



Department of
Environmental
Conservation

Executive Summary

Final

Supplemental Generic Environmental Impact Statement

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EXECUTIVE SUMMARY

High-volume hydraulic fracturing utilizes a well stimulation technique that has greatly increased the ability to extract natural gas from very tight rock. High-volume hydraulic fracturing, which is often used in conjunction with horizontal drilling and multi-well pad development, raises new, significant, adverse impacts not studied in 1992 in the Department of Environmental Conservation's (Department or DEC) previous Generic Environmental Impact Statement (1992 GEIS) on the Oil, Gas and Solution Mining Regulatory Program.¹

Since issuing a draft Scope for public review in October 2008, the Department has conducted an exhaustive evaluation of high-volume hydraulic fracturing's potential significant adverse environmental and public health impacts and possible mitigation measures to eliminate, avoid or reduce those impacts. The Department received over 260,000 public comments, an unprecedented number, on the 2009 Draft SGEIS (dSGEIS) and the 2011 Revised Draft SGEIS (rdSGEIS) and the associated regulatory documents which were considered before issuing this Final SGEIS (FSGEIS) (the drafts and the final SGEIS are collectively referred to as the "SGEIS," unless otherwise distinguished). During this period of time, a broad range of experts from academia, industry, environmental organizations, municipalities, and the medical and public health professions commented and/or provided their analyses of high-volume hydraulic fracturing. The comments referenced an increasing number of ongoing scientific studies across a wide range of professional disciplines. These studies and expert comments evidence that significant uncertainty remains regarding the level of risk to public health and the environment that would result from permitting high-volume hydraulic fracturing in New York, and regarding the degree of effectiveness of proposed mitigation measures. In fact, the uncertainty regarding the potential significant adverse environmental and public health impacts has been growing over time.

¹ The Generic Environmental Impact Statement (1992 GEIS) on the Oil, Gas and Solution Mining Regulatory Program is posted on the Department's website at <http://www.dec.ny.gov/energy/45912.html>. The 1992 GEIS includes an analysis of impacts from vertical gas drilling as well as hydraulic fracturing. Since 1992 the Department has used the 1992 GEIS as the basis of its State Environmental Quality Review Act (SEQRA) review for permit applications for gas drilling in New York State.

The Department worked closely with the New York State Department of Health (NYSDOH) during preparation of the SGEIS. Due to the increasing concern regarding high-volume hydraulic fracturing's impacts on public health, the Department on September 20, 2012, requested NYSDOH to conduct a review of the SGEIS and mitigation measures and advise the Department whether they were adequate to protect public health. On December 17, 2014, NYSDOH advised the Department that there are several potential adverse environmental impacts that can result from high-volume hydraulic fracturing which may be associated with adverse public health outcomes. These impacts include: 1) air impacts that could affect respiratory health due to increased levels of particulate matter, diesel exhaust, or volatile organic chemicals; 2) climate change impacts due to methane and other volatile organic chemical releases to the atmosphere ; 3) drinking water impacts from underground migration of methane and/or fracturing fluid chemicals associated with faulty well construction or seismic activity; 4) surface spills potentially resulting in soil, groundwater, and surface water contamination; 5) surface water contamination resulting from inadequate wastewater treatment; 6) earthquakes and creation of fissures induced during the hydraulic fracturing stage; and 7) community character impacts such as increased vehicle traffic, road damage, noise, odor complaints, and increased local demand for housing and medical care. NYSDOH concluded that "until the science provides sufficient information to determine the level of risk to public health from HVHF to all New Yorkers and whether the risks can be adequately managed ... HVHF should not proceed in New York State."

The Department concurs with NYSDOH, as the uncertainty revolving around potential public health impacts stems from many of the significant adverse environmental risks identified in the SGEIS for which the Department proposed and considered extensive mitigation measures. In response to additional scientific information regarding the magnitude of high-volume hydraulic fracturing's potential significant adverse impacts, the Department considered expanding many of the mitigation measures previously proposed in the rdSGEIS to protect public health and the environment with a greater margin of safety.

As a result, more and more area within the Marcellus Shale fairway would be off limits to high-volume hydraulic fracturing. For example, the Department considered prohibiting high-volume hydraulic fracturing on private lands within the Catskill Park, increasing setbacks to residences,

and natural and cultural resources, and expanding the sensitive areas that would be off limits. The additional restrictions and prohibitions and the necessity for close and coordinated regulatory oversight by the Department with involved and interested state and local agencies would substantially increase costs to industry, which would likely negatively impact the potential economic benefits associated with high-volume hydraulic fracturing..

The Court of Appeals decision in *Matter of Wallach v. Town of Dryden and Cooperstown Holstein Corp. v. Town of Middlefield*, which held that local governments could exercise their zoning and land use jurisdiction to restrict or prohibit high-volume hydraulic fracturing within their communities, would impact prior economic projections and would likely result in a decrease in potential economic benefits. This would also create potential land use conflicts with high-volume hydraulic fracturing's ancillary infrastructure in communities that reject high-volume hydraulic fracturing within their borders.

General Background

The Department has received applications for permits to drill horizontal wells to evaluate and develop the Marcellus Shale for natural gas production by high-volume hydraulic fracturing. In New York, the primary target for shale-gas development is currently the Marcellus Shale, with the deeper Utica Shale also identified as a potential resource. Additional low-permeability reservoirs may be considered by project sponsors for development by high-volume hydraulic fracturing.

Horizontal drilling with high-volume hydraulic fracturing facilitates natural gas extraction from large areas where conventional natural gas extraction is commercially unprofitable; thus, well operations would likely be widespread across certain regions within the Marcellus formation. Distinct from conventional natural gas extraction technologies governed by the Department's 1992 GEIS and related oil and gas permits, high-volume hydraulic fracturing involves substantially larger volumes of water and a multitude of potential chemical additives. The use of high-volume hydraulic fracturing with horizontal well drilling technology enables a number of wells to be drilled from a single well pad (multi-pad wells). Although horizontal drilling results

in fewer well pads than traditional vertical well drilling, the pads are larger and the industrial activity taking place on the pads is more intense.

Hydraulic fracturing requires chemical additives, some of which potentially pose hazards to public health and the environment through exposure. The high volume of water associated with hydraulic fracturing may also result in significant adverse impacts relating to water supplies, other water resources, wastewater treatment and disposal, and truck traffic. Horizontal wells also generate greater volumes of drilling waste (cuttings) than vertical wells. The industry projections of the level of drilling, as reflected in the intense development activity in neighboring Pennsylvania, has raised additional concerns relating to community character, including noise, and visual impacts; adverse impacts on cultural and historic resources, agriculture, tourism, and scenic resources; and socioeconomics impacts.

The Department has prepared this Final Supplemental Generic Environmental Impact Statement (Final SGEIS) to satisfy the requirements of the State Environmental Quality Review Act (SEQRA) by examining high-volume hydraulic fracturing and identifying new potential significant adverse impacts of these operations.

The Department's environmental review associated with the Department's determination whether to authorize high-volume hydraulic fracturing in New York State required extensive evaluation of the current and developing science underlying high-volume hydraulic fracturing's impacts and the increasingly stringent mitigation measures to protect the environment and public health.

SEQRA Procedure to Date

The public process to develop the SGEIS began with public scoping sessions in the autumn of 2008. Since then, engineers, geologists and other scientists and specialists in all of the Department's natural resources and environmental quality programs have collaborated to comprehensively analyze a vast amount of information about the proposed operations and the potential significant adverse impacts of these operations on the environment, identify mitigation measures that would prevent or minimize any significant adverse impacts, and identify criteria and conditions for future permit approvals and other regulatory action.

In September 2009, the Department issued an initial dSGEIS (2009 dSGEIS) for public review and comment. The extensive public comments revealed a significant concern with potential contamination of groundwater and surface drinking water supplies that could result from this new stimulation technique. Concerns raised included comments that the 2009 dSGEIS did not fully study the potential for gas migration from this new technique, or adequately consider impacts from disposal of solid and liquid wastes. Additionally, commenters stated the 2009 dSGEIS did not contain sufficient consideration of visual, noise, traffic, community character or socioeconomic impacts. Accordingly, in 2010 Governor Paterson ordered the Department to issue a revised dSGEIS (rdSGEIS) on or about June 1, 2011. Executive Order 41 also provided that no permits authorizing high-volume hydraulic fracturing would be issued until the SGEIS was finalized.

Since the issuance of the 2009 dSGEIS, and the subsequent rdSGEIS, the Department has gained a more detailed understanding of the potential impacts associated with high-volume hydraulic fracturing with horizontal drilling from: (i) the extensive public comments from environmental organizations, municipalities, industry groups, medical and public health professionals, and other members of the public; (ii) its review of reports and studies of proposed operations prepared by industry groups; (iii) extensive consultations with scientists in several bureaus within the NYSDOH; (iv) the use of outside consulting firms to prepare analyses relating to socioeconomic impacts, as well as impacts on community character, including visual, noise and traffic impacts; and, (v) its review of information and data from the Pennsylvania Department of Environmental Protection (PADEP) and the Susquehanna River Basin Commission (SRBC) about events, regulations, enforcement and other matters associated with ongoing Marcellus Shale development in Pennsylvania. In June 2011, moreover, Commissioner Joseph Martens and Department staff visited a well pad in LeRoy, Pennsylvania, where contaminants had discharged from the well pad into an adjacent stream, and had further conversations with industry representatives and public officials about that event and high-volume hydraulic fracturing operations in Pennsylvania generally.

In addition, as discussed above, NYSDOH conducted a comprehensive health review of high-volume hydraulic fracturing and completed its Public Health Review in December 2014.

During preparation of this Final SGEIS, the Department incorporated suggestions made by the public and, where appropriate, provided additional discussion in either the Final SGEIS or the Response to Comments to clarify the content of the drafts. Specifically, the Department has revised Chapter 1 to reflect all of the procedural changes and actions that have occurred following the time of publication of the rdSGEIS for public comment. In Chapter 2, a subsection drafted in 2011 relating to the potential public need and benefit of high-volume hydraulic fracturing was deleted because the subject is now addressed more accurately in the Department's Response to Comments, which is based on analysis subsequent to the rdSGEIS and public comment. The Department also revised Chapter 7 of the Final SGEIS to remove conclusory language with respect to the mitigation proposed, to better reflect remaining uncertainty as to the effectiveness or the degree to which the mitigation would reduce impacts and risks associated with high-volume hydraulic fracturing. The Department also revised Chapter 9 to better represent both the benefits and negative consequences of the No Action Alternative. This Executive Summary was also revised to reflect these changes, as well as to reflect some of the additional mitigation measures that were considered by the Department. These minor changes to the SGEIS do not reflect that some laws or regulations may have changed from the time of publication of the 2011 rdSGEIS, notably, amendments to the Water Resources Law and corresponding regulations.

Pursuant to 6 NYCRR Section 617.9(b)(8), the Final SGEIS consists of the prior drafts of the SGEIS, including all revisions noted above and the summary of the substantive comments received and the Department's responses, which both comprise the Department's Response to Comments. Consequently, the findings for this action will consider the relevant environmental and public health impacts, mitigation measures and facts discussed in the Final SGEIS, prior drafts of the SGEIS, and the 1992 GEIS, including the Department's Response to Comments. The Department's Response to Comments represents the Department's most current assessment of the impacts associated with high-volume hydraulic fracturing and the effectiveness of proposed or considered mitigation measures to adequately mitigate significant adverse environmental and public health impacts.

Each chapter of this final SGEIS is summarized below.

Chapter 1 – Introduction

This Chapter contains background information and an introduction to the SGEIS.

Chapter 2 – Description of Proposed Action

This Chapter includes a discussion of the purpose of proposed high-volume hydraulic fracturing operations, as well as the potential locations, projected activity levels, and environmental setting for such operations. Information on the environmental setting focuses on topics determined during scoping to require attention in the SGEIS. The Department determined, based on industry projections in 2010 that it would potentially receive applications to drill approximately 1,700 - 2,500 horizontal and vertical wells for development of the Marcellus Shale by high-volume hydraulic fracturing during a “peak development” year, if high-volume hydraulic fracturing were authorized. Based on these projections, an average year could see 1,600 or more applications. Development of the Marcellus Shale in New York could occur over a 30-year period. A consultant to the Department completed a draft estimate of the potential economic and public benefits of proposed high-volume hydraulic fracturing development, including an analysis based on an average development scenario as well as a more conservative low potential development scenario. That analysis calculates for each scenario the total economic value to the proposed operations, potential state and local tax revenue, and projected total job creation. However, given the cost of compliance with New York State’s draft high-volume hydraulic fracturing program conditions, the *Matter of Wallach v. Town of Dryden and Cooperstown Holstein Corp. v. Town of Middlefield* decision, the areas where high-volume hydraulic fracturing would be prohibited or restricted by the SGEIS, and the economics of oil and gas production, the Department cannot with any certainty predict how many applications would be submitted if high-volume hydraulic fracturing were authorized. However even with a reduced economic outlook, it remains likely that high-volume hydraulic fracturing would be widespread and would impact areas that previously have not been exposed to oil and gas development. In fact, if high-volume hydraulic fracturing were authorized, the proposed restrictions and prohibitions in certain areas would likely lead to intensified development in those areas where high-volume hydraulic volume would be permissible. Moreover, as discussed below, beyond directly impacting those particular areas where the activity would be allowed, the ancillary activities associated with high-

volume hydraulic fracturing and their corresponding significant adverse impacts would likely spread to those areas of the State where high-volume hydraulic fracturing is prohibited.

Chapter 3 – Proposed SEQRA Review Process

This Chapter describes how the Department would use the 1992 GEIS and the Final SGEIS in reviewing applications to conduct high-volume hydraulic fracturing operations in New York State if high-volume hydraulic fracturing were authorized. It describes the proposed Environmental Assessment Form (EAF) addendum requirements that would be used in connection with high-volume hydraulic fracturing applications, and also identifies those potential activities that would require site-specific SEQRA determinations of significance after the SGEIS is completed. Specifically, Chapter 3 states that site-specific environmental assessments and SEQRA determinations of significance would be required for the following types of high-volume hydraulic fracturing applications, regardless of the target formation, the number of wells drilled on the pad and whether the wells are vertical or horizontal (the Department considered expanding some of the distances listed below):

- 1) Any proposed high-volume hydraulic fracturing where the top of the target fracture zone is shallower than 2,000 feet along a part of the proposed length of the wellbore;
- 2) Any proposed high-volume hydraulic fracturing where the top of the target fracture zone at any point along the entire proposed length of the wellbore is less than 1,000 feet below the base of a known fresh water supply;
- 3) Any proposed well pad within the boundaries of a principal aquifer, or outside but within 500 feet of the boundaries of a principal aquifer;
- 4) Any proposed well pad within 150 feet of a perennial or intermittent stream, storm drain, lake or pond;
- 5) A proposed surface water withdrawal that is found not to be consistent with the Department's preferred passby flow methodology as described in Chapter 7; and
- 6) Any proposed well location determined by the New York City Department of Environmental Protection (NYCDEP) to be within 1,000 feet of its subsurface water supply infrastructure.

In all of the aforementioned circumstances a site-specific SEQRA assessment would be required because such application is either beyond the scope of the analyses contained in this draft SGEIS

or the Department has determined that proposed activities in these areas raise additional environmental issues that necessitate a site-specific review. Many of the issues for which the Department determined that a site-specific environmental assessment and SEQRA determination of significance would be required represent areas of heightened environmental concern where environmental impacts could be expected to be significant. As indicated previously, the Department continued its evaluation of more stringent conditions to address both the uncertainty regarding the potential impacts and the impacts that remain unresolved due to the potential inadequacy of mitigation measures. The Department weighed additional conditions to address programmatic concerns as the public comment and scientific studies revealed an expanding bibliography of scientific uncertainty and unresolved and unmitigated environmental impacts.

In addition to those site-specific SEQRA assessments described in Chapter 3, the Department considered requiring site-specific environmental assessments and SEQRA determinations of significance for the following additional types of high-volume hydraulic fracturing applications:

- 1) Any proposed centralized flowback water surface impoundment;
- 2) Any proposed well location within a contiguous, 30-acre, high- or medium-scoring grassland patch in a grassland focus area unless the ecological assessment demonstrates lack of a significant adverse impact on grassland habitat and grassland birds;
- 3) Any proposed well location within a contiguous, 150-acre forest patch in a forest focus area unless the ecological assessment demonstrates lack of a significant adverse impact on forest interior habitat and forest interior birds;
- 4) Any proposed well location on private lands that are totally surrounded by New York State Office of Parks, Recreation and Historic Preservation (OPRHP) lands or Department-administered State-owned lands;
- 5) Any proposed well location within the Catskill Park outside the New York City watershed or the Adirondack Park; and
- 6) Any proposed well location wholly or partially within or substantially contiguous to an historic district.

The Department also considered expanding the buffers of some of the previously proposed locations requiring a site-specific review, including expanding the 150-foot buffer from a

perennial or intermittent stream, storm drain, lake or pond to 300 feet and including freshwater wetlands, and converting some of the requirements for site-specific reviews to prohibitions.

Chapter 3 also identifies the Department's oil and gas well regulations, located at 6 NYCRR Part 550, and it discusses the existence of other regulations related to high-volume hydraulic fracturing. The Department proposed revised regulations relating to high-volume hydraulic fracturing in 2011 but abandoned the rulemaking in 2013.

Chapter 4 - Geology

Chapter 4 supplements the geology discussion in the 1992 GEIS (Chapter 5) with additional details about the Marcellus and Utica Shales, seismicity in New York State, naturally occurring radioactive materials (NORM) in the Marcellus Shale and naturally occurring methane in New York State.

Chapter 5 - Natural Gas Development Activities & High-Volume Hydraulic Fracturing

This Chapter comprehensively describes the activities associated with high-volume hydraulic fracturing and multi-well pad drilling, including the composition of hydraulic fracturing additives and flowback water characteristics. It is based on the 2011 description of proposed activities provided by industry and verified by the Department in addition to being informed by high-volume hydraulic fracturing operations ongoing in Pennsylvania and elsewhere. In this Chapter, the average disturbance associated with a multi-well pad, access road and proportionate infrastructure during the drilling and fracturing stage is estimated at 7.4 acres, compared to the average disturbance associated with a well pad for a single vertical well during the drilling and fracturing stage, which is estimated at 4.8 acres. As a result of required partial reclamation, the average well pad would generally be reduced to averages of about 5.5 acres and 4.5 acres, respectively, during the production phase.

This Chapter describes the process for constructing access roads, and observes that because most shale gas development would consist of several wells on a multi-well pad, more than one well would be serviced by a single access road instead of one well per access road as was typically the case when the 1992 GEIS was prepared. Therefore, in areas developed by horizontal drilling

using multi-well pads, it is expected that fewer access roads as a function of the number of wells would be constructed. Industry estimates that 90% of the wells used to develop the Marcellus Shale would be horizontal wells located on multi-well pads. However, the evolution of the technology that facilitates extraction of natural gas from deep low-permeability shale formations where it was previously not feasible would lead to more widespread impacts in certain regions that could not occur from conventional methods of extraction. Chapter 5 describes the constituents of drilling mud and the containment of drill cuttings, either in a lined on-site reserve pit or in a closed-loop tank system. This Chapter also calculates the projected volume of cuttings and the potential for such cuttings to contain naturally occurring radioactive materials (NORM).

This Chapter also discusses the process of high-volume hydraulic fracturing, the composition of fracturing fluid, on-site storage and handling, and transport of fracturing additives. The high-volume hydraulic fracturing process involves the controlled use of high volumes of water and chemical additives, pumped under pressure into a steel-cased and cemented wellbore. To protect fresh water zones and isolate the target hydrocarbon-bearing zone, high-volume hydraulic fracturing does not occur until after the well is cased and cemented, and typically after the drilling rig and its associated equipment are removed from the well pad. Chapter 5 explains that the Department would generally require at least three strings of cemented casing in the well during fracturing operations. The outer string (i.e., surface casing) would extend below fresh ground water and would have been cemented to the surface before the well was drilled deeper. The intermediate casing string, also called protective string, is installed between the surface and production strings. The innermost casing string (i.e., production casing) typically extends from the ground surface to the toe of the horizontal well.

The fluid used for high-volume hydraulic fracturing is typically comprised of more than 98% fresh water and sand, with chemical additives comprising 2% or less of the fluid. The Department has collected compositional information on many of the additives proposed for use in fracturing shale formations in New York directly from chemical suppliers and service companies and those additives are identified and discussed in detail in Chapter 5. It is estimated that 2.4 million to 7.8 million gallons of water may be used for a multi-stage hydraulic fracturing procedure in a typical 4,000-foot lateral wellbore. Water may be delivered by truck or pipeline

directly from the source to the well pad, or may be delivered by trucks or pipeline from centralized water storage or staging facilities consisting of tanks or engineered impoundments.

After the high-volume hydraulic fracturing procedure is completed and pressure is released, the direction of fluid flow reverses. The well is “cleaned up” by allowing water and excess proppant (typically sand) to flow up through the wellbore to the surface. Both the process and the returned water are commonly referred to as “flowback.” The SGEIS estimates flowback water volume to range from 216,000 gallons to 2.7 million gallons per well, based on a pumped fluid estimate of 2.4 million to 7.8 million gallons. After completion of drilling operations and while natural gas production is underway, brine fluids that preexisted naturally in the formation prior to drilling are returned to the surface from the borehole, which is commonly referred to as “production brine.” It is estimated that production brine per well may range from 400 gallons per day (gpd) to 3,400 gpd. Chapter 5 discusses the volume, characteristics, recycling and disposal of flowback water and production brine.

Chapter 6 – Potential Environmental Impacts

This Chapter identifies and evaluates the potential significant adverse impacts associated with high-volume hydraulic fracturing operations and, like other chapters, should be read as a supplement to the 1992 GEIS. The Department’s evolving understanding of the potential significant adverse impacts associated with high-volume hydraulic fracturing is reflected in the accompanying Response to Comments, which represents the Department’s current assessment of those impacts and of the effectiveness of proposed or considered mitigation measures. In this regard, the ever increasing collection of proposed mitigation measures demonstrates three essential weaknesses of the proposed program: (1) the effectiveness of the mitigation is uncertain; (2) the potential risk and impact from the proposed Action to the environment and public health cannot be quantified at this time, and (3) there are some significant adverse impacts that are simply unavoidable.

Water Resources Impacts

The Department recognizes the importance of protecting New York’s water resources for drinking water supplies, economic development, agriculture, recreation and tourism. As

memorialized in Environmental Conservation Law (ECL) § 15-0105, the Department must require the use of all known available and reasonable methods to protect and preserve the purity and quality of water resources over the long-term in order to serve public health, safety and welfare and to maintain ecological resources. Potential significant adverse impacts on water resources exist with regard to potential degradation of drinking water supplies; impacts to surface and underground water resources due to large water withdrawals for high-volume hydraulic fracturing; cumulative impacts; stormwater runoff; surface spills, leaks and pit or surface impoundment failures; groundwater impacts associated with well drilling and construction and seismic activity; waste disposal; and New York City's subsurface water supply infrastructure.

Water for hydraulic fracturing may be obtained by withdrawing it from surface water bodies away from the well site or through new or existing water-supply wells drilled into aquifers. Chapter 6 concludes that, without proper controls on the rate, timing and location of such water withdrawals, the cumulative impacts of such withdrawals could cause modifications to groundwater levels, surface water levels, and stream flow that could result in significant adverse impacts, including but not limited to impacts to the aquatic ecosystem, downstream river channel and riparian resources, wetlands, and aquifer supplies.

Using an industry estimate of a yearly peak activity in New York of 2,462 wells, the SGEIS estimates that high-volume hydraulic fracturing would result in a calculated peak *annual* fresh water usage of 9 billion gallons. Total *daily* fresh water withdrawal in New York has been estimated at about 10.3 billion gallons. This equates to an annual total of about 3.8 trillion gallons. Based on this calculation, at peak activity high-volume hydraulic fracturing would result in increased demand for fresh water in New York of 0.24%. Thus, water usage for high-volume hydraulic fracturing represents a very small percentage of water usage throughout the state. Nevertheless, as noted, the cumulative impact of water withdrawals, if such withdrawals were temporally proximate and from the same water resource, could potentially be significant.

Chapter 6 also describes the potential significant adverse impacts on water resources from stormwater runoff associated with the construction and operation of high-volume hydraulic fracturing well pads. All phases of natural gas well development, from initial land clearing for

access roads, equipment staging areas and well pads, to drilling and fracturing operations, production and final reclamation, have the potential to cause water resource impacts during rain and snow melt events if stormwater is not properly managed. Proposed mitigation measures to reduce significant adverse impacts from stormwater runoff are described in Chapter 7.

Nonetheless, the potential for significant cumulative as well as site-specific impacts resulting from uncontained contaminated runoff remains.

The SGEIS concludes that spills or releases in connection with high-volume hydraulic fracturing could have significant adverse impacts on water resources. The SGEIS identifies a significant number of contaminants contained in fracturing additives, or otherwise associated with high-volume hydraulic fracturing operations. Spills or releases can occur as a result of tank ruptures, equipment or surface impoundment failures, overfills, vandalism, accidents (including vehicle collisions), ground fires, or improper operations. Spilled, leaked or released fluids could flow to a surface water body or infiltrate the ground, reaching subsurface soils and aquifers. Proposed mitigation measures to reduce significant adverse impacts from spills and releases are described in Chapter 7.

Chapter 6 also assesses the potential significant adverse impacts on groundwater resources from well drilling and construction associated with high-volume hydraulic fracturing. Those potential impacts include impacts from turbidity, fluids pumped into or flowing from rock formations penetrated by the well, and contamination from natural gas present in the rock formations penetrated by the well. Because of the concentrated nature of the activity on multi-well pads, the larger fluid volumes and pressures associated with high-volume hydraulic fracturing and likely cumulative impacts across the area where high-volume hydraulic fracturing would be employed, an unacceptable level of uncertainty remains as to the degree of protection afforded by the enhanced procedures and mitigation measures that the Department evaluated and which are discussed in Chapter 7.

The SGEIS explains that the potential migration of natural gas to a water well, which presents a safety hazard because of its combustible and asphyxiant nature, especially if the natural gas builds up in an enclosed space such as a well shed, house or garage, was addressed in the 1992 GEIS. Gas migration most likely would be the result of poor well construction (i.e., casing and

cement problems). As with all gas drilling, well construction practices mandated in New York are engineered in a manner that would reduce the risk of gas migration.

Subsequent to the publication of the rdSGEIS, the Department considered public comment and evolving scientific knowledge associated with seismicity and faults and the opportunities for contamination to migrate to groundwater and potable water supplies. Impacts to water resources may occur due to underground vertical migration of fracturing fluids through the shale formations, specifically through preexisting faults or abandoned gas wells. Pathways may exist for upward migration of fracturing fluids and/or natural gas through the shale formations.

Drilling and fracturing fluids, mud-drilled cuttings, pit liners, flowback water and production brine, although classified as non-hazardous industrial waste, must be hauled under a New York State Part 364 waste transporter permit issued by the Department. Furthermore, as discussed in Chapter 7, environmental risks posed by the improper discharge of liquid wastes would be addressed through the institution of a waste tracking procedure similar to that which is required for medical waste. However, the Department recognizes that horizontal wells associated with high-volume hydraulic fracturing produce significantly more drilling and fracturing fluids, cuttings, flowback water and production brine, and result in an increase in the duration of use of pit liners. This increase in the volume of waste consequently creates greater waste disposal impacts, including the risk of inadequate disposal options and the likelihood of spills from accidents occurring during the transportation of this waste. Information about traffic management related to high-volume hydraulic fracturing is discussed in Chapter 7.

The disposal of flowback water and production brine could cause significant adverse impacts. Residual fracturing chemicals and naturally-occurring constituents from the rock formation could be present in flowback water and production brine and could result in treatment, sludge disposal, and receiving-water impacts. Salts and dissolved solids may not be sufficiently treated by municipal biological treatment and/or other treatment technologies which are not designed to remove pollutants of this nature. Mitigation measures have been identified that would attempt to reduce potential significant adverse impact from flowback water and production brine or treatment of other liquid wastes associated with high-volume hydraulic fracturing.

The potential for significant adverse environmental impacts from any proposal to inject flowback water and production brine from high-volume hydraulic fracturing into a disposal well would be reviewed on a site-specific basis with consideration to local geology (including faults and seismicity), hydrogeology, nearby wellbores or other potential conduits for fluid migration and other pertinent site-specific factors.

The 1992 GEIS summarized the potential impacts of flood damage relative to mud or reserve pits, brine and oil tanks, other fluid tanks, brush debris, erosion and topsoil, bulk supplies (including additives) and accidents. Those potential impacts would also result from high-volume hydraulic fracturing operations but the potential impacts could be significantly greater. Severe flooding is described as one of the ways that bulk supplies such as additives “might accidentally enter the environment in large quantities.” Mitigation measures that attempt to reduce the significant adverse impacts from floods are identified and recommended in Chapter 7.

Gamma ray logs from deep wells drilled in New York over the past several decades show the Marcellus Shale to be higher in radioactivity than other bedrock formations including other potential reservoirs that could be developed by high-volume hydraulic fracturing. However, based on the analytical results from field-screening and gamma ray spectroscopy performed on samples of Marcellus Shale, NORM levels in cuttings are similar to those naturally encountered in the surrounding environment. During production associated with high-volume hydraulic fracturing, however, radioactivity originating in wastewater may become more concentrated in pipe scale and liquid waste treatment residuals and may require additional mitigation.

As explained in Chapter 5, the total volume of drill cuttings produced from drilling a horizontal well may be about 40% greater than that for a conventional, vertical well. For multi-well pads, cuttings volume would be multiplied by the number of wells on the pad. The potential water resources impacts associated with the greater volume of drill cuttings from multiple horizontal well drilling operations would arise from the retention of cuttings during drilling, necessitating a larger reserve pit that may be present for a longer period of time that could impact integrity of a liner system, unless the cuttings are directed into tanks as part of a closed-loop tank system.

Impacts on Ecosystems and Wildlife

The SGEIS also analyzes the potential significant adverse impacts on ecosystems and wildlife from high-volume hydraulic fracturing operations. Four areas of concern related to high-volume hydraulic fracturing are: (1) fragmentation of habitat; (2) potential transfer of invasive species; (3) impacts to endangered and threatened species; and (4) use of State-owned lands.

The SGEIS concludes that high-volume hydraulic fracturing operations would have a significant adverse impact on the environment because such operations have the potential to draw substantial development into New York, which would result in unavoidable impacts to habitats (fragmentation, loss of connectivity, degradation, etc.), species distributions and populations, and overall natural resource biodiversity. Habitat loss, conversion, and fragmentation (both short-term and long-term) would result from land grading and clearing, and the construction of well pads, roads, pipelines, and other infrastructure associated with gas drilling. Possible mitigation measures are identified in Chapter 7.

The number of vehicle trips associated with high-volume hydraulic fracturing, particularly at multi-well sites, has been identified as an activity which presents the opportunity to transfer invasive terrestrial species. Surface water withdrawals also have the potential to transfer invasive aquatic species. The introduction of terrestrial and aquatic invasive species would have a significant adverse impact on the environment.

State-owned lands play a unique role in New York's landscape because they are managed under public ownership to allow for sustainable use of natural resources, provide recreational opportunities for all New Yorkers, and provide important wildlife habitat and open space. Given the level of development expected for multi-pad horizontal drilling, the SGEIS anticipates that there would be additional pressure for surface disturbance on State lands. Surface disturbance associated with gas extraction within and adjacent to state lands could have an impact on habitats, and recreational use of the state and private lands, especially large contiguous forest patches that are valuable because they sustain wide-ranging forest species, and provide more habitat for forest interior species.

The area underlain by the Marcellus Shale includes both terrestrial and aquatic habitat for 18 animal species listed as endangered or threatened in New York State that are protected under the State Endangered Species Law (ECL 11-0535) and associated regulations (6 NYCRR Part 182). Endangered and threatened wildlife may be adversely impacted through project actions such as clearing, grading and road building that occur within the habitats that they occupy. Certain species are unable to avoid direct impact due to their inherent poor mobility (e.g., Blanding's turtle, club shell mussel). Certain actions, such as clearing of vegetation or alteration of stream beds, can also result in the loss of nesting and spawning areas.

Mitigation measures for potentially significant adverse impacts from potential transfer of invasive species or from use of State lands, and mitigation measures for potential impacts to endangered and threatened species are discussed in Chapter 7.

Impacts on Air Resources

Chapter 6 of the SGEIS provides a comprehensive list of federal and New York State regulations that apply to potential air emissions and air quality impacts associated with the drilling, completion (hydraulic fracturing and flowback) and production phases (processing, transmission and storage). The Chapter includes a regulatory assessment of the various air pollution sources and the air permitting process.

As part of the Department's effort to address the potential air quality impacts of horizontal drilling and hydraulic fracturing activities in the Marcellus Shale and other low-permeability gas reservoirs, an air quality modeling analysis was undertaken by the Department's Division of Air Resources (DAR). The analysis identifies the emission sources involved in well drilling, completion and production, and the analysis of source operations for purposes of assessing compliance with applicable air quality standards.

After the September 2009 draft SGEIS was published, industry provided information that: (1) simultaneous drilling and completion operations at a single pad would not occur; (2) the maximum number of wells to be drilled at a pad in a year would be four in a 12-month period; and (3) centralized flowback impoundments, which are large-volume, lined ponds that function as fluid collection points for multiple wells, are not contemplated. Based on these operational

restrictions, the Department revised the limited modeling of 24 hour PM_{2.5} impacts and conducted supplemental air quality modeling to assess standards compliance and air quality impacts. In addition, the Department conducted supplemental modeling to account for the promulgation of new 1-hour SO₂ and NO₂ National Ambient Air Quality Standards (NAAQS) after September 2009. The results of this supplemental modeling indicate the need for the imposition of certain control measures to achieve the NO₂ and PM_{2.5} NAAQS. These measures, along with all other restrictions reflecting industry's proposed operational restrictions and recommended mitigation measures based on the modeling results, are detailed in Section 7.5.3 of the SGEIS and in the Response to Comments as proposed operation conditions to be included in well permits. As detailed in the Response to Comments, the modeling also demonstrates that high-volume hydraulic fracturing could contribute significantly to elevated ozone levels in the New York metropolitan ozone nonattainment area.

The Department also developed an air monitoring program to address potential for adverse air quality impacts beyond those analyzed in the SGEIS, which are either not fully known at this time or not verifiable by the assessments to date. The air monitoring plan would help determine and distinguish both the background and drilling-related concentrations of pertinent pollutants in the ambient air.

Air quality impact mitigation measures are further discussed in Chapter 7 of the SGEIS, including a detailed discussion of pollution control techniques, various operational scenarios and equipment that can be used to achieve regulatory compliance, and mitigation measures for well pad operations. In addition, measures to reduce benzene emissions from glycol dehydrators and formaldehyde emissions from off-site compressor stations are provided.

Greenhouse Gas Emission Impacts

All operational phases of proposed well pad activities associated with high-volume hydraulic fracturing were considered, and resulting greenhouse gas (GHG) emissions determined in the SGEIS. Emission estimates of carbon dioxide (CO₂) and methane (CH₄) are included as both short tons and as carbon dioxide equivalents (CO₂e) expressed in short tons for expected exploration and development of the Marcellus Shale and other low-permeability gas reservoirs

using high-volume hydraulic fracturing. The Department not only quantified potential GHG emissions from activities, but also identified and characterized major sources of CO₂ and CH₄ during anticipated operations so that key contributors of GHGs with the most significant Global Warming Potential (GWP) could be addressed, with particular emphasis placed on mitigating CH₄, with its greater GWP.

Whether the combustion of natural gas results in a net increase of GHG emissions depends on what energy sources are being displaced by natural gas. Replacing higher-emitting fuels such as coal and petroleum in the power, industry, building and transportation sectors may reduce GHG emissions. Recent research demonstrates that low-cost natural gas suppresses investment in and use of clean energy alternatives (such as renewable solar and wind, or energy efficiency), because it makes those alternatives less cost-competitive in comparison to fossil fuels. New York is also implementing a number of policies that promote the continued investment in renewables and efficiency, which should reduce the potential for gas development to pose an economic obstacle to development of renewable energy and investment in energy efficiency. In the long term, New York's policies are directed towards achieving substantial reductions in GHG emissions by reducing reliance on all fossil fuels, including natural gas.

Socioeconomic Impacts

To assess the potential socioeconomic impacts of high-volume hydraulic fracturing, including the potential impacts on population, employment and housing, three representative regions were selected. The three regions were selected to evaluate how high-volume hydraulic fracturing might impact areas with different production potential, different land use patterns, and different levels of experience with natural gas well development. All of the projections identified below relied on assumptions concerning the number of high-volume hydraulic fracturing wells that would be drilled in a year without reference to the buffers and prohibitions proposed in the SGEIS or to the Court of Appeals' decision in the *Matter of Wallach v. Town of Dryden and Cooperstown Holstein Corp. v. Town of Middlefield* and without reference to changes that have occurred in the energy market since this analysis was completed. The current circumstances reduce the projections of economic benefits for the regions where high-volume hydraulic fracturing would likely occur. In fact, the assumptions concerning the number of high-volume

hydraulic fracturing wells that would be drilled, and thus, economic benefits initially projected in the dSGEIS do not accurately reflect the current energy market, the high cost of adherence to the conditions that would have been imposed in New York State if high-volume hydraulic fracturing were authorized and the patchwork of local laws and land use controls that prohibit development. Therefore, such benefits would be significantly less than projected in this SGEIS, as explained in the Response to Comments.

Region A consists of Broome, Chemung and Tioga County. Region B consists of Delaware, Otsego and Sullivan County, and Region C consists of Cattaraugus and Chautauqua County. Using a low and average rate of development based on industry estimates, high-volume hydraulic fracturing could potentially have a positive economic effect where the activity takes place.

There would potentially be positive impacts on income levels in the state as a result of high-volume hydraulic fracturing. Employee earnings from operational employment were expected to range from \$121.2 million under the low-development scenario to \$484.8 million under the average-development scenario in Year 30. Indirect employee earnings were anticipated to range from \$202.3 million under the low-development scenario to \$809.2 million under the average-development scenario in Year 30. However, as discussed above, given the expected cost of compliance with New York State's draft high-volume hydraulic fracturing program conditions, the economics of oil and gas production and the areas where high-volume hydraulic fracturing would be prohibited or restricted these earnings and employment figures would be significantly lower. Chapter 6 details how the potential job creation and employee earnings might be distributed across the three representative regions.

Chapter 6 also assesses the potential temporary and permanent population impacts on each of the three selected regions, finding that Region A will experience an estimated 1.4% increase in the region's total population the first decade after high-volume hydraulic fracturing is introduced. The population of Region C is projected to be more modestly impacted by high-volume hydraulic fracturing.

While potentially providing positive impacts in the areas of employment and income, high-volume hydraulic fracturing could cause adverse impacts on the availability of housing, especially temporary housing such as hotels and motels. In Region A, where the use of high-volume hydraulic fracturing is expected to be initially concentrated, there could be shortages of rental housing. High-volume hydraulic fracturing would also bring both positive and negative impacts on state and local government spending. Increased activity could result in increases in local tax revenues and increases in the receipt of production royalties but would also result in an increased demand for infrastructure repair and local services, including emergency response services.

Visual, Noise and Community Character Impacts

The construction of well pads and wells associated with high-volume hydraulic fracturing will result in adverse impacts relating to noise. In certain areas the construction and development activities would also result in visual impacts. Potential mitigation measures to address such impacts if high-volume hydraulic fracturing were authorized are summarized in Chapter 7.

The cumulative impact of well construction activity and related truck traffic would cause impacts on the character of the rural communities where much of this activity would take place. Despite the recent New York Court of Appeals in *Matter of Wallach v. Town of Dryden and Cooperstown Holstein Corp. v. Town of Middlefield* that found that ECL Section 23-0303(2) does not preempt communities with adopted zoning laws from prohibiting or restricting the use of land for high-volume hydraulic fracturing drilling, it is likely that localities still may not be able to prevent cross boundary cumulative impacts to their respective community character. Even were a community to prohibit drilling, it is reasonably foreseeable that regional impacts related to high-volume hydraulic fracturing activities, including truck traffic, visual impacts, and impacts on cultural, historic, agricultural, tourism, and scenic resources would adversely affect neighboring municipalities that enact zoning prohibitions.

Transportation Impacts

The introduction of high-volume hydraulic fracturing has the potential to generate significant truck traffic during the construction and development phases of the well. The cumulative impact of this truck traffic has the potential to result in significant adverse impacts on local roads and, to a lesser extent, state roads where truck traffic from this activity is concentrated. It is not feasible to conduct a detailed traffic assessment given that the precise location of well pads is unknown at this time. However, such traffic has the potential to damage roads and impact air quality. Chapter 7 discusses the potential mitigation measures to address such impacts, including the requirement that the applicant develop a Transportation Plan that sets forth proposed truck routes, surveys road conditions along those routes and requires local road use agreements to address any impacts on local roads.

Additional NORM Concerns

Based upon currently available information it is anticipated that flowback water would not contain levels of NORM of significance, whereas production brine could contain elevated NORM levels. Although the highest concentrations of NORM are in production brine, it does not present a risk to workers because the external radiation levels are very low. However, the build-up of NORM in pipes and equipment (pipe scale and sludge) has the potential to cause a significant adverse impact because it could expose workers handling (cleaning or maintenance) the pipe to unsafe radiation levels. Also, wastes from the treatment of production brine may contain concentrated NORM and, if so, controls would be required to limit radiation exposure to workers handling this material as well as to ensure that this material is disposed of in accordance with applicable regulatory requirements.

Seismicity

There is a reasonable base of knowledge and experience related to seismicity induced by hydraulic fracturing. The information on the potential seismic impacts from high-volume hydraulic fracturing has increased since the release of the rdSGEIS. A recent study (Skoumal, 2015) ascribed a series of earthquakes in Poland, Ohio to high-volume hydraulic fracturing operations. Between March 4 and March 12, 2014, 77 earthquakes, ranging between 1.0 and 3.0

in magnitude, were identified and found to be closely related spatially and temporally to hydraulic fracturing operations at a nearby well. The Department's review of available information indicates unanswered questions remain on the seismic impacts associated with high-volume hydraulic fracturing. The Department would need to evaluate the risk to the public, infrastructure, and natural resources from induced seismicity related to hydraulic fracturing if this activity were authorized.

Chapter 7 – Mitigation Measures

This Chapter describes the measures the Department identified as of 2011 to address the potentially significant adverse impacts from high-volume hydraulic fracturing operations if high-volume hydraulic fracturing were authorized. However, there is currently insufficient scientific information to conclude that this activity can be undertaken without posing unreasonable risk to public health, and to determine what mitigation measures provide a level of assurance that potential risks have been satisfactorily minimized.

The Department recognizes the importance of protecting New York's surface and groundwater for drinking water supplies, economic development, and agriculture. In recognition of the potential for spills or releases in connection with high-volume hydraulic fracturing, the Department considered, as a general matter, requiring that operators develop and implement a groundwater monitoring program to detect potential spills and releases around the high-volume hydraulic fracturing well pad and to detect potential contamination in groundwater.

The following describes some of the mitigation measures that were evaluated in the SGEIS, as well as additional measures that were considered:

No High-Volume Hydraulic Fracturing Operations in the New York City and Syracuse Watersheds

In April 2010, the Department concluded that due to the issues presented by high-volume hydraulic fracturing operations within the drinking watersheds for the City of New York and Syracuse, the SGEIS would not apply to activities in those watersheds. Those areas present issues that primarily stem from the fact that they are unfiltered water supplies that depend on

strict land use and development controls to ensure that water quality is protected. Then in 2011, the Department concluded that the proposed high-volume hydraulic fracturing activity is not consistent with the preservation of these watersheds as unfiltered drinking water supplies. Notwithstanding the mitigation measures considered for this activity, a risk remains that significant high-volume hydraulic fracturing activities in these areas could result in a degradation of drinking water supplies from accidents, surface spills, etc. Moreover, such large-scale industrial activity in these areas, even without spills, could imperil Filtration Avoidance Determinations and result in the affected municipalities incurring substantial costs to filter their drinking water supply. Accordingly, this SGEIS supports a finding that high-volume hydraulic fracturing well pads not be permitted in the Syracuse and New York City drinking water supply watersheds or in a protective 4,000-foot buffer area around those watersheds.

In response to concerns raised about infrastructure associated with the Syracuse and New York City drinking water supply watersheds, the Department considered extending its initial 4,000-foot setback from unfiltered drinking water supply watersheds for the siting of high-volume hydraulic fracturing well pads. The setback would encompass a portion of the water supply infrastructure, including tunnels that transport water for drinking supplies. Beyond that, the Department also considered prohibiting the placement of any portion of a wellbore less than 2,000 feet from any water tunnel or underneath a tunnel, and requiring enhanced site-specific review plus consultation with the municipality for any wellbore located within two miles of any water supply infrastructure for the Syracuse and NYC drinking water supplies.

No High-Volume Hydraulic Fracturing Operations on Primary Aquifers

Eighteen other aquifers in the State of New York have been identified by NYSDOH as highly productive aquifers presently utilized as sources of water supply by major municipal water supply systems and have been designated as “primary aquifers.” Because these aquifers are the primary source for many public drinking water supplies, the potential significant impacts, similar to those that would impact the New York City and Syracuse drinking water supply watersheds, must be reduced to ensure that high-volume hydraulic fracturing would not pose a threat to these critical resources and the communities that rely on them. While the Department recommended in the SGEIS that high-volume hydraulic fracturing well pads should not be permitted above a

Primary Aquifer or within a 500-foot buffer area, the impacts may be more widespread and significant than was previously considered, and consequently broader mitigation measures may be necessary.

No High-Volume Hydraulic Fracturing Operations on Certain State Lands

This SGEIS supports a finding that site disturbance relating to high-volume hydraulic fracturing operations should not be permitted on certain State lands because the potential impacts resulting from high-volume hydraulic fracturing are inconsistent with the purposes for which those lands have been acquired including public access for a wide range of recreational activities.

Prohibition of high-volume hydraulic fracturing development would prevent the loss of habitat in the protected State land areas, which represent some of the largest contiguous forest patches where high-volume hydraulic fracturing activity could occur. Depending on the location of ancillary infrastructure and activities horizontal extraction of gas resources underneath State lands from well pads located outside this area may not significantly impact valuable habitat on forested State lands.

No High-Volume Hydraulic Fracturing Operations on Principal Aquifers Without Site-Specific Environmental Review

Similar to Primary Aquifers, Principal Aquifers are also highly productive. Because they are largely contained in unconsolidated material, and due to the high permeability (which allows rapid movement of groundwater) and shallow depth to the water table, both Primary and Principal Aquifers are particularly susceptible to contamination. Protection of these aquifers is critical for existing water supply needs, as well as to fulfill future needs for new or expanded water supplies. In order to reduce the risk of significant adverse impacts on these important water resources from potential surface discharges from high-volume hydraulic fracturing well pads, the SGEIS proposed that for at least two years from issuance of the final SGEIS, applications for high-volume hydraulic fracturing operations at any surface location within the boundaries of principal aquifers, or outside but within 500 feet of the boundaries of principal aquifers, would require (1) site-specific environmental assessments and SEQRA determinations of significance and (2) individual SPDES permits for storm water discharges. The Department considered removing the two year re-evaluation period for impacts to Principal Aquifers.

No High-Volume Hydraulic Fracturing Operations within 2,000 feet of Public Drinking Water Supplies

More than 360,000 people (or roughly 40.9% of the population) in the Marcellus Shale play area are served by individual private wells or public surface water supplies, or community supplies outside of Primary and Principal Aquifer areas. The SGEIS seeks to reduce the risk of significant adverse impacts on water resources from potential surface discharges from high-volume hydraulic fracturing well pads by proposing that high-volume hydraulic fracturing well pads at any surface location within 2,000 feet of public water supply wells, river or stream intakes and reservoirs should not be permitted. In an attempt to further reduce the potential risks, the Department additionally considered requiring a 2,000-foot prohibition around a public (municipal or otherwise) drinking water supply intake in flowing water with an additional prohibition of 1,000 feet on each side of the main flowing waterbody and any tributary to that waterbody, both for a distance of 1 mile upstream from the public drinking water supply intake.

No High-Volume Hydraulic Fracturing Operations in Floodplains or Within 500 Feet of Private Water Wells

In order to address potential significant adverse impacts due to flooding, the SGEIS evaluated the significant impacts associated with high-volume hydraulic fracturing development located wholly or partially within a 100-year floodplain. In further recognition of the increasing frequency and intensity of recent and potentially future flood events, the Department considered requiring that, in certain areas, well pads be elevated two feet above the 500-year floodplain elevation or the known elevation of the flood of record. However, the Department notes that flood risks change over time and consequently potential impacts could still occur from high-volume hydraulic fracturing as a result of incomplete data.

Since just 2000, 16,000 new private water wells in the Marcellus Shale play area have been reported to the Department; this averages out to over 1,000 per year. In order to reduce potential impacts on drinking water supplies from high-volume hydraulic fracturing operations, the SGEIS evaluated impacts on private water wells and domestic use springs and considered prohibiting any well pad located within 500 feet of a private water well or domestic supply spring, unless the Department issued a variance from the requirement, with the consent of the landowner, and any

tenants, if applicable. The final SGEIS reflects the importance of protecting this resource so critical to residents within the Marcellus Shall play area.

Mandatory Disclosure of Hydraulic Fracturing Additives and Alternatives Analysis

The SGEIS identifies by chemical name and Chemical Abstract Services (CAS) number 322 chemicals proposed for use for high-volume hydraulic fracturing in New York. Chemical usage was reviewed by NYSDOH, which provided health hazard information that is presented in the document. In response to public concerns relating to the use of hydraulic fracturing additives and their potential impact on water resources, this SGEIS contains a requirement that operators evaluate and use alternative hydraulic fracturing additive products that pose less potential risk to water resources if high-volume hydraulic fracturing were authorized. In addition, in the EAF addendum a project sponsor must disclose all additive products it proposes to use, and provide Material Safety Data Sheets for those products, so that the appropriate remedial measures could be employed if a spill were to occur. If high-volume hydraulic fracturing were authorized, the Department would publicly disclose the identities of hydraulic fracturing fluid additive products and their Material Safety Data Sheets, provided that information which meets the confidential business information exception to the Department's records access program will not be subject to public disclosure. In addition, the Department considered expanding the fracturing fluid chemical disclosure requirements to ensure that each chemical, and not merely each product, would be disclosed both before drilling and after completion of each well.

Enhanced Well Casing

In order to mitigate the risk of significant adverse impacts to water resources from the migration of gas or pollutants in connection with high-volume hydraulic fracturing operations, the SGEIS added a requirement for a third cemented "string" of well casing around the gas production wells in most situations. This enhanced casing specification is designed to specifically reduce potential impacts from migration of gas into aquifers.

Required Secondary Containment and Stormwater Controls

The risk of a significant adverse impact to water resources from spills of chemical additives, hydraulic fracturing fluid or liquid wastes associated with high-volume hydraulic fracturing, secondary containment, spill prevention and storm water pollution prevention have been evaluated in the SGEIS. However, because of the unique aspects of multi-well pad development associated with high-volume hydraulic fracturing, the existing Department engineering controls and management practices that would be required are untested for the scale of this activity and, consequently, it remains uncertain whether they would be adequate to prevent spills and mitigate adverse impacts if a spill occurs. Compounding this risk is the current uncertainty, as identified by NYSDOH, regarding the level of risk high-volume hydraulic fracturing activities pose to public health.

Conditions Related to Disposal of Wastewater and Solid Waste

The Department had proposed to require that before any permit is issued the well operator have Department-approved plans in place for disposing of flowback water and production brine. In addition, the Department proposed to require a tracking system, similar to what is in place for medical waste, for all liquid and solid wastes generated in connection with high-volume hydraulic fracturing operations.

The SGEIS also contains a requirement for closed-loop drilling to address impacts related to the disposal of pyrite-rich Marcellus Shale cuttings on-site.

Air Quality Control Measures and Mitigation for Greenhouse Gas Emissions

The SGEIS identifies additional mitigation measures designed to ensure that emissions associated with high-volume hydraulic fracturing operations would not result in the exceedance of any NAAQS if high-volume hydraulic fracturing were authorized. In addition, the Department has committed to implement local and regional level air quality monitoring at well pads and surrounding areas.

The SGEIS also identifies mitigation measures that could be required through permit conditions and possibly new regulations to reduce GHG emissions from high-volume hydraulic fracturing activities. The SGEIS would require a GHG emission impacts mitigation plan (the Plan). The Plan would include: a list of best management practices for GHG emission sources for implementation at the permitted well site; a leak detection and repair program; use of the U.S. Environmental Protection Agency's (EPA) Natural Gas Star best management practices for any pertinent equipment; use of reduced emission completions that provide for the recovery of methane instead of flaring whenever a gas sales line and interconnecting gathering line are available; and a statement that the operator would provide the Department with a copy of the report filed with EPA to meet the requirements of the EPA GHG Reporting Program (40 CFR §98), which mandates the monitoring and reporting of GHG emissions from certain source categories in the United States.

Mitigation for Loss of Habitat and Impacts on Wildlife

The Department had proposed several mitigation measures to attempt to address the significant adverse impacts on wildlife habitat caused by fragmentation of forest and grasslands on private land. Although a site-specific environmental assessment and SEQRA determination of significance may have assisted the Department in reducing such impacts, the cumulative nature of the impacts across the area where high-volume hydraulic fracturing would likely occur is such that the impacts would remain only partially mitigated.

Chapter 8 – Permit Process and Regulatory Coordination

This Chapter explains inter- and intra-agency coordination relative to the well permit process, including the role of local governments and a revised approach to local government notification and consideration of potential impacts of high-volume hydraulic fracturing operations on local land use laws and policies. The Department also considered requiring that every ECL Article 23 well application proposing high-volume hydraulic fracturing on a new well pad be subject to a fifteen-day public notice period, limited to site-specific issues on the subject application not addressed in the 1992 GEIS or this SGEIS. As a result of the *Matter of Wallach v. Town of Dryden and Cooperstown Holstein Corp. v. Town of Middlefield* decision, some towns could

exercise their zoning authority in such a way that they would be involved agencies under SEQRA. This means that the Department would be required to coordinate the environmental review with such government agencies if the permit required discretionary approvals from a local government agency (e.g., a special use permit or some other type of zoning approval).

Chapter 9 – Alternative Actions

Chapter 9 discusses the alternatives to well permit issuance that were reviewed and considered by the Department. The SGEIS considers a range of alternatives for authorizing high-volume hydraulic fracturing operations in New York. As required by SEQRA, the SGEIS considers the No Action Alternative. The No Action Alternative would not result in any of the significant adverse impacts identified herein, but would also not result in any of the potential economic and other benefits identified with natural gas drilling by this method.

The alternatives analysis also considers the use of a phased-permitting approach to developing the Marcellus Shale and other low-permeability gas reservoirs, including consideration of limiting and/or restricting resource development in designated areas.

The SGEIS also contains a review and analysis of the development and use of “green” or non-chemical fracturing alternatives. The use of environmentally friendly or “green chemicals” would depend on both their reduced toxicity and their technical effectiveness in the Marcellus Shale play and other shale plays. While more research and approval criteria would be necessary to establish benchmarks for “green chemicals,” this Final SGEIS proposes that if high-volume hydraulic fracturing were authorized, this alternative approach be adopted by requiring applicants to review and consider, to the Department’s satisfaction, the use of alternative additive products that may pose less risk to the environment, including water resources, where feasible, and to publicly disclose the chemicals that make up these additives. These requirements would be altered and/or expanded as the use of “green chemicals” begins to provide reasonable alternatives and the appropriate technology, criteria and processes are put in place to evaluate and produce “green chemicals.”

Chapter 10 – Review of Selected Non-Routine Incidents in Pennsylvania

Chapter 10 discusses a number of incidents involving high-volume hydraulic fracturing operations in Pennsylvania that have caused concern about the safety and potential adverse impacts associated with high-volume hydraulic fracturing operations.

Chapter 11 – Summary of Potential Impacts and Mitigation Measures

Chapter 11 highlights the mitigation measures implemented through the 1992 GEIS and summarizes the impacts and mitigation that are discussed in Chapters 6 and 7.

Response to Comments

The accompanying Response to Comments includes summaries of the substantive comments received on both the 2009 dSGEIS and the 2011 rdSGEIS, along with the Department's responses to such comments.