New York City Comments on:

Draft Supplemental Generic Environmental Impact Statement (dSGEIS) 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.

December 22, 2009

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Introduction

These comments are submitted by the City of New York (City) in response to the Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas and Solution Mining Regulatory Program issued on September 30, 2009 by the New York State Department of Environmental Conservation (NYSDEC).

The City, in these comments, identifies a number of important respects in which the dSGEIS fails to analyze and address a range of potential risks to the environment, and in particular to the City's drinking water supply. The dSGEIS is fundamentally incompatible with principle of watershed protection and pollution prevention that are relied upon by nine million people for clean and safe drinking water. The available knowledge of fractures in the watershed, past seepages into DEP tunnels during construction, instances of contamination in other jurisdictions, and the sheer magnitude of truck trips, chemicals, wellpads, and other activities – much of it ignored in the dSGEIS – demonstrates that a new SGEIS is required to disclose, analyze, and mitigate risks that would occur from the action, both at the local level and from a cumulative perspective. In addition, site-specific environmental reviews to address the many discretionary elements of subsequent permit applications are required.

Beyond shedding light on the shortcomings of the dSGEIS, these comments call attention to the unacceptable risk posed by natural gas drilling in the Marcellus Shale to the New York City Watershed and to the high quality water that is delivered daily to over nine million New Yorkers in the City and elsewhere. Under current drilling practices and technology, the hydraulic fracturing process, including the use of harmful chemicals, poses far too great a risk to the environment, public health, existing infrastructure, and the water supply to proceed in the Watershed.

The comments that follow detail the inadequacies and omissions of the dSGEIS, and identify failures to comply with the requirements of the State Environmental Quality Review Act (SEQRA). Among other things:

- The dSGEIS does not adequately analyze – or in some cases, fails entirely to analyze – items listed in the Final Scope for this environmental review.
- The dSGEIS fails to examine the impacts of activities that are integral to natural gas drilling, such as wastewater treatment and disposal, among other things, thus improperly segmenting the review of natural gas production in the Marcellus Shale.
- The dSGEIS does not analyze the cumulative impacts of the reasonably foreseeable extent of natural gas production activities in the Marcellus Shale.
- The dSGEIS does not adequately consider reasonable alternatives to the action as proposed, although such consideration of alternatives is required by SEQRA.
- The dSGEIS does not adequately analyze the risks to the environment, the City's water supply and public health from the large volumes of toxic chemicals that will be transported, stored, and injected into gas wells in connection with the hydrofracturing process.

- The dSGEIS relies on an analysis of mapped faults for its conclusions concerning hydrogeological impacts and subsurface migration of pollutants, but fails to consider numerous other mapped brittle-type structures and faults that have been identified but do not appear on the map reprinted in the dSGEIS.
- As a result of this inadequate hydrogeological analysis, the dSGEIS fails to identify the potential impacts of hydraulic fracturing on water supply infrastructure.

In addition, while the dSGEIS does propose some mitigation measures to address certain identified significant adverse impacts associated with natural gas drilling, many of these measures would need to be adopted as agency rules, which can be promulgated only in accordance with the rulemaking process established under the State Administrative Procedure Act (SAPA).

The City recognizes the difficult task of putting together this dSGEIS and applauds NYSDEC for its hard work, but we strongly urge NYSDEC to withdraw this dSGEIS and conduct a new, comprehensive environmental review that is more in line with the dictates of the SEQRA process, that more adequately identifies and provides mitigation for the impacts related to hydraulic fracturing, and that considers alternatives to natural gas drilling in the New York City Watershed.

SGEIS Scope

Many items that were listed in the Final Scope were either not analyzed or analyzed inadequately in the dSGEIS. These are discussed in more detail in the following sections. Specific scope items that are not satisfactorily addressed in the dSGEIS include:

2.1.2 Hydraulic Fracturing

"*Hydraulic fracturing design and modeling, with emphasis on containment of fractures and fracturing fluid in the target formation. The dSGEIS will review the available methodologies for ensuring containment, and evaluate the design parameters that should be included in well permit applications for staff review prior to permit issuance*."

2.1.2.2 Fluid Handling at the Well Site

"*Evaluation of potential well permitting procedures, such as verification of a disposal well permit or contract with a specific treatment plant, to ensure that available capacity exists for any proposed disposal destination*."

4.2.1 Water Withdrawals

"*The following concerns related to water withdrawals, including the potential cumulative impact of numerous withdrawals, will be addressed in the dSGEIS: … potential effects on volume of water available for other needs, including public water supply*."

4.2.1.4 Assessment of Water Withdrawals for High-Volume Hydraulic Fracturing in the Marcellus Shale and Other Low-Permeability Gas Reservoirs

"*For well permits which propose new water withdrawals outside the Susquehanna and Delaware River Basins for high-volume hydraulic fracturing of the Marcellus Shale and other low-permeability formations, and to the extent found necessary within the Basins, the dSGEIS will discuss potential review parameters and mitigation measures such as, but not limited to:*

- *assessment of combined impact of the proposed withdrawal and upstream/ downstream intakes within a certain distance,*
- *evaluation of impacts to aquatic resources, competing users and the stream's designated best use during periods of low flow,*
- *reduction or discontinuance of the withdrawal during periods of low flow,*
- *limitation of withdrawal rates and locations as necessary to maintain compliance with the Department's narrative flow standard for fresh surface water and protect best uses of the water body even during low flow periods,*
- *requirement for mitigation through water storage or conservation releases."*

4.2.4 New York City Watershed

"*The dSGEIS will address the need for any exclusion zone, additional environmental review and additional special permit conditions. Protection of correlative rights with respect to offset drainage from wells on properties adjacent to any exclusion zone will also be considered*."

4.8 Cumulative Impacts

"*The dSGEIS will review and assess the information and methodologies that are available for estimating the potential rate of Marcellus Shale development, and will include a description of likely development based on the information and methodology deemed most applicable and appropriate.*

The dSGEIS will assess the levels of activity within a reasonable temporal and geographic framework that may result in adverse cumulative impacts with respect to noise, visual effects, air quality and water resources."

State Administrative Procedure Act

The mitigation chapter in the dSGEIS is problematic in that many of the mitigation measures NYSDEC identifies in the dSGEIS are in fact agency rules that must be promulgated in accordance with the rulemaking process established under the State Administrative Procedure Act (SAPA). Although no dSGEIS provision is designated as a rule, a number of measures NYSDEC has found necessary to mitigate potential adverse impacts of natural gas production are characterized as non-discretionary requirements that would apply to all regulated parties, or to all drilling applications meeting certain conditions. Indeed, because of the ways they are described in the dSGEIS, public commentators and the media have consistently characterized

these mitigation requirements as "rules,"[1] yet NYSDEC has indicated no intention to follow SAPA's procedural requirements for rulemaking. Requirements of universal applicability to a regulated population, or of applicability to all members of that population in a specified category, are, however, rules within the definition of SAPA, subject to the provisions of that statute. Such requirements cannot be imposed through environmental review under State Environmental Quality Review Act (SEQRA).

What Constitutes a "Rule" under SAPA

Under SAPA, a legally binding determination by an agency of rights and responsibilities must be issued as a rule, defined as "the whole or part of each agency statement, regulation or code of general applicability that implements or applies law … or the procedure or practice requirements of any agency."…" (SAPA § 102(2)(a)(i)). The Court of Appeals has explained that a rule or regulation is a "fixed, general principle to be applied … without regard to other facts and circumstances relevant to the regulatory scheme of the statute it administers." (*Cubas v. Martinez*, 8 N.Y.3d 611, 620-21 (2007)). Rulemaking is required where a measure "directly and significantly affects that segment of the public over which [the regulator] exercises direct authority." (*Scwhartfigure v. Hartnett*, 83 N.Y.2d 296, 302 (1994)).

SAPA excludes the following categories of agency documents, among others, from its definition of rules: (1) explanatory documents such as instructions, interpretive statements and policy statements that themselves have no legal effect, and (2) guidance documents such as guidelines, memoranda, or similar documents that provide general information or guidance to assist parties in complying with a statute, rule, or legal requirement. (SAPA §§ 102(2)(b)(iv), 102(14)). The Environmental Conservation Law (ECL), however, specifically prohibits NYSDEC from issuing guidance memoranda or other documents of general applicability NYSDEC to implement the ECL or NYSDEC rules promulgated pursuant to the ECL, in lieu of a duly promulgated rule. (N.Y. ECL § 3-0301(2)(z)). That is, NYSDEC may not rely on guidance or other documents – including environmental impact statements – to implement legal requirements of general applicability. As explained below, a number of the mitigation measures relied upon in the dSGEIS constitute just such legal requirements, and thus may be adopted only through formal rulemaking.

Courts have identified a number of factors that determine whether an agency statement is a rule. First, where a statement sets forth a legislative or quasi-legislative norm or prescription that establishes a pattern or course of conduct for the future, it is a rule – in contrast to statements

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[1] *See, e.g.,* New York Times, *State Issues Rules on Upstate Natural Gas Drilling Near City's Water,* (Oct. 1, 2009), available at http://www.nytimes.com/2009/10/01/nyregion/01drill.html; Reuters, *NY Weights Natgas Drilling in Marcellus Shale,* (Oct. 1, 2009), *available at http://www.reuters.com/article/bondsNews/idUSN0128641420091001.* Marketwatch, *New York State Eyes New Rules on Marcellus Shale 'fracking'* (Oct. 1, 2009), *available at* http://www.marketwatch.com/story/new-york-eyes-new-rules-on-marcellus-drilling-2009-10-01; Steptoe & Johnson Energy Team, *More Rules for Marcellus Drilling* (Oct. 7, 2009), *available at* http://www.steptoe-johnson.com/publications/publicationstory/MoreRulesforMarcellus Drilling,301.aspx; K&L Gates, John F. Spinello et al., *Oil & Gas Alert: NYSDEC Draft Supplemental Generic Environmental Impact Statement for Natural Gas Drilling Activities in the Marcellus Shale Formation* (October 20, 2009), *available at* http://www.klgates.com/newsstand/detail.aspx?publication=5979.

allowing for ad hoc decisions, where the agency retains discretion based on individual facts and circumstances. (*See Med. Soc'y of N.Y. v. Serio*, 100 N.Y.2d 854, 868 (2003); *Alca Indus., Inc. v. Delaney*, 92 N.Y.2d 775 (1999)).

Additional factors for determining whether an agency has issued a rule or guidance document are the novelty, breadth, directness of public impact, and purpose of the statement. General applicability, direct impact on regulated parties or the public, and a motivating purpose of creating new law or duties weigh in favor of characterizing the statement as a rule. (*UCP-Bayview Nursing Home v. Novello*, 2 A.D.3d 643, 645, 769 N.Y.S.2d 285, 288 (2d Dep't 2003)).

The introduction to the dSGEIS mitigation chapter incorporates mitigation measures from the 1992 GEIS by reference, and notes the applicability of pre-existing regulations of NYSDEC and other agencies. (*dSGEIS* at 7-2). To the extent that proposed mitigation measures reflect interpretations of existing rules, there is no requirement for new rulemaking under SAPA. The introduction goes on, however, to suggest that the focus of the mitigation chapter is on recommendations for enhanced procedures not contained in the 1992 GEIS, and on permit conditions necessitated by hydrofracturing and horizontal drilling methods. To the extent that NYSDEC is relying on new requirements, independent of its existing rules, it may not simply impose them as conditions for all new drilling permits, or all new permits for applications meeting certain conditions, without adopting new rules.

dSGEIS Mitigation Measures Setting Forth New Requirements Applicable to All Drilling Operations Constitute Rules

Under the standards that distinguish rules from other agency statements, the dSGEIS mitigation measures that most obviously qualify as rules are those that are proposed by NYSDEC as permit conditions for all drilling operations. These measures include (1) permit terms applicable to all regulated parties requiring specific actions to mitigate impacts, leaving the agency no discretion to craft or accept the use of alternative mitigation mechanisms on a case-by-case basis, and (2) general prohibition of certain activities.

The Department has proposed at least two such rules for all drilling operations. For example, when discussing mitigation measures related to flowback water, the dSGEIS notes that "the Department proposes a requirement that flowback water handled at the well pad be directed to and contained in steel tanks." (*dSGEIS* at 7-34). A new requirement to utilize steel tanks at drilling sites constitutes a "fixed, general principle to be applied … without regard to other facts and circumstances" and must therefore be promulgated under SAPA.

Similarly, the Department states that annular disposal of drill cuttings will not be approved under any circumstances – a general ban of a practice allowed in other states[2] that can be adopted only through a rule.

Attachment A identifies these rules that the Department states will apply to all drilling operations as well as a number of other elements of the mitigation chapter that constitute rules applicable to all drilling operations meeting specified conditions.

Both the generally applicable permit conditions and the prohibition of specific actions are rules that must be promulgated pursuant to SAPA. They are broadly applicable to all parties who engage in natural gas production in New York State, and they are novel requirements imposing

[2] *See, e.g.,* Regulations of the Alaska Oil and Gas Conservation Commission, 20 AAC 25.080.

substantive obligations to test, monitor, report, construct, or undertake specified measures in order to comply with a permit, not tied to existing regulations. The conduct of regulated parties is directly affected. These measures leave no room for agency discretion, but rather apply regardless of the facts and circumstances relevant to any particular drilling application. Moreover, these measures are outcome determinative, and legally binding – the regulated parties must undertake the specified actions or be prohibited from conducting the regulated activity. For all of these reasons, these measures would have to be adopted as rules under SAPA, rather than solely as mitigation measures under SEQRA.

The Proposed Supplementary Permit Conditions for High-Volume Hydraulic Fracturing Constitute Rules

Another category of mitigation measures establishes requirements that will be included as supplementary permit conditions for high-volume hydraulic fracturing, referenced throughout the mitigation chapter of the dSGEIS and set forth separately in Appendix 10. For instance, the newly proposed supplementary permit conditions include a requirement that, prior to site disturbance, a well operator must sample and test residential water wells within 1,000 feet of the well pad as described in the SGEIS, and provide results to the property owner and the county health department. (*dSGEIS* at 7-38; *see also dSGEIS* at Appx. 10 item 5). The dSGEIS also prescribes the schedule and testing parameters for this required water sampling. (*dSGEIS* at 7-38 & 7-40 to 7-41).

Similarly, with regard to transportation and disposal of waste generated during drilling operations, the dSGEIS notes that "the Department will require that a *Drilling and Production Waste Tracking Form* be completed and maintained by generators, haulers and receivers of all flowback water associated with activities addressed by this Supplement. The record-keeping requirements and level of detail will be similar to what is presently required for medical waste. The form will be required regardless of whether waste is taken to a treatment facility, disposal well, centralized surface impoundment, another well pad, a landfill, or elsewhere." (*dSGEIS* at 7-50; *see also dSGEIS* at Appx. 10 items 40, 43, and 48). The dSGEIS includes an additional set of requirements for high-volume hydraulic fracturing operations involving multi-well pad operations. For instance, under such circumstances, tank-filling operations must be staffed, (*dSGEIS* at 7-27), and a number of requirements apply to the storage and removal of drilling fluids and flowback water, (*dSGEIS* at 7-30, and 7-34 to 35). Again, this requirement is a prescription which establishes a pattern or course of conduct for the future for a class of regulated entities, and must therefore go through the SAPA rulemaking process.

Additional examples of rules proposed for high-volume hydraulic fracturing operations are identified in Attachment A.

These supplementary permit conditions are rules subject to the SAPA rulemaking process. Because a permit is required to drill for natural gas, these conditions apply to every party engaging in high-volume hydraulic fracturing and thus constitute a set of generally applicable requirements. The permit conditions do not merely explain or interpret existing rules; rather, they establish a new regulatory framework to govern the activity of high-volume hydraulic drilling from beginning to end. NYSDEC has determined that these permit conditions are necessary to mitigate potential adverse impacts associated with high-volume drilling operations, and thus has given itself no discretion to pick and choose whether a particular party engaging in

such activities is subject to these requirements. For all these reasons, such permit conditions constitute rules.

The dSGEIS Relies on Other Proposed Permit Conditions That Would Apply Under Specified Conditions

In addition to the rules discussed above that would apply to all high-volume hydrofracturing operations, the dSGEIS identifies other permit conditions that would apply under certain specified conditions, or would require a regulated party to undertake actions if a specified event occurs. For example, centralized flowback water surface impoundments would be prohibited for all drilling operations in the New York City Watershed, in primary or principal aquifers, and in mapped 100-year floodplains. (*dSGEIS* 7-51, 7-64, and 7-96). Attachment A provides a number of additional examples of rules proposed in the mitigation chapter for drilling operations meeting specified criteria.

Like the proposed permit conditions discussed in the previous two sections, these provisions require rulemaking under SAPA. NYSDEC has proposed that they would apply to every member of a specified class of regulated parties. These permit conditions neither explain preexisting laws nor interpret existing rules or guidelines, and are too detailed to be general policy statements. Rather, they are regulations that seek to implement substantive restrictions on certain hydrofracturing operations, with the purpose of controlling that activity. The fact that the requirements would only be imposed under certain specified conditions does not exempt them from rulemaking requirements. As proposed, NYSDEC retains no discretion to apply such conditions on a case-by-case basis, but rather has determined that they are necessary under specified circumstances to mitigate potential adverse impacts.

Summary

In sum, the dSGEIS introduces a series of novel regulatory requirements that impose affirmative obligations or substantive restrictions on regulated parties. Though some dSGEIS mitigation measures are based on areas of pre-existing regulation, the dSGEIS also proposes new permit conditions that would be mandatory for all, or for specified categories of, hydraulic fracturing operations. Imposition of such mandatory requirements requires rulemaking under SAPA. Absent such rulemaking, the SGEIS and permits issued pursuant to it would be vulnerable to legal challenge.

Chapter 3 – SEQRA Process

General Comments

The dSGEIS fails to analyze a number of integral aspects of natural gas drilling, production, and transmission, thus segmenting the environmental review of the action under consideration. The current incomplete analysis does not satisfy the requirements of SEQRA.

The dSGEIS has effectively segmented the review of the proposed action, as segmentation is defined in 6 NYCRR Part 617.2(ag), by excluding certain critical elements required as part of natural gas development operations or likely to result from such operations (e.g., waste disposal,

induced growth, air quality impacts, pipeline construction, and ancillary infrastructure).[3] SEQRA requires that impacts associated with a whole action be evaluated and provides a test for segmentation based on timeframe, goals, geography, common planning/ownership, and functional dependence.

All of the excluded actions appear to violate one or more of the tests. For example, disposal of flowback and produced water from well drilling is dependent on the construction of underground injection wells or industrial wastewater treatment plants, or the permitting of pretreatment programs at municipal wastewater facilities or road spreading operations for brine water. The impacts of hydrofracking in the Marcellus thus cannot be separated from the impacts associated with creating such wastewater treatment and disposal infrastructure. Among other things, operation of injection wells is acknowledged in the dSGEIS to be associated with induced seismicity, which in turn can increase the hydraulic transmissivity of faults and fractures in strata above the target formation. The assumed, long-term integrity of these overlying units is integral to dSGEIS findings that hydraulic fracturing does not pose a reasonable threat to either groundwater or New York City's water supply system.

Similarly, the dSGEIS fails to consider the impacts of construction of the transmission lines that will be required in connection with gas development in the Marcellus, noting that under the Public Service Law, those impacts are reviewed in a separate process by the Public Service Commission. dSGEIS Section 5.16.8. In its generic environmental review of natural gas drilling in the Marcellus Shale as a whole, however, NYSDEC must develop a reasonable estimate of the extent to which new transmissions lines will be required in connection with hydrofracturing and horizontal drilling in the Marcellus Shale, and then evaluate the cumulative impacts associated with construction of transmissions lines on that scale.

The dSGEIS assessment of impacts is limited to a relatively narrow consideration of the hydrofracturing process itself, without full consideration of closely related, functionally dependent activities that are a necessary part of an overall plan for natural gas development. To the extent the dSGEIS relies implicitly or explicitly on regulatory approvals that would be required in the future for related activities such as construction of adequate wastewater treatment and disposal facilities, such future approvals do not serve as mitigation aspects of the project.

Moreover, as discussed extensively below, a comprehensive cumulative analysis of the regional impacts, which are substantially different than those evaluated in the 1992 GEIS, was not conducted.

The dSGEIS also references a number of incomplete analyses and proposed mitigation measures that are being deferred until a later date while the SEQRA process continues to move forward. This prevents public involvement in the review and comment on the ultimate outcome of the analyses and allows the dSGEIS to be finalized without provision of adequate mitigation of potentially substantial adverse impacts. The following analyses and mitigation measures must be completed prior to finalizing the dSGEIS:

- Section 7.1.1: NYSDEC's aquifer depletion study;

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[3] NYCRR Part 617.2(ag): *"Segmentation means the division of the environmental review of an action such that various activities or stages are addressed under this Part as though they were independent, unrelated activities, needing individual determinations of significance."*

- Section 7.8: Health impacts and mitigation requirements for naturally occurring radioactive material (NORM); and
- Section 7.1.1 Technical Operational and Guidance Series (TOGS) document for the narrative water quality standard for flow for 6 NYCRR 703.2.

Thus, the dSGEIS improperly segments analysis of a number of closely related actions, and relies improperly on studies, guidance documents, and regulatory reviews that may occur in the future as mitigation for impacts associated with the action under review.

The comments below address many specific technical deficiencies in the analysis in the dSGEIS, including NYSDEC's failure to conduct an adequate cumulative impacts analysis, to analyze growth that will be induced by natural gas production in the Marcellus, and to review reasonable alternatives as required under SEQRA. In addition, the NYSDEC fails to take the hard look required under SEQRA at information that calls into question conclusions in the dSGEIS concerning the likelihood of adverse impacts to water quality and the integrity of the City's water supply infrastructure.

For instance, NYSDEC's failure in the dSGEIS to analyze reported incidents of subsurface migration leading to water contamination in Dimock, Pennsylvania[4] and Garfield County, Colorado[5] renders the assessment of potential adverse impacts in the dSGEIS inadequate. The mandate under SEQRA to take a hard look at these impacts requires a thorough assessment of these and other identified instances of contamination.

Similarly, a recent investigation suggests that there may be as many as 400 instances in New York State where spills or leaks associated with oil and natural gas drilling were not investigated, remediated, or properly closed.[6] Yet the dSGEIS does not address the staffing levels required to inspect drilling sites and respond promptly and effectively to spills when they occur. The responsibilities of NYSDEC staff are likely to increase significantly with development of the Marcellus Shale formation. A complete environmental review of natural gas production in the Marcellus requires a thorough analysis of all available information concerning spills and remediation in the State, including mechanisms to prevent and address such spills and oversee such remediation.

Additional deficiencies in the environmental review are described below.

Recommendation

- Because of the serious omissions in the dSGEIS as well as SAPA concerns, this draft environmental review needs to be rescinded, these issues need to be fully addressed and a new draft released for public review.

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[4] Rapid Impact Assessment, NYCDEP, 2009.

[5] Colorado Oil and Gas Conservation Commission, 2004.

[6] Letter dated November 8, 2009 from Walter Hang, ToxicsTargeting, Inc., to Governor Paterson.

Chapter 4 – Geology

4.5 Seismicity in New York State

General Comments

This section discusses the history of seismic events in New York State and includes a depiction of the locations of those brittle structures (mapped by Isachsen and McKendree) considered to be faults (see Alpha Figure 4.13). However, the source map compiled originally by Isachsen and McKendree (1977) includes a more comprehensive depiction of brittle structures (consisting of faults, shear zones and linear features reflecting fracturing of the underlying bedrock) that are discounted in this portion of the dSGEIS (Figure 1). Of these types of features, all represent breaks or fractures in the bedrock, with faults and shear zones being a special case associated with movement of the comprising rock masses in a direction parallel to the feature.

The red colored lines indicated on the second figure correspond to those brittle structures identified by Isachsen and McKendree as "Tonal Linear Features" and "Topographic Linear Features" which reflect the locations of inferred fractures and/or faults in the underlying bedrock. These types of features are typically identified using aerial photographs, maps, and other ex-situ methods. In some cases these features are continuations of the known or mapped faults (two of the many examples of this correlation are evident within features located in Schuyler County and another that spans across Oneida and Herkimer Counties).

Section 4.5 of the dSGEIS should have addressed the possibility of un-mapped faults and other brittle-type structures such as these linear features with respect to induced seismicity and seismic hazards. Additionally, the dSGEIS does not present an adequate assessment of the possibility of faults and other features serving as conduits that could allow transmission of formation water or fracturing chemicals into the local freshwater aquifers or towards tunnels and aqueducts. This discussion should include an analysis of the likelihood of linear features as well as joint sets and un-mapped features contributing to the migration of formation water or fracturing chemicals in the subsurface and possibly to the surface.

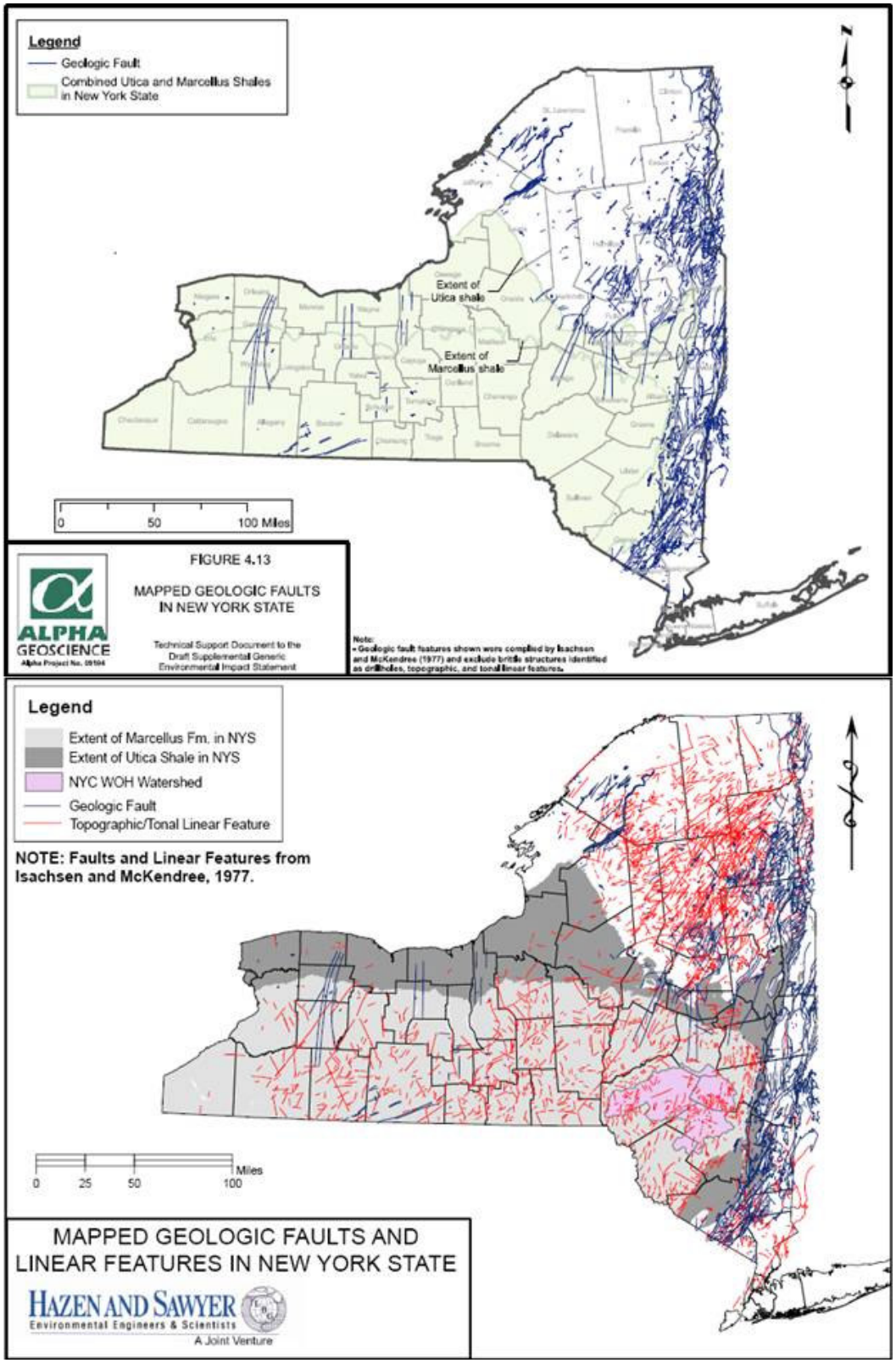

Figure 1. Comparison of dSGEIS Map with Original Data Source.

Chapters 6 and 7 – Potential Environmental Impacts and Mitigation Measures

6.1.1/7.1.1 Water Withdrawals

General Comments

The analysis and proposed mitigation measures included in the dSGEIS with respect to water withdrawals are insufficient to meet the requirements of SEQRA. The dSGEIS analysis does not include evaluation of the impacts on pre-existing consumptive uses, despite highlighting it as a potential impact from natural gas-related water withdrawals. As such, the mitigation measures proposed are flawed in that pre-existing consumptive uses are not required to be included in the interim passby flow calculations. The interim passby flow analysis, which is based on an outdated methodology, also lacks specific monitoring and enforcement requirements in order to ensure compliance. Finally, NYSDEC currently lacks legal authority to address adverse environmental impacts of cumulative surface water and groundwater withdrawals that are not intended for public water supplies.

6.1.1.7 The City agrees that "*Evaluation of cumulative impacts of multiple water withdrawals must consider the existing water usage, the non-continuous nature of withdrawals and the natural replenishment of water resources*." The section goes on to identify the permit systems and approval processes developed by the Delaware River Basin Commission (DRBC) and the Susquehanna River Basin Commission (SRBC) to mitigate withdrawal impacts in their respective basins. While these processes may or may not be sufficient to mitigate impacts in those basins, the section fails to note the absence of comparable authorities and withdrawal permitting/approval processes in other regions of the state that may be subject to water withdrawals for hydraulic fracturing, including areas of the New York City (NYC) watershed that lie outside of the Delaware and Susquehanna basins. The section misleadingly implies that the protections that exist in the Delaware and Susquehanna basins will mitigate withdrawal impacts throughout New York State.

In contrast, Section 3.4.1 of the Alpha report[7] acknowledges: "*The extent of the gas-producing shales in New York extends beyond the jurisdictional boundaries of the SRBC and the DRBC. The potential exists for gas drilling and associated water withdrawal to occur outside of the Susquehanna and Delaware River Basins. At this time, New York State regulations generally are not as comprehensive as those within the Susquehanna and Delaware River Basins with respect to controlling, evaluating, and monitoring surface water and ground water withdrawals for shale gas development*." The report goes on to state "*The NYSDEC, through Parts 605 and 607, and the SEQR process, has significant regulatory control to limit the potential impacts of stream flow reduction due to water taking associated with high-volume hydraulic fracturing of shales*." However, Part 605 is applicable only when a permit

[7] Survey of Regulations in Gas-Producing States, NYS Water Resources, Geology, New York City Watershed, Multi-Well Operations, and Seismicity

is required for a withdrawal.[8] If no permit is required, as is the case for water withdrawals for hydraulic fracturing, Part 605 does not apply. Further, even if Part 605 were applicable, the requirements therein, which are limited to basic site and withdrawal information and annual average maximum and minimum stream flow, are insufficient to characterize or prevent cumulative water withdrawal impacts.

Further, the quantitative evaluation of cumulative water withdrawal impacts presented in this section consists solely of a comparison of one year of annual average historical withdrawals for gas drilling and mining in the Delaware and Susquehanna basins versus withdrawals for other sectors. This analysis of impacts is fundamentally flawed and inadequate with respect to temporal and spatial scale, analytical method and geographic scope.

a) Temporal scale: Cumulative impacts of excessive water withdrawals occur at a finer temporal scale than can be adequately assessed using annual average diversion data for one year. Waters of the state are most susceptible to cumulative withdrawal impacts during seasonal low flow periods and during dry years.

b) Spatial scale: Cumulative impacts of excessive water withdrawals occur at a finer spatial scale than can be adequately assessed using basin-wide or state-wide diversion data for one year. All streams and water resources (aquifers and groundwater bearing formations providing aquifer recharge) in the state or even in the large river basins are not equivalent. Streams have varying degrees of quality and varying demands. In order to adequately evaluate potential adverse impacts, it is necessary to evaluate water withdrawals at the stream or sub-basin scale to ensure that critical headwaters and groundwater recharge source formations are not depleted, high-quality drinking water supplies are not compromised, and other stream-specific best uses are not degraded.

c) Analytical method: The analysis compares water diversions by sector, and implies that because diversions for mining/gas are small relative to other sectors, cumulative water withdrawal impacts are unlikely. This reasoning fails to consider the extent to which a watershed can support existing uses and their cumulative impacts. Furthermore, not only is the characterization based on outdated withdrawal data from before high volume hydraulic fracturing, it fails to address the cumulative level of withdrawals that can reasonably be expected to occur as development of the Marcellus proceeds. Note that the supporting material (Alpha, Chapter 1, pg 86) cites SRBC water withdrawal through the Commission's June 2009 meeting only. The document reports approval of 8.9 mgd from 18 separate locations at the March meeting, and 9.2 mgd from 19 locations in June, and cites individual withdrawal capacities at 0.04 to 3.0 mgd. In July, SRBC issued permits for withdrawal totaling over 120 mgd in Bradford County (PA) alone, and many of these permits were for withdrawal rates ranging from 4 to 7.5 mgd.

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[8] 6 NYCRR part 605 provides that the rules therein "*shall apply to all applications for a license or a permit to take, divert, appropriate or otherwise use the waters of the State, pursuant to article XIV of the Conservation Law, except applications for hydro-electric power projects*."

d) Geographic scope: The analysis is limited to the Delaware and Susquehanna basins, and does not address cumulative water withdrawal impacts elsewhere in New York State. The only New York State data presented is a comparison of total water withdrawals in New York State in 2000 versus withdrawals in other states, which provides no relevant information. What would be relevant is a characterization of historic and current water withdrawals for oil and gas mining in New York State, by basin or sub-basin, and most importantly a projection of potential future water withdrawals, by basin or sub-basin, for a range of future natural gas development scenarios.

6.1.1.7 In the discussion regarding entrainment of fish and macroinvertebrates, critical escape velocities should be reported for young-of-the-year fish and for invertebrate species likely to be impacted, as well as the distance from the proposed intake structure that these velocities exist. Flow velocities of existing and past water withdrawals for high volume hydraulic fracking in other areas should be reported for context. Providing this information should be a condition of a regime regulating water withdrawals and must be used to properly size and design the intakes to minimize impact.

6.1.4.3 The dSGEIS references a discussion in the GEIS regarding methane from wetlands as a contaminant of water supplies, but the GEIS does not provide any citation for this assertion. Further citations of methane produced from wetlands, especially of the size and type of typical wetlands in the study area, contaminating water supplies should be provided. If supporting evidence is not available, this assertion should be removed.

7.1.1 The dSGEIS cites several agencies that would be involved in water withdrawal regulation. Water withdrawal reporting requires that any entity that withdraws greater than 100,000 gallons per day needs to file an annual report with NYSDEC. All owners of individual wells or groups of wells that withdraw an average of 10,000 gpd or more during any 30 day period must register their wells with designated agency.

The final scoping document states "*The analysis of cumulative water resources impacts will acknowledge and evaluate the methodologies used by SRBC and DRBC to address cumulative impacts related to water withdrawal. Duplication of an existing authority's efforts will be avoided to the extent possible while still meeting the Department's resource protection objectives. Evaluation of cumulative impacts of water withdrawals will consider the scale of other everyday withdrawals, the non-continuous nature of withdrawals for well development*."

Registration and reporting to an agency is not in and of itself mitigation, and does not adequately ensure protection of water quantity. The cumulative impacts of water withdrawals were not evaluated in the dSGEIS, and seeking approvals from other regulatory agencies is not a substitute for a detailed cumulative impact analysis. Under SEQRA, environmental reviews are required to fully evaluate the potential environmental effect from an action. The responsibility to evaluate the environmental effect of an action cannot be delegated by the Lead Agency, in this case NYSDEC, to an Involved Agency, such as DRBC, in the environmental review process.

The dSGEIS states that outside of the environmental review process, aquifer depletion is being reviewed and addressed by NYSDEC. No rules have been proposed by NYSDEC to guide any such review or to enforce any requirements

necessary to protect aquifers. The City and the public should be granted the opportunity to comment on this analysis as part of the environmental review process. It is inappropriate to conduct an environmental assessment of an action outside of the public environmental review process.

7.1.1.1 The dSGEIS states "*Surface water withdrawals are subject to the recently enacted narrative water quality standard for flow promulgated at 6 NYCRR 703.2. This water quality standard generally prohibits any alteration in flow that would impair a fresh surface waterbody's designated best use*." Neither 6 NYCRR 703.2 nor any other state regulation[9] limits withdrawals for natural gas that may adversely impact pre-existing consumptive uses such as public water supplies. Thus, reference to this regulation does not satisfy NYSDEC's obligation to examine the impacts, including cumulative impacts, of water withdrawals in the dSGEIS.

7.1.1.4 The proposed Natural Flow Regime Method described in section 7.1.1.4 of the dSGEIS as an interim passby flow measure states that "*passby flow is calculated for each month of the year using a combination of 30% of Average Daily Flows (ADF), and 30% of Average Monthly Flows, (AMF). For any given month, the minimum passby flow must be the greater of either the 30% ADF or 30% AMF flow*."

While it is recognized that Natural Flow Regime Method (also known as the Montana Method) was a vast improvement over the fixed minimum flow requirements that were typical at the time of its development in the early 1970s,[10] in the 30 years since its inception it is now understood that *"[e]mpirical studies have been important to validate instream flow recommendations but they have not generated transferable relationships because of the complex nature of biological responses to hydrological change that must be evaluated over decadal time-scales*."[11] Therefore it is necessary to apply more advanced tools to determine the level of instream flows needed in order to adequately maintain habitat for aquatic species and overall riverine health.[12] The proposed Natural Flow Regime Method is a one-size-fits-all approach that fails to adequately consider stream-specific habitat requirements. The dSGEIS provides no evaluation of why reductions in flow will not adversely impact existing water supplies or other pre-existing consumptive uses on a cumulative basis.

7.1.1.4 As described in the dSGEIS, the Natural Flow Regime Method passby flows are based solely on flows at upstream gauges and do not take into account existing downstream consumptive uses. The in-stream flow recommendation developed by Tennant was designed to take into account all consumptive demands on the stream.[13]

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[9] Section 7.1.1.1 of the dSGEIS acknowledges that "surface and ground water withdrawals that are not on Long Island and not for drinking water supply currently are unregulated unless the withdrawals occur within the lands regulated by the DRBC and the SRBC."

[10] An, H. and J. W. Eheart. (2006) Evaluation of programs for regulating withdrawal of surface water under the riparian legal system. *Journal of Water Resources Planning and Management* **132**:5, 385.

[11] Petts, G.E. (2009) Instream flow science for sustainable river management. *Journal of the American Water Resources Association* 45:5, 1071-1086

[12] Whiting, P.J. (2002) Streamflow necessary for environmental maintenance. *Annual Review of Earth and Planetary Sciences* **30**:1, 181-206

[13] Tennant D.L. (1976) Instream flow regimes for fish, wildlife recreation and related environmental resources. Fisheries. 1:4, 6-10.

In the case of streams in New York, there are already substantial demands on surface water resources for public water supplies, particularly in the NYC watershed. Therefore, passby flows must take into account pre-existing downstream uses in addition to instream flows required for maintaining habitat in order to prevent adverse impacts to existing uses.

7.1.1.4 The dSGEIS does not indicate how the NYSDEC will monitor compliance with interim passby flow rules, what streamflow monitoring will be required of operators, whether records will be submitted to NYSDEC, or how the limits will be enforced.

7.1.1.4 This section does not address NYSDEC-mandated conservation releases required of the NYC Delaware System reservoirs, or compare these to potential water demands for hydraulic fracturing.

The cumulative effect of multiple short-term diversions for natural gas drilling operations can be expected to be significant compared to conservation release requirements, particularly during drought. As background, consider that SRBC has already issued multiple water diversion permits for diversions at rates up to 7.5 mgd. Applications for comparable diversions can be reasonably expected in New York. Even on a short term basis, issuance of multiple diversion permits within the Delaware Basin has the potential to be significant in comparison to the range of NYSDEC-mandated conservation releases (3 to 29 mgd for Neversink; 4 to 45 mgd for Pepacton; 5 to 210 mgd for Cannonsville; 0 to 15 mgd for Rondout), potentially resulting in pressure on the City to increase releases above levels otherwise required in order to mitigate impacts resulting from diversions for natural gas development.

7.1.1.5 This section includes the following February 2009 statement from the SRBC: "*the cumulative impact of consumptive use by this new activity (natural gas development), while significant, appears to be manageable with the mitigation standards currently in place*."

The inclusion of this statement in the dSGEIS is misleading because the statement was made early in the development of the Marcellus shale and does not address the level of withdrawals that can reasonably be anticipated to occur were the Marcellus to develop at a pace similar to comparable formations. Historical diversions do not necessarily characterize future diversions. Further, the statement is largely irrelevant because, as the dSGEIS identifies, "*New York State regulations do not address water quantity issues in a manner consistent with those applicable within the Susquehanna and Delaware River Basins with respect to controlling, evaluating, and monitoring surface water and ground water withdrawals for shale gas development*."

7.1.1.5 This section states that "*The application of the Natural Flow Regime Method to all surface water withdrawals to support the subject hydraulic fracturing operations is an <u>option</u> to comprehensively address cumulative impacts on stream flows. Adverse cumulative impacts could be addressed by the Natural Flow Regime Method described above <u>if</u> each operator of a permitted surface water withdrawal estimated or reported the maximum withdrawal rate and measured the actual passby flow for any period of withdrawal.*" *[Emphasis added.]*

NYSDEC's language in this section suggests that the proposed measure for mitigating cumulative water withdrawal impacts (the Natural Flow Regime Method) is in fact optional and not a requirement.

Recommendations

The following recommendations would limit adverse cumulative water withdrawal impacts on existing uses and in-stream habitat:

- Consistent with recommendations in the Alpha report, NYSDEC should require "*evaluations, procedures and monitoring equivalent to those established by the SRBC and DRBC for drilling-related withdrawals that may be proposed in New York outside the jurisdictional boundaries of the Susquehanna and Delaware River basins.*"
- A system should be implemented that requires operators to obtain diversion permits that include appropriate monitoring, enforcement, and control mechanisms such as curtailment of withdrawals during low flow conditions or if withdrawals adversely impact existing uses. Diversion permits should be based on an analysis of long-term stream flows, in-stream habitat requirements, existing SPDES discharges, pre-existing consumptive withdrawals, and other pertinent parameters, on a stream-by-stream basis, to determine the level of additional consumptive withdrawals allowable while avoiding adverse impacts.

6.1.2/7.1.2 Stormwater

General Comments

The dSGEIS does not fully evaluate potential increases in stormwater flows and potential impacts to water quality and public health. Site specific stormwater controls would be addressed in the stormwater pollution prevention plan for each well-site, but the dSGEIS does not consider the cumulative impacts of allowing high volume hydraulic fracturing for natural gas drilling. Induced growth was not evaluated, and increases in population are likely to increase road usage and spur development, which in turn could increase the amounts of impervious surfaces, and storm water flows.

Based on permitted well-spacing and developable area within the NYC watershed, the City estimated that 3,000-6,000 wells[14] could potentially be drilled in the watershed. The number of truck trips for the full-build out of these wells was estimated to be 3.6-7.2 million truck trips. The increase in road use and the potential need to create additional roadways could impact stormwater runoff and water quality. These impacts were not evaluated in the dSGEIS.

7.1.2 The wording of section 7.1.2 is vague and does not list specific Best Management Practices that will be required for the construction and maintenance of drill pads, access roads, stream crossings, or utility lines to prevent erosion or the transport of other contaminants off-site in order to minimize potential impacts to water resources.

7.1.2 The dSGEIS states that access roads and well pads associated with drilling operations are typically constructed using crushed stone, gravel or cobbles over a geotextile

[14] Final Impact Assessment Report, NYCDEP, 2009.

fabric. While soil permeability may vary greatly from site to site, the use of these pervious materials may reduce the runoff rates and runoff volumes associated with land clearing activities, provide for soil filtration of nutrients and other air borne pollutants, and maintain recharge to wetlands and surface water features. Pervious materials are not required, however, rendering these protections optional.

7.1.2 Wells at multi-well pads are not drilled in one concentrated period of time; drilling is typically spread out over several years. This allows the company to determine the productivity of the particular location before fully investing in additional wells. Unfortunately, this means the site is likely to remain disturbed for the entire 3-year period of the permit and possibly longer if a permit extension is granted. How this "temporary" land disturbance will be addressed in the State stormwater permit is unclear and could have serious ramifications for water quality impacts.

Requirements

- A regional assessment of stormwater impacts should be conducted. In addition to looking at erosion and stormwater issues on each well site, a regional cumulative impact analysis should be performed addressing increases in stormwater flows as a result of induced growth in the region, increased truck volumes, and potential development.
- NYSDEC should list the specific Best Management Practices that are to be used at all drill sites and in particular specify how the impacts from the "temporary" disturbance will be controlled.

6.1.3/7.1.3 Surface Spills

General Comments

The dSGEIS generally ignores the potential for serious adverse impacts to water quality as a result of surface spills. The NYSERDA Alpha Environmental surface spill analysis resulted in potential maximum contaminant limit (MCL) violations in City reservoirs, even under flawed assumptions. When the assumptions are corrected, the analysis reveals an even greater potential for an MCL violation due to spills. The Alpha report attempts to dismiss the potential for MCL violations by providing overly simplistic reasoning and ignoring the full range of potential incidents that could occur due to natural gas development in New York.

The dSGEIS further ignores all documented incidences of actual water resources impacts stemming from surface spills at natural gas drilling sites in other shale plays as well as historic spills in NYS. A recent investigation[15] has highlighted hundreds of spills listed in the NYSDEC Hazardous Substances Spills database related to oil and natural gas drilling. Reportedly, many sites are not fully remediated and some spill cases were administratively closed when transferred to a different division within NYSDEC. As noted above, in the absence of a thorough analysis of these incidents, the dSGEIS does not take the hard look at these impacts required under SEQRA.

[15] Letter dated November 8, 2009 from Walter Hang, ToxicsTargeting Inc., to Governor Paterson.

Spills clearly occur during well development. As such the proposed mitigation measures are not specific enough to ensure that they would adequately protect against the potential for adverse impacts from spills.

7.1.3 The dSGEIS incorrectly assumes that the violation of a regulated MCL accurately characterizes the extent of negative impacts to public water supplies. The City seeks to operate its water supply system not simply to avoid MCL violations but to provide water of the highest quality possible. All spills will require City operations staff to take remedial action, potentially including taking at-risk reservoirs offline, regardless of the potential for an MCL violation. This may result in significant impacts to the reliability of the system, depending on frequency, timing, and location of the incident(s), and can be expected to substantially affect public perception of the quality of the NYC drinking water supply and related watershed protection efforts. Further, it is not unlikely that accidents and spills in the watershed could negatively impact the City's Filtration Avoidance Determination. This is true for both large acute spills and for a chronic level of smaller mitigated spills.

7.1.3 The NYSERDA Alpha Environmental surface spill analysis for the NYC watershed was conducted by diluting the mass of contaminant with the entire contents of upstream system components for each location evaluated. Thus the results for the Kensico scenario are based on the contaminant mass divided by the combined storage in Ashokan and Schoharie. Similarly, West Branch results are based on dilution with the volume of the four Delaware reservoirs, and Hillview results are based on dilution with the total volume of the Catskill and Delaware reservoirs, West Branch, and Kensico.

The West Branch and Hillview scenarios are conceptually flawed and do not correspond to a physically possible scenario. For example, under the West Branch scenario, the analysis assumes that a spill into Rondout would be instantaneously mixed with the volume of Rondout <u>and</u> with the entire volume of the three upstream reservoirs (Cannonsville, Pepacton, and Neversink). The analysis is not conservative or even realistic because it is based on dilution assumptions that are physically impossible.

Using the data provided in Table 4.3 of the NYSERDA Alpha Environmental report, the approximate mass of chemicals per well was calculated for mix 1. The mass was then applied to a correct dilution calculation for a spill that might occur directly into Rondout Reservoir using the other assumptions listed in the Alpha report. The mass required for two wells of the chemical 2,2,-Dibromo-3-Nitrilopropionamide would be sufficient to result in a violation of an MCL in Rondout and Kensico Reservoirs. If the spill occurred near the outlet at Rondout Reservoir, the mass of 2,2,-Dibromo-3-Nitrilopropionamide from one well would be sufficient to result in an MCL violation in Kensico Reservoir. These findings deviate substantially from those of the Alpha Environmental report.

7.1.3 The NYSERDA Alpha Environmental Report developed scenarios for a surface spill that resulted in chemicals exceeding MCLs at various reservoirs throughout the system. The report then proceeded to describe the improbability of each assumption in its analysis. However, every assumption does not need to hold for a spill to result

in significant adverse impacts to water quality in the watershed, so a situation where a spill results in MCL violations is more likely than the Alpha report indicates. Additionally, given the potential magnitude of drilling in the watershed, the assumptions in the analysis are far more probable than indicated by the Alpha Environmental report.

Below is a discussion of the plausibility of each assumption used in the Alpha analysis.

Complete/instantaneous mixing in reservoirs – Complete mixing in reservoirs with volumes as large as NYC's reservoir is not a reasonable assumption under most circumstances. Short-circuiting, stratification, or spills in proximity to inlet structures must also be taken into consideration.

Spill directly to a reservoir – Given the large volume of heavy truck traffic required to develop the Marcellus shale and the proximity of major regional highways to all Catskill/Delaware reservoirs, it is not unreasonable to assume that at some point a chemical spill would result in direct contamination of a reservoir.

Drought conditions (reservoirs at 1/3 of full capacity) – The Barnett shale has been under development for 15 years and may continue to be developed for many more. It is not necessarily conservative to anticipate a spill occurring during a drought during the multi-decade timeframe anticipated for development of the Marcellus shale. It also does not require a declared drought for one or more reservoirs to be drawn down. Furthermore, it is likely that significant volumes of wastewater and fracking chemicals will be transported through the watershed for years after initial development. Once developed, disposal of produced water and refracturing will be routine operations. In short, once approved, these activities can be expected to continue for the life of the gas play and through a wide range of hydrological conditions, including drought.

No spill detection or attempt at mitigation – This assumption is not conservative with respect to identifying impacts associated with spills. It is reasonable to assume that hundreds or thousands of wells may be drilled in the watershed, and billions of gallons of wastewater generated and trucked to disposal sites. It is also reasonable to expect that some spills will go undetected due to negligence, human error, or intentional misconduct, or that even if spills are detected, circumstances will prevent full recovery of the contaminants. This is exemplified by the recent incident in Dimock, PA in which 8,000 gallons of fracture fluids were released into a stream resulting in a fish kill. The carcinogenic chemical (Halliburton LGC-35BM) is extremely soluble, so once released to the stream it could not be recovered.[16, 17]

Evaluation of individual chemicals with MCLs – Operators submitted to NYSDEC chemical compositions of nearly 200 products consisting of almost 300 chemical

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[16] Wilber, T. (2009) *Pennsylvania officials reviewing Cabot drilling plan*. Star-Gazette, October 13, 2009 (http://www.stargazette.com/article/20091013/NEWS01/910130378).

[17] Lustgarten, A. 2009. *Frack Fluid Spill in Dimock Contaminates Stream, Killing Fish*. ProPublica, September 21, 2009 (http://www.propublica.org/feature/frack-fluid-spill-in-dimock-contaminates-stream-killing-fish-921).

constituents. The Rapid Impact Assessment prepared for the City tabulated data on 450 products consisting of over 300 constituents. The industry is continuing to develop new products at a much faster rate than can be incorporated into water quality regulations. The absence of an MCL for a particular chemical does not guarantee it cannot degrade the water supply and result in adverse health impacts to consumers.

Chemical quantity present on-site is sufficient for up to eight wells – Given the large volumes of chemicals needed to fracture hundreds or thousands of wells in the region, well pads or other sites may be used to store large volumes of material for efficient distribution. Therefore it is reasonable to assume that sites in the watershed may store volumes of chemicals larger than that needed for a single well on a single pad.

No soil adsorption and no evaporation – Hydraulic fracturing requires very specialized chemicals to manipulate the physical properties of fracture fluid. Therefore, of the hundreds of potential chemicals available for fracture operations, many of the chemicals will be unaffected by evaporation or soil adsorption. One example, 2,2,-Dibromo-3-Nitrilopropionamide, which was evaluated as part of both fracture fluid mixes in the analysis, is highly toxic and according to its material safety data sheet, does not readily evaporate, volatilize, or adsorb to soil particles.

7.1.3 The NYSERDA Alpha Environmental report incorrectly assumes that all water for potable consumption must pass through Hillview Reservoir. Numerous outside community supplies withdraw water from the Catskill and Delaware Aqueducts and Kensico Reservoir. Those communities would be at a greater risk from a contamination event due to higher concentrations in the water supply before mixing with downstream waters.

7.1.3 Data collected on spills from the Colorado Oil and Gas Conservation Commission's (COGCC) Colorado Oil and Gas Information Service (COGIS) revealed that over the last three years oil and gas drilling spills in Colorado resulted in nearly 1,000 accidental spills/releases and that approximately 18 percent of incidents were classified as impacting ground water and eight percent of incidents were classified as impacting surface water. COGIS data is associated with all types of oil and gas well development (e.g., conventional, hydraulically fractured, vertical, horizontal); however the data indicated that spills at all types of well sites were generally related to the same mechanisms (i.e. equipment failure, human error, and accidents).

7.1.3.1 The supplementary permit conditions for secondary containment for diesel fuel tanks are limited to those on multi-well pads. Conditions for tanks that are less than 10,000 gallons are limited to those within "*500 feet of a primary or principal aquifer, public or private water well, a domestic-supply spring, a reservoir, reservoir stem or controlled lake, watercourse, perennial or intermittent stream, storm drain, wetland, lake or pond*."

NYSDEC SPOTS 10 requires secondary containment for tanks less than 10,000 gallons that could "*reasonably be expected to discharge petroleum to the waters of the State*." The multi-well pad criteria and the 500 feet limit from some water resources are not substantiated and not protective enough of State water resources. Furthermore, identification of a well pad as multi-well pad should be made at the time

of initial permitting and pad construction so that the first well on the pad is not exempt from multi-well pad requirements.

7.1.3.2 Section 7.1.3.4 proposes that pits not be allowed for storage of flowback fluids. However, reserve pits used to store drilling waste are also likely to lead to surface spills or shallow groundwater contamination due to failed linings or embankments.

7.1.3.2 Section 7.1.3.2 subsections 2) and 4) propose that fluids be removed from reserve pits and that flowback water storage tanks be removed from the well pad within 7 days of drilling/stimulation operations for each well and within 7 days of completion of the last well for multi-well pads. This requirement should also apply to pits at single-well pads in the watershed. It is unclear how this requirement will be reconciled with the intent expressed in Section 7.1.3.4 (Flowback Water) to "*encourage exploration of technologies that promote reuse or flowback water when practical.*" Furthermore, it is unclear where the removed fluids would be removed to. If they are relocated to a centralized facility or a nearby well pad then the risk may still exist.

7.1.3.3 Section 7.1.3.3 1) states "*[s]pecific secondary containment requirements will be included in supplementary well permit conditions for high-volume hydraulic fracturing on a site-specific basis if the proposed location or operation raises a concern about potential liquid chemical releases that is not, in the Department's judgment, sufficiently addressed by the GEIS, the SGEIS, inherent mitigation factors and well pad setbacks*."

This section does not provide specific criteria by which the NYSDEC will determine when secondary containment is required on a site-specific basis. Further, spills are always a concern because of the potential for accidents, human error, equipment malfunction, and other unforeseen circumstances.

7.1.3.3 Section 7.1.3.3 (2) states that the "*comprehensive SWPPP that is required by the Department's MSGP (GP-0-06-002) will include Best Management Practices relative to additive containers, mixing and pumping, including, but not limited to, a combination of some or all of the following, or other equally protective practices…*"

While it is necessary to allow for flexibility with the implementation of Best Management Practices, section 7.1.3.3 (2) is overly vague, and the dSGEIS provides no justification as to why specific best management practices (BMPs) should not be required on all sites to minimize the risk of chemical spills traveling off-site and impacting water resources. Section 5.18.3.2 of the dSGEIS references the following comprehensive list of BMPs from the NYSERDA Alpha Environmental Report that should be included as required mitigation measures in Section 7.1.3.3:

- Monitoring and recording inventories,
- Manual inspections,
- Berms or dikes,
- Secondary containment,
- Monitored transfers,
- Stormwater runoff controls,

- Mechanical shut-off devices,
- Setbacks,
- Physical barriers, and
- Materials for rapid spill cleanup and recovery.

Recommendations

The following requirements are proposed to more fully protect surface water resources from spill incidents due to natural gas development:

- Site-specific SEQRA reviews for all individual wells, laterals, and well pads associated with spacing units that include land within unfiltered water supply watershed areas to allow adequate review of siting, spill prevention and countermeasure procedures, BMPs, waste disposal plans, water supplies, chemical handling protocols, hydraulic fracturing plans, and well closure procedures in order to ensure that appropriate controls are in place and that, when necessary, a site-specific supplemental EIS is conducted.
- A prohibition on the transport of raw chemicals and waste on roads adjacent to public water supply reservoirs to reduce the risk of spills directly into reservoirs from vehicle accidents.
- Specific BMPs designed to limit the frequency and impacts of spills and accidental releases in the NYC watershed, including: a continuous berm around the entire site with drainage directed to a collection system that can be isolated in the event of a spill; impermeable pad and curbing for all bulk raw chemical storage on-site; secondary containment for all liquid storage tanks (fuel, chemicals, and wastes); and other BMPs recommended in the Alpha Environmental Report.
- Mandatory removal of all chemicals and liquid wastes from all well pads in the watershed, not just multi-well pads, within 7 days of drilling and stimulation completion, or immediately if operations are suspended.
- A prohibition against open waste pits and a requirement for closed-loop drilling with enclosed tanks at all drill pads in primary or principal aquifers areas or unfiltered water supply areas.

6.1.4/7.1.4 Ground Water Impacts

General Comments

The groundwater impact analysis is inadequate and ignores documented incidents of contamination in other areas where this type of drilling is currently active and ignores the probability of subsurface migration through fractures and unplugged well bores.

6.1.5 The dSGEIS states "…*regulatory officials from 15 states have recently testified that groundwater contamination from the hydraulic fracturing procedure is not known to have occurred despite the procedure's widespread use in many wells over several decades.*" However, the dSGEIS ignores numerous reported instances of

contamination.[18, 19] SEQRA requires the Lead Agency to take a hard look at potential impacts, which in turn would require, at a minimum, an analysis of these incidents.

6.1.4 Section 6.1.4 describes risks to groundwater resources from turbidity, fluids pumped into wells, and natural gas migration. However, the section ignored the potential for migration of naturally-occurring formation material, which could include BTEX[20] compounds, other hydrocarbons, brine (saline) water, or radioactive material (NORMs).

6.1.4 This section states that ineffectively sealed wellbores could provide subsurface pathways for groundwater pollution. The dSGEIS discounts this risk, citing mitigation provided in the 1992 GEIS for vertical wells. Specifically, the dSGEIS implies that casing and annulus seals to isolate the freshwater aquifers from the lower poor quality formations and lower borehole will adequately address such concerns. Furthermore, the dSGEIS identifies turbidity, drilling and formation fluids, and natural gas as comprising the main pollutants of concern associated with respect to groundwater impacts, and goes on to describe the natural and non-drilling related sources and mechanisms for these pollutants.

The dSGEIS does not acknowledge or discuss the potential for impacts associated with fluid migration enhanced by formation penetration by the horizontal, unlined or perforated component of the boreholes drilled for horizontal wells, which have a significantly greater potential for intercepting pre-existing pathways for pollutant migration in the penetrated bedrock formation. As such, the dismissal of concerns about aspects of well drilling and construction that are unique to horizontal wells is not justified by the information provided in the dSGEIS, nor are these aspects addressed by the GEIS.

7.1.4 The NYSERDA ICF Task 1 Report concluded that "*hydraulic fracturing does not present a reasonably foreseeable risk of significant adverse environmental impacts to potential freshwater aquifers*" (p. 34). However, the report did indicate that it was theoretically possible that a flow path influenced by open fractures, faults, or unplugged well bores could transmit drilling-related fluids to an aquifer. The report asserts that any impact from such a condition is unlikely since the combinations of these circumstances would be noticed by the contractors responsible for the related drilling and/or fracturing operations.

Contrary to the assertions in the report, however, a well-documented case of a similar combination of circumstances occurred in Garfield County, CO in 2004.[21] The operator ignored indications of potential problems while drilling, failed to notify the regulators as required by the drilling permit, and failed to adequately cement the well casing. These operator errors, in conjunction with the existence of a network of faults

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[18] Rapid Impact Assessment, NYCDEP, 2009.

[19] http://www.propublica.org/feature/water-problems-from-drilling-are-more-frequent-than-officials-said-731; http://www.propublica.org/feature/epa-chemicals-found-in-wyo.-drinking-water-might-be-from-fracking-825; http://www.propublica.org/feature/frac-act-congress-introduces-bills-to-control-drilling-609

[20] BTEX = benzene, toluene, ethylbenzene, xylene

[21] Colorado Oil and Gas Conservation Commission, 2004.

and fractures, led to significant quantities of formation fluids migrating vertically nearly 4,000 feet and horizontally over 2,000 feet surfacing as a seep in a creek. In addition to natural gas, water sample analyses indicated ground water concentrations of benzene reached 200 micrograms per liter and surface water concentrations of benzene reached 90 micrograms per liter. This is only one of several reported instances regarding subsurface and surface contamination associated with gas well drilling and fracturing that illustrate these potential concerns and calls into question many of the conclusions and assumed conditions listed in the NYSERDA report, including:

- Separation between shale formations and aquifers of at least 1,000 feet of low permeability rock (it is noted that two of the City's aqueducts are in direct contact with the Marcellus shale near the eastern edge of the formation);
- Insufficient review of the impact of pre-existing fractures/brittle structures on the potential for contaminant migration;
- Pressures required to drive fluid from the target formation are only applied for short periods during fracturing;
- Significant adsorption of some chemicals by the organic-rich shales;
- Diffusion as a satisfactory mechanism for significantly diluting the concentrations of the chemicals;
- Flow out of the target formation would reverse during flowback towards the wellbore and preclude significant migration.

7.1.4.1 This section states that NYSDEC "…*will require the sampling and testing of residential water wells within 1,000 feet of the well pad … or within 2,000 feet of the well pad if no wells are available for sampling within 1,000 feet….*" These requirements should be extended to include reservoirs used to contain drinking water and the rivers and streams that feed them.

Page 7-43 outlines a number of "*potentially polluting non-routine well pad incidents*" that may warrant immediate cessation, enforcement or corrective action, etc. Some of these items require additional clarification. Specifically, bullet items 5 (Significant lost circulation…) through 8 (Anomalous flow…) should be re-addressed in more detail.

Furthermore the sixth bullet-point in this list suggests that the presence of brine, gas or oil zones not anticipated in the pre-drilling reconnoiter would trigger regulatory action. The presence of unexpected fractures or faults should also be added here because of their potential to transmit fracking and formational fluids to the fresh-water aquifers.

Additionally, the City should be included with NYSDEC and New York State Department of Health (NYSDOH) in information sharing for wells in the vicinity of the NYC watershed or water supply tunnels.

7.1.4.1 The GEIS notes "*The initial response to water supply complaints is best handled by the appropriate local health office, which has expertise in dealing with water supply problems*." Furthermore it states that the local county health departments remain in

the best position to investigate initial water well complaints from residential well users. While counties will receive baseline monitoring reports, they would not receive full disclosure of chemicals under the current regulations. Also they do not receive revenue from Oil and Gas sector and may not be in a position to devote sufficient resources into investigation of potential contaminant concerns. If investigations are not handled quickly and thoroughly, there could be serious repercussions for public health. NYSDEC has discounted these concerns, stating in the Final Scoping Document that resource constraints are a "legislative" matter. That may be, but they are also a condition that has to be taken into account under SEQRA. Resource-constrained local health departments, facing an unfunded (albeit non-binding) mandate from the dSGEIS, are unlikely to take the kind of action that is necessary to prevent adverse environmental impacts.

7.1.4.2 Section 6.1.4.2 references the NYSERDA ICF Task 1 report that stated it is unlikely (less than 1 in 50 million chance) that fracture fluids would reach an "*USDW due to failures in the casing or casing cement existing*." The data used to justify this claim was based on properly constructed well casings. The analysis disregarded improperly constructed casings, which are more likely to fail and result in groundwater contamination. Improperly constructed casings can result from human error or unforeseen subsurface conditions.

Recommendations

Additional pre-drilling investigative and mitigation measures are required to ensure the integrity of well casings and minimize the potential for the migration of formation material away from the target formation.

- A variable density log and a cement bond log at a minimum are required on all wells in order to verify the cement bond with the bore hole and the well casing. Also operators must be required to follow the American Petroleum Institute Guidance Document HF1 Hydraulic Fracturing Operations—Well Construction and Integrity Guidelines and Technical Report 10TR1 Cement Sheath Evaluation to ensure the integrity of the casing and grouting for intermediate and production casings.
- Some method of fracture and fault mapping, such as fracture tracing or microseismic monitoring, must be required in connection with well development phases to monitor the extent of subsurface fracturing in order to ensure that fractures are confined to the target hydrocarbon zone during production phases of development.

6.1.5/7.1.5 Hydraulic Fracturing Procedure

General Comments

The dSGEIS analysis disregards the significance of pre-existing fractures relative to hydraulic fracturing. The dSGEIS utilizes only mapped faults, and fails to present or evaluate the significance of hundreds of other brittle structures (e.g., shear zones and linear features) that indicate fracturing of the underlying bedrock and pathways for hydraulic communication and contamination.

6.1.5 The dSGEIS states that "*Concern has been expressed that potential impacts to groundwater from the high-volume hydraulic fracturing process itself could result*

from a number of well component, drilling, and naturally occurring subsurface conditions." The dSGEIS generally precludes such impacts by alluding to testimony made by the industry-sponsored trade organization the Ground Water Protection Committee (GWPC) based on its review of letters provided by regulators in other states regarding there being no known occurrences of groundwater contamination (Section 5.18) associated with high-volume fracturing processes.

No supporting information is provided as to the nature of complaints alleged and the corresponding regulatory bodies' findings in response to investigating such complaints that lead them to be dismissed. Furthermore, it is important to note that the gas drilling in many of these states occurs in remote areas where no residential wells exist to be impacted, thus explaining why there was no detection of an impact.

The dSGEIS relies on documentation developed by ICF (Appendix 11) to support claims that impacts on groundwater from high-volume hydraulic fracturing associated wellbore failure and subsurface pathways are minimal using corresponding estimated probabilities of 1 in every 50 million wells, and conclusory statements such as "*does not present a reasonably foreseeable risk of significant adverse environmental impacts*." Furthermore, these claims are based on generalities related to the types of rock rather than locale-specific conditions.

For instance, ICF characterized the ability of hydraulic fracturing to cause the mobilization of contaminants from the target formation (e.g., Marcellus shale) into overlying aquifers as not representing "*a reasonably foreseeable risk*" when "*certain natural conditions*" exist. The natural conditions cited are based on the generic characteristics of shale as described by others in a textbook setting (Freeze & Cherry, 1979). Furthermore, ICF characterizes the low average hydraulic conductivity (about 1x10-5 cm/sec or about 3x10-3 ft/d) and average porosity (>10%) as being the primary controls of contaminant migration from the Marcellus shale and overlying shale-comprising formations into the shallower fresh groundwater bearing formations. Such characterizations focus on the fine-grain size of the materials that comprise the rock or matrix of the formation. However, available locale-specific data for the Marcellus shale and overlying formations indicate that naturally occurring fractures in the rock can result in hydraulic conductivity values several orders of magnitude greater than those presented in the dSGEIS (i.e., potentially as high as 10 ft/d). Such values would proportionally speed up the velocities of fluid and contaminant migration associated with the hydrofracturing process, which in turn would significantly increase the potential risks to overlying aquifers. The dSGEIS needs to address this issue using locale-specific information and recognize the significance of pre-existing fractures relative to hydrofracturing activities.

7.1.5 Section 7.1.5 states "*[a]s detailed in Section 6.15, potential impacts to ground water from the high-volume hydraulic fracturing procedure itself are, in most cases, not reasonably anticipated*."

The dSGEIS analysis assumes that all of the potential impacts from hydraulic fracturing chemicals are known. Chemicals introduced into the watershed environment could result in future water treatment requirements as our understanding of the fate, transport, and environmental and human health impacts of endocrine

disrupting chemicals continues to improve and as sophistication of test methods allows for detection of smaller concentrations.

7.1.5 This section does not include an adequate discussion on pre-existing faults and fractures that could serve as migration pathways for fracturing chemicals and formation waters. The dSGEIS includes a provision of a site-specific SEQRA review for sites where fracking is proposed and/or the target formation is in close proximity to underground sources of drinking water. Such a SEQRA review will not include the necessary geological analyses (i.e., brittle structure identification, rock quality determinations, and rock density analysis, etc.) to be protective of NYC drinking water (reservoirs and tunnels).

Recommendations

- Emerging contaminants are currently being extensively studied and should be included as a potential impact to public health as part of the dSGEIS evaluation of hydraulic fracturing given that many of the chemicals used in the process could act as endocrine disruptors. Likewise, historically recognized contaminants associated with drilling and deep bedrock formations also pose a threat to current water quality conditions in the event of hydraulic-fracturing enhanced migration associated with natural gas well drilling. It is recommended that the development and timely updating of a publicly accessible database of such chemicals, including typical volumes, doses of concern, and appropriate remedial responses, be incorporated as a condition of the dSGEIS, along with an appropriate pre-use review and approval process for all owners and operators of public water supplies.

6.1.6/7.1.6 Waste Transport

7.1.6 Section 7.1.6.2 indicates that road spreading of produced water would be allowed with a beneficial use determination, but no analysis of the potential adverse impacts is presented. Such an analysis, based specifically on the potential constituents of produced water, would be required to support a conclusion that there are no adverse environmental impacts associated with road spreading

Recommendation

- Road spreading should be prohibited in surface water supply watersheds due to the potential for runoff containing disinfection byproduct precursors, such as bromide, bromoform, chlorodibromomethane and dichlorobromomethane that could adversely impact compliance with state and federal regulations.

6.1.7/7.1.7 Centralized Flowback Water Surface Impoundments

7.1.7 Given the potential risk from centralized flowback water surface impoundments, it is appropriate that they be prohibited from unfiltered water supply watersheds and principal and primary aquifers.

6.1.8/7.1.8 Fluid Discharges and SPDES Regulations

General Comments

The dSGEIS does not provide a thorough evaluation of waste disposal issues, and instead describes existing permitting requirements. Without a thorough evaluation of waste disposal issues, including cumulative impacts and disposal capacity, NYSDEC would be allowing a significant waste-generating activity without ensuring that adequate treatment and disposal capacity exists. New facilities may need to be created to handle this waste, or upgrades to existing facilities may need to be made which will also entail environmental impacts that are not analyzed in the dSGEIS.

6.1.8 There are four primary methods described in the dSGEIS for disposing of wastewater generated from high volume hydraulic fracturing: waste injection wells, private industrial treatment facilities, publicly owned treatment works (POTW) with industrial pretreatment programs, and disposal out-of-state. Currently there is very limited underground injection well capacity in the State (a total of three private class II injection wells). Expanding underground injection capacity in the region may be difficult due to lack of suitable subsurface strata and the presence of thousands of uncharted, unplugged wells that predate current regulations.[22, 23] According to the dSGEIS, there are currently no private industrial treatment plants in New York capable of treating flowback fluids from natural gas wells. If new facilities are constructed, they will not be available immediately as it takes time to plan, permit, and build the facilities.

Whereas many POTWs have approved pretreatment programs, the dSGEIS requires a new headworks analysis prior to POTWs accepting flowback fluids. Therefore, NYSDEC does not currently know if any existing POTWs would be capable of accepting drilling wastewater and if so, how much. Additionally, contaminants such as dissolved solids are not removed at POTWs, but simply diluted. According to state reports, the high dissolved solids problem in the Monongahela River in Pennsylvania in the fall of 2008 stemmed largely from the discharge of drilling wastewater to POTWs that did not remove dissolved solids.[24] It can be anticipated that similar problems could occur in New York as well. It has been estimated that there is an overall lack of treatment and disposal capacity in Pennsylvania based on the potential for wastewater generation due to Marcellus shale development. Therefore, New York cannot rely on disposal capacity in Pennsylvania or other nearby states.

7.1.8 The dSGEIS states that fluid discharges will be managed at treatment facilities or in disposal wells and that the discharges from the treatment facilities would be regulated under the SPDES program. In the City's comments on the Scoping Document, the City requested that the dSGEIS identify the possible in and out of state treatment facilities (industrial or municipal) that can handle the expected volume and content of fluid discharges. While the dSGEIS lists treatment plants, it does not assess whether

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[22] Johnson, K. 2009. *EPA's Underground Injection Control Program: Regulation of Disposal Wells in Pennsylvania*. Presented at public meeting on Underground Injection Wells for Waste Disposal, Towanda, PA, April 14, 2009.

[23] Baker, B. 2009. *Marcellus Shale Wastewater Issues*. Presented at NYWEA 2009 Spring Technical Conference, New York, NY, June 2, 2009.

[24] *Pennsylvania DEP Investigates Elevated TDS in Monongahela River*. Water and Wastes Digest. October 27, 2008.

they have capacity to handle the anticipated volume of waste nor the capability to treat the chemicals present in that waste.

7.1.8 The final scoping document states that "*The analysis of cumulative water resources impacts will not address discharges governed by the Department's SPDES program, as the SPDES program is specifically designed to address cumulative loading of pollutants each time it issues a permit for a specific discharge*." However, without fully identifying where the fluid discharges can be received, the environmental analysis is incomplete. The dSGEIS estimates flowback volumes of "*216,000 gallons to 2.7 million gallons per well*." However, the dSGEIS does not estimate cumulative volume of waste generated from the total annual number of wells constructed.

7.1.8 According to Appendix 6 the disposal location is required to be listed in the fluid disposal plan. However, the dSGEIS does not indicate whether NYSDEC will verify that a disposal location has available capacity to store, treat, or dispose of the volumes of wastewater generated by the well being permitted. Appendix 6 indicates that information about the disposal location is only required in the fluid disposal plan if it is off-site and in New York State; additional information is not required for out-of-state disposal or on-site treatment and reuse. It further indicates that a centralized flowback storage facility, either surface impoundment or tank, is an acceptable disposal option for listing in the fluid disposal plan. However, long-term storage does not constitute disposal. The dSGEIS thus fails to analyze the potential environmental impacts associated with any realistic fluid disposal option.

Recommendations

- A detailed evaluation of necessary treatment technology and regional waste disposal capacity is required before the dSGEIS is finalized.
- The fluid disposal plan should include additional information to ensure there is available capacity at the proposed disposal location and that a facility is not over-allocated. Such information can include treatment/disposal rates, other drilling wastewater commitments, available storage, records indicating available disposal capacity, etc.
- The fluid disposal plan should be required to list similar information for both in-state and out-of-state disposal locations. For wastewater that is to be treated or reused on-site or used for road spreading, the operator should be required to provide detailed information on the processes, rates, permits, storage volumes, etc. in order to verify that wastewater will not be discharged to the environment.
- If a centralized storage facility is proposed, detailed information on the ultimate disposal location should be provided to ensure that there is a plan in place to dispose of the wastewater at a facility with adequate capacity.

6.1.9/7.1.9 Solids Disposal

General Comments

6.1.9 The dSGEIS states that "*Operators have not proposed on-site burial of mud-drilled cuttings, which would be equivalent to burial or direct ground discharge of the*

drilling mud itself. Contaminants in the mud or in contact with the liner if buried on-site could adversely impact soil or leach into shallow groundwater." It appears that only cuttings drilled with mud are prohibited from being buried on site. It is not clear how this would be enforced and whether there will be an on-site testing program to evaluate if other cuttings must be transported to a proper waste handling facility.

7.1.9 The dSGEIS includes a proposal for a waste tracking form to ensure the proper disposal of flowback fluids given the potential for contamination. Drill cuttings have a similar potential for contamination from chemicals, hydrocarbons, or NORM. Accordingly, a waste tracking form for solid waste associated with natural gas production should also be required.

Recommendations

- The Drilling and Production Waste Tracking Form proposed in section 7.1.6.1 should be required for solids disposal, as proposed for waste fluids, to prevent illicit dumping of contaminated wastes and ensure proper disposal.

6.1.10/7.1.10 New York City's Subsurface Water Supply Infrastructure

General Comments

Natural gas development poses a significant risk to the City's water supply infrastructure which the dSGEIS does not address. The dSGEIS ignores numerous fractures and brittle rock structures that could enhance mobility of drilling fluids and formation materials. In particular, the accumulation of methane gas in or around tunnels and shafts could pose a significant risk to health and safety. These pathways, and the resulting changes in the regional stress field from hydraulic fracturing, could also expose the City water tunnels to elevated external pressures which they are not designed to withstand.

6.1.10 Section 6.1.10 recognizes that drilling directly into a water supply tunnel could compromise the integrity of the system but states that "*damage to the system by high-volume hydraulic fracturing is not reasonably anticipated because the target fracturing zones are thousands of feet deeper than any underground water supply infrastructure*." However, impacts to the water supply infrastructure are not limited to direct contact with the drilling string.

7.1.10 Section 7.1.10 discusses the origins of the 1,000 foot corridor established around water tunnels or aqueducts for gas wells proposed for a depth of 500 feet or more based on previously identified concerns regarding geothermal wells. Wells proposed within this corridor are considered to pose a potentially significant threat to a municipal supply, necessitating a site-specific SEQRA review. A negative declaration is filed only upon satisfactorily demonstrating to NYCDEP that the drilling will not impact water supply facilities. NYCDEP is to be provided with copies of permit applications and is to be notified prior to commencement of drilling.

The dSGEIS fails to recognize that there are locations in which NYC water supply tunnels are in direct contact with Marcellus shale and the relatively shallow nature of the eastern portion of the Marcellus. The dSGEIS also omits mention of the presence of numerous fractures and related brittle structures in the regional bedrock system which is documented in the same source publication that provides the basis for

dSGEIS Figure 4.13 (Isachsen & McKendree). These features are far more abundant within the Catskill region and NYC watershed than are suggested by the map of faults only that is included in the dSGEIS (dSGEIS Figure 4.13). Horizontal well drilling in the Marcellus is reported to target these fractures for borehole penetration and subsequent fracking to optimize gas development efforts. As such, the interaction of these fractures and the NYCDEP infrastructure cannot be characterized as being "… *not reasonably anticipated.*"

Faults, fractures and related brittle geological features were encountered during water supply tunnel construction. These, and other undocumented features, can reasonably be expected to be altered in the future as a result of naturally occurring geologic changes and/or disturbances associated with widespread and repeated hydraulic fracturing. The dSGEIS indicates that fracturing may be accompanied by as much as a 1% increase in volume of the hydrofractured rock mass. It is reasonable to anticipate that this would alter rock stresses over an indeterminate distance which could allow fluid migration along existing brittle geological structures.

7.1.10 Groundwater inflows were encountered at numerous locations during tunnel construction and, in several cases, these align with mapped faults, fractures or brittle structures. More importantly, saline seeps and/or methane or hydrogen sulfide seeps were encountered at some locations. The saline seeps in particular are considered indicative of hydraulic connection to naturally-occurring pressurized groundwater in much deeper strata. Existing connections to much deeper strata can transmit pressure and/or saline water, radioactive formation water, and/or residual hydrofracturing chemicals upward to the vicinity of the tunnels (and to the surface).

Vertical migration of fluids (e.g. brine, methane, hydrogen sulfide) from deeper strata and infiltration into water supply tunnels is hydraulically possible, even with tunnels in operation. Lithostatic pressures in the Marcellus shale, which is known to be overpressurized in many locations, correspond to hydraulic grades well above the elevation of any of New York City's reservoirs, or the pressure in water supply tunnels, even without considering the pressures imposed during hydrofracturing.

The enhanced migration of deep formation gases such as methane and hydrogen sulfide through pre-existing brittle structures may be further influenced by laterally extensive zones of elevated hydraulic conductivity associated with tunnel routes and vertically drilled shafts. Tunnel and shaft routing configurations may also permit the accumulation of methane and/or hydrogen sulfide in pockets of the infrastructure that require access at some time for inspection and/or maintenance purposes. In such instances, the accumulation of either of these gases could represent a serious health and safety risk.

Sections of deep-rock tunnels could be subject to inflow of fluids from deeper strata through cracks in tunnel lining. This could occur most readily when a tunnel is out of service and internal pressures are reduced, or in a tunnel which operates at atmospheric pressure, as does much of the Shandaken Tunnel leading from Schoharie Reservoir. Additional liner cracks can be anticipated to develop as the tunnels age, due to normal geologic activity, and to changes in subsurface conditions associated with repeated, widespread hydrofracturing, gas reservoir depletion/withdrawal and

injection well operation. In the absence of the identification of other viable disposal options, underground injection of produced water must be considered a leading alternative for waste disposal. Although not mentioned in the dSGEIS, published sources indicate that as of November 2008 there were over 60 pending Underground Injection Control (UIC) permits for flowback water disposal in New York.

7.1.10 Sections of the tunnel lining could be subject to increased external pressures transmitted from deeper strata. If voids between the tunnel liner and surrounding rock were to be pressurized there is the potential for detrimental structural effects on the concrete tunnel liner.

7.1.10 Analysis using concentrations reported for several constituents of flowback water in Table 5.9 of the dSGEIS indicates that tunnel infiltration of fluids that have migrated from deeper strata would daylight as tunnel discharges at reservoirs exceeding applicable water quality standards, as established by NYSDEC's Part 703 water quality limits. For several parameters, these exceedences could occur at infiltration rates totaling much less than 1 mgd over the full length of a tunnel. Elevated levels of chlorides and total dissolved solids (TDS) are characteristically associated with formation water. As such, their availability is not limited by the volumes used in hydraulic fracturing.

In summary, there is more than sufficient pressure to drive fluids or gas upward from deep formations into tunnels or above grade, via geological faults or fractures, creating the potential for both structural damage to tunnel liners and violations of water quality standards that were not evaluated in the dSGEIS.

Recommendations

Available information does not support assumptions with respect to the adequacy and permanent integrity of intervening rock layers to isolate the NYC water system components from natural gas bearing strata and/or deep formation fluids and/or drilling fluids. The environmental review of hydrofracturing in the Marcellus in New York needs to address these concerns relative to:

- Available knowledge of extensive subsurface fracture systems, and the presence of identified, brittle, geological structures that commonly extend over a mile in length, and as far as seven miles in the vicinity of the NYC infrastructure;
- Demonstrated transmissivity of these fracture systems, as evidenced by saline water and methane seeps encountered at grade and in shallow formations near NYC infrastructure;
- The spatial extent and density at which hydraulic fracturing has been deployed in other major gas plays and the related influence on pre-existing fracture aperture and extent; and
- The possibility of subjecting unreinforced tunnel linings to pressures in excess of their design strength.

6.1.11/7.1.11 Protecting the Quality of New York City's Drinking Water Supply

General Comments

The dSGEIS does not sufficiently assess potential impacts to NYC's drinking water supply. The dSGEIS lists a number of reasons why NYSDEC discounts the potential impacts, but does not provide sufficient justification for NYSDEC to conclude that the NYC water supply is adequately protected. The dSGEIS does not evaluate cumulative impacts or induced growth as a result of the proposed action, both of which could have significant impacts to water quality and thereby threaten the Filtration Avoidance Determination.

The dSGEIS also does not include a separate impact assessment on Public Health. Given that this water resource supplies over 9 million New York State residents, a public health analysis is clearly warranted for the potential acute and chronic impacts on water quality from the cumulative well development in the NYC Watershed. In a letter to Commissioner Daines (dated November 10, 2009) the City requested that NYSDOH "*assess the public health impacts of drilling in our unfiltered watershed and whether, in NYSDOH's view, these risks can be sufficiently addressed over the long term before NYSDEC acts to finalize the dSGEIS*."

6.1.11 The dSGEIS only addresses potential surface contamination issues and does not recognize the potential for contamination of the New York City water supply via infiltration into water supply tunnels.

6.1.11 The City is extremely concerned about the vast quantities of hazardous chemicals that are used in hydraulic fracturing and which therefore may be inadvertently introduced to the water supply. NYSDEC is requiring operators to disclose the chemicals as part of the permitting procedure but states that it would be protected from disclosure to the public by the trade secrets exception to FOIL. Thus, involved stakeholders such as the City and local health departments will not have any knowledge of the chemicals that are released into the environment near water supplies. This greatly hampers the City's ability to conduct surveillance monitoring, protect inspection staff, safely respond to spills or other emergencies, and ultimately protect the public health of the water supply consumers.

6.1.11 The dSGEIS states that *"[d]egradation of New York City's drinking water supply as a result of surface spills is not a reasonably anticipated impact of the proposed activity*" and provides a list of reasons why the inevitable spills resulting from natural gas development in the watershed will not adversely impact the water supply. However, this statement is unsupported by the analysis in the dSGEIS. The dSGEIS provides no analysis of cumulative impacts, the Alpha Environmental surface spill methodology is inherently flawed, and documented cases of contamination of water resources in other states are ignored. Therefore the potential impact of spills in the watershed cannot be categorically dismissed.

6.1.11 The NYSERDA Alpha Environmental report's surface spill analysis indicated that hydraulic fracturing spills could result in MCL violations in NYC reservoirs. However, neither section 6.1.11 nor any other section in the dSGEIS makes note of these disturbing findings. Instead section 6.1.11, which purports to review "*potential impacts related to horizontal drilling and high-volume hydraulic fracturing*" repeats a

number of overly simplistic reasons as to why contamination is not an issue, as paraphrased and refuted below.

- Setback requirements (i.e., required separation distances) will preclude the possibility of the contents of a ruptured additive container or holding tank pouring directly into a reservoir.

Proposed setbacks do not preclude development of wells, but simply require additional site-specific reviews when development occurs within setback distances. Further the proximity of roads adjacent to every reservoir and the volume of truck traffic anticipated in the watershed to develop the resource increase the probability that a vehicle accident could result in contaminants discharging directly to a reservoir.

- It would not be possible for an on-site spill to reach a reservoir without first contacting the ground. Soil adsorption would occur and reduce the potential amount of contaminant reaching the reservoir by flowing across the ground. Natural attenuation processes in soil and water such as biodegradation, volatilization, and chemical or biological stabilization, transformation or destruction may also reduce the concentration of contaminants.
- Many chemicals, and chemicals dissolved in water, are subject to evaporation during the warmer months of the year, reducing the volumes or concentrations that would reach reservoirs.

These physical processes do not apply to every chemical potentially introduced into the watershed. One example, 2,2,-Dibromo-3-Nitrilopropionamide, which was evaluated as part of the Alpha analysis, is highly toxic and does not readily evaporate, volatilize, or adsorb to soil particles, as described in its material safety data sheet.

- It is not reasonable to expect multiple containers at one site or sufficient numbers of containers at separate sites to breach simultaneously and spill their entire contents directly into a reservoir without any detection or attempt at mitigation.
- Hydraulic fracturing is an intensely controlled and monitored activity, with more people present on-site than at any other time during the life of the well. On-site personnel and systems would result in the detection and mitigation of any rupture, equipment failure or any other cause for release.

It is reasonable and prudent to expect a certain percentage of spills to occur in any given year from many hundreds of active well sites. Experience in New York and other states reveals that impacts to water resources are an unavoidable result of natural gas development, regardless of controls and personnel onsite. Drilling and hydraulic fracturing is a complex process, and spills are inevitable due to accidents, human error, or equipment malfunctions. Additionally, a single spill event, as described in the Alpha report is sufficient to result in contamination of NYC water supplies.

- Construction and operation of the site in accordance with mitigation measures set forth in Chapter 7, including a required Stormwater Pollution Prevention Plan, would provide spill containment and prevent fluids from running off of the well pad.

No combination of Best Management Practices can prevent all instances of spills from leaving the well pad. Further, plans cannot prevent contamination if they are not followed, equipment is not maintained, and/or BMPs are not implemented.

- Complete and instantaneous mixing of contaminants in the reservoirs is not likely to occur because of various characteristics of both the chemicals (density, solubility and dispersion rate) and the reservoirs (areal geometry, wind patterns, tributaries, limnology).

The lack of complete mixing could result in more severe contamination, especially if the contaminants entered a reservoir near an outlet. This statement also seems to contradict the assumptions made for the spill scenarios, as explained in the NYSERDA Alpha Environmental report.

7.1.11 Section 7.11 states that "…*the possibility of high-volume hydraulic fracturing presents no realistic threat to the Filtration Avoidance Determination [FAD].*" This assertion is not supported by analysis. Nowhere in the dSGEIS or its supporting reports are the requirements of filtration avoidance listed or evaluated in terms of potential impacts from high volume hydraulic fracturing. Whereas a single well in the watershed may not impact the filtration avoidance determination, it is far more likely that drilling of hundreds or thousands of wells, together with other closely related activities essential to and induced by natural gas development, could have a very significant adverse impact. Experience in other shale gas plays, and in the Marcellus in Pennsylvania, clearly shows that it is not the impact of one or even a few wells that needs to be evaluated, but rather, of many. The dSGEIS provides no estimate either of the cumulative annual rate of well development or cumulative water quality impacts from spills or other types of contamination.

Further, it is not known, and the dSGEIS does not consider, how many instances of such contamination or incremental changes in land use, stormwater runoff characteristics, water diversions, and air quality would cause significant degradation of the watershed. Substantial natural gas development represents a wholly new level of industrial activity in the watershed. NYSDEC cannot predict how NYSDOH will evaluate impacts from natural gas development on an unfiltered surface water supply, nor should such impacts be categorically dismissed in the absence of an evaluation that takes into account nominal rates and density of well construction.

7.1.12 Setbacks

General Comments

The setbacks established in the dSGEIS do not prevent drilling in any sensitive areas but instead requires a site-specific SEQRA analysis, with no defined mechanism for NYCDEP review, for a well pad within 300 feet of a reservoir or 150 feet of a stream. The requirement for additional environmental review for activities within these setbacks is wholly insufficient to protect NYC drinking water quality based on the surface and subsurface contamination risks identified previously.

7.1.12 Section 7.1.12 references, among other sources, NYCDEP Watershed Rules and Regulations for the development of setback limits, claiming natural gas development

activities are analogous to other activities that might occur in the watershed. The NYC watershed is comprised of approximately 85% forest land, 8.6% agriculture land, 3.5% wetlands and water bodies, 1.5% residential, 1.3% urban/suburban, and 0.05% industrial, mining, and waste disposal land.[25] The Watershed Rules and Regulations do not include large setbacks for industrial activities because there was very limited potential for such activities to occur. However, natural gas development can reasonably be expected to result in extremely dense development (estimated at 6 to 9 wells per square mile spacing unit) across much of the watershed, resulting in the potential for thousands of sites storing, transporting, and injecting toxic chemicals. Given the potential density of natural gas related activities, they cannot be described as analogous to other development activities that occur in the watershed. Therefore it is reasonable to require substantial buffer distances for drilling activities to account for this difference in scale and density.

7.1.12 The dSGEIS proposes a site-specific SEQRA determination for any wells drilled within 1,000 feet of NYCDEP aqueducts to prevent damage from the vertical section of the well. However, well bores, induced fractures, and currently identified existing brittle structures could enhance mobility of drilling fluids and formation materials as well as expose the aqueducts to high pressures from the well and formation. Presently identified existing brittle structures in the Catskill/Delaware watershed can extend up to 7 miles laterally and up to 6,000 feet deep. The vertical and lateral persistence of these features in conjunction with failed casings or other predictable occurrences could result in significant surface and subsurface contamination, as illustrated by incidents in other well fields, most notably documented in Garfield County, CO (migration of toxic formation material through subsurface fractures) and Dimock, PA (migration of natural gas to the surface via improperly cased wells).

The dSGEIS includes no specific guidance with respect to vertical separation required above horizontal well components, and apparently relies on the presumed permanent integrity of intervening rock layers to isolate water system components from fractured, gas-bearing strata, even as it acknowledges (dSGEIS p. 5-89) that "*despite ongoing laboratory and field experimentation, the mechanisms that limit vertical fracture growth are not completely understood*."

Recommendations

Within the setbacks from aqueducts, reservoirs, reservoir, and streams, the dSGEIS proposes only a site-specific SEQRA review process in which the City has no assured presence or authority. The setbacks do not preclude horizontal drilling and hydraulic fracturing from occurring within 1000' of tunnels, 300' of reservoir, and 150' of streams. In fact, the dSGEIS does not explicitly exclude the development of natural gas wells anywhere in the state. Based on the occurrence of laterally extensive subsurface faults, fractures, and brittle structures and the associated risks of drinking water quality contamination and impacts to infrastructure integrity, the dSGEIS should establish buffer zones within which horizontal drilling and hydraulic fracturing are precluded from occurring. Specifically:

[25] NYCDEP GIS data. 2009.

- Natural gas spacing units should be excluded within a zone of 7 miles from NYC subsurface water supply infrastructure to minimize the risks and impacts associated with contaminating drinking water with fracking chemicals and formation water; and potentially compromising tunnel liner integrity; and
- Natural gas spacing units should be excluded within a 1,000 ft buffer of streams and a 2,000 ft buffer around reservoirs. These setbacks are consistent with the setbacks required for public water supply wells established in the original 1992 GEIS.

6.2/7.2 Protecting Floodplains

6.2 Section 6.2 of the dSGEIS states "*The GEIS summarizes 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*."Chapter 8 section K.3 of the 1992 GEIS stated: "*Local weather stations regularly issue flood watches or warnings as needed. In the event of a flood warning, an operator should have time to secure or remove temporary storage tanks.*" Section 3.6 of the NYSERDA Alpha Environmental report states "*Susquehanna and Delaware River Basins in New York are vulnerable to frequent, localized flash floods every year. These flash floods usually affect the small tributaries and can occur with little advance warning*."

The findings of the Alpha Environmental report contradict the findings in the GEIS report, indicating that chemicals or wastes stored in the 100-year floodplain are at risk from flooding. The report does not adequately note that the NYC watershed has experienced several significant flooding events in the past decade.

7.2 Section 6.2 of the dSGEIS states "*Severe flooding is described [in the 1992 GEIS] as 'one of the few ways' that bulk supplies such as additives 'might accidentally enter the environment in large quantities.*'"

Given the serious implications of this statement, the mitigation measures proposed in the dSGEIS appear inadequate. The only proposed restrictions on chemical and waste storage in floodplains is that a closed-loop tank system is required for multi-well pads and that centralized flowback water surface impoundments are prohibited. Large flood events in the watershed would wash the chemicals into the reservoirs – posing an extremely difficult if not impossible situation to mitigate.

Recommendations

- Given the potential risk of surface water contamination from flooding as described in the dSGEIS, Alpha Environmental report, and the 1992 GEIS, drill pads and related support vehicle/equipment staging areas, and surface tanks must be excluded from the 100-year floodplain to prevent accidental releases of chemicals or wastes during peak flow events.

6.3/7.3 Freshwater Wetlands

6.3 Several activities associated with horizontal drilling and high-volume fracturing that have significant potential to impact wetlands have not been adequately addressed in the SGEIS. These include: loss and degradation of wetlands through filling or

draining for the placement of well pads, access roads, pipelines, and other ancillary features, contamination due to spills or groundwater migration, and hydrologic modification associated with surface water and ground water withdrawals within wetland catchment areas.

6.3 The scope of included wetlands in the Environmental Assessment Form (EAF) and EAF addendum is unclear. NYSDEC only has statutory authority to regulate wetlands that are 12.4 acres or greater, although it can assess impacts to wetlands smaller than that threshold. The EAF Part 5.h. refers to "regulated wetlands" while the EAF addendum requirements are for any wetland. The scope should be clarified to include all wetlands regardless of their regulatory status and who regulates them. Given the permit-by-permit review of the well pads, the City is concerned that wetlands smaller than those regulated by the State will be seriously impacted by this activity because the State lacks the authority to impose permit conditions.

6.4/7.4 Ecosystems and Wildlife

6.4 The discussion of rare, threatened or endangered species in both the GEIS and SGEIS is inadequate. A protocol for identifying the presence or potential presence of listed species in an area to be disturbed should be detailed in the SGEIS along with potential mitigation measures to be taken to minimize risk. It should be noted that several of the watersheds that will be potentially impacted contain endangered and threatened freshwater mollusks among other species. Appendix 14 does include a place for noting rare species and their habitats but there is no guidance on how rigorous the survey process should be. Any indication that a listed plant or animal species may be impacted should require an individual SEQRA review for that well permit application.

6.4.1 Best management practices are needed in the invasive species sections for many of the document's recommendations, including standards for weed-free mulch, construction materials and native plant genotypes for restoration. Responsibility for oversight and enforcement of these and other standards and conditions should be detailed in the SGEIS. Methods of both rendering invasive species incapable of growth or reproduction and appropriate disposal should be described. The operator should be required to monitor the reclaimed site for invasive species for a period of five years after well abandonment.

6.5/7.5 Air Quality

6.5 (Tables 6.6 thru 6-9) The emissions under the venting scenario seem to be severely underestimated, but in the tables, flaring seems to increase pollutants rather than reducing them. Flaring should eliminate 95% of the volatile organic compounds (VOC), but VOC emissions were higher in the flaring scenario than in the venting scenario. These results must be confirmed and either corrected or explained.

6.5 The document should include a discussion of the effects of the proposed action on the State Implementation Plans (SIPs) (i.e. are the emissions included as part of the growth projection?). The relevant SIPs that could be affected by gas drilling activities include SIPs for PM 2.5, ozone, and regional haze. In addition, the impact

of drilling activities upon compliance with the new NO2 and SO2 rules proposed by the EPA must be assessed in the dSGEIS.

6.5.1.1 The document states that the two types of diesel engines (for drill rig and frac pump) would meet the NOx RACT emission limits to avoid RACT requirements. Since the equipment would not be permanently located at any site, but would be relocated to another site, NYSDEC should review the total operating hours of these equipment (not just the hours operating at one site) when considering controls on these equipment.

6.5.2.3 To account for operations at nearby pads, the assessment included a nearby pad with identical equipments/emissions located at a distance of one kilometer. This is roughly equivalent to 2.5 pads per sq. mile. Elsewhere in the document, it was stated that there could be up to 6 pads within one square mile area. It is not clear how the higher density would affect the conclusion regarding nearby pads. NYSDEC must resolve this inconsistency.

6.5.2.2 The document states that "*direct emissions from mobile sources are controlled under Title II of the Clean Air Act (CAA) and are specifically exempt from permitting activities. Thus, these emissions are also not addressed in a modeling analysis...*" The dSGEIS should disclose the potential effects of the on-road truck trips associated with natural gas production.

6.8/7.8 NORM

General Comments

The dSGEIS raises serious concerns that NORM could pose a risk to public health or the environment. However, NYSDEC released the dSGEIS without completing the NORM evaluation and included vague and contradictory language that does not provide adequate guidance on mitigating potential adverse impacts. Clearly more analysis is needed before any activity that is likely to generate radioactive waste can move forward. Proposing additional testing and evaluation in the future is not sufficiently protective of public health and does not meet the standard for an environmental review of impacts.

6.8 Section 6.8 states that "*the Marcellus shale is known to contain NORM concentrations at higher levels than surrounding rock formations.*" The dSGEIS indicates that:

- NORM concentrations in the gas, fluids and rock cuttings associated with gas well drilling and development in the gas shales of New York have the potential for exposure "*to human contact or to concentrate these constituents.*"
- Potential exposure routes are identified as produced water, pipe scale, cuttings, and produced gas. The dSGEIS concludes that "*activities that concentrate NORM need to come under government scrutiny to ensure adequate protection*."
- Radium-226 is "*the radionuclide of greatest concern from the Marcellus,*" with a half-life of 1,600 years.

Each of these statements demonstrates the significance of NORM in connection with gas development activities for the Marcellus shale, and exposes the uncertainty

regarding the respective levels of the comprising radionuclides and exposure routes. Other than identifying the need to conduct additional sampling and possibly requiring radioactive materials licensing, the dSGEIS does not propose mitigation measures, acceptable waste disposal methods, or provide a full assessment of the risks expected to arise from the elevated levels of NORM in the rock, groundwater, and natural gas of the Marcellus shale.

6.8 Data provided in Appendix 13 of the dSGEIS indicates that 11 out of 13 samples of produced brine had high concentrations of Radium-226 (ranging from 1,800 to 16,000 pCi/L).

Appendix 16-A table 2 of 10 NYCRR 16 sets the threshold for regulation of Radium-226 at 100 pCi/L. However, 10 NYCRR 16.100 exempts "*removal of source material from its place of deposit in nature*." Given that Radium-226 concentrations in brine water are generally 18 to 160 times greater than the threshold for regulation of other sources of Radium-226, the NYSDOH should re-evaluate the exemption for "source material" to ensure that the lack of regulation does not result in adverse impacts to human health.

6.8 6 NYCRR 617.7 (c) (2) states that the "*the creation of a hazard to human health*" is one of the criteria for determining a significant adverse impact. Section 6.8 of the dSGEIS states "*the build-up of NORM in pipes and equipment (scale) has the potential to expose workers handling (cleaning or maintenance) the pipe to increased radiation levels*."

The dSGEIS identifies but does not fully address the potential for impact on human health from handling build-up of NORM on equipment. Further testing is required to estimate likely radiation exposure levels to wastewater treatment plant operators, waste haulers, inspectors and other workers, as well as leaseholders and others living in close proximity to active well sites to prevent adverse impacts from exposure to elevated levels of NORM related to natural gas exploration and development.

7.8 Section 7.8 of the dSGEIS does not describe specific mitigation measures that are required to prevent human exposure to NORM wastes generated during natural gas development of the Marcellus shale such as radiological testing of brine water and specific thresholds for regulation by the state.

7.8 Appendix 10 Item 47 indicates that "*Fluids recovered after high volume hydraulic fracturing operations must be tested for NORM during flowback operations prior to removal from the site. Fluids recovered during the production phase (i.e., produced brine) must be tested for NORM prior to removal, and the ground adjacent to the tanks must be measured for radioactivity. All testing must be in accordance with protocols satisfactory to NYSDOH*." However, section 7.8.2 states "*In order to determine which gas production facilities may be subject to the licensing and environmental discharge requirements, radiological surveys and measurements are necessary including radiation exposure rate measurements of areas of potential NORM contamination, accessible piping, tanks or other equipment that could contain NORM scale buildup*." These sections are inconsistent.

Recommendations

- The dSGEIS should not be finalized until the evaluation of NORM, including identification of waste handling and disposal methods, and exposure mitigation measures has been completed and released for public review and comment.
- The testing requirements listed in Appendix 10 are inadequate to account for the potential buildup of NORM scale in pipes, tanks, and other equipment. The testing protocol should be expanded as indicated in section 7.8.2 to include pipes, tanks, and equipment. Further, testing should also include waste treatment facility equipment that could similarly have NORM scale buildup.

6.9/7.9 Visual Impacts

6.9 The dSGEIS provides photos of a variety of actual well sites in New York developed since the publication of the GEIS to illustrate their appearance during different stages of operation. It does not provide pictures of well sites from other states where high volume hydrofracturing and horizontal drilling in shale formations has occurred to show temporary and long term visual effects of the well development and operation of high volume hydro fracturing. Given the difference in well development between existing wells in New York and the proposed multi-well pads with hydraulic fracturing - graphics of existing wells in New York during development are unhelpful..

6.9 The dSGEIS notes that reclamation work will begin within 45 days of cessation of drilling and stimulation and that very little permanent visual impact is anticipated unless the site had been heavily forested, in which case the landscape will have been changed until the trees grow back. The dSGEIS needs to discuss how long the "temporary" disturbance may last and the cumulative impacts of many concurrently active sites. Erosion from the temporary loss of vegetation and trees, particularly within the NYC watershed could cause water quality impacts to the water supply, and need to be addressed.

6.11/7.11 Road Use

General Comments

The dSGEIS does not fully analyze the potential impacts on the local roadways. First of all, the analysis does not include the impacts of induced growth due to natural gas development which will lead to higher traffic levels. Second, the analysis does not fully account for the impacts of the expected truck traffic from all of the potential wells. The City has estimated the resulting truck trips based on the developable area within the watershed and the designated well spacing. The truck trips for annual well development are likely to range between 24,000 and 600,000 with a full build-out estimate of 3.6 – 7.2 million truck trips over the well development period.[26] The impact on local roadways from this amount of additional truck trips could be severe leading to heightened erosion problems and increased likelihood of accidents or spills. It should also be noted that the road use would not be evenly distributed but will be concentrated around staging areas or stations.

[26] Based on cumulative estimates calculated in the Final Impact Assessment Report, NYCDEP, 2009.

There are specific impacts to the NYC watershed that are not addressed in the dSGEIS. The City owns and operates 94 miles of secondary 2-lane highways, including 32 bridges within the area of study. These roadways circumnavigate the six West-of-Hudson reservoirs. Road pavement is vulnerable to rutting, cracking, shoulder damage, and subsequent potholes and dips resulting from repeated heavy live loads of truck traffic cycles. Degradation of these roads and bridges poses a particular risk to the water supply where erosion can lead to increased turbidity during storms and increased risks of spills in close proximity to an intake.

The dSGEIS states that natural gas well development involves a wide variety of heavy equipment: tanker trucks, sand hauling trucks, drilling Rigs, pumper trucks, semi trucks hauling bulldozers, concrete mixing trucks, blender trucks, nitrogen tanker trucks, dry chemical and equipment cartage trucks, and liquid chemical tank trucks. A lot of the gas well service traffic is off-road and as such, could cross the cut & cover sections of the Catskill Aqueduct, which is vulnerable to vehicle weights. Off road trucks usually use tire chains or are pulled to the well location using a bulldozer equipped with a winch. A chart provided in Attachment B was developed for the unprotected Catskill Aqueduct[27] and shows that the majority of the proposed vehicles are overweight to cross the Catskill Aqueduct without protective mat or crossing sub-base and pavement.

Finally, it should be recognized that the City as well as the local, county, town, and village highway departments do not have the time and resources to constantly monitor the NYSDEC website for information regarding gas development in their areas, and to complete a road system integrity study in order to levy fees for maintenance and improvements. The onus should be on NYSDEC to protect these resources and ensure that all the gas well or fracturing service companies in an area contribute to a fund to repair and maintain roadways (Attachment C). Since many of these companies are based out-of-state their vehicles and trucks are not registered in New York therefore do not pay the typical road use and fuel taxes needed to support the local highway departments and the roads they are using.

6.12/7.12 Community Character Impacts

General Impacts

The dSGEIS states that "*Many of the community character impacts associated with horizontal drilling and high volume hydraulic fracturing are the same as those addressed in the 1992 GEIS, and no further mitigation measures are required*" But as stated earlier in the dSGEIS, "*While the GEIS does address drilling in drinking water watersheds, areas of rugged topography, unique habitats and other sensitive areas, oil and gas activity in the eastern third of the State was rare to non-existent at the time of publication. Although the 1992 Findings have statewide applicability, the SGEIS examines whether additional regulatory controls are needed in any of the new geographic areas of interest given the attributes and characteristics of those areas. For example, the GEIS does not address drilling in the vicinity of the New York City watershed infrastructure which exists in the prospective area for Marcellus Shale drilling*."

Since well development under horizontal drilling and high volume hydraulic fracturing is substantially different than the drilling scenarios evaluated in the 1992 GEIS, a detailed

[27] "DRAFT REPORT ON CATSKIILL AQUEDUCT LOADING" by Joint Venture of HDR and Gannett Fleming for Contract CAT-232, March 25, 2008.

community character assessment should be included in the dSGEIS to evaluate the potential impacts from horizontal drilling and high volume hydraulic fracturing. The dSGEIS acknowledges socioeconomic benefits of drilling, but it does not evaluate the environmental impacts of induced growth in the region. Growth, particularly in the NYC watershed, could result in increased development, road usage, traffic and increased demand on community services, which could impact the watershed and subsequently water quality.

6.13/7.13 Cumulative Impacts and Induced Growth

General Comments

Cumulative impacts are not adequately evaluated in the dSGEIS. Though future development scenarios are by nature uncertain and inherently difficult to estimate, it is a requirement of SEQRA for environmental reviews to estimate background development trends and the effects of the proposed action. NYSDEC must rigorously evaluate the cumulative impacts of horizontal drilling and high volume hydraulic fracturing under a reasonable worst case development scenario, and evaluate the extent to which the proposed mitigation measures address those impacts.

6.13.2 The dSGEIS states that "*This density was anticipated in 1992 and areas of New York, including Chautauqua, Cayuga and Seneca Counties have experienced drilling at this level without significant negative impacts to agriculture, tourism, other land uses or any of the topics discussed in this report*."

The density spacing that is referenced was not specifically evaluated for the NYC watershed. The well spacing density considers only the impacts related to land disturbance for the individual well site and not the cumulative land disturbance from well development regionally. The dSGEIS does not perform a cumulative impact assessment and instead proposes the adoption of a well density scheme.

6.13.2.1 The dSGEIS states, "*the number of wells which will ultimately be drilled cannot be known in advance, in large part because the productivity of any particular formation at any given location and depth is not known until drilling occurs. Changes in the market and other economic conditions also have an impact on whether and how quickly individual wells are drilled.*"

It may be the case that an exact number of wells to be drilled is unknown; however the dSGEIS should evaluate a range of possible well scenarios and evaluate a reasonable worst case scenario for different regions, including the NYC watershed, in order to be able to evaluate the cumulative impact from the proposed action. The number of wells could reasonably be estimated based on the rates of development in neighboring Pennsylvania counties or in other states.

Estimates developed for the NYC watershed area yielded rates of development between 20 and 500 wells per year and ultimate build out in the watershed of between 3,000 to 6,000 wells (this estimate assumed that various classes of land, e.g., Catskill Forest Preserve, DEP-owned lands, amounting to roughly 40% of the total watershed area are not subject to natural gas development.[28] Cumulative well development

[28] Based on cumulative estimates calculated in the NYCDEP Final Impact Assessment Report.

estimates can then be used to estimate cumulative impacts and determine the thresholds of development at which additional mitigation measures are required.

6.13.2.1 The dSGEIS states that: "*Accordingly, any limitation on development, aside from mitigation measures discussed in the next chapter, is more appropriately considered in the context of policy making, primarily at the local level outside of the SGEIS*." It is unclear what this means or whether local governments have any authority to ban or limit drilling in their jurisdictions.

6.13.2.1 Section 6.13.2.1 of the dSGEIS states "*[It is not] possible to define the threshold at which development results in adverse noise, visual and community character impacts*."

Despite the difficulty in estimating cumulative impacts due to the uncertainty of future development that will be induced by natural gas production, SEQRA requires an estimate of such impacts. The failure of the dSGEIS to attempt such an analysis is improper. Moreover, the section omits potential regional impacts from water consumption, contaminated solid waste disposal, and industrial wastewater treatment and disposal, among others. These impacts are even less subjective than noise, visual, or community character impacts, and the dSGEIS must define a threshold at which development results in adverse impacts.

7.13 6 NYCRR 617.7(c)(2) states "*For the purpose of determining whether an action may cause one of the consequences listed in paragraph (1) of this subdivision, the lead agency must consider reasonably related long-term, short-term, direct, indirect and cumulative impacts, including other simultaneous or subsequent actions …*"

Cumulative impacts are always uncertain and SEQRA does not allow cumulative impacts to be ignored just because there is some uncertainty in development patterns. It is possible to generate reasonable estimates of annual and ultimate build out of wells based on development of similar resources in other shale plays in other states; such estimates should have been included in the dSGEIS.

By neglecting to include the cumulative impacts from a reasonable worst-case development scenario of developing wells throughout New York, and specifically the NYC watershed, the dSGEIS does not adequately evaluate the potential adverse environmental impact from the proposed action. By focusing only on the impacts of single well development, the dSGEIS does not fully disclose the potential adverse environmental impacts that could result from the proposed action.

6.13.2 The dSGEIS does not address impacts from the expected induced growth in the region due to natural gas development. In a July 2009 Preliminary Report for Broome County Legislators on the Potential Economic and Fiscal Impacts from Natural Gas Production in Broome, County, NY, the authors note, based on natural gas exploration in other states, that drilling has led to substantial increases in population, employment, income and local tax revenues. A host of local business may expand or increase to supply the drilling companies. Equipment and service providers that are currently out of state may locate within New York State. The report also notes that in late May 2009, Chesapeake Energy announced it was looking for property in

Bradford County, Pennsylvania for a housing development to provide lodging for about 180 workers.

Furthermore, Chapter 2 of the dSGEIS states: "*The local economic impacts are already being realized in some cases as exploration companies continue to lease prospective acreage in the Southern Tier and as oil and gas service companies seek to locate in the heart of the activity to better serve their customers. News reports on June 20, 2009, detailed the terms of a lease agreement between Hess Corporation and a coalition of landowners in the Towns of Binghamton and Conklin. The coalition represents some 800 residents who control more than 19,000 acres. The lease provides bonus payments of $3,500 per acre and a royalty of 20 percent. On August 26, 2009, it was reported that in Horseheads, NewYork, Schlumberger Technology Corporation is planning to build a $30 million facility to house $120 million worth of equipment and technology to service oil and gas exploration companies in the Southern Tier and Northern Pennsylvania. The facility will become the company's northeast headquarters*." The cumulative environmental impacts of this growth have not been evaluated in the dSGEIS.

Similar increases in population, growth and development would be anticipated if drilling proceeds within the NYC Watershed. The impacts of this development and its resulting stormwater and sanitary flows were not evaluated in the dSGEIS.

Bringing natural gas to the region would bring workers and could lead to increased population and development of business to support the growth in the region. Induced growth and resulting development would increase traffic, impervious surface areas, stormwater flows, wastewater flows, and water usage, each of which has the potential to affect the region's water quality and the filtration avoidance determination.

7.13 Section 7.13 of the dSGEIS briefly mentions cumulative impacts from water withdrawals, noise, aesthetics, traffic, and community character without sufficient analysis, and completely fails to undertake any analysis whatsoever of the many other potential cumulative impacts:

- Water quality impacts due to substantial volumes of industrial wastewater that may be treated and discharged to surface waters from POTWs or disposed of on roads;
- The overall lack of sufficient industrial water treatment and disposal capacity within the state and larger region based on the significant volumes of wastewater produced at each well;
- Impacts from chemical spills based on the probability of trucking accidents, given the reasonably anticipated number of truck trips;
- The air impacts from the likely long-distance hauling of produced and flowback water;
- Groundwater contamination resulting from the potential subsurface migration of chemicals into potable aquifers from dozens, hundred, or thousands of wells;
- Public health impacts due to exposure of cumulative volumes of radioactive material brought to the surface;

- Potential induced seismicity from injection wells needed to dispose of drilling and fracturing wastewater;
- Increases in solid waste production from contaminated drill cuttings and other solid wastes that must be disposed of in an approved facility; and
- Increases in population and induced growth related to natural gas development.

Such serious omissions violate SEQRA.

Recommendation

- The lack of a comprehensive analysis of cumulative impacts and growth reasonably projected to be induced by natural gas production is a serious flaw in the dSGEIS. Based on the fact that an evaluation of cumulative impacts is required by SEQRA and that adverse impacts from most natural gas development activities cannot otherwise be adequately evaluated, the dSGEIS should not be finalized until a comprehensive cumulative impact and induced growth analysis is completed and released for public review and comment.

6.14 Seismicity

General Comments

As stated in the comments under Chapter 4, the seismicity analysis is based on a flawed subset of data that greatly underestimates the number of faults and fractures in the area.

The dSGEIS states that hydraulic fracturing-induced seismicity by fluid injection "*can trigger seismic events... if the injected fluid reaches an existing geologic fault*." Such events have been documented in Colorado (Rangely) and Indiana/Illinois (Wabash Valley) in connection with natural gas development and hydro-fracturing[29]. As such, the significance of documented faults and linear features in the eastern region of the Marcellus shale as well as the potential significance of undocumented features needs to be adequately addressed by the dSGEIS. Furthermore, the future role of possible underground disposal wells and possible carbon sequestration wells targeting the depleted gas-shale beds and/or deeper formations needs to be addressed by the dSGEIS since both types of wells and related injection activities have been identified as possibilities in connection with proposed natural gas development in the region. Both of these activities will also result in subsurface pressure and fluid buildups, which are documented as being of concern relative to induced seismic activity along pre-existing faults.

Chapter 8 – Permit Process and Regulatory Coordination

General Comments

Natural gas exploration and production may lead to a significant level of industrial activity for a prolonged period within the NYC watershed, but the City presently has no statutory authority to participate in permit approvals or site-specific SEQRA reviews. Given the City's crucial role in protecting the 9 million consumers of the NYC water supply, this is an unacceptable situation.

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[29] James F. Gibbs, John H. Healy, C. Barry Raleigh and John Coakley, 1973, "Seismicity in the Rangely, Colorado Area: 1962-1970", Bulletin of the Seismological Society of America; v. 63; no. 5; p. 1557-1570.

8.1.1.1 Section 8.1.1.1 indicates "*the following additional actions will also include all opportunities for public input normally provided under SEQRA*" and includes "*Issuance of a permit to drill the first well when high-volume hydraulic fracturing is proposed on a well pad within 300 feet of a reservoir, reservoir stem or controlled lake*." It is unclear if this section is referring to the site-specific SEQRA review process. Section 8.1.1.1 does not use the term "*site-specific SEQRA review*," but a well pad within 300 feet of a reservoir, reservoir stem, or controlled lake is one of the triggers for a site-specific review.

This section highlights the fact that there are numerous activities that require site-specific SEQRA determinations but the dSGEIS does not describe the site-specific review process, level of public involvement, review criteria, or other pertinent information necessary to evaluate the effectiveness of a site-specific review as a suitable mitigation mechanism.

8.2.1 Requirements for gas well permitting are described in chapters 7 and 8, and appendices 6, 9, 10, 20, and 22. Individual sections describe permitting requirements differently with varying degrees of information and specificity. It is unclear which sections are binding, which could lead to confusion regarding permitting and compliance. For example, regarding chemical disclosure, Chapter 8 states that full disclosure is only required for permit applications proposing open surface impoundments, but the EAF addendum only indicates additives are required to be submitted and does not differentiate between sites proposing open surface impoundments or not. However, Appendix 10 indicates that chemical information is required for all products not previously reviewed. Appendix 10 also raises the potential for a site-specific SEQRA determination based on using different fracturing products, which does not appear to be noted anywhere else in the dSGEIS. Based on these inconsistencies, it is unclear under what circumstances full chemical disclosure is required for obtaining a drilling permit. Text from various sections of the dSGEIS is provided below.

Recommendations

- A formal agreement or policy between NYSDEC and NYCDEP is necessary to provide NYCDEP a decision-making role in the review and approval process for all gas wells associated with spacing units that are within the NYC watershed, in whole or in part, or overlying buffer zones proposed for NYC tunnels, to assure that the protection of the NYC water supply is adequately taken into consideration. Further, the agreement should also include information sharing to ensure NYCDEP can appropriately respond to emergencies or other incidents that might occur in the watershed. This should include:
  - Full disclosure of chemicals;
  - Immediate notification of spills, accidents, or fires; and
  - Sharing of water sampling data submitted to NYSDEC.
- The dSGEIS should provide detailed information on the site-specific review process including: review criteria, time line for public comment period, how NYSDEC will respond to comments, appeal process, notification requirements, when a public

meeting is required, and any differences between the site-specific SEQRA review and a typical SEQRA review for an EIS.

- A single section needs to be included in the dSGEIS that details all binding requirements on the permitting of natural gas wells that use high volume hydraulic fracturing. The section must then be coordinated with the rest of the document to ensure there are no discrepancies such as for chemical disclosure described above.

Chapter 9 – Alternative Actions

General Comments

The alternative actions identified in Chapter 9 are not given sufficient consideration, and are too limited in scope to allow for an adequate assessment of the full range of potential options. SEQRA requires the consideration of a No Action alternative.

9.1 The dSGEIS states that "*the prohibition of development of Marcellus Shale and other low permeability gas reservoirs by horizontal drilling and high-volume hydraulic fracturing would be contrary to state and national interests*." However, if the dSGEIS does not satisfactorily evaluate the potential risks and cumulative impacts on water resources and public health, then proceeding with the development of natural gas drilling would – and certainly should – be contrary to state interests.

Given that the potential impact on the NYC water supply was one driving force behind doing a supplemental analysis, consideration of a partial or full prohibition within the watershed is entirely consistent with the Environmental Conversation Law. The dSGEIS does not provide any support for the conclusion that a ban on drilling in 5.8% of the deposits would undermine the purported benefits of gas shale development to the State and the Nation. Indeed, it is the obligation the dSGEIS to consider a range of development scenarios as an alternative to state-wide drilling.

9.2 The dSGEIS does not evaluate the potential rate of development and cites uncertainties involved in the calculation. NYSDEC can, however, make certain assumptions based on permitted drilling density and rates of development in similar shale formations, particularly in Pennsylvania counties and come up with a range of scenarios for different regions of the state, including the NYC Watershed.

The dSGEIS states that the density for the multi-well pads, one per 640-acre spacing unit is significantly less than for single well pads, reducing the number of disturbances to the landscape. This is not necessarily true. While the actual land disturbance per well site might be less, this type of drilling will involve substantially more water, chemicals, trucking and put increased burdens on roadways. It opens up more land to this type of industrial activity. The dSGEIS does not consider induced growth or development that may occur as a result of this industry. While some services for this drilling may currently be out of state, new businesses catering to this industry could emerge in New York. Development in the New York City watershed could have significant impacts to water quality. Increased trucking of chemicals and flowback fluids increases the likelihood of accidents or spills. The use of multi-well pads does not adequately mitigate these impacts.

9.3 The dSGEIS notes that the use of 'environmentally friendly' or 'green' alternatives may reduce, but not entirely eliminate, adverse environmental impacts. A few environmentally-friendly technology alternatives were mentioned (Liquid Carbon dioxide alternative, nitrogen based foam alternative, liquefied petroleum gas), but their use in the U.S. is limited at best. The potential public health impact of these 'green' chemicals as well as the traditional chemicals on water quality should be addressed. The feasibility of using fewer chemicals, and less hazardous ones, should be further be evaluated. If such a "green chemical" alternative is feasible, it should be required through duly adopted regulations.

Recommendations

- A reasonable alternative that should be included in the alternatives analysis is a prohibition on high volume hydraulic fracturing in unfiltered water supply watersheds.
- When and if natural gas well development using high volume hydraulic fracturing proceeds in New York State, it is further proposed that gas well permits be auctioned at regular intervals under NYS direction, in order to afford regulatory overview of the rate and density of gas development activities during a given time period, and moderate the levels of peak industrial activities required for development of the resource.

Attachment A – Mitigation Measures from the dSGEIS that Constitute Rules

Category of Rule	Mitigation Identified in dSGEIS	Category of Impact Mitigation (dSGEIS Section)	dSGEIS Page
Rule Applying to All Drilling Operations	Flowback water handled at the well pad must be directed to and contained in steel tanks.	Flowback Water (7.1.3.4)	7-34
Rule Applying to All Drilling Operations	Annular disposal of drill cuttings is prohibited.	Solids Disposal (7.1.9)	7-61
Rule Applicable to All High-Volume Hydraulic Fracturing Operations	Fluids must be removed if there will be a hiatus in site activity longer than 45 days; Fluids must be removed within 45 days of completing drilling and stimulation operations at last well on pad; and Fluid transfer operations from tanks to tank trucks must be manned at the truck and at the tank if the tank is not visible to the truck operator from the truck.	Drilling Fluids (7.1.3.2)	7-34
Rule Applicable to All High-Volume Hydraulic Fracturing Operations	Subject to the property owner's permission, residential water wells within 1000 feet of the well pad must be sampled and tested. If no wells are available for sampling within 1000 feet either because there are none of record or because the property owner denies permission, residential water wells within 2000 feet of the well pad must be sampled and tested. All testing and analysis must be by an ELAP-certified laboratory, and the results of each test must be provided to the property owner and the county health department prior to commencing drilling operations. The initial sampling and analysis must be conducted prior to site disturbance at the first well on the pad, and prior to drilling commencement at additional wells on multi-well pads; sampling and analysis is also required three months after reaching total measured depth (TMD) at any well on the pad if there is a hiatus of longer than three months between reaching TMD and any other milestone on the well pad that would require sampling and analysis; and additional sampling and analysis is required three months, six months and one year after hydraulic fracturing operations at each well on the pad. In each instance, the wells must be tested for: sampling and analysis will be for static water level, total dissolved solids (TDS), total suspended solids (TSS), chlorides, carbonates, bicarbonates, sulfate, barium, strontium, arsenic, surfactants, methane, hydrogen sulfide, benzene, gross alpha, and gross beta.	Private Water Wells (7.1.4.1)	7-38

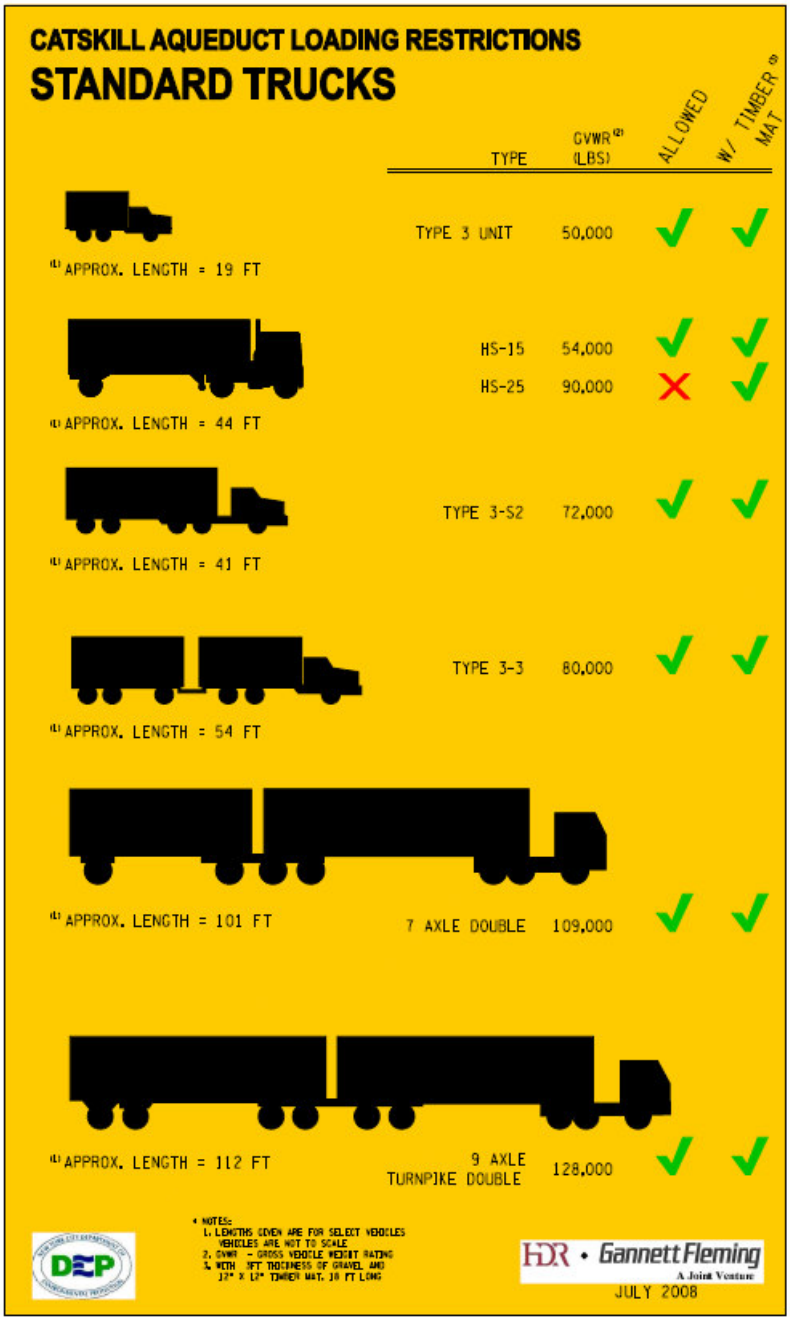
Category of Rule	Mitigation Identified in dSGEIS	Category of Impact Mitigation (dSGEIS Section)	dSGEIS Page
Rule Applicable to All High-Volume Hydraulic Fracturing Operations	A *Pre-Frac Checklist and Certification Form* must be submitted at least 48 hours prior to commencement of high-volume hydraulic fracturing operations. Regarding the surface casing hole, the pre-frac form will: a) Attest to well construction having been performed in accordance with the well permit or approved revisions; b) List the depth and estimated flow rates where fresh water, brine, oil and/or gas were encountered or circulation was lost during drilling operations, and c) Include information about how any lost circulation zones were addressed. Hydraulic fracturing will not be authorized to proceed without the above information and certifications.	Sufficiency of As-Built Wellbore Construction (7.1.4.2)	7-45
Rule Applicable to All High-Volume Hydraulic Fracturing Operations	If intermediate casing is not installed, then production casing must be fully cemented to surface. If intermediate casing is installed, it must be fully cemented to the surface, and production casing cement must be tied into the intermediate casing string with at least 300 feet of cement. NYSDEC anticipates a waiver process for this rule: "Any request to waive the preceding requirement must be made in writing with supporting documentation and is subject to the Department's approval. The Department will only approve a waiver if open hole wireline logs and all other information collected during drilling from the same well pad verify the migration of oil, gas or other fluids from one pool or stratum to another will otherwise be prevented. In any event, the top of cement on the production casing must be at least 500 feet above the casing shoe or tied into the previous casing string with at least 300 feet of cement"	Sufficiency of As-Built Wellbore Construction (7.1.4.2)	7-47
Rule Applicable to All High-Volume Hydraulic Fracturing Operations	The operator must run a cement bond log to verify the cement bond on the intermediate casing, if any, and the production casing. Remedial cementing shall be required if the cement bond is not adequate to isolate hydraulic fracturing operations.	Sufficiency of As-Built Wellbore Construction (7.1.4.2)	7-47
Rule Applicable to All High-Volume Hydraulic Fracturing Operations	A *Drilling and Production Waste Tracking Form* must be completed and maintained by generators, haulers and receivers of all flowback water associated with high-volume hydraulic fracturing operations. NYSDEC indicates that the record-keeping requirements and level of detail will be similar to what is presently required for medical waste, and that the form will be required regardless of whether waste is taken to a treatment facility, disposal well, centralized surface impoundment, another well pad, a landfill, or elsewhere.	Waste Transport (7.1.6.1)	7-50

Category of Rule	Mitigation Identified in dSGEIS	Category of Impact Mitigation (dSGEIS Section)	dSGEIS Page
Rule Applicable to All High-Volume Hydraulic Fracturing Operations	If the invasive species survey submitted with the EAF Addendum shows the presence of invasive species in the topsoil, consultation with the NYSDEC Division of Fish, Wildlife and Marine Resources will be required prior to any ground disturbance.	Ecosystems and Wildlife – Terrestrial (7.4.1.1)	7-75 to 76
Rule Applicable to All High-Volume Hydraulic Fracturing Operations	The operator must construct and operate the site in accordance with a greenhouse gas emissions impacts mitigation plan. At a minimum, the plan must include the list of BMPs planned for implementation at the permitted well site and the first compressor facility receiving the well's production. The operator's greenhouse gas emissions impacts mitigation plan shall be available to NYSDEC upon request.	Greenhouse Gas Emissions (7.6.7)	7-95
Rule Applicable to All High-Volume Hydraulic Fracturing Operations	The operator must construct and operate the site in accordance with a visual impacts mitigation plan that incorporates a range of mitigation practices identified by NYSDEC. The operator's visual impacts mitigation plan shall be available to the Department upon request.	Visual Resources (7.9.4)	7-103 to 106
Rule Applicable to All High-Volume Hydraulic Fracturing Operations	Unless otherwise required by private lease agreement, the access road must be located as far as practical from occupied structures, places of assembly and unleased property.	Noise Impacts (7.10.4)	7-108 to 109
Rule Applicable to All High-Volume Hydraulic Fracturing Operations	The well operator must operate the site in accordance with a noise impacts mitigation plan that incorporates specific practices and, to the extent practicable, local land use policy documents. The operator's noise impacts mitigation plan shall be available to NYSDEC upon request. Additional, site-specific noise mitigation measures will be added to individual permits if a well pad is located within 1000 feet of occupied structures and places of assembly.	Noise Impacts (7.10.4)	7-109
Rule Applicable to All High-Volume Hydraulic Fracturing Operations Involving Multi-Well Pad Operations	Secondary containment consistent with the objectives SPOTS [Spill Prevention Operations Technology Series] 10 will be required for all tanks larger than 10,000 gallons and for smaller tanks if the tank will be positioned within 500 feet of a primary or principal aquifer, public or private water well, a domestic-supply spring, a reservoir, reservoir stem or controlled lake, watercourse, perennial or intermittent stream, storm drain, wetland, lake, or pond.	Drilling Rig Fuel Tank and Tank Refilling (7.1.3.1); see also Freshwater Wetlands (7.3)	7-27; 7-73

Category of Rule	Mitigation Identified in dSGEIS	Category of Impact Mitigation (dSGEIS Section)	dSGEIS Page
Rule Applicable to All High-Volume Hydraulic Fracturing Operations Involving Multi-Well Pad Operations	Tank filling operations must be manned at the fueling truck and at the tank if the tank is not visible to the fueling operator from the truck.	Drilling Rig Fuel Tank and Tank Refilling (7.1.3.1)	7-27
Rule Applicable to All High-Volume Hydraulic Fracturing Operations Involving Multi-Well Pad Operations	Troughs, drip pads or drip pans will be required beneath the fill port of the tank during filling operations if the fill port is not within the secondary containment.	Drilling Rig Fuel Tank and Tank Refilling (7.1.3.1)	7-27
Rule Applicable to All High-Volume Hydraulic Fracturing Operations Involving Multi-Well Pad Operations	a) Surface water and stormwater runoff must be diverted away from the pit; b) The pit volume is limited to 250,000 gallons, or 500,000 gallons for multiple pits on one tract or related tracts of land; c) Beveled walls (45 degrees or less) are required for pits constructed in unconsolidated materials; d) Sidewalls and bottoms must be free of objects capable of puncturing and ripping the liner; e) Sufficient slack must be provided in liner to accommodate stretching; f) The liner must have a minimum thickness of 30-mil; g) Liners must be installed and seamed in accordance with the manufacturer's specifications; h) The freeboard must be monitored and a minimum freeboard of 2 feet maintained at all times; i) Fluids must be removed and the pit inspected prior to additional use if longer than a 45-day gap in use; and j) Fluids must be removed and the pit reclaimed within 45 days of completing drilling and stimulation operations at last well on pad.	Drilling Fluids (7.1.3.2)	7-30
Rule Applicable to All High-Volume Hydraulic Fracturing Operations Involving Multi-Well Pad Operations in Primary or Principal Aquifer	a) Fluids must be removed within 7 days of drilling/stimulation operations for each well; b) Fluids must be removed immediately if operations are suspended and the site is left unattended at any time; and c) Fluids must be removed within 7 days of completing drilling and stimulation operations at last well on pad.	Flowback Water (7.1.3.4)	7-34 to 35
Rule Applying to All Drilling Operations in the New York City Watershed	Centralized flowback water surface impoundments would be prohibited. This Rule would also apply in all primary and principal aquifers, and in mapped 100-year floodplains.	Protecting the Quality of New York City's Drinking Water Supply; Centralized Flowback Water Surface Impoundments (7.1.11; 7.1.7; 7.7)	7- 64 See also 7-51 and 7-96.

Category of Rule	Mitigation Identified in dSGEIS	Category of Impact Mitigation (dSGEIS Section)	dSGEIS Page
Rule Applying to All Drilling Operations in the New York City Watershed	Operators must remove fluids from any reserve pit or on-site (i.e., well pad) tanks within seven days of completing drilling and stimulation operations at the last well on the pad, or immediately if operations are suspended and the site will be left unattended.	Protecting the Quality of New York City's Drinking Water Supply; Drilling Fluids (7.1.11; 7.1.3.2)	7-64
Rule Applicable within 100-Year Floodplains	NYSDEC will not allow above-ground flowback water piping and conveyances in 100-year floodplains.	Floodplains (7.2)	7-72
Rule Applicable to Multi-Well Pad Operations within 100-Year Floodplains	Within floodplains, because of the length of time that activity may continue at a multi-well pad, a closed-loop tank system will be required instead of a reserve pit for managing fluids and cuttings.	Floodplains (7.2)	7-72
Rule Applicable Within and Adjacent to Wetlands and Wetland Buffers	To the extent practical, fuel tanks for drilling rigs may not be placed within 500 feet of a wetland.	Freshwater Wetlands; Drilling Rig Fuel Tank and Tank Refilling (7.3; 7.1.3.1)	7-73
Rule Applicable to All Operations Involving Liquid Chemical Releases	Hydraulic fracturing additives must be removed from the site if the site will be unattended.	Surface Spills and Releases at Well Pad (7.1.3.3)	7-32
Rule Applicable to All Applications Producing Annular Gas	If annular gas is to be produced, a pressure relieve valve shall be installed in an appropriate manner and set at a pressure approved by the Department.	Annular Pressure Buildup (7.1.4.3)	7-48

Attachment B – Catskill Aqueduct Loading Restrictions



CATSKILL AQUEDUCT LOADING RESTRICTIONS

SPECIALTY VEHICLES

TYPE	GVWR[2] (LBS)	ALLOWED	W/ TIMBER[3] MAT
FIRE TRUCK	56,500	✓	✓
OIL TRUCK	60,600	✓	✓
GARBAGE TRUCK	72,000	✓	✓
CONCRETE MIXER	100,000	✗	✓
OIL TRACTOR TRAILER	120,000	✓	✓

[1] APPROX. LENGTH = 30 FT

[1] APPROX. LENGTH = 28 FT

[1] APPROX. LENGTH = 32 FT

[1] APPROX. LENGTH = 18.5 FT

[1] APPROX. LENGTH = 58 FT

* NOTES:
1. LENGTHS GIVEN ARE FOR SELECT VEHICLES VEHICLES ARE NOT TO SCALE
2. GVWR - GROSS VEHICLE WEIGHT RATING
3. WITH 3FT THICKNESS OF GRAVEL AND 12" X 12" TIMBER MAT, 10 FT LONG

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A Joint Venture

JULY 2008

CATSKILL AQUEDUCT LOADING RESTRICTIONS
TRUCK CRANES
TYPE
GVWR (2) (LBS)
ALLOWED
W/ TIMBER (3) MAT
2 AXLE TRUCK 49,000
(1) APPROX. LENGTH = 28 FT
3 AXLE TRUCK 70,000
(1) APPROX. LENGTH = 28 FT
4 AXLE TRUCK 106,000
(1) APPROX. LENGTH = 33 FT
5 AXLE TRUCK 132,500
(1) APPROX. LENGTH = 47 FT
6 AXLE TRUCK 158,700
(1) APPROX. LENGTH = 60 FT
8 AXLE TRUCK 212,000
(1) APPROX. LENGTH = 64 FT
9 AXLE TRUCK 238,500
(1) APPROX. LENGTH = 68 FT
* NOTES:
1. LENGTHS GIVEN ARE FOR SELECT VEHICLES
VEHICLES ARE NOT TO SCALE
2. GVWR = GROSS VEHICLE WEIGHT RATING
3. WITH 3FT THICKNESS OF GRAVEL AND
12" X 12" TIMBER MAT, 16 FT LONG
DEP
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CATSKILL AQUEDUCT LOADING RESTRICTIONS

CONSTRUCTION VEHICLES

	TYPE	GVWR[2] (LBS)	ALLOWED	W/ TIMBER[3] MAT
WHEEL LOADER	904B	9,800	✓	✓
	966H	52,300	✓	✓
	988H	111,500	✗	✗
	994F	430,900	✗	✗
TRACK LOADER (TRACK)	939C	20,900	✓	✓
	973C	58,100	✓	✓
BACKHOE LOADER		27,100	✓	✓
LOG SKIDDER	WHEEL	39,800	✓	✓
	TRACK	47,300	✓	✓
WHEEL DOZER	814F	47,900	✓	✓
	834H	103,800	✗	✓
	854G	219,100	✗	✗
ARTICULATED TRUCK	725 (E)[4]	49,500	✓	✓
	740 (E)	73,000	✗	✗
	725 (L)[4]	101,000	✓	✓
	740 (L)	157,000	✗	✗
OFF HIGHWAY TRUCK	770 (E)[4]	76,000	✗	✓
	777F (E)	145,000	✗	✗
	770 (L)[4]	157,000	✗	✗
	777F (L)	360,000	✗	✗

[1] APPROX. LENGTH = 30 FT

[1] APPROX. LENGTH = 24 FT

[1] APPROX. LENGTH = 26 FT

[1] APPROX. LENGTH = 25 FT

[1] APPROX. LENGTH = 20 FT

[1] APPROX. LENGTH = 23 FT

[1] APPROX. LENGTH = 36 FT

[1] APPROX. LENGTH = 30 FT

* NOTES:
1. LENGTHS GIVEN ARE FOR SELECT VEHICLES VEHICLES ARE NOT TO SCALE
2. GVWR - GROSS VEHICLE WEIGHT RATING
3. WITH 3FT THICKNESS OF GRAVEL AND 12" X 12" TIMBER MAT, 10 FT LONG
4. E = EMPTY, L = LOADED

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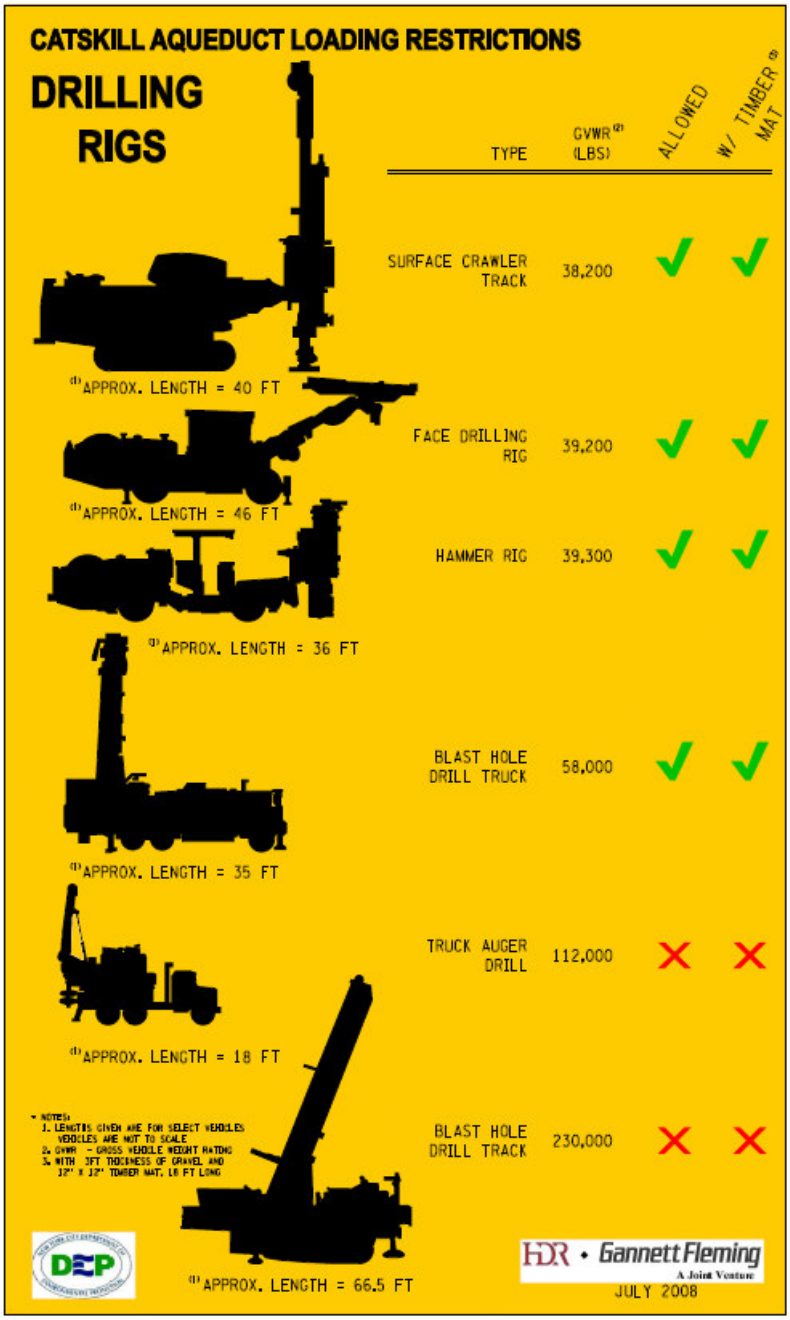
CATSKILL AQUEDUCT LOADING RESTRICTIONS
DRILLING RIGS
TYPE
GVWR (2) (LBS)
ALLOWED
W/ TIMBER (3) MAT
SURFACE CRAWLER TRACK
38,200
(1) APPROX. LENGTH = 40 FT
FACE DRILLING RIG
39,200
(1) APPROX. LENGTH = 46 FT
HAMMER RIG
39,300
(1) APPROX. LENGTH = 36 FT
BLAST HOLE DRILL TRUCK
58,000
(1) APPROX. LENGTH = 35 FT
TRUCK AUGER DRILL
112,000
(1) APPROX. LENGTH = 18 FT
BLAST HOLE DRILL TRACK
230,000
(1) APPROX. LENGTH = 66.5 FT
* NOTES:
1. LENGTHS GIVEN ARE FOR SELECT VEHICLES
VEHICLES ARE NOT TO SCALE
2. GVWR - GROSS VEHICLE WEIGHT RATING
3. WITH 3FT THICKNESS OF GRAVEL AND
12" X 12" TIMBER MAT, 16 FT LONG
DEP
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Attachment C – Impacts of Road Maintenance

The impact of road maintenance on vehicle operating costs

This example analyzes the impact of road maintenance on VOCs using data from 33 countries. It compares a limited number of potential road maintenance strategies against a base case consisting of routine maintenance only (that is, off-carriageway work). The four maintenance strategies evaluated are:
• Patching, plus 5 cm overlays when surface roughness reaches 6.0 international roughness index (IRI) meters per kilometer (m/km).

- Patching, plus 5 cm overlays when surface roughness reaches 5.0 IRI (m/km).
- Patching, plus 5 cm overlays when surface roughness reaches 4.0 IRI (m/km).
- Patching, plus 5 cm overlays when surface roughness reaches 3.0 IRI (m/km).

The evaluation looked at these strategies over a 50-year period during which traffic was assumed to grow at 3 percent per year. The benefits and costs of each option were calculated using a 12 percent discount rate.

The results are summarized below for roads in fair condition for average daily (two-way) traffic (ADT) volumes of 300, 1,000, 3,000, and 10,000 vehicles per day (vpd). Thirty percent of the traffic consists of trucks with medium loading (that is, the loading corresponds to the average loading for the 33 countries included in the analysis). To make the tables understandable to a wider audience, expenditures on maintenance and VOC savings have been expressed as equivalent annual discounted outlays divided by savings, rather than as total net present value. The benefit-cost ratio thus shows the equivalent annual (discounted) payoff from each strategy.

Road maintenance is shown to be highly cost-effective, with equivalent annual benefit-cost ratios that vary from 1.4 when traffic volumes are 300 vpd to 44.8 when traffic volumes are 10,000 vpd. That is, each equivalent annual dollar spent on maintenance saves at least $1.4 per year in VOCs (with 300 vpd) and as much as $44.8 per year (with 10,000 vehicles per day).

	ADT = 300 vpd				Fair condition, ADT = 1,000 vpd			
Strategy:	1	2	3	4	1	2	3	4
Increased maintenance (dollars per year)[a]	2.39	4.83	7.96	10.15	2.72	4.94	8.04	10.13
VOC savings (dollars per year)[b]	3.32	4.74	5.88	6.15	12.48	16.83	20.69	21.59
Benefit-cost ratioc	1.39	0.98	0.74	0.61	4.59	3.41	2.57	2.13
Net present value (millions of dollars)	8.69	–0.85	–19.31	–37.26	90.73	110.63	117.62	106.59
Incremental benefit-cost	n.a.	0.58	0.37	0.12	n.a.	2.04	1.24	0.43

	ADT = 3,000 vpd				ADT = 10,000 vpd			
Strategy:	1	2	3	4	1	2	3	4
Increased maintenance (dollars per year)[a]	4.07	5.82	8.42	10.51	3.88	5.68	8.32	10.08
VOC savings (dollars per year)[b]	56.02	67.26	78.05	80.86	173.83	213.54	250.51	258.79
Benefit-cost ratio[c]	13.76	11.55	9.27	7.69	44.84	37.60	30.13	25.69
Net present value (millions of dollars)	483.14	571.40	647.64	654.28	1,580.7	1,933.31	2,252.68	2,313.33
Incremental benefit-cost	n.a.	6.42	5.16	1.34	n.a.	22.06	14.00	4.71

n.a. Not applicable.
a. Equivalent annual VOC savings attributable to increased maintenance spending.
b. Equivalent annual expenditures in addition to routine maintenance.
c. VOC savings divided by spending on increased maintenance.

Source: General Review: Heggie, Ian G. and P. Vickers. 1998. Commercial Management and Financing of Roads. Technical Paper 409, World Bank, Washington, DC.