NEW YORK STATE WATER RESOURCES INSTITUTE

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Groundwater and Shale Gas Development

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Background

In parts of New York where shale gas extraction is possible, the Marcellus formation lies 3000 to 5000 feet below the surface. Meanwhile, groundwater suitable for human use lies at depths of less than 500 feet or so. Although a great distance separates shale gas and potable water there are still risks associated with shale gas activities. To get to gas in the Marcellus, one first has to drill a horizontal well through shallow sediments and rock layers that might contain fresh water. Therefore, shale gas-associated drilling within the first several hundred feet of groundwater is the focus of concern and regulatory attention.

Creation of a well, whether it is for gas, water, or oil, can disrupt the natural groundwater flow and/or quality. Alteration of the natural pressure gradient during drilling operations can cause groundwater to flow in an abnormal direction, potentially interrupting water production in nearby water wells. Introduction of air and oxygen as the drilled well is exposed to the atmosphere can cause changes in groundwater chemistry that may lead to increased turbidity (cloudiness) or taste and odor issues.

Additionally, the development of a shale gas well entails other groundwater risks. As drilling proceeds, the bore hole created is cased with steel pipe which is then sealed into place with cement, as shown in the figure below that was taken from the EPA Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources. Closest to the surface, multiple layers of steel pipe and cement can be used. If done properly, this separates and protects the surrounding rock, soil, and groundwater from the drilling fluids and natural gas that flows inside the pipe. This cement seal should

extend from the surface through and beyond the several hundred to 1000 feet of groundwater. If the bore hole is not properly sealed, it is possible for natural gases and groundwater from deeper layers to travel up the space outside of the casing and mix with potable groundwater near the surface. This is often a difficult concept to understand, since the risk involved may not have anything to do with gas found in the Marcellus shale itself, and since these risks may arise before or in the absence of hydraulic fracturing operations. More information and illustrations can be found at:

http://exploreshale.org/
http://fracfocus.org/water-protection/casing-process

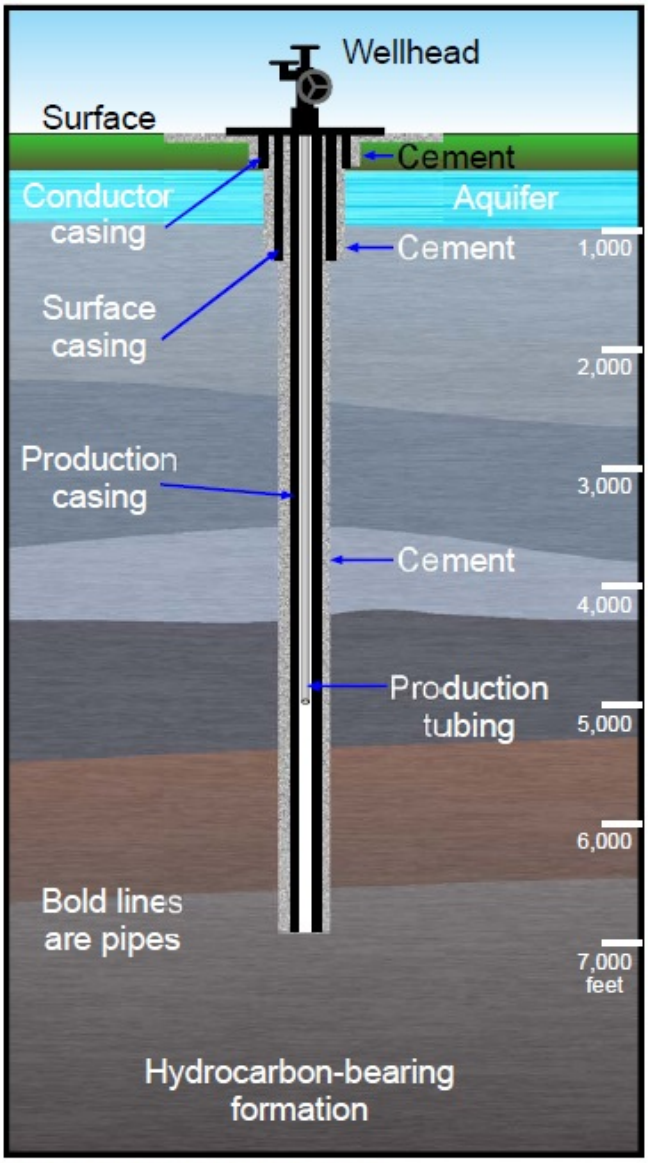

FIGURE 8. WELL CONSTRUCTION

Regulations and Risks

A variety of regulations, primarily at the state level, exist with respect to protection of groundwater resources and the potential impacts of drilling. For example, The New York State Department of Environmental Conservation (DEC) mandates casing and cementing of well bore holes, and also prescribes a number of practices that must be carried out during the casing process (http://www.dec.ny.gov/energy/1757.html).

Although New York has banned high volume hydraulic fracturing, making shale gas development in the state unlikely, the DEC has crafted a set of regulations that would apply to extraction activities if there were to ever proceed. For example, drillers would be required to use only air or freshwater when drilling through freshwater aquifers (http://www.dec.ny.gov/docs/materials_minerals_pdf/dgeisv1ch9.pdf). Proposed regulations also stipulate that wells or well pads be a certain distance (known as a setback) from public water wells (2000 feet) and private wells (500 feet). Proposed regulations also prohibit shale gas development from occurring in a zone containing a primary aquifer, or where the target shale formation is not greater than 2000 feet below the surface and 1000 feet below the base of potable water.

Despite proposed and existing state regulations in NY and elsewhere, risks to groundwater do persist. It is difficult if not impossible to eliminate risk entirely, and chances of accidents remain due to operator error, unforeseen geological conditions, or other unpredicted events. The NY DEC has released a fact sheet that identifies issues of concern noted during development of shale gas in PA, and risk to groundwater as a result of insufficient casing and cementing is among them. The US EPA also notes the potential risks associated with poor casing and cementing in its draft report on the possible relationship between groundwater quality and natural gas development in the Pavillion, Wyoming area. WRI has suggested that such risks, and the potential impacts that could result from casing and cementing failure, should prompt both state and federal regulators to review, update, and possibly strengthen their rules and policies pertaining to well drilling. At the same time, more research is needed to develop better well sealing practices that protect adjacent groundwater and are less likely to deteriorate or fail over time. All in all, well casing and cementing is likely to continue to be an important topic for all stakeholders for as long as drilling-based resource

extraction continues.