Section 5: Summary

This section summarizes the impacts of natural gas development using horizontal drilling/high-volume hydraulic fracturing on the NYC water supply watershed and infrastructure.

Rate and Density of Well Development in the NYC Watershed

Reasonably foreseeable natural gas well development scenarios for the NYC watershed based on experience in comparable formations suggest that under favorable economic and regulatory conditions annual well completion rates would increase from initial rates as low as 5 to 20 wells per year to an average of 100 to 300 wells per year, potentially peaking at 500 wells per year. Consistent with NYSDEC spacing unit requirements and development in other formations, it is estimated that on the order of 3,000 to 6,000 wells could ultimately be drilled and fractured in the NYC watershed. This does not include re-fracturing of the same wells, nor does it include drilling and fracturing of wells to tap natural gas in the Utica, Oriskany, or Trenton/Black River formations underlying the NYC watershed. Development of these formations would require additional well construction but not necessarily new ancillary infrastructure.

Meaningful assessment of risks and impacts must be guided by the scale of natural gas development. Any individual hydraulic fracturing operation poses a relatively small risk to the water supply. But at the rates and densities of development as currently practiced elsewhere in the Marcellus and comparable formations, the likelihood of negative impacts and the subsequent risk to the water supply is substantially higher. When the issue is considered from the standpoint of not one well but of hundreds or thousands of wells, the cumulative risks become significant. Prevention of polluting activities is certain to protect water quality and infrastructure from these cumulative risks. To illustrate minimum mitigation measures that would be required to reduce risks for any one individual impact, Appendix D sets forth certain mitigation strategies.

The following are considered foreseeable risks, and merit detailed consideration:

Land Disturbance, Site Activity, and Truck Traffic (Industrialization)

- High levels of site disturbance, truck traffic and intensive industrial activity, on a relatively constant basis, over a period of decades, and attendant impacts on overall watershed health.
- Trucking activity will be accompanied by provision of equipment and material supply systems (warehouses, garages, support services), gas gathering and pipeline systems, compressor stations, and waste disposal systems.
- Without some limits on the rate or density of development in the watershed, it is reasonable to expect that a significant and relatively rapid industrialization of the NYC watershed could occur.

Tunnel Integrity and Subsurface Migration

- Widespread hydraulic fracking will permanently and irreversibly compromise a significant geological formation that presently constitutes part of the subsurface system that isolates near-surface, fresh water flow regimes from non-potable, highly saline waters of deeper formations.
- The subsurface impact of repeated and extensive fracturing on intervening strata will increase the likelihood of the migration of hazardous chemicals and/or poor quality formation water and infiltration into overlying groundwater, watershed streams, reservoirs, and tunnels.

- The inadvertent extension of fractures beyond the target strata, and long-term changes in subsurface stresses will likely increase the number and capacity of migration pathways through the geologic strata underlying the watershed, and increase the likelihood of subsurface contamination of the water supply system.
- Infiltration of formation or fracking fluids could cause tunnel discharges to exceed NYSDEC discharge standards even at low infiltration rates.
- Transmittal of pressurized fluids from presently isolated deep formations could expose the external surfaces of the unreinforced concrete tunnel liners to excessive pressures and compromise liner integrity.

Water Withdrawals

- Despite representing a small portion of overall watershed yield, withdrawals for hydrofracturing could significantly impact commitments for water supply and habitat protection, particularly during periods of drought. The severity of impacts will depend on the amount and timing of withdrawals. Withdrawals while reservoirs are spilling would have little impact. Withdrawals during dry periods could increase the duration of drought watch, warning, or emergency conditions.
- Delaware Basin withdrawals downstream of the NYC West-of-Hudson reservoirs could impact system operations by requiring increased releases to meet in-stream flow requirements. Similarly, withdrawals from the Upper Esopus Creek could require increased releases from Schoharie Reservoir to meet minimum downstream flow requirements.
- Excessive water withdrawals may also impact aquatic habitat and biota.

Chemical Usage

- Introduction of hundreds of tons per day of fracturing chemicals into the watershed over a period of several decades will likely be accompanied by the gradual dispersion of low levels of toxic chemicals into the environment and potentially the water supply via multiple transport pathways.

Surface Spills

- A chronic and persistent occurrence of small scale surface spills and contamination incidents will inevitably accompany the thousands upon thousands of fluid transfer activities necessary for widespread hydrofracturing and gas well operation, and can be expected to reduce public and regulatory agency confidence in the quality and safety of the water supply.
- Occasional acute spills that could cause operational impacts, potential MCL violations and further undermine confidence in the ability to maintain current high water quality standards.

Wastewater Treatment and Disposal

- The flowback and produced waters resulting from hydrofracturing and gas well operations will produce an industrial-strength waste stream characterized by exceptionally high concentrations of a wide range of substances with the potential for adverse health and water quality effects which can be expected to exceed existing treatment and assimilative capacities within a few years.
- There is high level of uncertainty as to whether effective waste treatment processes and sufficient capacity will be available in the future. Sufficient dilution capacity is unlikely to be available. Residuals productions associated with the only presently available treatment

technology could produce a waste stream that amounts to three to four times the dry sludge total disposed of by NYC's fourteen wastewater treatment plants.
- Solids disposal options will be further limited by elevated levels of radioactivity.
- Waste management and transport will likely contribute to a long-term, low level increase in truck traffic and transport of hazardous chemicals.
- Siting of injection wells and or treatment facilities will add an additional category of industrial activity to the region.
- Widespread use of injection wells, if geologically feasible, would provide additional contaminant transport pathways and could possibly increase low-level seismic activity, increasing opportunity for subsurface contaminant transport.

Filtration Avoidance Determination

- Given the importance of watershed protection for unfiltered water supply systems, major changes in land use and/or increased levels of industrial activity in the watershed could jeopardize the Filtration Avoidance Determination granted to the Catskill and Delaware water systems and decrease public confidence in the high quality of the NYC water supply.
- In the event that filtration is ultimately required, NYC expects that the current $10 billion filtration plant design would not be adequate to remove the chemicals that could be introduced into the watershed. Advanced oxidation, granular activated carbon adsorption, and/or membrane filtration processes could be required. All of these advanced processes are significantly more expensive than the current design, and it is quite possible that the available treatment site would not even accommodate the additional treatment technology. Net impacts on overall treatment facility requirements processes would be expected to increase costs by at least 50 percent and possibly more than 100 percent relative to the current design.

Taken together, these potential impacts - some very likely, some less so, many simply unknown –suggest that large-scale horizontal drilling/high-volume hydraulic fracturing in the NYC watershed will substantially increase the overall risk to the NYC water supply compared to current conditions.

This assessment has focused on activities and impacts that would most directly affect NYC's water supply system. Other effects, which for the purposes of this effort have been considered to be secondary, would not necessarily be minor or insignificant. Induced growth, and the economic changes that it would bring, can adversely impact water quality. It often results in additional demand on roads and other local infrastructure, including schools, local water supply and municipal wastewater treatment systems, hospitals and emergency services. Adverse air quality impacts and impacts on flora, wildlife and soil chemistry can also be expected given the level of industrial activity that would accompany hydraulic fracturing and horizontal drilling operations, particularly if implemented at rates and densities employed elsewhere.