreases when few new wells are installed. Water production decreases when the number of active wells decrease; however, gas production is only slightly affected by reducing the number of active wells because wells that have low gas production and/or high water production are preferentially shut-in.



Locations within the PRB for each area represented by charts A, B, and C.



Total water (solid line) and gas (dashed line) produced per month in Wyoming CBM areas (northern most two townships only). Wyoming development is increasing to the east by the Powder River.

*Please note that the areas referenced here are not field designations, they are unofficial names used in the MBMG annual monitoring report to designate the general area being referenced.

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