

ARID SYSTEM CASE STUDIES

Below is a short list of case studies related to the implementation of the ARID water handling system. These case studies are related to both "test" CBM wells that have been selected by the CBM Operator to validate the water handling capacity of the ARID System, and after the system had been validated, on "gas producing" CBM wells that are "selling" gas. We do not list all implementations as case studies. If you would like more specific information about these case studies, or to discuss other implementations that are not listed, please contact our Big Cat Sales office.

CBM OPERATOR #1, Case Study #1

CBM Well Location: Barlow State Wells, Dead Horse Creek area 12 miles west of Gillette Wyoming.

Water handling problem: These wells were stranded and had no water handling or gas line infrastructure in place, yet these wells had very high water levels and were not producing gas because of the high water levels. These wells had been stranded since 1999 and these were wells that were on property that was acquired by the CBM Operator years prior. These wells were already drilled and completed by the CBM Operating Company many years prior to implementing the ARID System. ARID was implemented as a test to evaluate the effectiveness of the ARID System in very difficult water handling circumstances. Part of the reason these wells had not been developed was due to landowner conflicts relative to the water mitigation. The landowner did not want any impoundments and did not want the water piped off the property. Thus to implement any other water mitigation system, the CBM Operator would have incurred extensive litigation and or condemnation of the property in order to get the right to access the property and mitigate the water using any other means. When the wells were originally drilled many years prior, they had been pumped and surface discharged for about four months by the original CBM Operator. The wells were then shut down due to landowner dispute because of the discharge method that was used. A landowner can delay well drilling and production if acceptable water handling is not implemented by the Operator.

Implementation of ARID System: After evaluating the wells for available aquifer recharge injection and testing of water in the recharge injection zone for comparable quality, the ARID System was permitted within 6 weeks. Further, the landowner was pleased with the underground recharge injection concept, and due to the number of viable injection zones, the CBM Operator was able to work with the landowner to select a zone that did not interfere with water wells currently on the property. The CBM well was fitted with the ARID System and pumps were turned on in June of 2008 in order to move the water that was in the coal seam to the available receiving zone. These wells were single point wells, as no other wells had yet to be drilled on the property, though the field allowed for about 160 additional wells. Because these selected wells were single point wells, the ARID system was required to pull down a large quantity of water from the single well location in order to de-pressurize the zone and produce gas.

Results: The ARID system was able to handle the migration of class 3 water at the rate of 25 gpm /840 barrels per day from the coal seam into the receiving recharge zone. Further, these wells de-pressured until gas was produced, though no gas was sold from these test wells. This test showed the CBM Operator that the ARID System would safely and effectively move water out of a coal seam and move the water to another underground recharge zone, and that this method was optimal where no other water handling system could be implemented effectively.

ROI: The CBM Operator obtained the critical knowledge necessary to validate the ARID System, and the confidence to move forward with ARID System implementations on production wells. It further validated their ability to rapidly obtain permits for ARID Wells without large reclamation bonds, and that most landowners would be pleased with the use of ARID to enhance their aquifers and reduce surface disturbances, to reduce the time to gas production, to drastically reduce their cost per barrel of water removed from the coal seam. This proved to be very valuable for more rapidly producing gas from areas where water balancing was unfavorable, there was no other water handling infrastructure, or the other water handling infrastructure that was in place, or

was over utilized and not able to handle the water from additional wells in the same area. The Operator expanded their use of the ARID System to other production wells after this test was completed.

CBM OPERATOR #1, Case Study #2

CBM Well Location: West Innes Wells, Big George Coal Seam, 40 miles South of Gillette Wyoming, 2 wells.

Water handling problem: The CBM Operator had already seen the results that could be achieved with the ARID System. Initially, these wells were in production and handling water conventionally, but the Operator wanted to drill more wells in the same area and wanted to test the receiving zone to see if it would absorb an average flow of water at 10 to 15 gpm/340 to 500 barrels a day.

1. The Operator didn't have enough water handling capacity with impoundments to drill additional wells and handle the water.
2. They did not want to spend the additional money to build additional reservoirs nor did they have the time to get surface discharge permits.
3. They didn't want to lock up working capital with bond fees required for reclamation.
4. During the winter months the impoundments became full due to limited evaporation, requiring wells to be shut down.

Implementation of ARID System: After evaluating the wells for available receiving zones and aquifer recharge injection and testing of the water in the injection zone for comparable quality, the ARID System was permitted within 4 weeks. The well was fitted with the ARID System and turned on in order to transition the water that was being pumped out of the well into a central pipeline for impoundment. The well had to be troubleshoot for water migration back into the coal seam from the top of the well head. These turned out to be issues with the integrity of the riser pipe string, over pressuring the well head, and incomplete cementing of the well casing in the well bore. All of which had to be mitigated in order to maximize the results of the ARID System.

Results: The ARID system was able to handle 10 to 15 gpm/340 to 500 barrels a day of the water being produced from the well and redistributed the water in the selected receiving recharge zone. This allowed the Operator to reduce the water flows to their impoundments. Gas Production was restored and the well was still producing gas and selling gas while supporting drawdown from the rest of the well field.

ROI: This reduced the time and cost of permitting and building additional impoundments, eliminated the concern for shutting down well in the winter months, and dramatically reduced pump wear and tear and electrical costs. The wells commenced selling gas within the first week of operation, and pumping costs were reduced by eliminating the above ground pumping of the water to a centralized disposal point.

CBM OPERATOR #2, Case Study #1

CBM Well Location: West Kingsbury, Kingsbury Land and Kingsbury State, West of Gillette Wyoming.

Water handling problem: The CBM Operator had no water handling capacity available for this well.

Implementation of ARID System: A receiving zone was identified and the well was re-permitted for UIC and the ARID System was installed. The CBM Operator began to immediately pump water out of the coal seam to the receiving zone.

Results: The receiving recharge zone was accepting 28 gpm/950 barrels per day of water from the coal seam, and maintained a consistent rate of water drawdown for over one year.

ROI: Created a production well out of a well that was shut down, because no surface discharge was in place.

CBM Operator #3, Case Study #1

CBM Well Location: Voiles Wells, near Gillette Wyoming.

Water handling problem: This was an initial well test of the ARID System for this CBM Operator. This well was a new well that had never been hooked up to available but overburdened water impoundments. The infrastructure for water handling was in place but never hooked up to the well, as they did not want to push more water into their impoundment.

Implementation of ARID System: After evaluating the wells for available aquifer reinjection zones and testing of water in the injection zone for comparable quality, the ARID System was permitted within 4 weeks. The well was fitted with the ARID System. Big Cat handled the troubleshooting and training of the Roustabout regarding the proper method of handling the surface connections for the ARID System. The well was turned on and immediately started moving water from the coal seam to the receiving zone.

Results: The ARID system was able to re-inject 10 to 12 gpm / 350 to 400 barrels per day of the water being produced from the water pumped from the coal seam into the selected aquifer recharge zone.

ROI: This well immediately began to sell gas without the cost of pumping the water to impoundment that was already overburdened. Electric and pumping costs were reduced and thus total water handling costs were reduced. The CBM Operator is adding 4 more ARID wells with rapid permitting, limited infrastructure costs, and reduced electrical and pumping costs. The landowner is satisfied that the water is staying on their property and there is no need for more impoundments on their property.