



# United States Department of the Interior

## U.S. GEOLOGICAL SURVEY

425 Jordon Road  
Troy, New York 12180

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Mr. Jack Dahl, Director  
Bureau of Oil and Gas Regulation, 3<sup>rd</sup> Floor  
NYSDEC  
625 Broadway, Albany, NY 12233-6500

Mr. William Boria, WR Specialist  
Chautauqua County Dept. of Health  
Hall R. Clothier Bldg.  
7 North Erie Street  
Mayville, NY 14757

Dear Mr. Dahl and Mr. Boria:

I have read the discussion of the water-quality issues at the Ferrugia household in your letters (dated June 1, 2009 and the response July 6, 2009). Because I have been included, by way of copies, in this discussion I wanted to comment on the scientific evidence presented. Based simply on the information provided in these two packages, there may not be sufficient data or information to show that the water-quality changes were or were not related to gas well development.

The comments on the variability of water quality in the region are worth considering and to some extent are shown by the additional sample analyses from the neighbor wells provided in the DEC response. The shift in ratios at the Ferrugia well shown in the Piper diagrams appears to be consistent with a shift towards gas field brine. However, ratios alone may not be sufficient to understand the changes. Concentrations of major ions and trace elements should be considered.

Barium, a trace element that can be associated with gas-field brines, shows a 6-fold increase at the Ferrugia well from 2005 to 2007. This increase was accompanied by a 50 percent drop in sulfate concentration, which is also consistent with the introduction of deep, anoxic source waters or brines (where gypsum is absent in bedrock). These two 2007 concentrations at the Ferrugia well differ significantly from those at the other domestic wells.

Given the concentrated nature of gas well brines, only very small percentages (tenths of percents) need mix with local groundwater to have adverse water-quality effects. This kind of contamination could be in the form of discrete slugs of contaminated water and (or) gradual leaching as recharge passes through contaminated overburden material.

I should also note that the 2009 water analysis is suspect. The charge balance (the balance between positive and negative ions) is in error by 28.4 percent, which is considered unacceptable. The two previous samples had errors of 0.7 and 6.4 percent. The likely cause of this imbalance is either the chloride concentration (low) and (or) the sodium concentration (high). Given the consistency or

