

recommended additional parameters to test if gas drilling nearby is the reason for water testing;³⁷

- NYSDOH recommendations relative to private water well testing dated July 21, 2009, based on review of fracturing fluid constituents and flowback characteristics;
- URS, 2009, water well testing recommendations based on review of fracturing fluid constituents and flowback characteristics;
- Alpha, 2009, regarding:
 - water well testing requirements in other states identified through a survey of regulations in 10 other jurisdictions; and
 - previous drilling in aquifers, watersheds and aquifer recharge areas; and
- ICF, 2009a, regarding:
 - water well testing recommendations; and
 - review of hydraulic fracturing design and subsurface fluid mobility.

7.1.4.1 Private Water Well Testing

The Department proposes to require, via permit condition, that the operator, at its own expense, sample and test all residential water wells within 1,000 feet of the well pad, subject to the property owner's permission, or within 2,000 feet of the well pad if no wells are available for sampling within 1,000 feet either because there are none of record or because the property owner denies permission. The Department would require that results of each test be provided to the property owner within 30 days of the operator's receipt of laboratory results. The Department would further require that the data be available to the Department and local health department upon request for complaint investigation purposes.

Schedule

Testing before drilling is recommended as a mitigation measure related to the potential for groundwater contamination because it provides a baseline for comparison in the event that water contamination is suspected. Testing prior to drilling each well at a multi-well pad provides ongoing monitoring between drilling operations, so the requirement would be attached to every

³⁷ http://www.health.state.ny.us/environmental/water/drinking/part5/append5b/fs3_water_quality.htm, accessed 9/16/09.

well permit that authorizes high-volume hydraulic fracturing. Testing at established intervals after drilling or hydraulic fracturing operations provides opportunities to detect contamination or confirm its absence. If no contamination is detected a year after the last hydraulic fracturing event on the pad, then further routine monitoring should not be necessary. The Department proposes to require, via permit condition the following ongoing monitoring schedule:

- Initial sampling and analysis prior to site disturbance at the first well on the pad, and prior to drilling commencement at additional wells on multi-well pads;
- Sampling and analysis three months after reaching total measured depth (TMD) at any well on the pad if there is a hiatus of longer than three months between reaching TMD and any other milestone on the well pad that would require sampling and analysis; and
- Sampling and analysis three months, six months and one year after hydraulic fracturing operations at each well on the pad.

For multi-well pads where drilling and hydraulic fracturing activity is continuous, to the extent that water well sampling and analysis according to the above schedule would occur more often than every three months, the Department proposes to simplify the protocol so that sampling and analysis occurs at three month intervals until six months after the last well on the pad is hydraulically fractured, with a final round of sampling and analysis one year after the last well on the pad is hydraulically fractured.

More frequent sampling and analysis, or sampling and analysis beyond one year after last hydraulic fracturing operations, may be warranted in response to complaints as described below or for other reasonable cause.

Parameters

The NYSDOH recommends testing for the analytes listed in Table 7.3 to aid with determining whether gas drilling may have had an impact on the quality or quantity of a well. This analysis is not intended to constitute a comprehensive evaluation. In the event that a potential impact is determined, additional investigation (e.g., isotopic analysis of methane to determine source or site-specific chemical analysis) may be necessary.

Table 7.3 - NYSDOH Water Well Testing Recommendations
(Revised July 2011 to reflect more recent recommendations from NYSDOH)

Parameter	Notes
Barium	Barium (barite) is a principal component of many drilling muds. In the event that barite is not used in the drilling mud, a substitution should be made for a component that is present in the drilling mud.
Chloride	A measure of chloride anions in water. Chlorides and other salts are naturally occurring and can be found in many different geologic zones, but deep groundwater typically contains high levels of chloride. Flowback water contains high levels of chlorides. Therefore, an increase in chlorides may be an indication that drilling has allowed communication between geologic zones and/or flowback water has contaminated an aquifer.
Conductivity	A measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol and sugar do not conduct electrical current very well and therefore have a low conductivity when in water. A change in water quality as a result of drilling is expected to affect the conductivity.
Gross alpha/beta	Radioactivity is typically elevated in shale relative to other rock types and the Marcellus Shale is especially enriched. Drilling and production of shale may have the ability to mobilize radioactivity towards the surface where it could either concentrate or infiltrate aquifers. These Gross analyses are screening values for defining when to perform more detailed analyses.
Iron	Iron is commonly found in many aquifers and may be mobilized during initial drilling activities.
Manganese	Manganese is commonly found in many deep and shallow aquifers and may be mobilized during initial drilling activities.
Dissolved methane & ethane	Occurs naturally in many aquifers but may also migrate into aquifers as a product of drilling and production. Additional analysis may be necessary to determine the source and/or percentages of dissolved gasses.
pH	A measure of how acidic or basic water is. pH is sensitive to small changes in water chemistry such as those that may result from natural gas drilling.
Sodium	Sodium is naturally occurring and commonly found in most water. However, sodium is found in high concentrations in deep shale production brines and gas wells.
Total dissolved solids (TDS)	A measure of all dissolved organic and inorganic species in water. TDS is useful as an indicator of aesthetic characteristics of drinking water and as an aggregate indicator of the presence of a broad array of chemical contaminants. An increase in TDS may be indicative of drilling operations having introduced contaminants into the water supply.
Static water level	Static water level is the level of the water in the well during normal conditions prior to any pumping. This is a measure of the amount of water in the aquifer. Analysis of changes in static water level should carefully consider the well's construction, maintenance and operational history, recent precipitation and use patterns, the season and the effects of competing wells.
Volatile organic compounds (VOCs), specifically BTEX	VOCs encompass a number of compounds that are expected to be used extensively during surface operations and would account for water supplies potentially being affected by spills, leaking pits, or other unforeseen incidents. Additionally, certain VOCs are known to exist in shale and are expected to be a contaminant of concern in the event that flowback waters or production brines migrate into an aquifer.

Sampling Protocol

The Department proposes to require that water samples to be collected by a qualified professional and analyzed utilizing a NYSDOH ELAP approved laboratory,³⁸ including the use of proper sampling and laboratory protocol, in addition to the use of proper sample containers, preservation methods, holding times, chain of custody, analytical methods, and laboratory QA/QC.

The water samples would be representative of the aquifer being produced by the well. Therefore, the well pump should be allowed to run for at least 5 minutes prior to sample collection. The sample should be collected prior to any in home water treatment that may be present. If this is not feasible, the type of treatment that is present on the well survey should be noted. The samples should be collected in appropriate containers, refrigerated, and transported to the laboratory for analysis.

Recommended Sampling Procedure for Water Supply Wells

- Select an indoor, leak-free, cold water faucet from which to collect the sample. If treatment (softener, filter, RO, etc) exists the sample should be collected from an untreated location or the treatment should be bypassed;
- Remove the faucet's aerator or strainer, if one is present;
- Disinfect the faucet by cleaning and flaming the inside of the faucet;
- Let cold water run for 5 minutes;
- Reduce water flow to a stream of water the size of a pencil or smaller;
- Fill sample bottles per method specifications, making sure not the touch the inside of the bottle or cap; and
- Cap bottles, refrigerate, and transport to the laboratory for analysis.

³⁸ <http://www.wadsworth.org/labcert/elap/elap.html>, accessed 9/16/09.

Complaints

As noted in the 1992 GEIS:

The diversity of jurisdictions having authority over local water supplies complicates the response to complaints about water supplies, including those complaints that complainants believe are related to oil and gas activity. Water supply complaints occur statewide and take many forms, including taste and turbidity problems, water quantity problems, contamination by salt, gasoline and other chemicals and problems with natural gas in water wells. All of these problems, including natural gas in water supplies, occur statewide and are not restricted to areas with oil and gas development.³⁹ *and:*

The initial response to water supply complaints is best handled by the appropriate local health office, which has expertise in dealing with water supply problems.⁴⁰

The Department has MOUs in place with several county health departments in western NY whereby the county health department initially investigates a complaint and then refers it to the Department when a problem has been verified and other potential causes have been ruled out. For complaints that occur more than a year after the last hydraulic fracturing operations on a well pad within the radius where baseline sampling occurred (1,000 feet or 2,000 feet), or for complaints regarding water wells that are more than 2,000 feet away from any well pad, the Department proposes to continue following the aforementioned procedure statewide. Complaints would be referred to the county health department, who would refer them back to the Department for investigation when a problem has been verified and other potential causes have been ruled out. Sampling and analysis to verify and evaluate the problem would be according to protocols that are satisfactory to the county health department, with advice from NYSDOH as necessary.

Complaints that occur during active operations at a well pad within 2,000 feet or the radius where baseline sampling occurred, or within a year of last hydraulic fracturing at such a site, should be jointly investigated by the Department and the county health department. Mineral Resources staff would conduct a site inspection, and if a complaint coincides with any of the following documented potentially polluting non-routine well pad incidents, then the Department would consider the need to require immediate cessation of operations, immediate corrective

³⁹ NYSDEC, 1992, GEIS, pp. 15-4 et seq.

⁴⁰ NYSDEC, 1992, GEIS, p. 15-5.

action and/or revisions to subsequent plans and procedures on the same well pad, in addition to any applicable formal enforcement measures:

- Surface chemical spill;
- Fracturing equipment failure;
- Observed leaks in surface equipment onto the ground, into stormwater runoff or into a surface water body;
- Observed pit liner failure;
- Significant lost circulation or fresh water flow below surface casing;
- The presence of brine, gas or oil zones not anticipated in the pre-drilling prognosis;
- Evidence of a gas-cut cement job;
- Anomalous flow or pressure profile during fracturing operations;
- Any non-routine incident listed in ECL §23-0305(8)(h) (i.e., casing and drill pipe failures, casing cement failures, fishing jobs, fires, seepages, blowouts); or
- Any violation of the ECL, its implementing rules and regulations, or any permit condition, including the requirement that the annulus between the surface casing and the next casing string be maintained in a non-pressurized condition; and

The Department and the county health department would share information. All data on file with the county health department relative to the subject water well, including pre-existing conditions and any available information about the well's history of use and maintenance, would be considered in determining the proper course of action with respect to well pad activities. Sub-section 8.2.3 describes the Department's enforcement authority and the enforcement mechanisms available to the Department.

7.1.4.2 Sufficiency of As-Built Wellbore Construction

Wellbore construction is addressed by the existing 1992 GEIS. While the same concepts apply to wells used for high-volume hydraulic fracturing, some enhancements are proposed because of the high pressures that will be exerted, the large fluid volumes that will be pumped and potential concentration of the activity in areas without much subsurface well control. Further, recent