Preliminary Revised Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program

Well Permit Issuance for Horizontal Drilling And High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs

New York State Department of Environmental Conservation

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EXECUTIVE SUMMARY

"High-volume hydraulic fracturing" ("HVHF") is a gas well stimulation technique that has greatly increased the ability to extract natural gas from very tight rock. HVHF, which is often used in conjunction with horizontal drilling and multi-well pad development, is an approach to extracting natural gas in New York that raises new, potentially 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] Increased production of domestic natural gas resources from deep underground shale deposits in other parts of the country has dramatically altered future energy supply projections and has the promise of lowering costs for users and purchasers of this energy commodity.

HVHF is distinct from other types of well completion that have been allowed in the State under the 1992 GEIS and Department permits due to the much larger volumes of water used to conduct hydraulic fracturing operations. The use of HVHF with horizontal well drilling technology provides for 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. Also, hydraulic fracturing requires chemical additives, some of which may pose hazards when highly concentrated. The extra water associated with such drilling may also result in significant adverse impacts relating to water supplies, wastewater treatment and disposal and truck traffic. Horizontal wells also generate greater volumes of drilling waste (cuttings). The industry projections of the level of drilling, as reflected in the intense development activity in neighboring

[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.

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Pennsylvania, has raised additional concerns relating to community character and socioeconomics.

General Background

In New York, the primary target for shale gas development is 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 HVHF. The Department has received applications for permits to drill horizontal wells to evaluate and develop the Marcellus Shale for natural gas production by HVHF.

The Department has prepared this preliminary Draft Supplemental Generic Environmental Impact Statement ("draft SGEIS" or "dSGEIS" or "draft Supplement") to satisfy the requirements of SEQRA by studying the new technique and identifying potential new significant adverse impacts for these anticipated operations. In reviewing and processing permit applications for HVHF in these deep, low-permeability formations, the Department would apply the requirements contained within the final SGEIS and the findings drawn from it, including criteria and conditions for future approvals, in conjunction with the 1992 GEIS.

The final SGEIS will apply statewide, except in areas that the Department proposes should be off-limits to surface drilling for natural gas using HVHF technology. As explained below, these areas include the watersheds associated with unfiltered water supplied to the New York City and Syracuse areas pursuant to Filtration Avoidance Determinations issued by the U.S. Environmental Protection Agency ("EPA"), reforestation areas, wildlife management areas, state parks, and "primary" aquifers as defined by State regulations, and additional setback and buffer areas. Forest Preserve land in the Adirondacks and Catskills is already off-limits to natural gas development pursuant to the New York State Constitution.

SEQRA Procedure to Date

The public process to develop the dSGEIS 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 2009 the Department issued a 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 technology. Concerns raised included comments that the 2009 dSGEIS did not fully study the potential for gas migration from this new drilling method, 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 on or about June 1, 2011. The Executive Order also provided that no permits authorizing HVHF would be issued until the SGEIS was finalized.

Since the issuance of the 2009 draft SGEIS, the Department has gained a more detailed understanding of the potential impacts associated with horizontal drilling from: (i) the extensive public comments from environmental organizations, municipalities, industry groups 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 New York State Department of Health ("NYSDOH"); (iv) the use of outside consulting firms to prepare analyses relating to socioeconomic impacts, as well as impacts on community character, visual, noise and traffic impacts; and, (v) its review of information and data from the Pennsylvania Department of Environmental Protection ("PA-DEP") 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 Le Roy, 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 HVHF operations in Pennsylvania generally.

The draft SGEIS

The draft SGEIS contains revised and additional analyses relating to HVHF operations compared to the 2009 dSGEIS. The document is deemed "preliminary" because, as indicated below, it omits a number of areas of analysis that are still ongoing and will be finalized later in 2011 and incorporated into this draft. When the Department deems this draft Supplement complete, it will be published in full and a formal public comment period will be commenced. For ease of comparison by the public, this document underscores revised or additional discussion from the 2009 draft, and indicates where text from the 2009 draft has been omitted. Its contents are summarized below.

Chapter 1 – Introduction

This Chapter contains an introduction to the dSGEIS. The Chapter summarizes the changes in HVHF operations seen since the original draft SGEIS was prepared in 2009, describes the methodology of this environmental review, and highlights enhanced mitigation and new precautionary measures incorporated into the document.

Chapter 2 – Description of Proposed Action

This Chapter includes a discussion of the purpose, public need and benefit of proposed HVHF 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 has determined, based on industry projections, that it may receive applications to drill approximately 1,700 – 2,500 horizontal and vertical wells for development of the Marcellus Shale by HVHF during a "peak development" year. An average year may see 1,600 or more applications. Development of the Marcellus Shale in New York may occur over a 30-year period. Those peak and average levels of development are the assumptions upon which the analyses contained in this dSGEIS are based. A consultant to the Department is currently undertaking a revised estimate of the

potential economic and public benefits of proposed HVHF development, including an analysis based on an average development scenario as well as a more conservative low potential development scenario. That analysis will calculate for each scenario the total economic value to the proposed operations, potential state and local tax revenue, and projected total job creation. That revised estimate will be incorporated into the draft SGEIS at a later date, prior to the commencement of the public comment period.

Chapter 3 – Proposed SEQRA Review Process

This Chapter describes how the Department intends to use the 1992 GEIS and the final SGEIS in reviewing applications to conduct HVHF operations in New York State. It describes the proposed Environmental Assessment Form ("EAF") that would be used in connection with HVHF 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 HVHF applications, regardless of the target formation, the number of wells drilled on the pad and whether the wells are vertical or horizontal:

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 that is not a tributary to a public drinking water supply, 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 is 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 environmental issues that necessitate a site-specific review.

Chapter 3 also identifies the Department's oil and gas well regulations, located at 6 NYCRR Part 550, and makes clear that detailed requirements applicable to drilling operations are routinely attached as conditions to well drilling permits issued pursuant to ECL Article 23 and would continue to be attached to conditions for HVHF permits. The dSGEIS includes as appendices the casing and cementing requirements that apply for all wells in the State and the supplementary permit conditions for wells drilled in principal aquifers.

Identified mitigation measures for HVHF operations beyond what is required in current regulations would be enforced through binding permit conditions attached to any permit authorizing HVHF operations. In addition, although permits would be considered following the completion of environmental review, the Department intends to propose new, and more detailed, regulations relating to HVHF techniques and revise its existing regulations as another means to implement additional environmental controls identified in the dSGEIS.

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 in the Marcellus Shale and naturally occurring methane in New York State. Chapter 4 does not contain significant revisions or additions from the prior draft.

Chapter 5 - Natural Gas Development Activities and HVHF

This Chapter comprehensively describes the activities associated with HVHF and multi-well pad drilling, including the composition of hydraulic fracturing additives and flowback water characteristics. It is based on the most recent up-to-date description of proposed activities provided by industry and informed by HVHF operations currently 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. This method provides the most flexibility to avoid environmentally sensitive locations within the acreage to be developed.

With respect to overall land disturbance from a horizontal drilling, there would be a larger surface area used for an individual multi-well pad. This would be more than offset, however, by the fewer total number of well pads required within a given area and the need for only a single access road and gas gathering system to service multiple wells on a single pad. Overall, there clearly is a smaller total area of land disturbance associated with horizontal wells for shale gas development than that for vertical wells. For example, a spacing of 40 acres per well for vertical shale gas wells would result in, on average, 70 – 80 acres of disturbance for the well pads, access roads and utility corridors (4.8 acres per well) to develop an area of 640 acres. A single well pad with 6 to 8 horizontal shale gas wells could access all 640 acres with only 7 to 8 acres of total land disturbance.

Chapter 5 describes the constituents of drilling mud and the containment of drilling cuttings, through either 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").

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This Chapter also discusses the hydraulic fracturing process, the composition of fracturing fluid, on-site storage and handling and transport of fracturing additives. The HVHF process involves the controlled use of water and chemical additives, pumped under pressure into the cased and cemented wellbore. Hydraulic fracturing occurs after the well is cased and cemented to protect fresh water zones and isolate the target hydrocarbon-bearing zone, and after the drilling rig and its associated equipment are removed. 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 inner string (i.e., production casing) typically extends from the ground surface to the toe of the horizontal well.

The fluid used for HVHF 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 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." Chapter 5 discusses the volume, characteristics, recycling and disposal of flowback water. The dSGEIS 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.

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Finally, Chapter 5 provides estimates of potential gas production from HVHF operations and also discusses waste disposal associated with HVHF operations, including disposal of cuttings, flowback and production brine.

Chapter 6 – Potential Environmental Impacts

This Chapter identifies and evaluates the potential significant adverse impacts associated with HVHF operations and, like other Chapters, should be read as a supplement to the 1992 GEIS.

Water Resources Impacts

Potential significant adverse impacts on water resources exist with regard to water withdrawals for hydraulic fracturing; stormwater runoff; surface spills, leaks and pit or surface impoundment failures; groundwater impacts associated with well drilling and construction; waste disposal and New York City's subsurface water supply infrastructure. During the public scoping process, additional concerns were raised relating to the potential degradation of New York City's surface drinking water supply and potential groundwater contamination from the hydraulic fracturing procedure itself.

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 dSGEIS estimates that HVHF 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 HVHF 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. The mitigation measures to ensure that such impacts are prevented are described in Chapter 7, summarized below.

Chapter 6 also describes the potential impacts on water resources from stormwater flow associated with the construction and operation of HVHF 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 prevent significant adverse impacts from stormwater runoff are described in Chapter 7.

The dSGEIS concludes that spills or releases in connection with HVHF could have significant adverse impacts on water resources. The dSGEIS identifies a significant number of contaminants contained in fracturing additives, or otherwise associated with HVHF 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 prevent 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 HVHF. 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. The dSGEIS concludes that these potential impacts are not unique to horizontal wells or HVHF and are described and fully assessed in the 1992 GEIS. Nevertheless, because of the concentrated nature of the activity on multi-well pads and the larger fluid volumes and pressures associated with high-volume hydraulic fracturing, enhanced procedures and mitigation measures are proposed and described in Chapter 7.

A supporting study for this dSGEIS concludes that it is highly unlikely that groundwater contamination would occur by fluids pumped into a wellbore for hydraulic fracturing. The 2009 dSGEIS further observes that regulatory officials from 15 states recently testified that groundwater contamination as a result of the hydraulic fracturing process itself has not occurred.

The dSGEIS 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 fully addressed in the 1992 GEIS. Well construction associated with HVHF presents no new significant adverse impacts with regard to potential gas migration. Gas migration is a result of poor well construction (i.e., casing and cement problems). As with all gas drilling, well construction practices mandated in New York are designed to prevent gas migration. Those practices would also minimize the risk of migration of other formation fluids such as oil or brine.

The dSGEIS acknowledges that migration of naturally-occurring methane from wetlands, landfills and shallow bedrock can also contaminate water supplies independently or in the absence of any nearby oil and gas activities. Chapter Section 4.7 of this dSGEIS explains how the natural occurrence of shallow methane in New York can affect water wells unrelated to natural gas development.

Chapters 5 and 6 contain analyses that demonstrate that no significant adverse impact to water resources is likely to occur due to underground vertical migration of fracturing fluids. The developable shale formations are vertically separated from potential freshwater aquifers by at least 1,000 feet of sandstones and shales of moderate to low permeability. In fact, most of the bedrock formations above the Marcellus Shale are other shales. That shales must be hydraulically fractured to produce fluids is evidence that these types of rock formations do not readily transmit fluids. The high salinity of native water in the Marcellus and other Devonian shales is evidence that fluid has been trapped in the pore spaces for hundreds of millions of years, implying that there is no mechanism for discharge of fluids to other formations.

Hydraulic fracturing is engineered to target the prospective hydrocarbon-producing zone. The induced fractures create a pathway to the intended wellbore, but do not create a discharge

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mechanism or pathway beyond the fractured zone where none existed before. The pressure differential that pushes fracturing fluid into the formation is diminished once the rock has fractured, and is reversed toward the wellbore during the flowback and production phases. Accordingly, there is no likelihood of significant adverse impacts from the underground migration of fracturing fluids.

No significant adverse impacts are identified with regard to the disposal of liquid wastes. Drilling and fracturing fluids, mud-drilled cuttings, pit liners, flowback water and produced 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, any environmental risk 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, even though the hazards are not equivalent. Another concern relates to potential spills as a result of trucking accidents. Information about traffic management related to high-volume hydraulic fracturing will be added to other sections of this dSGEIS later in 2011.

The disposal of flowback water could cause a significant adverse impact if the wastewater was not properly treated prior to disposal. Residual fracturing chemicals and naturally-occurring constituents from the rock formation could be present in flowback water 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 eliminate any potential significant adverse impact from flowback water or treatment of other liquid wastes associated with HVHF.

The Department is not proposing to alter its 1992 GEIS Finding that proposed disposal wells require individual site-specific review under SEQRA. Therefore, the potential for significant adverse environmental impacts from any proposal to inject flowback water 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.

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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 are equally applicable to HVHF operations. Severe flooding is described as "one of the few ways" that bulk supplies such as additives "might accidentally enter the environment in large quantities." Mitigation measures to ensure that significant adverse impacts from floods do not occur in connection with HVHF operations 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 not significant because the levels are similar to those naturally encountered in the surrounding environment. As explained in Chapter 5, the total volume of drill cuttings produced from drilling a horizontal well may be one-third 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 impact 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, unless the cuttings are directed into tanks as part of a closed-loop tank system. The geotechnical stability and bearing capacity of buried cuttings, if left in a common pit, would need to be reviewed prior to pit closure.

Impacts on Ecosystems and Wildlife

The dSGEIS has been revised to expand the analysis of the potential significant adverse impacts on ecosystems and wildlife from HVHF 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 dSGEIS concludes that HVHF operations would have a significant 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. Partial mitigation of such impacts is 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 dSGEIS anticipates that there would be additional pressure for surface disturbance on State lands. Surface disturbance associated with gas extraction could have an impact on habitats on State lands, and recreational use of those 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 Marcellus Shale project area 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 for potentially significant adverse impacts from potential transfer of invasive species or from use of State lands, and mitigation for potential impacts to endangered and threatened species is identified in Chapter 7.

Impacts on Air Resources

Chapter 6 of the dSGEIS 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 revised Chapter includes a regulatory assessment of the various air pollution sources and the air permitting process, as well as a supplemental analysis of impacts not addressed in the 2009 dSGEIS. The review of potential air impacts and expanded analyses accounts for information acquired subsequent to the initial review.

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 DEC'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.

Since September 2009 industry has 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) flowback impoundments, which are large volume, lined ponds that function as centralized fluid collection points, are not contemplated. Based on these operational restrictions, the Department revised the limited modeling of 24 hour PM2.5 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 SO_2 and NO_2 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 NO_2 and PM2.5 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 6.5.5 of the dSGEIS as proposed operation conditions to be included in well permits. The Department also developed an air monitoring program to fully address potential for adverse air quality impacts beyond those analyzed in the dSGEIS, which are either not fully known at this time or 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 dSGEIS, 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 were considered, and resulting greenhouse gas (GHG) emissions determined in the dSGEIS. Emission estimates of carbon dioxide (CO_2) and methane (CH_4) are included as both short tons and as carbon dioxide equivalents (CO_2e) 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 CO_2 and CH_4 during anticipated operations so that key contributors of GHGs with the most significant Global Warming Potential (GWP) could be addressed and mitigated, with particular emphasis placed on mitigating CH_4, with its greater GWP.

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 produced waters, 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 increased radiation levels. Also, wastes from the treatment of production waters 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. Information reviewed indicates that there is essentially no increased risk to the public, infrastructure, or natural resources from induced seismicity related to hydraulic fracturing. The microseisms created by hydraulic fracturing are too small to be felt, or to cause damage at the ground surface or to nearby wells. Accordingly, no significant adverse impacts from induced seismicity are expected to result from HVHF operations.

Chapter 7 – Mitigation Measures

This Chapter describes the measures the Department has identified that, if implemented, would eliminate or mitigate potentially significant adverse impacts from HVHF operations. A number of significant, new mitigation measures not contained in the 2009 dSGEIS have been identified as follows.

No HVHF Operations in the New York City and Syracuse Watersheds

In April 2010 the Department concluded that due to the unique issues presented by HVHF 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 unique 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.

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The revised analysis of HVHF operations in the dSGEIS concludes that the proposed HVHF activity is not consistent with the preservation of these watersheds as an unfiltered drinking water supply. Even with all of the criteria and conditions identified in this dSGEIS, a risk remains that significant HVHF 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 EPA's Filtration Avoidance Determinations and result in the affected municipalities incurring substantial costs to filter their drinking water supply. Accordingly, this dSGEIS supports a finding that site disturbance relating to HVHF operations not be permitted in the Syracuse and New York City watersheds or in a protective 4,000 foot buffer area around those watersheds.

No HVHF Operations on Primary Aquifers

Although not subject to Filtration Avoidance Determinations, 18 other aquifers in the State of New York have been identified by the New York State Department of Health as highly productive aquifers presently utilized as sources of water supply by major municipal water supply systems and are designated as "primary aquifers." Because these aquifers are the primary source of drinking water for many public drinking water supplies, the Department recommends in this dSGEIS that site disturbance relating to HVHF operations should not be permitted there either or in a protective 500-foot buffer area around them. Horizontal extraction of gas resources underneath Primary Aquifers from well pads located outside this area would not significantly impact this valuable water resource.

No HVHF Operations on Certain State Lands

This dSGEIS supports a finding that site disturbance relating to HVHF operations should not be permitted on certain State lands because it is inconsistent with the purposes for which those lands have been acquired. In addition, precluding site disturbance on certain State lands would partially mitigate the significant adverse impacts from habitat fragmentation on forest lands due to HVHF activity. It would preclude the loss of such habitat in the protected State land areas which represent some of the largest contiguous forest patches where HVHF activity could occur.

Horizontal extraction of gas resources underneath State lands from well pads located outside this area would not significantly impact this valuable habitat on forested State lands.

No HVHF Operations on Principal Aquifers Without Site-Specific Environmental Review

Principal Aquifers are aquifers known to be highly productive or whose geology suggests abundant potential water supply, but which are not intensively used as sources of water supply by major municipal systems at the present time. In order to mitigate the risk of significant adverse impacts on these important water resources from the risk of surface discharges from HVHF well pads, the dSGEIS proposes that for at least two years from issuance of the final SGEIS, applications for HVHF 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 SEQRA determinations of significance and (2) individual SPDES permits for storm water discharges. The dSGEIS proposes the Department re-evaluate the necessity of this restriction after two years of experience issuing permits in areas outside of the 500-foot boundary.

No HVHF Operations within 2,000 feet of Public Drinking Water Supply and Site Specific Environmental Review For HVHF Operations Within 500 Feet of Tributaries to Such Supply

The dSGEIS seeks to mitigate the risk of significant adverse impacts on water resources from the risk of surface discharges from HVHF well pads by proposing that HVHF operations at any surface location within 2,000 feet of public drinking water supplies should not be permitted. The dSGEIS further proposes that HVHF operations at any surface location within 500 feet of tributaries to public drinking water supplies be subject to a site specific environmental review. The dSGEIS proposes that the Department re-evaluate the necessity of this approach after three years of experience issuing permits in areas outside of these setbacks.

No HVHF Operations in Floodplains or Within 500 Feet of Private Water Wells

In order to address potential significant adverse impacts due to flooding, the dSGEIS supports a finding that the Department not issue permits for HVHF operations at any surface location that is wholly or partially within a 100-year floodplains. In order to ensure that there are no impacts on

DIM0160975 DIM0160994

drinking water supplies from HVHF operations, the dSGEIS also supports a finding that no permits be issued for any well pad located within 500 feet of a private water well or domestic use spring , unless waived by the landowner.

Mandatory Disclosure of Fracking Additives and Alternatives Analysis

The dSGEIS 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 dSGEIS adds a new requirement that operators evaluate the use of alternative hydraulic fracturing additive products that pose less potential risk to water resources. In addition, in the EAF addendum a project sponsor must disclose all chemical additives it proposes to use, so that the appropriate remedial measures can be imposed if a spill occurs. The Department will continue to publicly disclose the identity of chemical constituents to hydraulic fracturing additives, provided that additive information which meets the confidential business information exception to the Department's records access program will not subject to public disclosure.

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 HVHF operations, the dSGEIS adds 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 address concerns over migration of gas into aquifers. Required elements of every operator's emergency response plan have been specified.

Required Secondary Containment and Stormwater Controls

In order to mitigate the risk of a significant adverse impact to water resources from spills of chemical additives, fracking fluid or other liquid wastes associated with HVHF, secondary containment, spill prevention and storm water pollution prevention are comprehensively

addressed for all stages of well pad development. The dSGEIS supports the Department's proposal for a new category of stormwater general permit for gas drilling operations that would address potential stormwater impacts associated with HVHF operations.

Conditions Related to Disposal of Wastewater and Solid Waste

As provided in the 2009 dSGEIS, to ensure that wastewater from HVHF operation is properly disposed, the Department proposes to require that before any permit is issued the operator have Department-approved plans in place for disposing of flowback water and production brine. In addition, the Department proposes to require a tracking system, similar to what is in place for medical waste, for all liquid and solid wastes generated in connection with HVHF operations.

The dSGEIS also proposes to expand its proposed requirement for closed-loop drilling in order to ensure that no significant adverse impacts related to the disposal of pyrite-rich Marcellus Shale cuttings on-site.

Air Quality Control Measures and Mitigation for Greenhouse Gas Emissions

The dSGEIS identifies additional mitigation measures designed to ensure that emissions associated with HVHF operations do not result in the exceedence of any NAAQS. In addition, the Department has committed to implement local and regional level air quality monitoring at well pads and surrounding areas.

The dSGEIS also identifies mitigation measures that can be required through permit conditions and possibly new regulations to ensure that HVHF do not result in significant adverse impacts relating to climate change. The dSGEIS proposes to require a greenhouse gas emission impacts mitigation plan (the Plan). The Plan must 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 USEPA's 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 is available; and a statement that the operator would provide the Department with a copy of the report filed with USEPA to meet the GHG Reporting Rule.

Mitigation for Loss of Habitat and Impacts on Wildlife

In order to further mitigate significant adverse impacts on wildlife habitat caused by fragmentation of forest and grasslands outside of state-owned land, the Department proposes to require specified Best Management Practices for surface disturbance in contiguous forest patches of 150 acres or more and contiguous grassland patches of 30 acres or more.

Other Control Measures

Other important existing and anticipated regulatory requirements and/or permit conditions that would be imposed to ensure that HVHF operations do not cause significant impacts on the environment in New York include:

- Before a permit is issued, Department staff would review the proposed layout of the well site based on analysis of application materials and a site visit. Risky site plans would either not be approved or would be subject to enhanced site-specific construction requirements.

- The Department's staff reviews the proposed casing and cementing plan for each well prior to permit issuance. Permits are not issued for improperly designed wells, and in the case of HVHF, the as-built wellbore construction would be verified before the operation is allowed to proceed.

- The current dSGEIS proposes to require in most cases fully cemented intermediate casing, with the setting depths of both surface and intermediate casing determined by site-specific conditions.

- Fracturing equipment components would be pressure tested with fresh water prior to the introduction of chemical additives.

- The current dSGEIS requires pressure testing of blowout prevention equipment, the use of at least two mechanical barriers that can be tested, the use of specialized

DIM0160975 DIM0160997

equipment designed for entering the wellbore when pressure is anticipated, and the on-site presence of a certified well control specialist.

- Flowback water stored on-site must use watertight tanks within a secondary containment and must remove the fluid within certain time periods.

- The Department has a robust permitting and approval process in place to address any proposals to discharge flowback water or production brine to wastewater treatment plants. The Department would require that before any permit is issued the operator have Department-approved plans in place for disposing of flowback water and production brine. Permission to treat such wastewater at a treatment plant in New York State would not be granted without a demonstrable showing that such wastewater can be properly treated at the plant. Additionally, the Department anticipates that operators would favor reusing flowback water for subsequent fracturing operations as they are now doing in Pennsylvania, so that disposal of flowback would be minimized.

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 HVHF operations on local land use laws and policies. Unlike the 2009 dSGEIS, the current draft Supplement supports a condition that local governments be given notice in writing of all HVHF applications in the locality. A continuously updated database of local government officials and an electronic notification system would be developed for this purpose.

In addition, the EAF Addendum would require the project sponsor to identify whether the proposed location of the well pad, or any other activity under the jurisdiction of the Department, conflicts with local land use laws or regulations, plans or policies. The project sponsor would also be required to identify whether the well pad is located in an area where the affected community has adopted a comprehensive plan or other local land use plan and whether the

proposed action is inconsistent with such plan(s). Where the project sponsor indicates that the location of the well pad, or any other activity under the jurisdiction of the Department, is either consistent with local land use laws, regulations, plans or policies, or is not covered by such local land use laws, regulations, plans or policies, no further review of local land use laws and policies would be required.

In cases where a project sponsor indicates that all or part of their proposed application is inconsistent with local land use laws, regulations, plans or policies, or where the potentially impacted local government advises the Department that it believes the application is inconsistent with such laws, regulations, plans or policies, the Department intends to request additional information in the permit application to determine whether this inconsistency raises significant adverse environmental impacts that have not been addressed in the SGEIS.

Chapter 9 – Alternatives

Chapter 9 discusses the alternatives to well permit issuance that were reviewed and considered by the Department. Chapter 21 of the GEIS and the 1992 Findings Statement discussed a range of alternatives concerning oil and gas resource development in New York State that included both its prohibition and the removal of oil and gas industry regulation. Regulation as described by the GEIS was found to be the best alternative.

The dSGEIS considers a range of alternatives to the proposed approach for regulating and authorizing HVHF operations in New York. As required by SEQRA, the dSGEIS considers the no action alternative. The Department finds that the no action alternative would not result in any of the significant adverse impacts identified herein, but would also not result in the significant economic and other benefits identified with natural gas drilling by this method. The Department believes that this alternative is not preferable because significant adverse impacts from HVHF operations can be fully or partially mitigated.

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. As discussed above, the

Department proposes to partially adopt this alternative by restricting resource development in the New York City and Syracuse watersheds (plus buffer), public water supplies, primary aquifers and certain state lands. In addition, restrictions and setbacks relating to development in other areas near public water supplies, principal aquifers and other resources as outlined above are recommended. The Department does not believe that resource development should be further limited by imposing an annual limit on permits issued for HVHF operations. The Department believes any such annual limit would be arbitrary. Rather, the Department proposes to limit permit issuance to match the Department resources that are made available to review and approve permit applications, and to adequately inspect well pads and enforce permit conditions and regulations.

The dSGEIS also contains a review and analysis of the development and use of "green" or non-chemical fracturing alternatives. The Department finds that the use of environmentally-friendly or "green chemicals" would proceed based on the characteristics of the Marcellus Shale play and other shale plays across the United States, as well as the potential environmental impacts of the development. While more research and approval criteria would be necessary to establish benchmarks for 'green chemicals,' this dSGEIS adopts this alternative approach where feasible by requiring applicants to review and consider the use of alternative additive products that may pose less risk to the environment, including water resources, and to publicly disclose the chemicals that make up these additives. These requirements may be altered and/or expanded as the use of 'green chemicals' begin to provide reasonable alternatives and the appropriate technology, criteria and processes are in place to evaluate and produce "green chemicals."

Chapter 10 – Case Studies

Chapter 10 discusses a number of widely publicized incidents involving HVHF operations in Pennsylvania and elsewhere that have caused public concern about the safety and potential adverse impacts associated with HVHF operations. The case studies describe the events and their likely causes, and explains how protective measures currently in place or identified as proposed mitigation measures in this dSGEIS would further minimize the risk of such events occurring should HVHF operations be permitted in New York.

Chapter 11 – Summary Table

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.

Next Steps

After the addition of Chapters on issues requiring additional analysis, the dSGEIS will be officially noticed to the public and comments will be accepted. A Final SGEIS will then include summaries of the substantive comments received on both the September 2009 Draft and this dSGEIS, along with the Department's responses to such comments. The Final SGEIS will also incorporate by reference all volumes of the 1992 GEIS.

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