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Chapter 15

Water Supply and Wastewater Challenges in Marcellus Shale Development

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Synopsis

§ 15.01. Introduction to the Dual Water Supply and Wastewater Challenge.

Development of the extensive natural gas reserves contained in the Marcellus Shale deposits promises to be one of the most important opportunities for the United States for the next several decades. At the same time, exploitation of this gas resource poses interesting water resource, water supply, and wastewater challenges which the oil and gas industry has rarely faced in the Appalachian Basin.

While some traditional oil and gas development has utilized, to a modest extent, water supplies in the drilling and fracing processes, Marcellus Shale exploitation involves orders of magnitude greater water resource requirements. Horizontal drilling techniques, coupled with hydraulic fracturing of deep horizontal extensions, entails water use multiple times greater than traditional wells.

Based on experience in the Barnett Shale and developing experience in the Marcellus play, approximately one- to five-million gallons of water are required for fracing each gas well, with slickwater frac techniques utilizing as much as 500,000 to 1,000,000 gallons of fluid in each of multiple stages. To be sure, recycling of flowback water will likely be utilized to reduce disposal requirements, thereby reducing somewhat the draft on freshwater supplies. But the technology allowing for large-scale reuse of water has encountered some limitations, such that even in water-challenged jurisdictions such as Texas, only a relatively small percentage of water needed for frac operations (typically 10 to 15 percent) is derived from recycled water. Thus, the challenge will be to secure adequate and reliable sources of water with appropriate quality characteristics in reasonable proximity to proposed well sites to meet the gas well development requirements.

At the same time, the fracture stimulation of Marcellus Shale wells results in substantial volumes of flowback wastewaters containing high salt contents and other constituents of potential concern. Of the volumes pumped downhole for fracing, a portion (ranging from 25 to 50 percent) emerges

from the well over time as flowback water, followed by additional production brines. Efforts to obtain representative characterization of Marcellus Shale flowback and produced waters are still underway, but not complete. Generally, such flowback waters contain four to 25 percent salts (including constituents from the underground formations), plus oil and gas, and chemicals added during the frac. Typical total dissolved solids (TDS) concentrations may exceed 100,000 milligrams per liter (mg/l) — higher than experienced in some other regions and shale plays.

These high-TDS wastewaters pose a substantial challenge, both in terms of volume and concentrations. A number of eastern streams are already burdened with high TDS concentrations, largely from abandoned mines and acid mine drainage, with limited capacity to assimilate additional loadings, particularly during low flow periods. Other streams, particularly in rural watersheds across the northern portions of Pennsylvania and southern New York, are subject to special protection for their high quality, with discharges strictly regulated under "anti-degradation" standards. Some states, such as Pennsylvania, have moved to impose stringent restrictions on new or increased loadings of TDS from Marcellus Shale development, pointing the way to effective "zero discharge" scenarios for wastewater management. At the same time, environmental organizations have petitioned the U.S. Environmental Protection Agency (EPA) to base introduction of gas well wastewaters from publicly-owned treatment works (that is, sewage treatment plants) and to establish new effluent guidelines for the oil and gas sector, establishing a no discharge limit for central wastewater treatment facilities receiving oil or gas-related wastewaters.[1]

Thus, the entire "water balance" of Marcellus Shale development is a critical element to successful pursuit of this play. Concurrently, the acquisition

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1 Letter from EarthJustice, *et al.,* to Carey A. Johnston, Water Docket, U.S. Environmental Protection Agency, re: Comments on Final 2008 Effluent Guidelines Program Plan and Suggestions for the 2009 Annual Review: Oil and Gas Exploration, Stimulation, and Extraction, Docket EPA-HQ-OW-2008-0517 (April 7, 2009).

of adequate and reliable supplies of water, coupled with the treatment, reuse and disposition of wastewater, pose key technical, regulatory and legal challenges requiring concerted attention.

§ 15.02. The Water Resource Challenge in Perspective.

From a statewide or basin perspective, water requirements for Marcellus Shale development might appear comparatively modest. The Susquehanna River Basin Commission, for example, estimates that annual consumptive water use for all gas well development, once full-scale development has been reached, will equate to approximately 28 million gallons per day (mgd),[2] representing approximately three percent of total basin consumptive water use.[3] By comparison, the total Marcellus Shale gas well water demand equates to about one-half the basin-wide water use by the recreational sector (golf courses and ski resorts), and less than one nuclear power plant.[4] However, in some basins, cumulative consumptive water use (from all uses) poses concerns during drought and low flow events, as eastern states and water management agencies attempt to balance demands by upstream users versus needs for downstream flows to maintain wastewater assimilative capacity, fisheries, salinity control in estuaries, and other environmental conditions.[5] At the same time, much of the Marcellus Shale development occurs in areas with smaller headwater streams, many with high quality

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2 Thomas R. Beauduy, *Accommodating a New Straw in the Water: Extracting Natural Gas from the Marcellus Shale in the Susquehanna River Basin*, SRBC White Paper, Feb. 2009, available at http://www.srbc.net/programs/projreviewmarcellus.htm.

3 SRBC reports that current "approved" consumptive use totals approximately 563 mgd (*id.*), but the total current maximum consumptive use in the basin (including both grandfathered uses and those approved by SRBC) has been estimated 882.5 mgd. SRBC, *Consumptive Use Mitigation Plan*, SRBC Pub. No. 253 (March 2008) at 5, available at http://www.srbc.net/planning/CUMP.htm.

4 T. R. Beauduy, *supra* note 2.

5 The Susquehanna River Basin likewise faces challenges in balancing growing consumptive water use with maintenance of flows in the lower river and into the upper Chesapeake Bay, where such flows are important to both migratory fish habitat and Bay salinity. SRBC, *Consumptive Use Mitigation Plan*, SRBC Pub. No. 253 (March 2008).