To: NYS Department of Environmental Conservation
From: Win McIntyre, Otsego Lake Watershed Manager
Re: dSGEIS Comments
Date: December 20, 2011

Introduction

These comments on the dSGEIS for gas drilling and high volume hydraulic fracturing (HVHF) are focused on the potential impacts on public drinking water supplies in the Upper Susquehanna River (USR) watershed north of Binghamton, NY. This watershed, which provides drinking water for several hundred thousand people, is roughly the size of the west-of-Hudson watershed that supplies drinking water to New York City. The USR watershed encompasses the headwaters of the Susquehanna River, the largest tributary to the Chesapeake Bay, and extends from Otsego Lake and Cooperstown, NY down through many villages, and small cities.

Gas Drilling and HVHF

Gas companies have obtained over 1,000 gas leases in the Upper Susquehanna watershed, and it is difficult to estimate the build-out of wells over time. But, in a study of the NYC watershed, which is similar in size and geology to the Upper Susquehanna, Hazen and Sawyer (2009) estimated a build-out of 3,000 to 6,000 gas wells, and that the initial rate of drilling would be 5-20 wells per year, increasing to 100-300 per year, and peaking at 500 wells per year. With the construction activities, truck traffic, and well completions using HVHF, this would be a significant industrialization of the landscape.

To get an idea of the magnitude of this industrialization, one needs to look at the quantities of water, chemicals, and wastewater associated with HVHF. For one well, the HVHF process uses 4,000,000 gallons of water and 340,000 pounds (170 tons) of chemicals (1% of fracturing fluid), and generates approximately 2,000,000 gallons of wastewater. This will require the use of over 1,200 large tanker trucks. If this is looked at as quantities for every 100 wells, it's 120,000 trucks hauling 17,000 tons of chemicals, 400,000,000 gallons of water, and 200,000,000 gallons of wastewater. The numbers become mind-boggling when considering a build-out of thousands of wells.

Contamination of Water Supplies

Of primary concern for the protection of both ground and surface water resources are the chemicals used for HVHF and the wastewater that flows back from the well (flowback water). The chemicals are used as surfactants, friction reducers, gelling agents, scale inhibitors, pH adjusting agents, iron control agents, bactericides, and corrosion inhibitors. Many of the chemicals used are hydrocarbons, including toxic cyclic compounds such as benzene, toluene, and xylenes. The flowback wastewater contains all of the chemical contaminants added to the fracturing fluid plus contaminants from the shale bedrock such as heavy metals, radionuclides (radium), and dissolved solids, or salt brine. The total number of chemical entities that could potentially be used in hydraulic fracturing fluids numbers over 300. In a study of HVHF flowback waters in Pennsylvania conducted by DEC for a previous version of the dSGEIS, 16 chemicals were found that are included in the list of regulated contaminants in the federal drinking water standards, which includes a total of 70 such chemicals.

Pathways of Contamination

There are two main pathways for contaminants from drilling operations to enter water supplies - overland flow and vertical migration, both upwards and downwards.

Overland Flow

As indicated above, as build-out progresses, there could be thousands of wells drilled in the USR watershed. With this scale of industrialization, which would include the handling of over 200,000 tons of liquid chemicals, and greater than two billion gallons of wastewater, there will be many opportunities for spills. In fact, spills of incoming chemicals and outgoing chemicals will occur due to tanker truck accidents, transfer leaks, and leaks at storage facilities. These spills will enter waterbodies due to the small setbacks proposed in the dSGEIS - 150 feet for streams and 100 feet for wetlands.

Vertical Migration

The spills mentioned above will also permeate the ground and flow downward to contaminate ground water. Of primary concern for public drinking water supplies are primary aquifers for current use, but also principal aquifers for use in the future. Both primary and principal aquifers are highly productive sources of ground water. If the bedrock in the area is limestone and karst conditions exist (sinkholes and sinking streams), vertical migration will occur through solution conduits, and it will be rapid. Spills in karst areas can contaminate waterbodies thousands of feet from a spill site in a matter of hours. Karst conditions exist in the northern part of the USR watershed, north of Otsego Lake and Canadarago Lake, the drinking water supplies for the villages of Cooperstown and Richfield Springs, respectively.

Contamination of ground and surface waters can also occur through migration upward from the shale fracture zone. Proponents of HVHF will say that it's the thousands of feet of impermeable bedrock above the shale that protects ground water. However, bedrock is far from impermeable. There are numerous faults and fractures in the bedrock in NYS that overlies gas-bearing shale formations (Marcellus, Utica, Trenton/Black River). Studies done by Jacobi and Smith (2002) show extensive faulting throughout the state, including Otsego County, the headwaters of the Susquehanna River. These faults and fractures were discussed in the Hazen and Sawyer report on the NYC watershed in 2009. Under pressure, hydro-fracturing fluids can migrate upward and contaminate freshwater aquifers. Other contaminants that can follow these pathways include heavy metals, radon, and salt brine from the shale bedrock, and gas (methane) from the shale formation. Methane can also mobilized through the well bore during drilling.

Long-Term Impact on Water Supplies

It's a certainty that contaminants from gas drilling operations will enter both ground and surface waters. As previously indicated, these contaminants include hydro-fracturing chemicals, a number of which are toxic, heavy metals such as barium, cadmium, and chromium, radioactive compounds such as radon, and sodium chloride from brine. The data gathered by DEC on HVHF wastewater in Pennsylvania showed barium to be 300 times and benzene 100 times the maximum concentration allowed by the federal drinking water standards. And, importantly, these contaminants are in solution, meaning they are dissolved in the wastewater.

In the neighboring NYC watershed, just to the east of the USR watershed, the dSGEIS prohibits gas drilling using HVHF, and stipulates that well pads have to be at least 4,000 feet outside the watershed boundary (drainage divide). The rationale given for this is that drinking water from the NYC watershed is unfiltered, inferring that, without filtration, any contaminants from gas drilling operations cannot be removed from the drinking water supply. Conversely, this infers that if the drinking water is filtered, contaminants can be removed. This is simply not true. Conventional filtration processes used by municipalities to treat surface drinking water cannot removed contaminants in solution such as those from gas drilling/HVHF operations.

Municipalities use filters containing mixed granular media with a range of particle sizes. A common type of mixed media filtration is called "Rapid Sand Filtration". Quoting from a paper by the Civil Engineering Department at Virginia Tech University, "Rapid sand filtration is the flow of water through a bed of granular media, normally following settling basins in conventional water treatment trains. The purpose of this filtration is to remove any particulate matter left over after flocculation and settling. (Note: flocculation is a process of aggregating fine suspended particles.) The filter process operates based on two principles, mechanical straining and physical adsorption. Sand filtration is a "physical-chemical process for separating suspended and colloidal impurities from water passage through a bed of granular material. Water fills the pores of the filter medium, and the impurities are adsorbed on the surface of the grains or trapped in the openings." (Culp) The key to this process is the relative grain size of the filter medium." The point is that the typical filtration process for surface drinking waters removes only insoluble particulate matter, and not contaminants in solution.

Thus, if gas drilling using HVHF takes place in a drinking water watershed at an industrial scale as previously described, it is inevitable that the drinking water supply will become contaminated with low-level concentrations of toxic chemicals and heavy metals. And, there is no data on the long-term effects on public health, an issue that has not been addressed by the NYS Department of Health.

Mitigation

The draft SGEIS proposes mitigation measures to protect drinking water supplies, the primary method being setbacks, or separation distances. Here are the main ones for public drinking water:

• NYC watershed	4,000 feet (from drainage divide)
• Reservoirs	2,000 feet
• Primary aquifers	500 feet
• Principal aquifers	0 feet

These setbacks, which apply to the well pad, are inadequate to protect drinking water supplies. A horizontally drilled well bore can extend thousands of feet, and if faults and fractures are present in the overlying bedrock, contamination can occur via vertical migration. Also, the setback from a perennial stream in a watershed is only 150 feet, creating a contamination scenario via overland flow. There is no protection provided in the dSGEIS for principal aquifers, which are a valuable ground water resource.

Recommendations

To protect ground and surface drinking water supplies:

1. The setback for drinking water watersheds, such as the Upper Susquehanna River watershed, should be 4,000 feet from the watershed boundary (drainage divide). This is the same as the DEC has recommended for the NYC watershed, and to not treat all drinking water watersheds the same is disparate treatment.

2. The setback for both primary and principal aquifers should be 4,000 feet. This will protect the aquifers from vertical migration of contaminants from hydraulically fractured horizontal well bores.

Respectively Submitted,

Win McIntyre
Manager, Otsego Lake Watershed
Consultant, Water Resources Management