Testimony of Carter H. Strickland, Jr.
Commissioner, New York City Department of Environmental Protection

Committee on Environmental Protection
Council of the City of New York

Oversight - Examination and Discussion of NYC Department of Environmental Protection's Comments on NYS Department of Environmental Conservation's Revised Draft Supplemental Generic Environmental Impact Statement on High Volume Hydraulic Fracturing

Friday, February 17, 1 pm
250 Broadway

Good afternoon, Chairman Gennaro and Members. I am Carter Strickland, Commissioner of the New York City Department of Environmental Protection (DEP). Thank you for the opportunity to testify today on DEP's comments on the New York State Department of Environmental Conservation's (DEC's) Revised Draft Supplemental Generic Environmental Impact Statement (RDSGEIS) on high volume hydraulic fracturing and New York City's (the City's) drinking water infrastructure. I also want to thank you, Mr. Chairman, for your vigorous advocacy in protecting the invaluable resources and system that provide the highest quality drinking water in the nation to New York City every day. I am joined today by Dr. Kimberlee Kane, Special Assistant for Watershed Protection Programs in the Bureau of Water Supply.

When Deputy Commissioner Paul Rush testified before this committee last September, DEP was reviewing the draft study it had commissioned to better understand potential impacts to the water supply infrastructure posed by high volume hydraulic fracturing (high volume hydrofracking). In January 2012, DEP submitted its comment letter on the RDSGEIS to DEC along with the technical report that is the subject of this hearing. Both the comment letter and the technical report are posted on our website.

As Deputy Commissioner Rush testified, we are very pleased that DEC proposed banning high volume hydrofracking in the watershed, which addressed many of the concerns we raised in 2009. Given the ban, our January 2012 comments focus on the potential impacts to the City's water supply infrastructure, particularly our dams and tunnels. Protecting that infrastructure is just as critical as protection of the watershed itself; both are critical elements of the City's water supply.

Before I speak about our infrastructure, however, I'd like to comment on one aspect of the ban on drilling within the New York City drinking water watershed. The City strongly supports the proposed ban on high volume hydrofracking, which will prevent industrialization of the watershed that supplies water to nine million New York State residents.

The City previously understood this environmental review to apply to all horizontal drilling and all hydrofracking, but based on recent conversations with DEC staff we now understand it to be limited to high volume hydraulic fracturing (both horizontal and vertical) and not to low volume hydraulic fracturing (LVHF), whether horizontal or vertical. DEC defines high volume hydraulic fracturing based on water usage and designates high volume as using more than 300,000 gallons per well. DEC's position is that low volume hydraulic fracturing, using less than 300,000 gallons per well, is already covered under the 1992 GEIS. While DEC has stated that it does not believe LVHF will occur in New York State to any significant degree, DEP remains concerned that LVHF wells could prove economically viable along the edges of the watershed – particularly if they can be re-fracked – because of their close proximity to productive areas outside of the watershed that may be developed with high volume horizontal wells. LVHF in the watershed, if it were in fact to occur, could have significant adverse impacts that were not considered in the 1992 GEIS. For these reasons, we have requested that the Final SGEIS commit to further environmental review in the event that there is any indication that LVHF may take place, beyond an occasional isolated instance, in the New York City watershed.

Returning to the RDSGEIS and the issue of water supply infrastructure, in preparation for our comments on the RDSGEIS, we hired Hager Richter Geosciences to evaluate the risk to our infrastructure, review our past

recommendations and assess the protections proposed in the RDSGEIS. Hager-Richter (H-R) is an engineering and geophysical services company in the northeastern U.S. H-R provides a broad range of geophysical services for geotechnical engineering, environmental, and water supply projects.

The major findings of their technical report are:

- The region around the tunnels is more faulted and fractured than the RDSGEIS discloses and analyzes, and some of these faults cross our tunnels. Also, subsurface faults may exist underground without any surface expression.

- Microseismicity (defined as less than 1 on the Richter scale) from hydrofracking is not likely a threat to the tunnels. But induced earthquakes (1–3 on the Richter scale) generated from subsurface migration of fluids could pose a risk to the tunnels' unreinforced concrete liners, potentially causing liner collapse, leaks, and less efficient transport, but not catastrophic tunnel collapse. Induced earthquakes from injection wells are a well-known phenomenon; however, induced earthquakes directly linked to hydrofracking have only recently been confirmed in reports from England and Oklahoma.

- H-R concurred that the RDSGEIS 1,000-foot infrastructure buffer is inadequate, and that the previous statistical model used to develop the seven-mile buffer recommendation is a reasonable approach.

- H-R did not specify an appropriate infrastructure buffer distance and stated that what constitutes an acceptable level of risk of damage to the critical water supply infrastructure is a matter of policy, not geophysics.

We need to develop protections for critical resources like the City's water supply infrastructure while balancing the needs for new energy sources and economic growth. Based on our independent expert review of the risks of high volume hydrofracking and the City's analysis of the potential consequences to our infrastructure, including the time and cost of repairing liner collapse in our tunnels,

the City is recommending a hybrid approach that retains our initial seven-mile buffer recommendation but with some modifications. I will outline our conclusions regarding buffers around infrastructure first and around dams second. Our comments took into account both the risks and the potential consequences of impacts from high volume hydrofracking near our infrastructure.
In our January 2012 comments, the City recommended the following:

- A seven-mile Infrastructure Exclusion Zone, where no high volume hydrofracking would be permitted, around the Delaware and Catskill Aqueducts that begin at the Rondout and Ashokan Reservoirs, respectively. These two aqueducts currently carry 100% of the water to New York City. Even non-catastrophic leaks or liner collapse would have significant consequences for DEP's ability to meet in-city and upstate water demand, and would be expensive and time consuming to repair.

- A two-mile Infrastructure Exclusion Zone around other tunnels overlying the Marcellus shale deposits (East Delaware Tunnel, West Delaware Tunnel, Neversink Tunnel) because damage to one of those tunnels would affect the City's ability to access water from only a single reservoir. DEP's water supply system has the flexibility to withstand an outage of these tunnels during a repair process.

- An Infrastructure Enhanced Protection Zone between two and seven miles around the tunnels. All drilling applications within the Infrastructure Enhanced Protection Zone should require site specific review of proposed high volume hydrofracking wells, additional permit conditions, and the City's approval.

- Both the Infrastructure Exclusion Zone and the Infrastructure Enhanced Protection Zone should be measured from the tunnel to the tip of the lateral well bore, rather than from the well pad.

This proposal would put an additional 327 square miles off limits to drilling in the Marcellus Shale in addition to the watershed ban. However, 15% of this area (50

sq. mi.) would already be protected by other proposed prohibitions (that is, the area is within State parks or other State land, or is within a primary aquifer), meaning that the net impact is 277 square miles, or an additional 1.5% of the total area of Marcellus Shale deposits in New York State.

With regard to our dams, the SGEIS proposed a 4,000-foot no-drill buffer, measured from a well pad, around the City watershed boundary and the dams. The City completed an assessment of the ability of the dams to withstand seismic events under prior contracts. The potential magnitude of seismic events known to be triggered by high volume hydrofracking (i.e., magnitude of 1–3 on the Richter scale) is well within the ranges that our dams can safely withstand. However, the City is concerned about potential structural impacts to the dams in the situation where a drill pad would be outside of the 4,000-foot buffer around the watershed proposed by DEC, but the horizontal section of the well would extend closer to or even underneath a dam. These concerns include the possibility of migration of high volumes of fluids near our dams, from directions not anticipated in the design of the dams, and other changes to the hydraulic regime.

The City is recommending that a site-specific review be conducted when the horizontal section of the well comes within the 4,000-foot buffer proposed by DEC around any part of the dam. Additional permit conditions within this area should include enhanced subsurface geophysical surveys conducted prior to drilling, and City review and approval of permits.

Taken on the whole, if we add up the City's proposal for a no-drill area – including otherwise unprotected lands in the watershed, the 4,000-foot buffer zone around dams, and the two-mile buffer zone from tunnels and seven-mile buffer zone from major aqueducts – only 1,511 square miles of otherwise unprotected land would be taken out of production at this time. This is 8.1% of New York State's Marcellus shale footprint. Given the significant risks to the water supply from damage to the City's infrastructure and the 50% of the state's residents who depend on our drinking water, the City believes that our proposed measures are reasonable and prudent.

We will continue to discuss our concerns with DEC and work to ensure that the best decisions will be made to protect our water supply and its infrastructure.

Thank you for the opportunity to testify. I would be glad to answer any questions.

RIVERKEEPER

NY's clean water advocate

Testimony of:
Katherine Hudson, Watershed Program Director, Riverkeeper, Inc.

New York City Council
Committee on Environmental Protection

Oversight - Examination and Discussion of NYC Department of Environmental Protection's Comments, Entitled "Geophysical Evaluation of Infrastructure Risks of Natural Gas Production on New York City West of Hudson Water Supply Infrastructure," to the NYS Department of Environmental Conservation (DEC) Regarding DEC's Revised Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program.

February 17, 2012

Thank you to the New York City Council Committee on Environmental Protection for the opportunity to testify concerning the threats to New York City's (NYC) drinking water supply posed by the New York State Department of Environmental Conservation's (DEC) proposal, embodied in its 2011 revised draft Supplemental Generic Environmental Impact Statement (SGEIS) and draft regulations, to move forward with shale gas extraction by means of high-volume hydraulic fracturing (HVHF or hydrofracking) in New York.

Riverkeeper is a member-supported watchdog organization whose mission includes safeguarding the environmental, recreational and commercial integrity of the Watershed that provides NYC its drinking water. Riverkeeper is actively involved in advocacy and public education surrounding the issue of shale gas extraction via hydrofracking, in particular because of its potential impacts on New York's water supply.

As you know, the comment period has closed on the SGEIS, and DEC is currently reviewing more than 60,000 comments, an unprecedented number. Riverkeeper submitted detailed technical and legal comments, many of which specifically address the threats to NYC's Watershed and water supply. DEP likewise submitted comments, some of which propose added protections to DEC's regulatory scheme. We commend DEP for the strong recommendations it has made, but we remain concerned that they do not go far enough and fail to fully address some significant threats to the water supply.

Despite the volume of comments, DEC has, within the last few days, announced that it plans to finalize the SGEIS by this spring. It is therefore crucial for the City Council, for DEP and for us all to continue to urge DEC now to make significant changes to the SGEIS and regulations so that the FGEIS will be sufficiently protective of the NYC Watershed and drinking water supply.

I. DEP's Revised Recommendations Fail to Fully Mitigate the Risks of Hydrofracking to NYC's Drinking Water and Filtration Avoidance Determination

The Catskill/Delaware portions of the NYC Watershed provide pristine drinking water to nine million New Yorkers – almost half of the state's population. This Watershed is one of only five urban systems in America for which the U.S. Environmental Protection Agency (EPA) has granted a filtration avoidance determination (FAD) under the Safe Drinking Water Act because of its high quality source water. Avoiding filtration saves NYC billions of dollars in capital expenditures and millions of dollars in operations and maintenance costs each year.

NYC's FAD is currently undergoing mid-term review by the Department of Health (DOH), which has been granted primacy from EPA to oversee the FAD. An unacceptable level of risk posed by HVHF could lead DOH and EPA to withdraw the City's filtration waiver. In its 2011 comments to DEC, DEP identifies just such a risk: "[e]ven with a robust regulatory program in place, and a diligent HVHF operator, failures due to human error or natural disaster are inevitable."[1]

As a part of its deliberations over what comments and recommendations to make to DEC on the 2011 SGEIS and draft regulations, DEP should have consulted with DOH and EPA concerning what risks associated with DEC's proposal might pose a threat to its filtration waiver. Based on DEP's 2011 comments, it does not appear that that consultation took place, or if it did, that it informed DEP's recommendations. Instead, it appears that DEP based its revised recommendations on an attempt to balance providing adequate protection with attempting to not unduly limit the potential for drilling in the vicinity of the Watershed and its infrastructure. Based on that balancing, even though it concluded that a uniform width buffer would be "a reasonable approach," DEP decided to narrow the seven-mile buffer around its infrastructure to two miles for all but two of its aqueducts and tunnels, because "DEP's water supply system has the flexibility to withstand an outage of these tunnels."[2]

Why should the agency charged with the responsibility for protecting the invaluable resource of NYC's drinking water for nine million people choose to put it at risk in order to not unduly restrict drilling by a few oil and gas companies, particularly as DEP admits that there is a "lack of detailed subsurface information and research on the potential impacts on this type of infrastructure"?[3] Instead, it would seem that DEP's responsibility to protect, as well as to avoid undue risk that might threaten the FAD, would mandate a precautionary rather than a balancing approach. Such a precautionary approach would provide a firm basis for its seven-mile, uniform width buffer until more information was available that would prove that a smaller buffer would be sufficiently safe.

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[1] Letter from Carter Strickland, Commissioner, DEP to Joseph Martens, Commissioner, DEC, Jan. 11, 2012 (DEP's 2012 Comments) at 3, *available at* http://www.nyc.gov/html/dep/pdf/natural_gas_drilling/nycdep_comments_on_rdsgeis_for_hvhf_20120111.pdf.

[2] *Id.* at 11-12.

[3] *Id.* at 11.

Riverkeeper urges DEP to revisit its recommendations, taking a precautionary approach. To adequately protect NYC's drinking water supply, DEP should not back off its original recommendation of a seven-mile buffer. DEP's willingness to take on a certain level of risk in the absence of critical information, its attempt to balance maximizing the potential for drilling against adequate protection, and its effort to justify the sacrifice of non-terminal tunnels as "an acceptable level of risk"[4] potentially threatens the City's filtration waiver. By modifying its previous, well-founded recommendations, DEP is shirking its duty to its customers to serve the interests of the gas industry.

II. Potential Dangers Hydrofracking Poses to the NYC Drinking Water Supply Watershed that DEP's Revised Recommendations Fail to Adequately Address.

This testimony is focused on five fundamental flaws in the SGEIS and regulations that pose a major threat to the NYC Watershed and DEP's response to those flaws, specifically DEC's failure to ban: (1) horizontal drilling and hydrofracking underneath the Watershed; (2) hydrofracking in the Watershed involving less than 300,000 gallons of water (deemed by DEC to be low-volume hydraulic fracturing); (3) hydrofracking adjacent to Watershed infrastructure; (4) water withdrawals within the Watershed; and (5) pipelines and other gas-related infrastructure within the Watershed. We have appended to this testimony Riverkeeper's individual comments on the SGEIS, which focus specifically, and in greater detail, on these and other potential threats to the NYC Watershed.

1. DEC allows high-volume hydrofracking underneath the Watershed.

The proposed draft HVHF regulations ban only "HVHF on the ground surface" within 4,000 feet of the NYC Watershed.[5] However, horizontal drilling can extend over a mile (5,280 feet) underground thus leaving the Watershed and critical Watershed infrastructure vulnerable to the dangers of methane migration, hydrofracking fluid contamination, and seismic events, among others. The only change to DEC's surface drilling ban that DEP proposed was to recommend a heightened review whenever a horizontal well-bore comes within the 4,000 foot buffer proposed by DEC around any part of a dam.[6] In that case, DEP requests a site-specific review to be conducted and City review and approval of any permit.[7] Riverkeeper urges instead that both DEP and the City Council advocate for a true HVHF ban in and within 4000 feet of the Watershed, measured from the end of the closest horizontal well bore to prevent hydrofracking in and underneath the Watershed and its fragile infrastructure.

2. DEC allows low-volume hydrofracking within the Watershed.

DEC's proposed regulations allow what DEC arbitrarily deems "low-volume" hydrofracking (utilizing less than 300,000 gallons of water) within the Watershed. Given that low-volume hydrofracking uses the same chemicals and processes as high-volume hydrofracking, it poses the similar risks to the water supply. DEP notes in its 2012 comments

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[4] *Id.* at 11.
[5] *See* 33 N.Y. State Reg. 39, at 17 (Sep. 28, 2011) (to be codified at 6. N.Y.C.R.R. § 750-3.3(b)(1)).
[6] DEP's 2012 Comments at 5.
[7] *Id.*

that high-volume hydrofracking near the Watershed could inadvertently provide incentive for low-volume hydraulic fracturing within the Watershed.[8] Pipelines and other auxiliary facilities constructed within and around the Watershed to facilitate high-volume hydrofracking can also facilitate low-volume wells, making natural gas production within the Watershed financially feasible. In response to this concern, DEP only requests that DEC make a commitment to "consider whether further environmental review is necessary" in the event that there is any indication that LVHF may take place in the Watershed "beyond an occasional isolated instance."[9] To prevent contamination, Riverkeeper urges the City Council to advocate instead for a ban on all hydrofracking, regardless of the volume used, within or near the Watershed.

3. DEC allows drilling adjacent to NYC water supply infrastructure.

Much of NYC's water supply infrastructure (the aqueducts, tunnels, and dams that deliver the water) is located west-of-the-Hudson, directly atop the Marcellus Shale, and falls outside of the boundaries of the Watershed. Despite the well-known susceptibility of this aging and already leaking infrastructure, DEC has proposed virtually no protection. There are at least two major risks from drilling on or around water supply infrastructure: (1) the threat that seismicity from drilling activities could jeopardize the stability of the tunnels themselves; and (2) the threat that hydrofracking fluids or other contaminants could migrate from drilling sites into the tunnels via small cracks or fissures in the tunnel walls – potentially contaminating NYC's drinking water.

DEC calls for only a site-specific review for any well pad proposed within a 1,000-foot wide corridor surrounding a water tunnel or aqueduct, which would allow gas drillers to obtain a permit to drill directly adjacent to and underneath those tunnels and aqueducts.[10] In its 2009 comments, DEP requested a seven-mile buffer around all Watershed infrastructure.[11] In its 2012 comments, however, DEP compromised its earlier recommendation and proposed a hybrid approach "to mitigate the significant adverse consequences that could arise from HVHF near deep rock tunnels and other infrastructure."[12] It has recommended three levels of protection: (i) a seven-mile buffer around the Delaware and Catskill Aqueducts, which carry water from terminal reservoirs; (ii) a two-mile buffer on non-terminal reservoir tunnels; (iii) and an "infrastructure enhanced protection zone" that will cover the area between two to seven-miles on either side of the non-terminal reservoir tunnels.[13] In this "enhanced protection zone," DEP proposes that a site-specific review and the City's approval be required and that when drilling is permitted within that zone, additional permit conditions should be included "to provide the City

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[8] *Id.* at 4.
[9] *Id.* at 4.
[10] RDSGEIS at 7-68.
[11] DEP, 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 (DEP's 2009 Comments) at 38 (2009), *available at* http://www.nyc.gov/html/dep/pdf/natural_gas_drilling/nycdep_comments_final_12-22-09.pdf.
[12] DEP's 2012 Comments at 2.
[13] *Id.* at 2, 12.

and DEC the ability to make informed site-specific determinations about the safety of allowing a particular well to be drilled within this distance, rather than relying on a blanket prohibition."[14]

DEP noted in its comments that the close proximity of drilling could cause catastrophic damage to infrastructure due to "direct penetration, differential pressures, seismic activity, and impacts from migration of fluids and/or gas."[15] DEP admits in its comments that there are no examples of "deep rock tunnels in other areas of the country (or world) where HVHF is occurring" and there is no current science adequate to determine the necessary buffers around the infrastructure.[16] Despite this, DEP indefensibly backs off the seven-mile buffer zone it previously recommended, while at the same time admitting that it does not have "the expertise or staffing to review the tremendous quantities of technical data" that will be included in well applications and asserting that NYC and upstate water ratepayers should not bear the expense.[17] New York State should not become the testing ground for hydrofracking near our infrastructure. Our water is too important. Riverkeeper continues to advocate for the seven-mile buffer that DEP originally called for, in all areas, to protect critical Watershed infrastructure and prevent catastrophic harm, and for maintaining that buffer until more data is collected and additional studies are completed that demonstrate that a smaller buffer would provide sufficient protection.

4. DEP's 2009 Comments Concerning Water Withdrawals from the Watershed Remain Valid

The RDSGEIS estimates that HVHF will result in a "peak *annual* fresh water usage for high-volume hydraulic fracturing of 9 billion gallons," or over 24 MGD on average.[18] Yet the RDSGEIS does not estimate the volume of water to be withdrawn from the NYC Watershed, nor does it consider the effects that such withdrawals could have on the drinking water of over 9 million people.[19] The RDSGEIS proposes, as the only mitigation measure, its draft water withdrawal regulations,[20] but these regulations are inadequate to protect the NYC Watershed. DEC's water withdrawal regulations allow water withdrawal from the NYC Watershed for use in hydrofracking anywhere within or outside of the state.[21] Impacts of such withdrawals could reduce inflow to NYC reservoirs, reduce available supplies, and decrease the probability of refilling reservoirs prior to drawdown. These withdrawals could also strain reservoirs that are required to release water to meet minimum flow requirements to protect downstream users, aquatic habitat and biota.[22]

DEP advocated in 2009 for DEC to implement a system that requires gas drillers to obtain permits that "include appropriate monitoring, enforcement, and control mechanisms such as curtailment of withdrawals during low flow conditions or if withdrawals adversely impact

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[14] *Id.* at 12.
[15] *Id.* at 5.
[16] *Id.* at 4.
[17] *Id.* at 12 n. 23.
[18] RSDGEIS at 6-10 (emphasis in original).
[19] *Id.*
[20] RDSGEIS at 7-2 to -4; Water Withdrawal Permit, Reporting and Registration Program, 33 N.Y. State Reg. 47, at 8 (Nov. 23, 2011) (to be codified at 6. N.Y.C.R.R. § 601, 621).
[21] 33 N.Y. State Reg. 47, at 8 (Nov. 23, 2011) (to be codified at 6. N.Y.C.R.R. § 601, 621).
[22] *Id.*

existing uses," among other mechanisms.[23] Riverkeeper is likewise opposed to allowing hydrofracking withdrawals from the NYC Watershed, and other drinking watersheds, that could potentially affect critical drinking water supplies.

5. DEP Failed to Address the Potential for Impacts from Construction of Pipelines and Other Gas Infrastructure in the Watershed

Pipeline and compressor station development is of particular concern because it is not banned within the NYC Watershed and the impacts of construction activities alone associated with building pipelines and facilities (such as stormwater runoff as well as contamination from accidents) may be significant. Riverkeeper urges the City Council to advocate for a ban on all ancillary facilities within the Watershed.

III. Conclusion

We reiterate that protecting the NYC Watershed from hydrofracking is vital; merely the threat of contamination could cause EPA and DOH to annul the FAD, costing the city, and in turn the NYC ratepayers, billions of dollars. We urge the City Council to join us in advocating for full protection of the NYC Watershed, by urging DEC to prohibit any hydrofracking in or underneath this area or within seven miles of its infrastructure.

Riverkeeper thanks the City Council Committee on the Environment for the opportunity to participate in today's hearing and for the important role that the Committee and the City Council continue to play on the issue of hydrofracking in New York State. We look forward to continuing to work with the City Council on this area of significant environmental concern.

Contact:

Katherine Hudson, Riverkeeper, Inc., 914-422-4410, khudson@riverkeeper.org

[23] DEP's 2009 Comments at 17.

RIVERKEEPER.
NY's clean water advocate

Attn: dSGEIS Comments
New York State Department of Environmental Conservation
625 Broadway
Albany, NY 12233-6510

January 11, 2012

Dear Sir or Madam:

Riverkeeper, Inc. (Riverkeeper) submits these additional, New York City (NYC) Watershed-specific comments to the New York State Department of Environmental Conservation (NYSDEC) on the Revised Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas, and Solution Mining Regulatory Program (RDSGEIS) and draft high-volume hydraulic fracturing (HVHF) regulations.

Riverkeeper is a member-supported watchdog organization whose mission includes safeguarding the environmental, recreational and commercial integrity of the Watershed that provides drinking water to nine million NYC and Hudson Valley residents. Riverkeeper is actively involved in advocacy and public education surrounding the issue of shale gas extraction via HVHF (also referred to as fracking), in particular because of its potential impacts on New York's drinking water supply.

Riverkeeper, the Natural Resources Defense Council (NRDC), Earthjustice, Inc. (Earthjustice), Catskill Mountainkeeper, and Delaware Riverkeeper Network have submitted over 500 pages of joint technical comments prepared by a team of leading national environmental review and scientific experts (Louis Berger Group, Inc., Harvey Consulting, LLC, Dr. Tom Myers, Dr. Glenn Miller, Dr. Ralph Seiler, Dr. Susan Christopherson, Meliora Environmental Design, Kevin Heatley, Dr. Kim Knowlton, Dr. Gina Solomon, and Briana Mordick) under separate cover. We are also submitting separately detailed legal and policy comments prepared jointly by the above organizations. Both of these joint comment letters are incorporated herein by reference.

After extensive evaluation and technical review, we have concluded that, for the issues identified below and in our joint comments, the RDSGEIS and draft HVHF regulations are so fundamentally flawed that NYSDEC must revise significant portions of the RDSGEIS and draft regulations and make them available for further public comment. Although our joint summary of flaws is more detailed and comprehensive than our discussion below, we submit these additional comments to underscore why we believe that NYSDEC failed to adequately analyze the potential impacts of HVHF gas development on the NYC Watershed in the RDSGEIS, and as a consequence, has not proposed sufficient protections for the Watershed in either the RDSGEIS or the draft HVHF regulations.

The Catskill/Delaware portions of the NYC Watershed provide pristine drinking water to nine million New Yorkers – almost half the state's population. This Watershed is one of only five urban systems in America for which the U.S. Environmental Protection Agency (EPA) has granted a filtration avoidance determination (FAD) under the Safe Drinking Water Act because of its high quality source water.[1] When drinking water is obtained from surface waters (such as rivers), it is generally "filtered" to remove contaminants. Water obtained from the NYC Watershed is not filtered. Rather, the water is disinfected and distributed by a system of aqueducts, tunnels and pipes to citizens in NYC and upstate communities. Avoiding filtration both allows the City to maintain extraordinarily high quality water and saves NYC billions of dollars in capital expenditures and millions of dollars in operations and maintenance costs each year.

We have focused these comments on six fundamental flaws in the RDSGEIS and regulations that pose a major threat to the NYC Watershed, specifically NYSDEC's failure to: (1) adequately assess the potential impacts of horizontal drilling and HVHF underneath the Watershed; (2) ban drilling in the Watershed involving less than 300,000 gallons of water; (3) fully protect Watershed infrastructure; (4) analyze wastewater issues related to the Watershed; (5) consider water withdrawal issues; and (6) evaluate impacts of gas pipelines and compressor stations in the Watershed. Although these comments address the NYC Watershed, they extend equally to the Syracuse Watershed.

HVHF operations should be prohibited both on the surface of and underneath Watershed lands.

The draft HVHF regulations ban "HVHF on the ground surface" within 4,000 feet of and including the NYC and Syracuse Watersheds.[2] However, horizontal well bores used in HVHF operations can reach over a mile (5,280 feet). NYSDEC's proposed restriction therefore leaves the Watershed vulnerable to horizontal drilling underneath its surface.

As explained in detail in our joint technical comments, the RDSGEIS generally assumes that HVHF deep underground is safe because the geologic layers above the Marcellus shale will prevent contamination of aquifers.[3] However, the RDSGEIS fails to provide sufficient geologic information on these layers, and ignores the potential for existing faults and fractures to expedite contaminant transport. It also ignores studies that show that hydraulic fracturing has inadvertently fractured geologic layers as much as 1,500 feet above the target shale area, thereby providing pathways through the geologic layers and compromising the only mechanism that the RDSGEIS proposes will stop contaminant transport. The RDSGEIS further fails to assess the overall regional impacts of HVHF on the geological characteristics of the shale and the environmental implications, particularly for HVHF operations occurring near the watershed, of those impacts.

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[1] Riverkeeper is a signatory of the 1997 Watershed Memorandum of Agreement ("MOA"), which requires New York City to meet the requirements of the FAD and maintain the quality of its unfiltered drinking water. This FAD is currently undergoing mid-term review, a process in which Riverkeeper is actively involved.

[2] *See* 33 N.Y. State Reg. 39, at 17 (Sep. 28, 2011) (to be codified at 6. N.Y.C.R.R. § 750-3.3(b)(1)).

[3] For a full discussion of this issue, including references to studies, see the technical memorandum drafted by Dr. Tom Myers, appended as Attachment 2 to our joint technical comments.

Specific recommendations for addressing these gaps and deficiencies in the RDSGEIS, including mapping groundwater gradients, requiring seismic surveys of local faults prior to drilling, and groundwater monitoring, are set forth in our technical comments. Given the significance of the risk involved and the value of the NYC Watershed, Riverkeeper also strongly recommends that NYSDEC revise its regulations to ban all HVHF operations underneath Watershed lands. This added protection is particularly imperative because even a perceived risk of water contamination could lead the EPA to retract its filtration avoidance determination.

Low-volume hydraulic fracturing should also be banned within the Watershed.

Although the 2009 DSGEIS suggested that hydraulic fracturing using between 80,000 and 300,000 gallons of water "may be considered high-volume,"[4] NYSDEC excludes such wells from consideration under the RDSGEIS and its draft regulations. The RDSGEIS provides no justification for this change, which leaves the Watershed vulnerable to drilling involving less than 300,000 gallons of water without any additional environmental review. This is particularly concerning in light of the Economic Assessment Report appended to the RDSGEIS that assumes approximately 10% of the gas wells developed in the state may be vertical wells, which typically require less than 300,000 gallons of water.[5] Furthermore, as the City's Department of Environmental Protection (DEP) noted in its RDSGEIS comments, the ban on HVHF in the Watershed could have the unintentional effect of incentivizing lower volume hydraulic fracturing in the area.[6] To ensure adequate protection of the Watershed, NYSDEC should ban all forms of gas drilling within and underneath the Watershed.

NYSDEC should prohibit HVHF operations within seven miles of Watershed infrastructure.

Much of NYC's water supply infrastructure (the aqueducts, tunnels, and dams that deliver the water) is located west-of-the-Hudson, directly atop the Marcellus Shale, but falls outside of the boundaries of the City's Watershed itself. It is therefore not protected by the RDSGEIS' proposed Watershed surface drilling ban. Despite the well-known susceptibility of this aging and already leaking infrastructure, DEC has proposed virtually no protection. The RDSGEIS calls for only a site-specific review for any well pad proposed within a 1,000-foot wide corridor surrounding a water tunnel or aqueduct.[7] There are at least two major risks from drilling on or around water supply infrastructure, including tunnels, dams and aqueducts: (1) a threat that seismicity from drilling activities could jeopardize the stability of the tunnels themselves; and (2) a threat that fracking fluids or other contaminants could migrate from drilling sites into the tunnels via small cracks or fissures in the tunnel walls – potentially contaminating NYC's drinking water.

DEP, which is responsible for this infrastructure, has previously called for a buffer of

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[4] 2009 DSGEIS at 3-5.

[5] Economic Assessment Report for the RDSGEIS, 4-3. This assumption is attributed to the Independent Oil and Gas Association of New York (IOGA-NY).

[6] Letter from Carter Strickland, Commissioner, DEP to Joseph Martens, Commissioner, DEC, Jan. 11, 2012, at 5, *available at* http://www.nyc.gov/html/dep/pdf/natural_gas_drilling/nycdep_comments_on_rdsgeis_for_hvhf_20120111.pdf.

[7] RDSGEIS at 7-68.

seven miles to protect this water supply infrastructure, based on analysis by its own scientists and consultants. The fragility of this infrastructure is apparent from the fact that the water supply tunnels are already compromised; the Delaware Aqueduct has been leaking more than 30 million gallons of water per day (MGD) for more than two decades.

Allowing unsafe HVHF to occur near vulnerable critical water supply infrastructure is a completely unacceptable risk. DEP has stated that "it would take more than a decade for the City to design and build a filtration treatment facility that could protect against the contaminants of concern (if that were even feasible); during these many years, the public health, safety, and welfare of millions of New Yorkers would be at risk."[8] Given the magnitude of the risk involved, NYSDEC should ban all HVHF operations on the surface of and underneath areas within seven-miles of the infrastructure both within and outside the Watershed. Failure to do so could lead the EPA to retract its FAD, which would force New York to attempt to install a filtration system at great cost to NYC ratepayers.

NYSDEC should analyze and suggest mitigation measures for wastewater management and disposal.

As discussed in more detail in our joint legal comments, the RDSGEIS does not adequately address wastewater management and disposal.[9] We raise this point here to note that the RDSGEIS and draft HVHF regulations do not ban wastewater transport or disposal in the watershed. The options that the RDSGEIS sets forth for possible treatment of HVHF wastewater include deep well injection and treatment in municipal or private facilities. Neither of these options are properly analyzed in the RDSGEIS, so the potential significant adverse impacts of each are therefore not examined, nor are possible mitigation measures identified.

Deep well injection is problematic due to the lack of permitted injection wells in New York and the distance the contaminated water would need to be hauled in order to dispose of it in other states where permitted wells exist. Without knowing the location where the waste is to be hauled, it is impossible to ascertain whether HVHF wastewater may be trucked in or near the watershed area. NYSDEC should fully analyze management and disposal options in the RDSGEIS, including the potential impacts of increased truck traffic across long distances and the potential for truck accidents and spills. In particular, the RDSGEIS should evaluate if this waste will be trucked in or near water supply areas, as accidents in those areas could be devastating.

As to the wastewater treatment option, New York currently does not have any municipal or private wastewater treatment plants equipped to treat wastewaters from HVHF operations, so any plant accepting such waste would have to undergo retrofitting and permitting to accept HVHF waste. The RDSGEIS makes no attempt to analyze what plants might undergo this retrofitting, or even have capacity to accept additional fracking waste, but does provide a list, in Appendix 21, of wastewater treatment plants in New York State that have industrial pre-

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[8] Letter from Carter Strickland, Commissioner, DEP to Joseph Martens, Commissioner, DEC, Jan. 11, 2012, at 3, *available at* http://www.nyc.gov/html/dep/pdf/natural_gas_drilling/nycdep_comments_on_rdsgeis_for_hvhf_20120111.pdf.

[9] For a full discussion of this issue, see the technical memorandum drafted by Dr. Glenn Miller, appended as Attachment 3 to our joint technical comments.

treatment programs. Notably, Appendix 21 identifies three wastewater treatment plants within the NYC Watershed (Delhi, Hobart, Walton) and seven treatment plants (Port Jervis, Wallkill, Harriman, Newburgh, Poughkeepsie, Beacon, and Kingston) that, if retrofitted to accept wastes, could potentially require HVHF waste to be transported through the Watershed area.

Ultimately, the state has no idea how the toxic and radioactive wastewater generated will impact the Watershed, or the state generally. Under SEQRA, an EIS must consider the full range of environmental impacts associated with an action, including short term and long term impacts.[10] NYSDEC has not yet met that mandate, and has instead improperly segmented out of its review an analysis of the impacts that the management and disposal of millions of gallons of wastewater will have on both the Watershed and the state as a whole. NYSDEC must remedy this failure by fully analyzing those impacts and identifying appropriate mitigation measures.

The RDSGEIS should analyze the potential impacts of pipelines in the Watershed.

Pipeline and compressor station development is of particular concern because it is not banned within the NYC Watershed. The impacts of construction activities alone associated with building pipelines and facilities (such as stormwater runoff, habitat fragmentation, air pollution, and noise) may be significant and should be evaluated for the state as a whole, and in particular for the NYC Watersheds. This is another example of NYSDEC's improper segmentation of its environmental review, as NYSDEC failed to consider impacts of pipelines and compressor stations that will be needed if HVHF development goes forward.

The RSDGEIS does not analyze the potentially significant impacts of pipelines and compressor stations based on the flawed reasoning that such an analysis is not required because the pipelines would be reviewed under the Public Service Commission's Article VII process. The regulatory review process for pipelines is irrelevant to the environmental review required by SEQRA, which requires state and local agencies to consider all reasonably foreseeable long-term impacts of an action.[11] The draft HVHF SPDES General Permit is also flawed by its failure to address construction of pipelines or compressor facilities, and the corresponding stormwater pollution that will be associated with this development.

This omission also reflects NYSDEC's complete failure to adequately consider cumulative impacts, including the cumulative impacts of developing multiple well pads, pipelines, and compressor stations throughout the state, and in the Watershed, in violation of SEQRA.

The RDSGEIS should analyze the potential threat to the NYC Watershed from water withdrawal for HVHF.

The RDSGEIS estimates that HVHF will result in a "peak *annual* fresh water usage for high-volume hydraulic fracturing of 9 billion gallons," or over 24 MGD on average.[12] Although the RDSGEIS acknowledges the extensive comments NYSDEC received in 2009 regarding

[10] E.C.L. § 8-0109(2).
[11] *Id.*
[12] RSDGEIS at 6-10 (emphasis in original).

potential degradation of NYC's surface drinking water supply, the RDSGEIS does not estimate the volume of water to be withdrawn from the NYC Watershed, nor does it consider the effects such withdrawal will have on the drinking water of over 9 million people.[13]

The RDSGEIS proposes, as the only mitigation measure, its draft water withdrawal regulations,[14] but these regulations are inadequate to protect the NYC Watershed. The water withdrawal regulations as proposed allow water withdrawal from the NYC Watershed for use in HVHF anywhere within or outside of New York State.[15] The regulations also allow water withdrawal from waterbodies outside of and downstream from the NYC Watershed. These withdrawals could require NYC, as a result of Delaware River Basin Compact obligations, to use NYC reservoir water to meet minimum flow requirements, thereby depleting NYC drinking water supplies. HVHF operators may withdraw 2 MGD from such sources without a permit until 2016,[16] and even this limit may be easily thwarted with multiple-owner tanker truck runs

NYSDEC improperly segmented its RDGEIS analysis by failing to address the likelihood and impacts of multi-million-gallon withdrawals for HVHF from both within and outside the NYC Watershed and the threat they pose to NYC's drinking water.[17] These impacts could include withdrawals that will reduce inflow to NYC reservoirs, reduce available supplies, and decrease the probability of refilling reservoirs prior to drawdown. During dry periods, these withdrawals could increase the amount of time spent under drought watch, warning, or emergency conditions. These withdrawals could also strain reservoirs that are required to release water to meet minimum flow requirements to protect downstream users, aquatic habitat and biota.[18] DEC should supplement its RDSGEIS to estimate the probable impacts on NYC's Watershed of the large water withdrawals that would be required for HVHF.

* * *

Although we have not duplicated those comments here, as noted in our joint comments, Riverkeeper is also concerned that the mitigation measures, including buffers and setbacks, proposed for water supplies throughout the state, from primary and principle aquifers to private water wells, are grossly inadequate.

Governor Cuomo has promised that he will not allow fracking to move forward until he has the facts and the science that show it will be safe and a net benefit to New Yorkers. The RDSGEIS fails to give him the information he needs to keep that promise. For the reasons identified in our joint and individual comments, the RDSGEIS and draft HVHF regulations are so fundamentally flawed that NYSDEC must go back and revise significant sections and make them available for further public comment.

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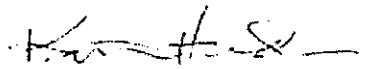
[13] *Id.*
[14] RDSGEIS at 7-2 to -4; Water Withdrawal Permit, Reporting and Registration Program, 33 N.Y. State Reg. 47, at 8 (Nov. 23, 2011) (to be codified at 6. N.Y.C.R.R. § 601, 621).
[15] 33 N.Y. State Reg. 47, at 8 (Nov. 23, 2011) (to be codified at 6. N.Y.C.R.R. § 601, 621).
[16] 33 N.Y. State Reg. 47, at 8 (Nov. 23, 2011) (to be codified at 6. N.Y.C.R.R. § 601.7(b)(2)).
[17] N.Y. CITY DEP'T OF ENVT'L PROT., FINAL IMPACT ASSESSMENT REPORT; IMPACT ASSESSMENT OF NATURAL GAS PRODUCTION IN THE NEW YORK CITY WATER SUPPLY WATERSHED 33-34 (2009).
[18] *Id.*

Thank you for your consideration of these comments.

Sincerely,



Kate Hudson
Watershed Program Director
Riverkeeper, Inc.

APPENDIX B

Prepublication Copy

Myers, T., in review. POTENTIAL CONTAMINANT PATHWAYS FROM HYDRAULICALLY FRACTURED SHALE TO AQUIFERS

POTENTIAL CONTAMINANT PATHWAYS FROM HYDRAULICALLY FRACTURED SHALE TO AQUIFERS

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ABSTRACT

Hydraulic fracturing (fracking) of deep shale beds to develop natural gas has caused concern regarding the potential for various forms of water pollution. Two potential pathways – diffuse transport through bulk media and preferential flow through fractures – could allow the transport of contaminants from the fractured shale to aquifers. There is substantial geologic evidence that natural vertical flow drives contaminants, mostly brine, to near the surface from deep evaporite sources. Interpretative numerical modeling shows that diffuse transport could require up to tens of thousands of years to move contaminants to the surface, but also that fracking the shale could reduce that transport time to tens or hundreds of years. Conductive faults or fracture zones, as found throughout the Marcellus shale region, could reduce the travel time further. Injection of up to 15,000,000 liters of fluid into the shale generates high pressure at the well which decreases with distance from the well and with time after injection as the fluid advects through the shale. The advection displaces native fluids, mostly brine, and fractures the bulk media and widens existing fractures. Simulated pressure returns to pre-injection levels in about 90 days. The overall system requires from three to six years to reach a new equilibrium reflecting the significant changes caused by fracking the shale. The rapid expansion of hydraulic fracturing requires that monitoring systems be employed to track the movement of contaminants and that gas wells have a reasonable offset from faults.

Introduction

The use of natural gas (NG) in the United States has been increasing, with 53 percent of new electricity generating capacity between 2007 and 2030 projected to be with NG-fired plants (EIA 2009). Unconventional sources account for a significant proportion of the new NG available to the plants. A specific unconventional source has been deep shale-bed NG, including the Marcellus shale primarily in New York, Pennsylvania, Ohio, and West Virginia (Soeder 2010), which has seen over 4000 wells developed between 2009 and 2010 in Pennsylvania (Figure 1).Unconventional shale-bed NG differs from conventional sources in that the permeability is so low that gas does not naturally flow in timeframes suitable for development. Hydraulic fracturing (fracking, the industry term for the operation (Kramer 2011)) loosens the formation to release the gas and provide pathways for it to move to a well.

Fracking injects 13 to 19 million liters of fluid consisting of water and additives, including benzene at concentrations up to 560 ppm (Jehn 2010), at pressures up to 69,000 kPa (PADEP 2011) into low permeability shale to force open and connect the fractures. This is often done using horizontal drilling through the middle of the shale. Horizontal wells may be more than a kilometer (km) long. The amount of injected fluid that returns to the ground surface after fracking ranges from 9 to 34 percent of the injected fluid (Alleman 2011; NYSDEC 2009), although some would be formation water.

Many agency violation reports and legal citations (ODNR 2008; PADEP 2009) and peer-reviewed articles (DiGuilio et al. 2011; Osborn et al. 2011; Breen et al. 2007; White and Mathes 2006) have found more gas in water wells near areas being developed for unconventional NG, documenting the source can be difficult. One reason for the difficulty is the different sources – thermogenic for gas formed by compression and heat at depth in shale and bacteriogenic for gas formed by bacteria breaking down organic material (Schoell 1980). The source can be distinguished based on both C and H isotopes and the ratio of methane to higher chain gases (Osborn and McIntosh 2010; Breen et al 2007). Thermogenic

gas can reach aquifers only by leaking from the well bore or by seeping vertically from the source. In either case, the gas must flow through potentially very thick sequences of sedimentary rock to reach the aquifers. Many studies which have found thermogenic gas in water wells found there to be more gas near fracture zones (DiGuilio et al. 2011; Osborn et al. 2011; Thyne 2008; Breen et al. 2007), suggesting that fractures are pathways for gas to move from shale or other deep formations to aquifers.

A pathway for gas would also be a pathway for fluids and contaminants to advect from the fractured shale to the surface, although the time for transport would likely be longer. Two reports (DiGuilio et al. 2011; EPA, 1987) have documented the presence of fracking fluid in aquifers and another found elevated chloride (Thyne 2008), linked to fracking, in wells, although the exact source and pathways had not been determined.

There is sufficient documented gas movement and circumstantial evidence regarding fluids movement to suggest that there is a potential for fracking fluid or shale-bed formation fluid to reach aquifers. With the vastly increasing development of unconventional NG sources, the risk to aquifers could seemingly be increasing. However, there is almost no data concerning the movement of contaminants along pathways from depth, either from wellbores or from deep formations, to aquifers. The only way in the short term to explore the risk is with conceptual analyses.

To consider the potential transport from depth to aquifers, I have considered first the potential pathways for contaminant transport through bedrock between deep shale and surface aquifers, and the necessary conditions for such transport to occur. Second, I have estimated contaminant travel times through the potential pathways, with a bound on these estimates based on formation hydrologic parameters, using interpretative MODFLOW-2000 computations. The modeling does not, and cannot, account for all of the complexities of the geology, which could either increase or decrease the travel

times compared to those considered herein. The intent of this study is to characterize the risk factors, so the modeling is used, similar to that by Hsieh (2011), to consider the possibilities.

The Marcellus shale area of northern Pennsylvania and southern New York is the study area (Figure 1), although the concepts should apply anywhere there is a deep unconventional NG source separated from the surface by sedimentary rock.

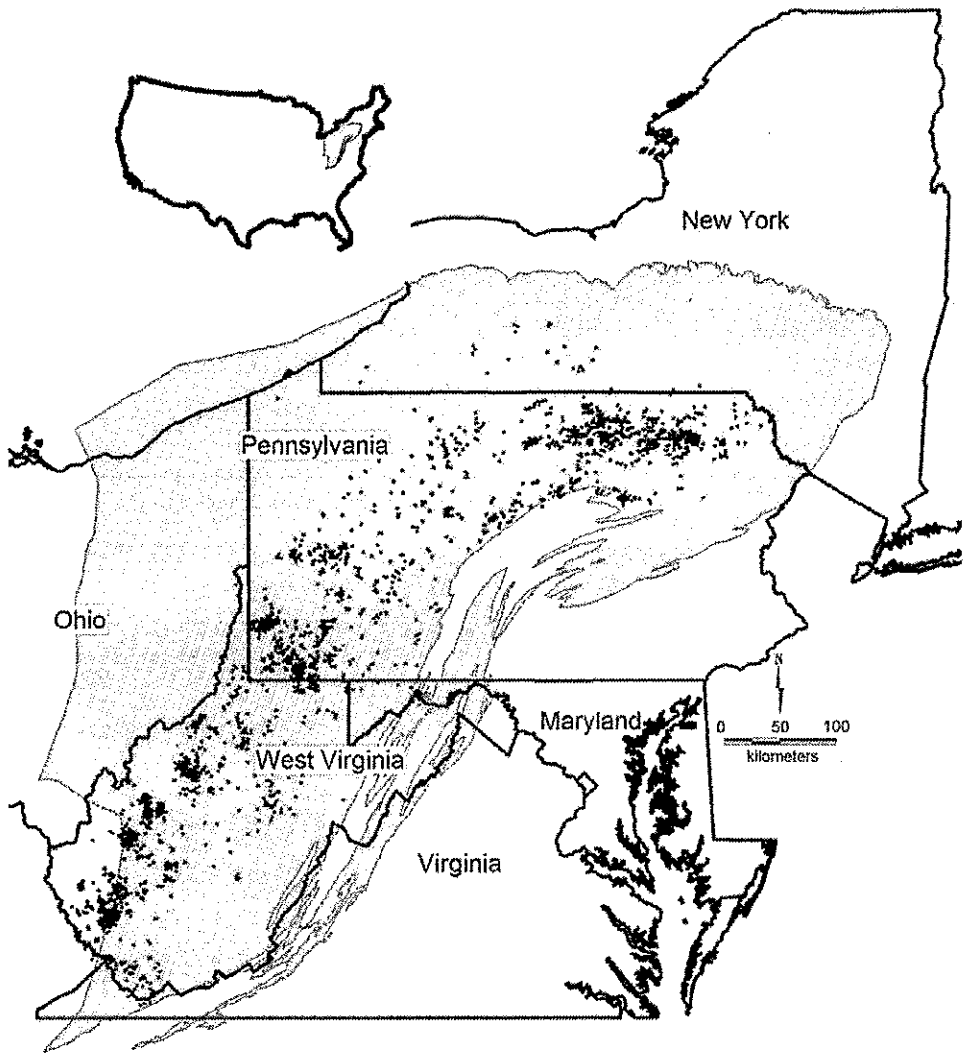

Figure 2: Location of Marcellus shale in northeastern United States. Location of Marcellus wells (dots) drilled July 2009 to June 2010 and total Marcellus shale wells in New York and West Virginia. There are 4064 wells shown in Pennsylvania, 48 wells in New York, and 1421 wells in West Virginia. Faulting in the area may be found in PBTGS (2001), Isachsen and McKendree (1977), and WVGES (2011, 2010a and 2010b).

Method of Analysis

I consider several potential scenarios of transport from shale, 1500 m below ground surface to the surface, beginning with pre-development steady state conditions to establish a baseline and then scenarios considering transport after fracking has potentially caused contaminants to reach the overlying formations. To develop the conceptual models and MODFLOW-2000 simulations, it is necessary first to consider the hydrogeology of the shale and the details of hydraulic fracturing, including details of how fracking changes the shale hydrogeologic properties.

Hydrogeology of Marcellus Shale

Shale is a mudstone, a sedimentary rock consisting primarily of clay- and silt-sized particles, which tend to break in one direction (Nichols 2009). It forms through the deposition of fine particles in a low energy environment, such as a lake- or seabed. The Marcellus shale formed in very deep offshore conditions during Devonian time (Harper 1999) where only the finest particles had remained suspended. Because sufficient organic matter settled with the clay and silt, anaerobic decomposition caused the formation of methane. The depth to the Marcellus shale varies to as much as 3000 m in parts of Pennsylvania, and averages about 1500 m in southern New York. Between the shale and the ground surface are layers of sedimentary rock, including sandstone, siltstone, and shale (NYSDEC 2011).

Marcellus shale has very low natural intrinsic permeability, on the order of 10^{-16} Darcies (Kwon et al. 2004a and 2004b; Neuzil 1994 and 1986), which makes it an extremely efficient seal, or capstone, for keeping natural gas in underlying sandstone. At a gradient equal to 1 with an intrinsic permeability equal to 100×10^{-9} darcies, water would flow only 0.000025 m in a year.

Schulze-Makuch et al. (1999) described Devonian Shale of the Appalachian Basin, of which the Marcellus is a major part, as containing "coaly organic material and appear either gray or black" and being "composed mainly of tiny quartz grains < 0.005 mm diameter with sheets of thin clay flakes". Median

particle size is 0.0069±0.00141 mm with a grain size distribution of <2% sand, 73% silt, and 25% clay. Primary pores are typically 5 x 10^{-5} mm in diameter, matrix porosity is typically 1% to 4.5% and fracture porosity is typically 0.078 to 0.09% (Schulze-Makuch et al. 1999 and references therein).

The Marcellus shale is fractured by faulting and contains synclines and anticlines which cause tension cracks (Engelder et al. 2009; Nickelsen 1986). It is sufficiently fractured in some places to support water wells just six to ten km from where it is being developed for NG at 2000 m below ground surface (bgs) in eastern Lycoming County, Pennsylvania (Lloyd and Carswell 1981) (Figure 2).

Porous flow in unfractured shale is negligible due to the low bulk media permeability, but at larger scales the fractures control and may allow significant flow. Conductivity scale dependency (Schulze-Makuch et al.1999) may be described as follows:

$$K = Cv^m$$

K is hydraulic conductivity (m/s), C is the intercept of a log-log plot of observed K to scale (the K at a sample volume of 1 m^3), V is sample volume (m^3), and m is a scaling exponent determined with log-log regression; for Devonian shale, C equals -14.3 and m equals 1.08 (Schulze-Makuch et al. 1999). Most of their samples were small because the deep shale is not easily tested at a field-scale and no groundwater models have calibrated for flow through the Marcellus shale, therefore field scale K estimates are uncertain. Considering a 1 km square area with 30 m thickness, the Kh would equal 5.96x10^{-7} m/s (0.0515 m/d). This effective K is low and the shale would be an aquitard, but a leaky one.

Contaminant Pathways from Shale to the Surface

Three studies (Osborn et al. 2011; Thyne 2008; Breen et al. 2007) have found gas in near-surface water wells and suggested that the most likely cause was vertical transport of gas from depth, possibly linked to the presence of faults through which the gas could flow. Osborn et al. (2011) found systematic

circumstantial evidence for higher methane concentrations in wells within 1 km of Marcellus shale gas wells that had been fracked. Gas moves through fractures depending their width (Etiope and Martinelli 2001) and is a primary concern for many projects, including carbon sequestration (Annunziatellis et al. 2008) and natural gas storage projects (Breen et al. 2007).

Pathways for gas suggest pathways for fluids and contaminants, if there is a gradient. Vertical hydraulic gradients of a up to a few percent, or about 30 m over 1500 m, exist throughout the Marcellus shale region as may be seen in various geothermal developments in New York (TAL 1981). Brine more than a thousand meters above their evaporite source (Dresel and Rose 2010) is evidence of upward movement of contaminants from depth to the surface. The Marcellus shale, with salinity as high as 350,000 mg/l (Soeder 2010; NYDEC 2009), may be a primary brine source. Relatively uniform brine concentrations over large areas (Williams et al. 1998) suggest widespread diffuse transport, which would occur if there is a sufficient concentration gradient. The transition from briny to freshwater suggests a long-term equilibrium between the upward movement of brine and downward movement of freshwater.

Faults, which occur throughout the Marcellus shale region (Gold 1999), could provide pathways (Caine et al. 1996; Konikow 2011) for more concentrated advective and dispersive transport. Brine concentrating in faults or anticline zones reflects potential preferential pathways (Wunsch 2011; Dresel and Rose 2010; Williams 2010; Williams et al. 1998).

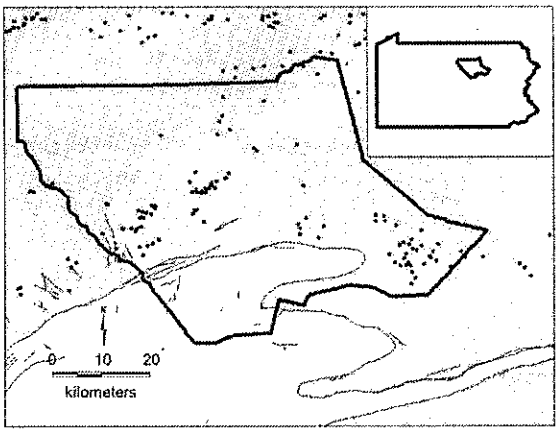

Figure 3: Marcellus shale wells and the Marcellus outcrop in Lycoming County, Pennsylvania. The grey shading is the area of Marcellus shale, which outcrops along its boundary along an area about 1 km wide (Lloyd and Carswell 1981). Faults from PBTGS (2001).

Effect of Hydraulic Fracturing on Shale

Fracking increases the permeability of the targeted shale to make extraction of natural gas economically efficient (Engelder et al. 2009; Arthur et al. 2008). Fracking creates fracture pathways with up to 9.2 million square meters of surface area in the shale accessible to a horizontal well (King 2010; King et al. 2008) and connects natural fractures (Engelder et al. 2009; King et al. 2008). No post-fracking studies that documented hydrologic properties such as conductivity were found while researching this article (there is a lack of information about pre- and post-fracking properties (Schweitzer and Bilgesu 2009)), but it is reasonable to assume the K increases significantly because of the newly created and widened fractures.

Fully developed shale typically has wells spaced at about 300-m intervals (Krissane and Weissert 2011; Soeder 2010). Up to eight wells may be drilled from a single well pad (NYDEC 2009; Arthur et al. 2008), although not in a perfect spoke pattern. Reducing by half the effective spacing did not enhance overall productivity (Krissane and Weissert 2011) which indicates that 300–m spacing creates sufficient overlap among fractured zones to assure adequate gas drainage. The properties controlling groundwater flow

would therefore be affected over a large area, not just at a single horizontal well or set of wells emanating from a single well pad.

Fracking is not intended to affect surrounding formations, but shale properties vary over short ranges (King 2010; Boyer et al. 2006) and out of formation fracking is not uncommon. Fluids could reach surrounding formations just because of the volume injected into the shale, which must displace natural fluid, such as the existing brine in the shale. For example, if 15 million liters is injected into shale over a 1000 m long horizontal well, the fluid could occupy all of the pore spaces within 7 to 16 m from the well for effective porosity ranging from 0.1 to 0.02. Even with 20% of the fluid returning to the well, a significant amount of existing pore space would be occupied by the injected fluid, displacing the existing brine and gas.

Analysis of Potential Transport along Pathways

Fracking could cause contaminant to reach overlying formations either by fracking out of formation, connecting fractures in the shale to overlying bedrock, or by simple displacement of fluids from the shale into the overburden. Advective transport will manifest if there is a significant vertical component to the regional hydraulic gradient. Advective transport can be considered with the simple particle velocity determined with Darcy velocity and effective porosity.

Numerical modeling provides flexibility to consider potential conceptual flow scenarios, but should be considered interpretative (Hill and Tiedeman, 2007). Numerical simulation presented herein was completed with the MODFLOW-2000 code (Harbaugh et al. 2000). The simulation considers the rate of vertical transport of contaminants to near the surface for the different conceptual models, based on an expected, simplified, realistic range of hydrogeologic aquifer parameters.

MODFLOW-2000 is a versatile numerical modeling code, but it is not perfect for all of the factors required for this simulation. The native water at depth near the shale is brine, much saltier than seawater, therefore the injected fluid would be lighter so buoyancy factors may speed the upward flux beyond the simple consideration of hydraulic gradient. As more data becomes available, it may be useful to consider the added upward force caused by the brine by using the SEAWAT-2000 module (Langevin et al. 2003).

Vertical flow would be perpendicular to the general tendency for sedimentary layers to have higher horizontal than vertical conductivity. Fractures and improperly abandoned wells would provide pathways for much quicker vertical transport than general advective transport. This paper considers the fractures as vertical columns with cells having much higher conductivity than the surrounding bedrock. The cell discretization is fine, so the simulated width of the fracture zones is realistic. Dual porosity modeling would not be useful because high velocity vertical flow through the fractures is unlikely. MODFLOW-2000 has a module, MNW (Halford and Hansen 2002), that could simulate flow through open bore holes. Open boreholes would clearly provide rapid transport if the head deep in the borehole exceeds that near the surface or if fractures containing fracking fluid intersect or come close to the borehole. Because it is possible to simply plug open boreholes, I have limited consideration here to fractures; however, models of well fields should include known boreholes.

The thickness of the formations and fault would affect the simulation, but much less than the several-order-of-magnitude variation possible in the shale properties. The overburden and shale thickness were set equal to 1500 and 30 m, respectively, similar to that observed in southern New York. The estimated travel times are proportional for thicker or thinner sections. The overburden could be predominantly sandstone, sections of shale, mudstone, and limestone could exert local control. The vertical fault is assumed to be 6 m thick.

There are five conceptual models of flow and transport of natural and post-fracking transport from the level of the Marcellus shale to the near-surface to consider with an interpretative numerical model.

1. The natural upward diffuse flow due to a head drop of 30 m from below the Marcellus shale to the ground surface, considering the variability in both shale and overburden K. This is a steady state solution for upward advection through a 30-m thick shale zone and 1500-m overburden and is a baseline condition for upward flow through unfractured sedimentary rock.
2. Same as number 1, but with a fracture zone connecting level of the shale with the surface. This emulates the conceptual model postulated for flow into the alluvial aquifers near stream channels, the location of which may be controlled by faults (Williams et al 1998). The fault K varies from 10 to 1000 times the surrounding bulk sandstone K.
3. This scenario tests the effect of extensive fracturing in the Marcellus shale by increasing the shale K from 10 to 1000 times its native value over an extensive area. This transient solution starts with initial conditions being a steady state solution from scenario 1. The K in the shale layers increases from 10 to 1000 times at the beginning of the simulation, to represent the relatively instantaneous change on the regional shale hydrogeology imposed by the fracking. This scenario estimates both the changes in flux and the time for the system to come to equilibrium after fracking.
4. As number 3, considering the effect of the same changes in shale properties but with a fault as in number 2.
5. This scenario simulates the actual injection of 13 to 17 million liters of fluid in five days into fractured shale from a horizontal well with and without a fault.

Model Setup

The model domain was 150 rows and columns spaced at 3 m to form a 450 m square (Figure 3) with 50 layers bounded with no flow boundaries. The 30-m thick shale was divided into 10 equal thickness layers from layer 40 to 49. The overburden layer thickness varied from 3 m just above the shale to layer 34, 6 m layer 29, 9 m to layer 26, 18 m in layer 25, 30 m to layer 17, 60 m to layer 6, 90 m to layer 3, and 100 m in layers 2 and 1

The model simulated vertical flow between constant head boundaries in layers 50 and 1, as a source and sink, so that the overburden and shale properties control the flow. The head in layers 50 and 1 was 1580 and 1550 m, respectively, to create an upward gradient of 0.019 over the profile. Varying the gradient would have much less effect on transport than changing K over several orders of magnitude and was therefore not done.

This simulation considers particle travel times between the top of the shale and the top of the model domain based on an effective porosity of 0.1. A 6-m wide fault is added for some scenarios in the center two rows from just above the shale, layer 39 to the surface. The fault is an attempt at considering fracture flow, but the simulation treats the six meter wide fault zone as homogeneous, which could underestimate the real transport rate in fracture-controlled systems. The simulation also ignores diffusion between the fracture and the adjacent shale matrix (Konikow, 2011).

Scenario 5 simulates injection using a WELL boundary in layer 44, essentially the middle of the shale, from columns 25 to 125 (Figure 3). It injects 15 million liters over one 5-day stress period, or 3030 m^3/d into 101 model cells at the WELL. The modeled shale K was changed to its assumed fracked value at the beginning of the simulation. Simulating high rate injection generates very high heads in the model domain, similar to that found simulating oil discharging from the well in the Deepwater Horizon crisis (Hsieh, 2011) and water quality changes caused by underground coal gasification (Contractor and El-

Didy 1989). DRAIN boundaries on both sides of the WELL simulated return flow for sixty days after the completion of (Figure 3), after which the DRAIN was deactivated. The sixty days were broken into four stress periods, 1, 3, 6, and 50 days long, to simulate the changing heads and flow rates. DRAIN conductance was calibrated so that 20% of the injected volume returned within 60 days to emulate standard industry practice (Alleman 2008; NYSDEC 2009). Recovery, continuing relaxation of the head at the well and the adjustment of the head distribution around the domain, occurred during the sixth period which lasted for 36,500 days, a length of time that simulation of scenarios 3 and 4 indicated would suffice.

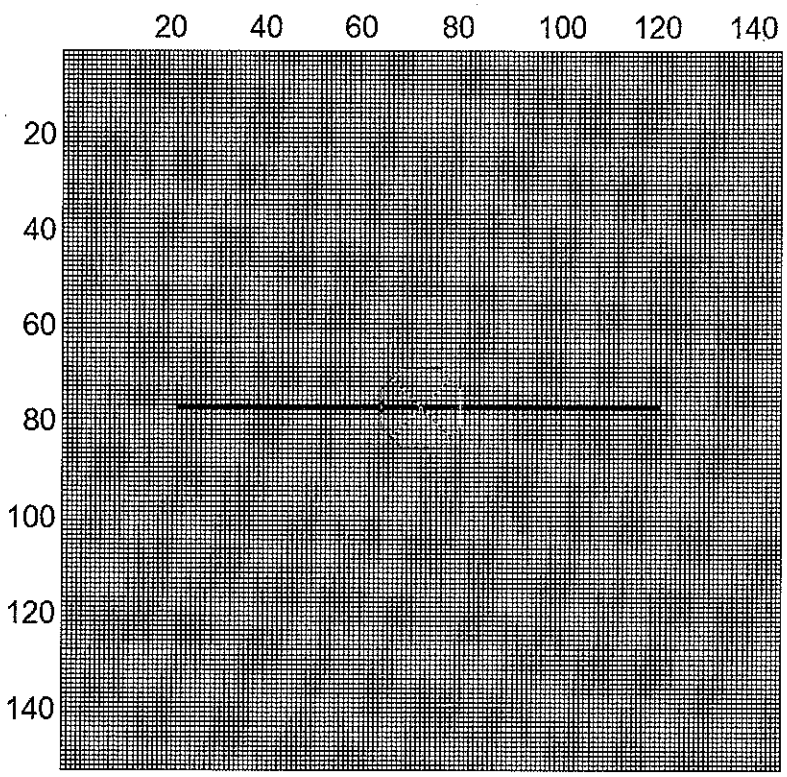

Figure 4: Model grid through layer 44 showing the horizontal injection WELL (red) and DRAIN cells (yellow) used to simulate flowback. The figure also shows the monitoring well.

There is no literature guidance to a preferred value for fractured shale storage coefficient, so I estimated S with a sensitivity analysis using scenario 3. With fractured shale K equal to 0.001m/d, two orders of magnitude higher than the in-situ value, the time to equilibrium resulting from simulation tests of three fractured shale storage coefficients, 10^{-3}, 10^{-5}, and 10^{-7} m^{-1}, varied twofold (Figure 4). The slowest time to equilibrium was for S=10^{-3} m^{-1} (Figure 4), which was chosen for the transient simulations because more water would be stored in the shale and flow above the shale would change the least.

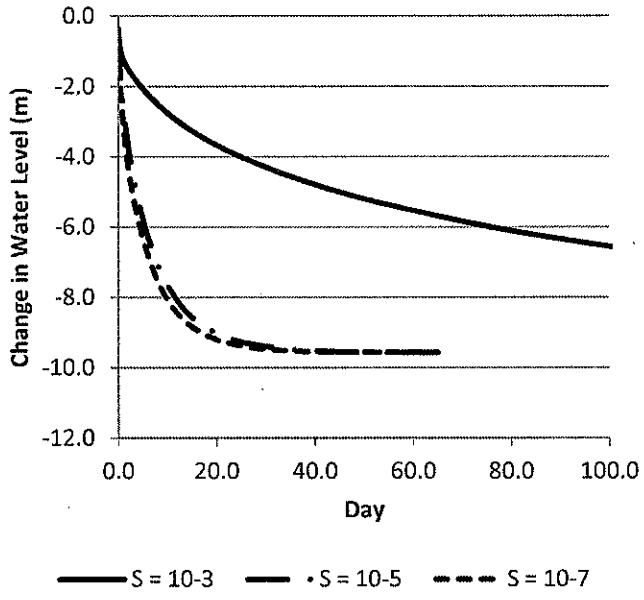

Figure 5: Sensitivity of the modeled head response to the storage coefficient used in the fractured shale for model layer 39 just above the shale.

Results

Scenario 1

The travel time for a particle to transport through 1500 m of sandstone and shale equilibrates with one of the formations controlling advection (Figure 5). For example, when the shale K equals 1x10^{-5} m/d, transport time does not vary with sandstone K. For sandstone K at 0.1 m/d, transport time for varying

shale K ranges from 40,000 years to 160 years. The lower travel time estimate is for shale K similar to that found by Schulze-Makuch et al. (1999). The shortest simulated transport time of about 20 years results from both the sandstone and shale K equaling 1 m/d. Other sensitivity scenarios emphasize the control exhibited by one of the media (Figure 5). If shale K is low, travel time is very long and not sensitive to sandstone K.

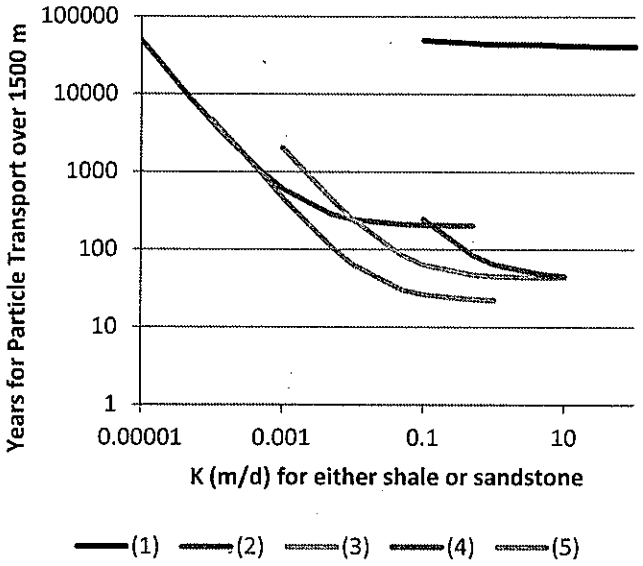

Figure 6: Sensitivity of particle transport time over 1500 m for varying shale and sandstone vertical K. Effective porosity equals 0.1. (1) – varying Kss, Ksh=10-5 m/d, (2) – varying Ksh, Kss= 0.1 m/d, (3) – varying Kss, Ksh = 0.1 m/d, (4): varying Kss, Ksh = 0.01 m/d, and (5): varying Ksh, Kss= 1.0 m/d.

Scenario 2

Vertical transport time through a system including a high-K fault zone was limited primarily by the shale K, presumably because the fault K was one to two orders of magnitude more conductive than that of the surrounding sandstone (Figure 6). Including a fault increased the particle travel rate by about 10 times (compare Figure 8 with Figure 6). The fault K controlled the transport rate for shale K less than 0.01 m/d. A highly conductive fault could transport fluids to the surface in as little as a year for shale K equal to 0.01 m/d (Figure 6).

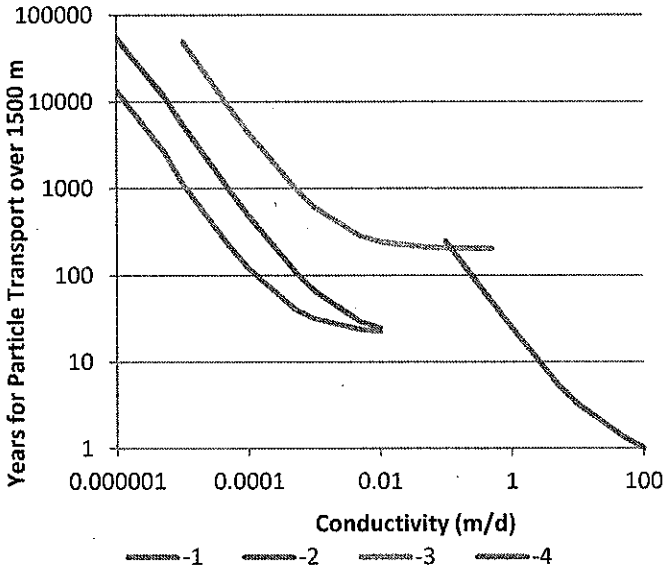

Figure 7: Variability of transport through various scenarios of changing the K for the fault or shale. Effective porosity equals 0.1. (1): Vary Ksh, Kss=0.01 m/d; (2): Varying Ksh, Kss=0.1 m/d; (3), no fault; (4): Varying K fault. Kss=0.1 m/d, Ksh=0.01 m/d. Unless specified, the vertical fault has K=1 m/d for variable shale K.

Scenarios 3 and 4

Scenarios 3 and 4 estimate the time to establish a new equilibrium for scenarios 1 and 2. Equilibrium times would vary by model layer as the changes propagate through the domain, and flux rate for the simulated changes imposed on natural background conditions. The fracking-induced changes cause a significant decrease in the head drop across the shale and the ultimate adjustment of the potentiometric surface to steady state depends on the new shale properties.

The time to equilibrium for one scenario 3 simulation, shale K changing from 10^{-5} to 10^{-2} m/d with sandstone K equal to 0.1 m/d, varied from 5.5 to 6.5 years, depending on model layer (Figure 7). Near the shale (layers 39 and 40), the potentiometric surface increased from 23 to 25 m reflecting the decreased head drop across the shale. One hundred meters higher in layer 20, the head increased about 20 m. These changes reflect the decrease in K across the shale. Simulation of scenario 4, with a fault with K=1 m/d, decreased the time to equilibrium to from 3 to 6 years within the fault zone,

depending on model layer (Figure 7). Faster transport occurred only in areas near the fault. Highly fractured sandstone would allow more vertical transport, but diffused advective flow would also increase so that the base sandstone K would control the overall rate.

The flux across the upper boundary changed within 100 years for scenario 3 from 1.7 to 345 m^3/d, or 0.000008 m/d to 0.0017 m/d. There is little difference in the equilibrium fluxes between scenario 3 and 4 indicating that the fault primarily affects the time to equilibrium rather than the long-term flow rate.

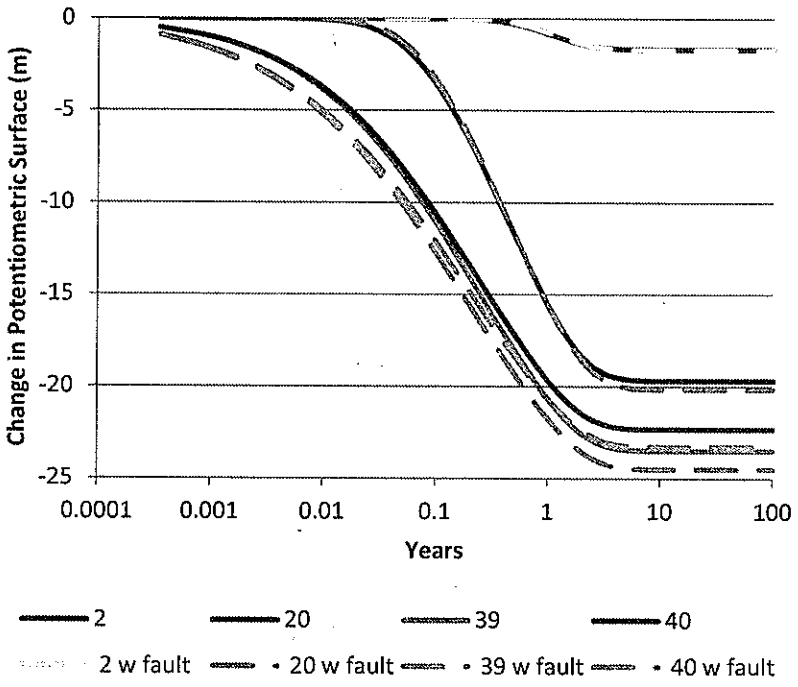

Figure 8: Monitoring well water levels for specified model layers due to fracking of the shale: monitor well in the center of the domain, including in the fault. K of the shale changes from 0.00001 to 0.01 m/d at the beginning of the simulation.

Scenario 5: Simulation of Injection

The injection scenarios simulate 15 million liters entering the domain at the horizontal well and the subsequent potentiometric surface and flux changes throughout. The highest potentiometric surface

increases (highest injection pressure) occurred at the end of injection (Figure 8), with a 2400 m mound at the horizontal well. The peak pressure simulated both decreased but occurred longer after the cessation of injection with distance from the well (Figure 8). The pressure at the well returned to within a meter of pre-injection levels in about 95 days (Figure 8). After injection ceases, the peak pressure simulated further from the well occurs longer from the time of cessation, which indicates there is a pressure divide beyond which fluid continues to flow away from the well bore while within which the fluid flows toward the well bore. The simulated head returned to near pre-injection levels slower with distance from the well (Figure 9), with levels at the edge of the shale (layer 40) and in the near-shale sandstone (layer 39) requiring several hundred days to recover. After recovering from injection, the potentiometric surface above the shale increased in response to flux through the shale adjusting to the change in shale properties (Figure 9), as simulated in scenario three. The scenario required about 6000 days (16 years) for the potentiometric surface to stabilize at new, higher, levels (Figure 9). Removing the fault from the simulation had little effect on the time to stabilization, and is not shown.

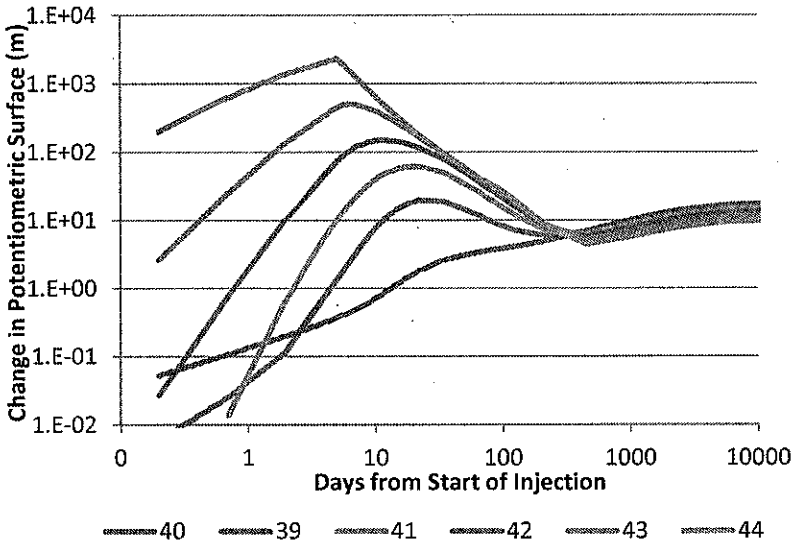

Figure 9: Simulated potentiometric surface changes by layer for specified injection and media properties; Kss=0.01 m/d, Ksh = 0.001 m/d, Kfault = 1 m/d. S(fractured shale) = 0.001 m^{-1}, S(ss) = 0.0001 m^{-1}

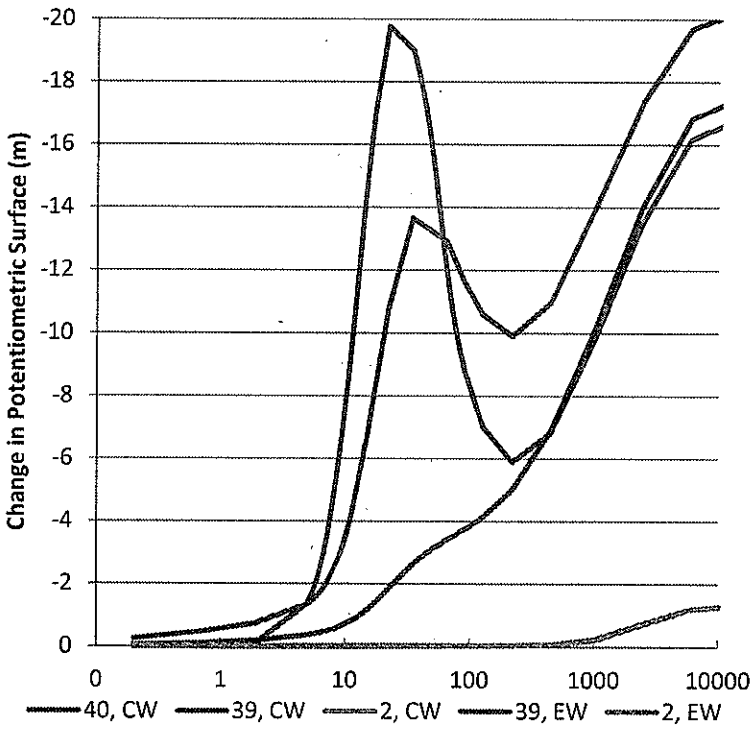

Figure 10: Simulated potentiometric surface changes for layers within the shale and sandstone. CW is center monitoring well and EW is east monitoring well, about 120 m from the centerline. Fault is included. The line for Layer 2, CW plots beneath the line for Layer 2, EW. Kss = 0.01 m/d, Kshale = 0.001 m/d, Kfault=1m/d, S(fractured shale) = 0.001 m^{-1}, S(ss) = 0.0001 m^{-1}

Prior to injection, the steady flow for in-situ shale ($K=10^{-5}$ m/d) was generally less than 2 m^3/d and varied little with sandstone K (Figure 5). Once the shale was fractured, the sandstone controlled the flux which ranges from 38 to 135 m^3/d as sandstone K ranges from 0.01 to 0.1 m/d (Figure 10), resulting in particle travel times of 2390 and 616 years, respectively. More conductive shale would allow faster transport (Figure 8). Adding a fault to the scenario with sandstone K equal to 0.01 m/d increased the flux to about 63 m^3/d with 36 m^3/d through the fault (Figure 10) and decreased the particle travel time to 31 from 2390 years. The fault properties control the particle travel time, especially if the fault K is two or more orders of magnitude higher than the sandstone.

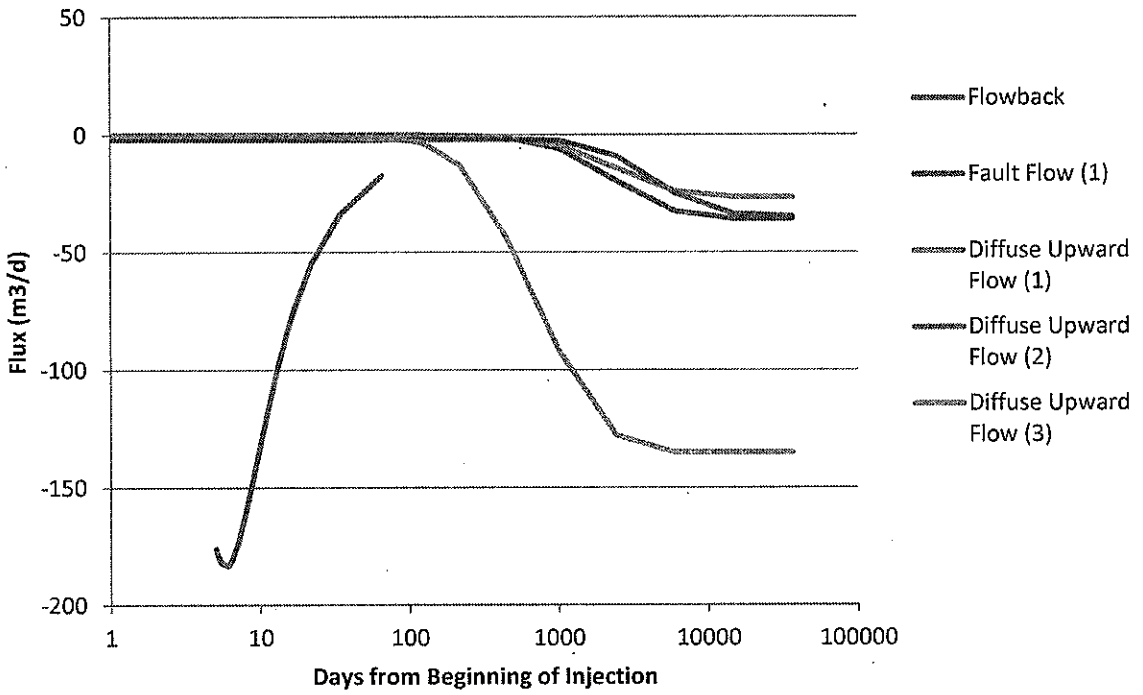

Figure 11: Various fluxes for three separate scenarios. Flowback is the same for all scenarios. (1): Kss=0.01 m/d, Kshale = 0.001 m/d, Fault K = 1 m/d; (2): Kss = 0.01 m/d, Kshale = 0.001 m/d, no fault; (3) Kss= 0.1 m/d, Kshale = 0.001 m/d, no fault.

Simulated flowback varied little with shale K because it had been calibrated to be 20 percent of the injection volume. A lower storage coefficient or higher K would allow the injected fluid to move further from the well, which would lead to less flowback. Lower K would also lead to higher injection pressure which in turn would fracture the shale more.

Vertical flux through the overall section with a fault varies significantly with time, due to the adjustments in potentiometric surface. One day after injection, vertical flux exceeds significantly the pre-injection flux about 200 m above the shale (Figure 11). After 600 days, the vertical flux near the shale is about 68 m^3/d and in layer 2 about 58 m^3/d; it approaches steady state through all sections after 100 years with flux equaling about 62.6 m^3/d. The 100-year steady flux is about 61.5 m^3/d higher than the pre-injection flux because of the changed shale properties.

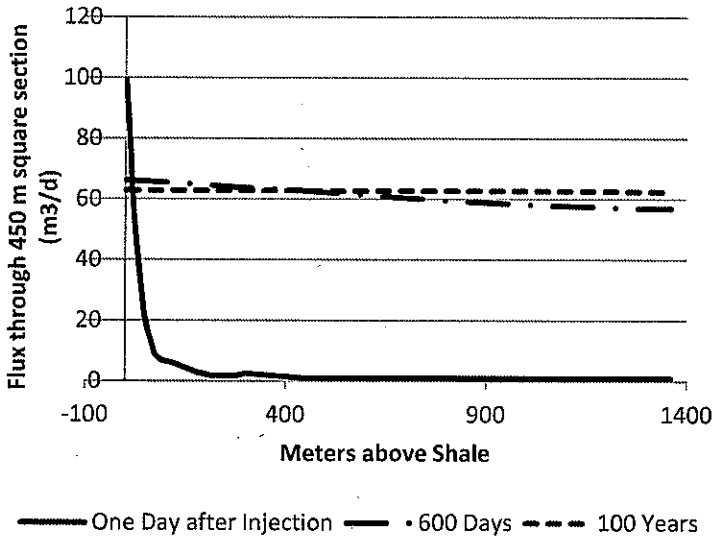

Figure 12: Upward flux across the domain section as a function of distance above the top of the shale layer. Cross section is 202,500 m^2.

Discussion

The interpretative modeling completed herein has revealed several facts about fracking. First, MODFLOW can be coded to adequately simulate fracking. Simulated pressures are high, but velocities even near the well do not violate the assumptions for Darcian flow. Second, injection for five days causes extremely high pressure within the shale that decreases with distance from the well. The time to maximum pressure away from the well lags the time of maximum pressure at the well. The pressure drops back to close to its pre-injection level at the well within 90 days, indicating the injection affects the flow for significantly longer periods than just during the fracking operation. Although the times may vary based on media properties, the difference would be at most a month or so, based on the various combinations of properties simulated. The system transitions within six years due to changes in the shale properties. The same order of magnitude would apply to changes in shale properties from less to more conductive. The equilibrium transport rate would transition from a system requiring thousands of years to one requiring hundreds of years or less within less than ten years.

Third, most of the injected water in the simulation flows vertically rather than horizontally through the shale. This reflects the higher sandstone K 20 m above the well and the no flow boundary within 225 m laterally from the well, which emulates in-situ shale properties that would manifest at some distance in the shale.

Fourth, the interpretative model accurately and realistically simulates long-term steady state flow conditions, with an upward flow that would advect whatever conservative constituents exist at depth. Using low, unfractured K values, the transport simulation may correspond with advective transport over geologic time although there are conditions for which it would occur much more quickly (Figure 5). If the shale K is 0.01 m/d, transport could occur on the order of a few hundreds of years. Faults through the overburden could speed the transport time considerably. Reasonable scenarios presented herein suggest the travel time could be decreased further by an order of magnitude.

Fifth, fracking increases the shale K by several orders of magnitude. The regional hydrogeology changes due to the increased K. Vertical flow could change over broad areas if the expected density of wells in the Marcellus shale region (NYSDEC 2011) actually occurs.

Sixth, fault fracture zones coming close to contacting the newly-fractured shale could allow contaminants to reach surface areas in tens of years. Faults can decrease the simulated particle travel time several orders of magnitude.

Conclusion

Fracking can release fluids and contaminants from the shale either by changing the shale hydrogeology or simply by the injected fluid forcing other fluids out of the shale. The complexities of contaminant transport from hydraulically fractured shale to near-surface aquifers render estimates uncertain, but a range of interpretative simulations suggest that transport times could be decreased from geologic time

scales to as few as tens of years. Preferential flow through fractures could further decrease the travel times to as little as just a few years.

There is no data to verify either the pre- or post-fracking properties of the shale. The evidence for potential vertical contaminant flow is strong, but there are also almost no monitoring systems that would detect contaminant transport as considered herein. Several improvements could be made.

- Prior to hydraulic fracturing operations, the subsurface should be mapped for the presence of faults and measurement of their properties
- A reasonable setback distance from the fracking to the faults should be established. The setback distance should be based on a reasonable risk analysis of fracking increasing the pressures within the fault.
- The properties of the shale should be verified, post-fracking, to assess how the hydrogeology will change.
- A system of deep and shallow monitoring wells and piezometers should be established in areas expecting significant development, before that development begins (Williams 2010).

Acknowledgements

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Appendix C

Review of NYSERDA Commissioned Review of Myers Comments on the 2009 DSGEIS

Prepared by: Tom Myers

11/30/11

Introduction

The New York State Energy and Resource Development Agency (NYSERDA) commission Alpha Geosciences (Alpha) to complete a review of the comments I had prepared for the 2009 Draft Supplemental Generic Environmental Impact State (DSGEIS). This report replies to some of those review comments. Throughout, I refer to the review as "Alpha".

General Points

Alpha divided my comments into various subsets for their response, but they rely very much on several points throughout their response. One is their perception of there being no hydraulic connection between groundwater at depth, in the Marcellus shale, and the near-surface aquifers; they also dismiss the analysis from ICF (2009) on the same basis, even though they have no data with which to dismiss the argument. Their second line of reasoning is the results or conclusions from the 2004 EPA study of coal bed methane fracking.

Alpha rejects the suggestion that a water balance for the project area or subareas "would not serve the purpose of the SGEIS" (Alpha, at 4). They provide no reason for this conclusion, but also state that a "water balance clearly is site-specific" (Id.). A water balance can be useful for any size study area or portion of the study area. A water balance for the overall study area would help to understand the total volume of water involved in fracking; a similar argument can be made for a watershed – a water balance for the groundwater would help to understand whether the water amounts used for fracking is a substantial portion of the local water balance.

Alpha partially rejects my suggestion that a better description of the area's hydrogeology is needed by quoting my statement that "the Marcellus Shale is 'notoriously heterogeneous'" (Alpha, at 4). The request for a better description pertains to the overall area, not specifically the Marcellus shale. Additionally, the statement supports the concept that reported permeability values for the shale may not be representative and that broader scale description are required.

Hydraulic Connection between Shale and Surface

Alpha argues that the "target shales exist as an isolated system from the overlying fresh water-bearing units" (Alpha, at 4). "Isolated" overstates the case even for natural conditions, although the connection may be limited, as I accepted in 2009. Alpha claims that the "shales ... are not part of, and are not connected to, the regional hydrogeological systems. Their baseline geologic evidence that fluid

migration to overlying fresh water aquifers is improbable includes studies that show the Marcellus shale has remained isolated from overlying formations for millions of years" (Alpha, at 5). Alpha does not directly provide citations for these "studies", but in the next sentence references the "facts that these units are 'overpressured' and that natural gas and saline water has remained trapped ... for millions of years" (Id.) to two industry studies and the GEIS. This all ignores the science, cited in Myers (in review) of the upward movement and artesian pressure, observed during geothermal exploration, in formations above the shale. The salt in the shale may be the source of the salt in overlying formations, with the upward movement of salt balanced by the downward movement of freshwater recharge. This balance could be substantially upset by the changes wrought by fracking on the shale.

The "overpressuring" of the shale does not prove that the shale itself is isolated. Overpressuring is due to the gas being contained in the low permeability, very small pore spaces of the shale. Once fracked, the overpressuring may provide an initial source for water to flow into the formations above the shale.

The isolation argument is invoked again, by Alpha, at 11&12, 20, and 33.

My discussion relied and continues to rely for the 2011 rDSGEIS on the fact that fracking will change those conditions, changing the shale from an almost impervious aquitard into a low-conductivity formation; the previously isolated formation water will no longer be "isolated" because fracking fluid injection will push some into surrounding formations. The "overpressuring" in the shale may suggest that the shale itself is isolated at least in places. Myers' (2009 and in review) argument relies on the connection in the formation above the shale. Once fracked, the shale will have a much higher permeability so that fluids in the shale can move into surrounding formations within which the general groundwater flow will control.

Alpha refers to the fact that shallow water wells may be hydrofractured as "additional evidence that natural fractures and structures are not necessarily transmissive" (Alpha, at 4 and 37). This is a comparison of "apples and oranges". Hydrofracturing water wells may be done to increase their yield when screened in low-transmissivity formations; fracking water wells is done to increase the well yield from a few gallons per minute. The transmissivity of unfracked shale is orders of magnitude less than that in the formations in which a water well may have been screened. The cause for fracking in water wells differs from the cause for fracking a gas well; the comparison is irrelevant and proves nothing about the isolated nature of shale.

A further reliance on "overpressuring" is demonstrated (Alpha, at 5) where Alpha notes that eight research wells in the Marcellus shale had pressure gradients of 0.46 to 0.51 psia/ft when hydrostatic pressure is 0.433 psia/ft. That waters remain contained in the shale even with this overpressuring demonstrates their isolation. Once fracking hydraulically connects the shale with the overlying formations, the overpressuring is a source of pressure that would cause an upward gradient. The pressure would likely dissipate with time, but it would also cause an upward gradient after fracking.

Alpha indicates that my "hypothetical pathway ... to ground water is along faults and fractures that intersect the Marcellus or induced fractures that extend beyond the target formation" (Alpha, at 5). This mischaracterizes the argument in two ways. First, it ignores the potential flow through the bulk media, through the primary porosity of the formations; this pathway would be slower, but flow is possible if there is a connection (Myers, in review) with the newly fractured shale. Myers (in review) found this flow to require from 100s to 1000s of years for contaminant transport. Second, natural faults and fractures do not have to "intersect" the shale, just reach its edge. Fluids within the shale would access the natural fractures above the shale, once fracked; the overpressuring would provide an added gradient for flow from the shale to surrounding formations, once fracking releases the fluids.

Alpha's second point is correct; out-of-formation fractures would provide an additional pathway. Although Alpha continues to suggest that out-of-formation fracking is rare, in their view, more current evidence is that it occurs frequently and extends as much as 2000 feet above the target formation (Fischer 2010); Alpha even references a personal communication from Fisher (Alpha, at 24) to recommend that the "SGEIS acknowledge that hydrofracturing has been shown to induce fractures beyond the target formation" (Id.). It appears that Alpha is not familiar with up to date literature or science.

Alpha rejects the "suggestion of 'head level maps'" that I had suggested in 2009 based on their rejection of the concept of saturated conditions from the "top of the target zone to the land surface" (Alpha, at 20). If there is no connection, groundwater levels will show nothing. They also note the isolation argument (at 20, 21) to reject the need for head level maps. Head level maps as recommended by Myers (2009) would confirm or deny the presence of upward head gradients in the formations above the shale. Once released by fracking, contaminants could advect along the flow paths which would be delineated by the hydraulic gradient. Although the fracking itself will change the gradient and potentially increase the potential upward flow, mapping the groundwater levels would assist the NYSDEC in determining where transport is possible. Alpha's recommendation is to basically ignore science and ignore the possibility of upward flow. Alpha replied to my comment suggesting that the rDSGEIS discuss properties resulting from fracking by discussing the direction that fractures would take in the shale (Alpha, at 15). My comments indicated that the rDSGEIS should include hydrogeologic properties, therefore Alphas reply was not responsive to the comment. Alpha's response that my "argument that the fractures will extend to and connect overlying fractures or paleofractures contradicts rock mechanics principles and field observations" is countered by the recent data in Fisher (2010) showing out-of-formation fracking. Alpha is unclear and provides no references as to how the comments contradict "rock mechanics principles".

I had also recommended that the NYSDEC require the industry to monitor post fracking shale properties. Alpha states that "[f]racture monitoring is required by the Proposed Supplementary Permit Conditions ... (#33 and #34)" (Alpha at 16). That is incorrect; those permit conditions require the driller report on recorded operations during fracking, including pressure and the amount of injected, but that is not the same thing as doing post-frack monitoring, which could include microseismic surveys or core sampling. They also suggest that "[f]racture monitoring also can be evaluated on a well-specific basis using the

same criteria as the requirement to collect core samples and well logs" (Alpha, at 16). Those requirements are for pre-fracking conditions, not post-fracking.

Myers' Groundwater Modeling and ICF Analytical Modeling

I prepared (Myers 2009) an interpretative numerical groundwater model to consider whether and over what time frame flow could occur from the shale to freshwater aquifers. The "theory supporting Myers' model" is NOT from Hill and Tiedeman (2007) (Alpha, at 23). The reference is to the concept of "interpretative" modeling as opposed to a calibrated, predictive model. "Myers acknowledges that his model is not calibrated and cannot be used for predictive purposes" (Alpha, at 12). An interpretative model is not used for prediction, so Alpha's attack on the model is an attack here is irrelevant. The model does assume that the interburden between the ground surface and top of the shale is saturated, but not through the "isolated shale gas formations" (Id.). Again, the modeling is of the interburden and the shale, once it is fracked to its edge or beyond, is a boundary or a source of both fluids and contaminants. Or, flow through the shale is estimated based on its extremely low in-situ conductivity.

The numerical model I used in 2009 was not "to support [my] opinion" (Id.) but to test my conceptualization as to whether the flow was possible and under what conditions. Alpha criticizes the fact the model "oversimplifies ground water flow and transport". All groundwater models simplify flow; simple applications of Darcy's law are the most oversimplified analyses. The addition of secondary permeability, or fracture flow, to a contaminant transport analysis usually increases the rate that contaminants move, thus my estimated times should be low.

Alpha asserts that my "offered alternate model is not technically defensible" apparently based on their perceived lack of a hydraulic connection. They state that an assumption of a hydraulic connection "contradicts decades of hydrofracturing data and experience in the U.S." (Alpha, at 11) without referencing or outlining the data in support of their contention. They also claim that my analysis is based on "the entire bedrock stratigraphic column [being] highly fractured" (Alpha, at 12). This statement does not reflect the analysis in Myers (2009), for reasons noted above - the conductivity values used for the formations between the shale and surface were based on observed primary conductivity values (Anderson Woessner 1992), not fractured values.

ICF's flow equations are correct (Alpha at 11), but the problem is how they were parameterized and time frame they were applied over. As Myers (2009) discussed, the relevant gradient is not from the well to the aquifers, but from the well to just beyond the influence of the spreading injected fracking fluid, the point at which the background pressure has not changed. Also, the conductivity parameters for the formations between the shale and the aquifers do not reflect fractures, unless specifically parameterized as such. The parameters reflect standard textbook bulk conductivity values for sandstone.

Vertical Contaminant Transport

I had argued that "natural gradients" would allow vertical contaminant transport of frack fluid through advection. Alpha claims that "Engelder refutes that injected frac water would migrate vertically upward

in his slide-presentation review of others" (Alpha, at 24). Aside from the confusing phrase, "slide-presentation review of others", this line of reasoning cannot be correct because frack fluid is lighter than the high-TDS brine found in the shale; buoyancy due to frack fluid being lighter than brine would enhance its upward movement. The movement of high-TDS formation water could be inhibited by its denser nature, but the point is that upward hydraulic gradients cause the flow. The overpressuring discussed above is proof of these upward gradients and suggestive that fracking would release some of this pressure into the formations lying above.

Engelder's "principle of viscosity" (Id.) may apply "to ground water as well as gases", but the fact that low viscosity gases have been contained from vertical migration for millions of years does not mean that fracking will not release contaminants that could migrate upward much quicker. The relevant "containment" is provided in the shale and has nothing to do with the properties of overlying formations. Shale has contained gas for millions of years; fracking will cause that gas to be released in 30 to 50 years (the length of time most wells will produce). This can only occur if the properties that contain the gas will vastly change.

Leaks from Well Bores

The DSGEIS had implied that leaks do not occur from properly-constructed wells, but did not specify how often wells are found to not be properly constructed, and I requested (Myers 2009) that they provide an estimate of the times the wells are not properly constructed. Alpha responded with a quote from an industry source that estimated risk from failures to properly constructed wells is less than one in 50 million (Alpha, at 32). Alpha should have included the entire paragraph from which they selectively chose their quote, because it indicates the wells considered are class II injection wells and are properly constructed. Fracking wells experience a much higher, although much shorter, pressure during operations. They also should realize that the comment had to do with wells that are improperly constructed, because most failures, those that have allowed gas into groundwater, have resulted from improperly constructed wells.

Alpha also protests too much when they discuss my examples of gas in water wells (Alpha, at 33, 34). Incidents not related specifically to fracking are relevant because they show that the gas does move long distances through the groundwater, regardless of the source. Coal bed methane development relies on the gas moving through the groundwater, in coal seams, to the production wells; those production wells commonly pump as much water as do water wells, so, if gas is present to move to the water wells, the conceptual model for flow to water wells is similar. The point has to do with gas moving through aquifers due to any source – direct from the shale or a leak from the well bore.

Comparison to CBM Wells

Alpha used the conclusion to the EPA's 2004 CBM study, that fracking in coal seams poses little or no threat to underground sources of drinking water (Alpha, at 20) to support their conclusion that I had ignored relevant data (EPA's study) and that my arguments were fallacious because CBM wells are a much higher risk. They also state that "[c]oalbed hydrofracturing events approximate conditions where shale hydrofracturing is performed closest to ground water resources" (Id.). This is simply not true, and

it directly contradicts the conditions that the EPA put on their conclusion. EPA relied on the nature of CBM wells for their conclusion. "Although potentially hazardous chemicals may be introduced into USDWs when fracturing fluids are injected into coal seams that lie within USDWs, the risk posed to USDWs by introduction of these chemicals is **reduced significantly by groundwater production and injected fluid recovery**, combined with the mitigating effects of dilution and dispersion, adsorption, and potentially biodegradation" (EPA, 2004, at 7-5, emphasis added).

In fracked shale, there is no intentional "injected fluid recovery" brought about by pumping the injection wells, as in CBM wells. CBM wells pump water toward the gas well; this pumping decreases the hydrostatic pressure which releases the gas from the coal. Water and contaminants in the coal seam flows toward the CBM well. If there were contaminants in the coal, they would be drawn toward the CBM well.

Fracking in a coal seam would require much less pressure as well which would cause less out-of-formation fractures, which would limit the chance for out-of-formation fractures to occur. Additionally, EPA relies on the "high stress contrast between adjacent geologic strata" as a barrier to fracture propagation. The fact the coal is softer and the seams are much shallower and require much less fracking pressure helps to limit the fractures to the coal, much in contrast to shale seams (Fisher, 2010).

Finally, although the EPA's reasoning is reasonable, their methodology for concluding there has been no contamination is suspect; they only considered reported cases of contamination rather than relying on monitoring data. Fracking fluids in water wells near coal seams would be reported only if someone detects a problem. There have been cases of methane reaching water wells in the coal seams, but methane is obvious as it bubbles coming from the faucet.

Alpha claims that "Myers fails to address the historical data presented by ICF (2009, p. 22)" (Alpha at 19). ICF (2009, p 22) does not actually present data, contrary to Alpha's allegation. GWPC (1998), the source of ICF's "data", presents the results of a survey to which officials from states with over 10,000 coal-bed methane wells had responded they had never found groundwater contamination. However, contrary to Alpha's allegation, GWPC did not analyze 10,000 wells' worth of data. GWPC does not present monitoring data as proof, they present survey data from agency personnel claiming there has been no reported contamination. There is no indication whether the agencies ever looked for contamination beyond the claims of well owners. ICF also notes that coal seams may be used as aquifers, but did not indicate how many of the coal seams being developed by the CBM wells in the states replied to by the agency personnel were also aquifers.

Alpha truly mixes apples and oranges by using studies of CBM development, including fracking, to conclude that shale-gas development poses no threat to groundwater.

General Hydrogeology

Alpha's response to comments regarding aquifer depletion is a stretch to show how they actually disagree with my comments. Specifically, my comments about failures to regulate are replied to by stating the various commissions must permit the withdrawal – the problem is that there are really no

specifics provided about how the decision to permit would be granted. The DSGEIS did not specify what standard had to be met, beyond simple reporting, to be granted a permit.

Mitigating Surface Water Impacts

Alpha goes out of its way to find something to criticize in its review of my general surface water comments (Alpha, at 44, 45). My comments were generally qualitative and Alpha's responses are generally not substantial enough to require a reply here.

In Alpha section 4.2, regarding the use of the natural flow regime method, Alpha states that I was incorrect in claiming the NYSDEC would not require its use (Alpha, at 48). The 2011 rDSGEIS states clearly that it is NYSDEC's intent to require use of the NFRM, but the 2009 DSGEIS only states that it is "preferred", not required (2009 DSGEIS, at 7-3).

Alpha responds in detail to my comments regarding the Delaware and Susquehanna River Basin Commissions' methods (Alpha at 46, 47), even though they acknowledge the dSGEIS would require the NFRM. Because the rDSGEIS states the NFRM will be used throughout the project area, there is little reason to reply further to Alpha's comments at this point.

Ultimately, Alpha adapts many of my recommendations regarding surface water flow (Alpha, at 50, 51). They do not specifically endorse the recommendation to minimize the effect on aquatic habitats (outlined at Alpha, p. 47), the RDSGEIS does adapt a recommendation for using the Q60 or Q75 flow by month, which by month is better than my original recommendation.

Setbacks

Alpha discusses vertical setbacks along with my comments on monitoring and the need for water level mapping (Alpha, section 3.1). Much of their response relies on their perceived lack of hydraulic connection among formations, which has been discussed above.

Regarding horizontal setbacks, I had suggested that the recommended values are not based on any data or analysis of their effectiveness. Alpha simply rejects this without providing any reference, data, or results. "Myers assumes the setbacks proposed in the dSGEIS are not based on analysis; however, the setbacks are supported by practical application, experience, and historical analyses" (Alpha, at 43). Alpha repeats this sentence twice, verbatim, on the same page. When stating something as being based on analyses, it is customary scientific practice to cite the references to these analyses, something Alpha has failed to do. Alpha also suggests the "dSGEIS reference SEQRA, NYSDOH, NYC Watershed Rules and Regulations, the Clean Water Protection Act, and public water protection rules from other states" (Id.). Alpha does not indicate where in the dSGEIS these references are made, not indicates that the references include any analysis. Referencing others' rules without analyzing their effectiveness is not a scientific justification for specifying a setback. My statements are not that the setbacks are wrong, but that it is unknown whether they are effective. My recommendations may be larger than those in the dSGEIS, but they are designed to be protective to encourage a site specific analsis.

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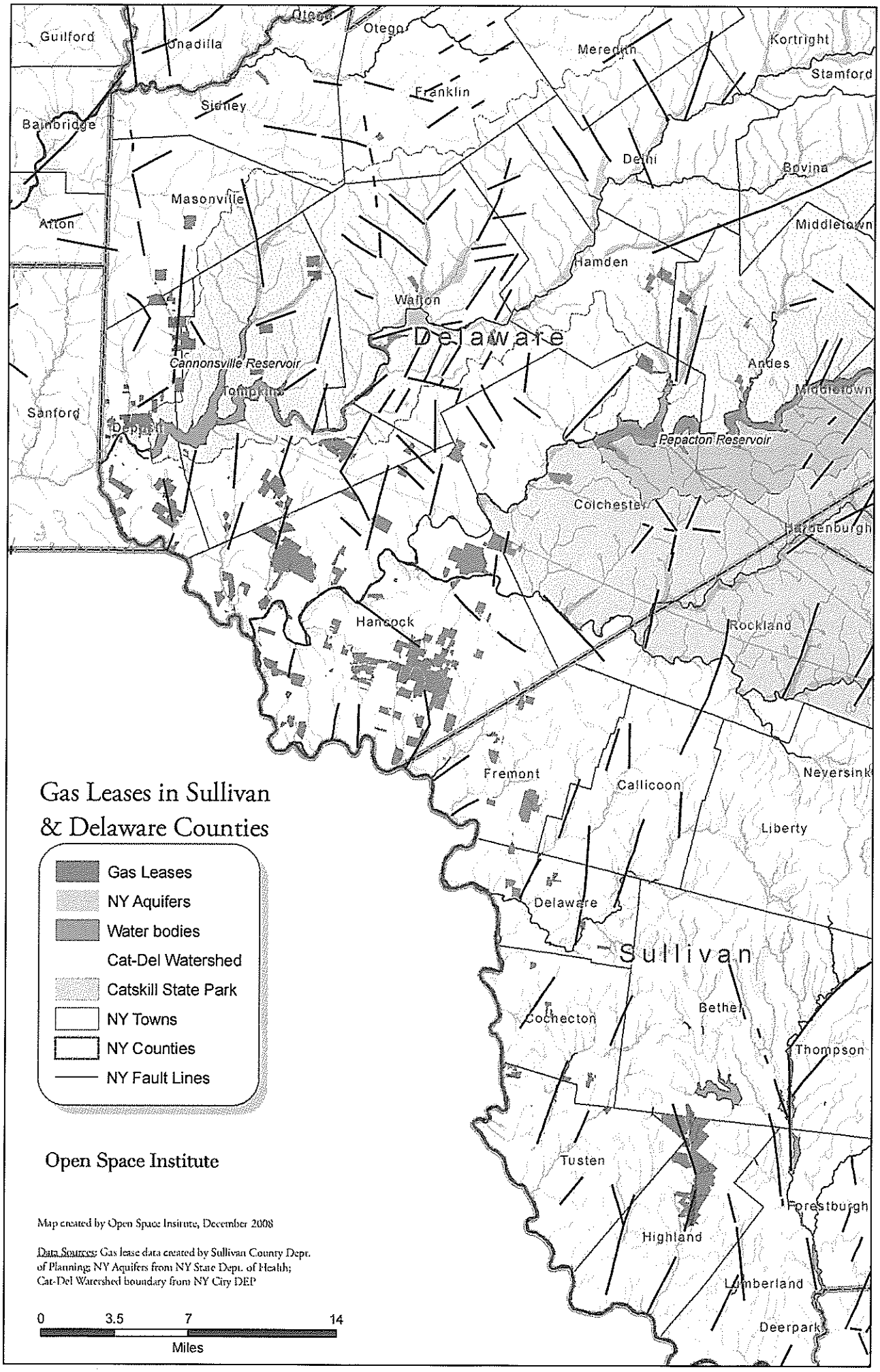
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Open Space Institute
Map created by Open Space Institute, December 2008
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Testimony of Food & Water Watch
February 17, 2012

New York City
Committee on Environmental Protection

My name is Jessica Roff, and I'm a volunteer with Food & Water Watch, a nonprofit organization whose mission is to ensure that our food and water is safe, accessible, and sustainably produced.

We want to thank Chairman Gennaro and the Committee on Environmental Protection for holding this hearing. We are grateful, Chairman Gennaro, for your persistent and diligent attention to this issue. In particular, we greatly appreciate your calling attention to the continued threats to New York City posed by Governor Cuomo's plans to open the state to fracking.

As you're aware, the Department of Environmental Conservation's Supplemental General Environmental Impact Statement (SGEIS) proposes to confine drilling and fracking operations to outside of a buffer around the watersheds that provide New York City with its famously-high quality of drinking water – so high quality, in fact, that filtration is not required.

But New York City's water, air, and food would still be put at great risk if the state is opened up to fracking for shale gas. New York City should support a ban on fracking in New York.

First, New York City's water would still be at risk despite the proposed buffer around the city's watershed. Shale gas wells can be drilled horizontally, and fracking would still technically be allowed BENEATH our watershed. Much of the toxic fracking fluid and wastewater remains underground indefinitely. How far and how fast it might move is difficult to predict and cannot be controlled.

Then there are the millions of gallons of fracking wastewater that does come out of each well. This wastewater contains toxic chemicals used in fracking fluids, as well as naturally occurring contaminants from deep underground, such as Radium 226. There is no plan for managing this wastewater. If inadequately treated fracking wastewater were to contaminant New York City's watershed, the city could be forced to filter its supply of water, and this would cost over 10 billion dollars.

Second, New York City's air quality is likely to be harmed by fracking in the state. Fracking emits large quantities of dangerous air pollutants such as benzene, volatile organic compounds, and particulate matter, which can travel long distances and contribute to smog problems implicated in asthma, cancer, and heart disease.

Third, fracking is a threat to the safety of our food. Much of the Marcellus region is active farmland, and fracking fluids, wastewater, and air pollution pose a risk to the water and soil that our state's large agricultural sector rely upon.

Finally, drilling and fracking for shale gas releases large amounts of methane, a powerful greenhouse gas. Several recent scientific studies have suggested that widespread shale gas development will actually accelerate climate change in the coming decades. This means that New

York City will have to adapt even more rapidly to the threats that climate change poses, including rising sea level, increased frequency and intensity of droughts and floods, and increased ferocity of storms.

In our comments to the DEC, Food & Water Watch documented three critical flaws in the SGEIS. First, the DEC enormously exaggerated the so-called benefits of fracking, particularly the number of jobs it would create for New Yorkers. Second, the DEC underestimated – and, in some instances, completely ignored – the tremendous public costs of fracking, including to public health, public infrastructure and economic sectors such as agriculture and tourism.

Most fundamentally, though, we maintain that fracking is inherently dangerous and beyond our capacity to safely regulate. In the final analysis, there are safer alternatives to natural gas, but there are no alternatives to water. We urge the New York City Council to join other local elected bodies across the state in supporting a statewide ban on fracking.

TESTIMONY OF
THE NEW YORK PUBLIC INTEREST RESEARCH GROUP FUND (NYPIRG)
BEFORE THE ENVIRONMENTAL PROTECTION COMMITTEE
OF THE NEW YORK CITY COUNCIL
ON THE EXAMINATION AND DISCUSSION OF NYC DEPARTMENT OF ENVIRONMENTAL PROTECTION'S COMMENTS, ENTITLED "GEOPHYSICAL EVALUATION OF INFRASTRUCTURE RISKS OF NATURAL GAS PRODUCTION ON NEW YORK CITY WEST OF HUDSON WATER SUPPLY INFRASTRUCTURE,"
TO THE NYS DEPARTMENT OF ENVIRONMENTAL CONSERVATION (DEC)
REGARDING DEC'S REVISED DRAFT SUPPLEMENTAL GENERIC ENVIRONMENTAL IMPACT STATEMENT ON THE OIL, GAS AND SOLUTION MINING REGULATORY PROGRAM
NEW YORK, NEW YORK
FEBRUARY 17, 2012

Good afternoon, my name is Cathleen Breen. I am the Watershed Protection Coordinator for the New York Public Interest Research Group (NYPIRG). We commend the City Council for holding a hearing on this important issue and for being a staunch advocate for the protection of the city's drinking water supply.

NYPIRG has long been active in protecting New York City's drinking water supply and is a signatory to the 1997 Watershed Memorandum of Agreement (MOA). The MOA represented a comprehensive effort to protect and preserve New York City's high-quality water supply while preserving and enhancing the economic vitality and social character of the communities within the watershed. The city's $1.5 billion investment to date in comprehensive watershed protection efforts has paid off: New York City continues to qualify for a filtration waiver or Filtration Avoidance Determination (FAD) from the Environmental Protection Agency (EPA).

However, if the city fails to demonstrate that it can successfully protect the system from pollution, city officials will be ordered to build the filtration plant, which is estimated to cost between $10 and $20 billion. The practical consequences of that decision will be that water rates will rise threatening tens of thousands of housing units in the city's poorest neighborhoods; and, funds will be drained from police, infrastructure, health care, culture, transportation, fire, sewage and other city services. Worst of all, there is no guarantee that a filtration plant will preserve public health.

The MOA and the FAD did not guarantee that our water would remain safe. Rather, it began years of hard work and vigilance that, we believe, have been essential to protecting our drinking water. Granted there have been threats over the years that have challenged the city's

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ability to continue to meet filtration waiver requirements and its ability to deliver safely that water to the more than 9 million New Yorkers who rely on it. However, never before has there been such a threat to the integrity of our water supply and delivery system as the threat of natural gas drilling, an intensely industrial activity.

We believe the gas extraction method proposed for the Marcellus Shale formation known as high-volume horizontal hydrofracturing, more commomly known as hydrofracking or fracking, — a process involving the high-pressure injection of millions of gallons of water, sand and toxic chemicals into horizontal wells to fracture the shale layer so trapped gas can escape — carries a potentially huge environmental price tag. The New York State Department of Environmental Conservation (DEC), the agency charged with overseeing gas drilling in New York, has not provided New Yorkers with a plan that shows that drilling will not harm the public and the environment.

DEC's revised draft Supplemental Generic Environmental Impact Statement (rdSGEIS) also did not fulfill the requirements of Executive Order 41, which was issued in December 2010 by Governor Paterson and later confirmed by Governor Cuomo.

Specifically, Executive Order 41 instructed DEC to "[m]ake such revisions to the Draft SGEIS that are necessary to analyze comprehensively the environmental impacts associated with high-volume hydraulic fracturing combined with horizontal drilling, ensure that such impacts are appropriately avoided or mitigated consistent with the State Environmental Quality Review Act (SEQRA), other provisions of the Environmental Conservation Law and other laws, and ensures that adequate regulatory measures are identified to protect public health and the environment."

One of the many deficiencies of the rdSGEIS is that while it calls for a fracking ban in the New York City Watershed, it leaves New York City's already fragile water infrastructure vulnerable.

Unfortunately, the New York City Department of Environmental Protection (DEP) has softened its position on how much protection is needed to safeguard the water infrastructure. In their 2009 comments to DEC on the first draft SGEIS, DEP proposed a seven-mile zone around all water infrastructure due to the concern that small earthquakes triggered by fracking could cause cracks in the concrete linings of the tunnels.

As DEP noted in those comments, "The unrefined linings of the City water tunnels were designed to keep water in, not to withstand external pressures. Fracking raises the distinct possibility that the unreinforced tunnel linings will be exposed to pressures in excess of their design strength."

Now, DEP has discontinued their call for a seven-mile buffer for all water infrastructures and is instead putting forth a "hybrid protection scheme" whereby some tunnels would be given less protection:

- A seven mile Infrastructure Exclusion Zone, where no fracking would be permitted, around the Delaware and Catskill Aqueducts from the reservoirs.
- A two mile Infrastructure Exclusion Zone around all other tunnels plus an Infrastructure Enhanced Protection Zone from two to seven miles around these tunnels that would require site specific review and city approval.

Given the uncertainty of the impacts from injection-induced seismic events, we believe this is short-sighted. According to DEP's geophysical consultant's report, "[r]ecently released research has shown that HVHF (high volume hydraulic fracturing) stimulation of a shale gas well triggered low magnitude earthquakes in the UK and possibly did so in Oklahoma in 2011. *The newly released research demonstrates the possibility that HVHF treatment of horizontal drill holes in the vicinity of the critical WOH NWI could induce one or more earthquakes that the unreinforced concrete lined water supply tunnels would not experience otherwise.*"

Rather than weakening safeguards, DEP should be leading the charge for the strongest possible protections for New York City's water supply. The proposed lower buffer distances are not identified in the consultant's report, which states, "Analysis does not identify a single, specific buffer distance."

For New York City, the sensitive water infrastructure is at risk and there is much to lose if the city's water supply is compromised. DEP must put the health and safety of the water consumers first.

Also at risk is the drinking water for people living in the impacted areas where drilling is expected to take place. NYPIRG has actively worked with thousands of students and citizens across the state to encourage and facilitate commenting on the rdSGEIS.

There are many reasons for New Yorkers to be concerned. DEC has opted to fast track the process instead of following Executive Order 41 and undertaking a true environmental review that includes sound scientific analysis and a public health impact assessment. Also, DEC does not have the staff or resources to monitor this intense industrial activity or to enforce the guidelines.

In consideration of the aforementioned, we believe the DEC should rescind this rdSGEIS and instead fulfill the requirements of Executive Order 41. We believe these risks are unacceptable--everyone deserves to have safe, clean drinking water and we must make sure all New Yorkers are protected from the dangers of fracking.

Thank you for providing me the opportunity to testify before you today.

For the Record

ECONOMIC TRUTH ABOUT FRACKING. Prepared By Batya Lewton, Coalition for a Livable West Side - Feb. 14, 2012

Chesapeake to Cut Number of Gas Rigs - NYTimes.com
http://www.nytimes.com/2012/01/24/business/energy-environment

Shale gas fate trips up on politics and bubblenomics. John Dizard. Financial Times. By John Dizard. Jan. 29, 2012
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The Wall Street maxim is that they never ring a bell at the top. However, on Jan. 23, Chesapeake Energy did ring a bell at the bottom. The undoubted leader of the shale gas revolution announced that it **would reduce drilling expenditures this year by more than 70 per cent, curtail its gas production by 8 per cent, cut land buying by $2 billion, and allow uneconomic gas leases to expire.**

When you are betting on shale gas, watch the dealer's eyes By Steve LeVine Financial Times. January 30, 2012
http://oilandglory.foreignpolicy.com/posts/2012/01/30/when_you_are_betting_on_shale_gas_watch_the_dealers_eyes
When someone invites you to a party but leaves before dessert, it might be time to locate your own coat and hat. Such are the suspicions generated by Chesapeake Energy, which after selling numerous billion-dollar pieces of its vast shale gas holdings to the world's largest energy companies has abruptly announced that it is drawing down.

Economists say fracking study is flawed. By Jordan Lipschik. Dec. 19, 2011
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The Economic Value of Shale Natural Gas in Ohio Posted on December 22, 2011 by clotworthy Ohio State University / by Mark Partridge and Amanda Weinstein
http://www.cleveland.com/business/index.ssf/2011/12/shale_gas_will_not_create_2000.html
The economic boon of shale gas — ballyhooed for months by Gov. John Kasich and the gas industry — is overblown, a team of Ohio State University economists concludes. Their independent study asserts that the development of shale gas might create 20,000 jobs over the next four years – not the 200,000 jobs the industry forecast in a study in September, just before Kasich's heralded energy summit...

New Report by Agency Lowers Estimates of Natural Gas in U.S.
By IAN URBINA NY Times. Published: January 28, 2012
http://www.nytimes.com/2012/01/29/us/new-data-not-so-sunny-on-us-natural-gas-supply.html?_r=1&ref=todayspaper
The difficulty and uncertainty in predicting natural gas resources was underscored last week when the Energy Information Administration released a report containing sharply lower estimates. The agency estimated that there are 482 trillion cubic feet of shale gas in the United States, down from the 2011 estimate of 827 trillion cubic feet — a drop of more than 40 percent. The report also said the Marcellus region, a rock formation under parts of New York, Ohio, Pennsylvania and West Virginia, contained 141 trillion cubic feet of gas. That represents a 66 percent drop from the 410 trillion cubic feet estimate offered in the agency's last report.

How New York State Exaggerated Potential Job Creation from Shale Gas Development - November 29th, 2011
http://www.foodandwaterwatch.org/reports/how-new-york-state-exaggerated-potential-job-creation/
Food & Water Watch closely examined New York's socioeconomic impact analysis and found that it does the people of New York a disservice. The New York analysis concluded that an **"average" shale gas development scenario would bring 53,969 jobs, but only in the fine print of a footnote of the widely read factsheet is it mentioned that this is a 30-year projection.**

100 years of shale gas? How speculative assumptions created a "gas bubble". Slate, Dec. 29, 2011.- OSU study on economic value of shale gas, 100 years of shale gas? How speculative assumptions created a "gas bubble"

Brendan DeMelle: Shale Gas Bubble: Insiders Suggest Fracking Boom Is a Bust
http://www.huffingtonpost.com/brendan-demelle/shale-gas-bubble-insiders_b_1199138.html?ref=fracking

Insiders Sound an Alarm Amid a Natural Gas Rush. By IAN URBINA. NYT 6/25/11
http://www.nytimes.com/2011/06/26/us/26gas.html?_r=1

Shale Bubble Grows on Near-Record Prices for Untested Fields. 1/9/12
http://www.bloomberg.com/news/2012-01-09/shale-bubble-inflates-on-near-record-prices-for-untested-fields.html

Regulators Seek Records on Claims for Gas Wells By IAN URBINA. NY Times. July 29, 2011
http://www.nytimes.com/2011/07/30/us/30gas.html?ref=ianurbina
WASHINGTON — The Securities and Exchange Commission sent subpoenas this week to energy companies asking them for documents about how they calculate and publicly disclose the performance of their shale gas wells, according to oil and gas industry lawyers. The subpoenas reflect the regulators' interest in determining whether companies are overstating how their gas wells perform and how much gas these companies can profitably extract over the long term.

New York Subpoenas Energy Firms. IAN URBINA. NY Times 8/18/11
http://www.nytimes.com/2011/08/19/us/19gas.html?_r=1&ref=nyregion
New York State's attorney general has sent subpoenas to three large energy companies as part of a broad investigation into whether they have accurately described to investors the prospects for their natural gas wells, according to several sources familiar with the inquiry.

Hydrofracking: A Bad Bet for the Environment and the Economy 1/5/12
www.huffingtonpost.com/paul-gallay/fracking environment_b_1186998.html

Shale Promises? or Shale Spin? Deborah Rogers lecture |
http://shaleshock.org/2012/01/shale-promises-or-shale-spin-deborah-rogers-lecture

NYSDOT doc leaked to un-naturalgas.org: NYS not ready for Marcellus
http://un-naturalgas.org/weblog/2011/07/leaked-draft-nysdot-document-the-potential-impacts-are-ominous/
The potential transportation impacts are ominous.

FRACKING AND EARTHQUAKES. Prepared By Batya Lewton, Coalition for a Livable West Side - Feb. 14, 2012

Geologic survey of earthquakes in Oklahoma. Jan. 27, 2012
http://www.ogs.ou.edu/pubsscanned/openfile/OF1_2011.pdf

Ohio voters want fracking halted for safety studies: poll By Kim Palmer
http://www.reuters.com/article/2012/01/19/us-energy-fracking-ohio-idUSTRE80I2HF20120119
Jan 19, 2012 - CLEVELAND (Reuters) - Ohio voters by a wide margin want a halt to hydrofracking until more impact studies are conducted, though they believe there are economic benefits to drilling for natural gas and oil, a Quinnipiac University poll released on Thursday found. The poll comes just weeks after Ohio ordered the shutdown of five wells around Youngstown that accept waste materials from the fracking process, after a series of earthquakes that could be related to their operation. ***Seventy-two percent of voters polled said there should be a halt in hydraulic fracturing, or simply fracking, in Ohio until more was known about the impact of the process, Quinnipiac found***.

New Questions About Quake Danger, At City Frack Hearing, 11/30/11 Ilya Marritz
http://www.wnyc.org/articles/wnycnews/2011/nov/30/bloombergadministration-fracking-induced-quakes-could-damage-watersystem/

Fracking Quakes Shake the Shale Gas Industry - Technology Review. Jan 21, 2012
http://www.technologyreview.com/energy/39489/?p1=A1

Fracking Earthquakes | myBrainshark
http://my.brainshark.com/Fracking-Earthquakes-318380990

After Earthquakes, Ohio City Questions Future Fracking Wells. Scientific American. Jan. 13, 2012
http://www.scientificamerican.com/article.cfm?id=after-earthquakes-ohio

FRACKING AND RISKS TO WATER AND TREATMENT OF WASTE. Prepared By Batya Lewton, Coalition for a Livable West Side - Feb. 14, 2012

Flooding and Fracking – A Dangerous Combination
http://www.catskillmountainkeeper.org/our-programs/fracking/whats-wrong-with-fracking-2/flooding/

The Case for a Ban on Gas Fracking
http://www.foodandwaterwatch.org/tools-and-resources/the-case-for-a-ban-on-gas-fracking/
Over the past 18 months, at least 10 studies by scientists, Congress, investigative journalists and public interest groups have documented environmental problems with fracking. Download the complete document. It cites 222 primary sources.

Fracking: It's All About the Water
http://motherjones.com/environment/2012/01/fracking-water-poisoning-protest-movement

EPA Announces Final Study Plan to Assess Hydraulic Fracturing - Congressionally directed study will evaluate potential impacts on drinking water. 11/3/2011
http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/197771b608adfddb8525793d005379c9!OpenDocument

Hydraulic Fracturing for Natural Gas Pollutes Water Wells
A new study indicates that fracturing the Marcellus Shale for natural gas is contaminating private drinking water wells By David Biello **| May 9, 2011 | Scientific American**
http://www.scientificamerican.com/article.cfm?id=fracking-for-natural-gas-pollutes-water-wells

EPA Sees Risks to Water, Workers In New York Fracking Rules by Joaquin Sapien | Jan. 17, 2012
http://www.propublica.org/article/epa-sees-risks-to-water-workers-in-new-york-fracking-rules

EPA Says Fracking Likely Contaminated Groundwater Supplies in Wyoming. Dec. 10, 2011
http://ecocentric.blogs.time.com/2011/12/09/contaminated-epa-says-fracking-likely-polluted-groundwater/

EPA Plans to Issue Rules Covering Fracking Wastewater – by Nicholas Kusnetz ProPublica, Oct. 20, 2011
http://www.propublica.org/article/epa-plans-to-issue-rules-covering-fracking-wastewater

EPA to Test Water in Pennsylvania near Fracking Site. Jan. 20, 2012
http://www.scientificamerican.com/article.cfm?id=us-epa-to-test-water-in-pennsylvania

After the Gas Rush (Part 2) –Rocky Kistner -1/18/12
http://www.huffingtonpost.com/rocky-kistner/after-the-gas-rush-part-2_b_1213218.html
NRDC Journey OnEarth producer Roshini Thinakaran and cameraman/editor Zak Wenning got rare footage of this waste water during a behind-the-scenes tour of a Pennsylvania gas drilling recycling plant, where waste water from fracking operations is processed and toxic contaminants are carted off to landfills for disposal.

With Natural Gas Drilling Boom, - Pennsylvania Faces Flood of Wastewater: Scientific American. Jan. 2012
http://www.scientificamerican.com/article.cfm?id=wastewater-sediment-natural-gas-mckeesport-sewage

Regulation Lax as Gas Wells' Tainted Water Hits Rivers -
http://www.nytimes.com/2011/02/27/us/27gas.html?_r=1&pagewanted=al

Did fracking kill Dunkard Creek? Dec. 2, 2011
http://www.salon.com/2011/12/02/did_fracking_kill_dunkard_creek/

Guardian.co.uk: Shale gas drilling's dirty secret is out. Dec. 9, 2011
http://www.guardian.co.uk/commentisfree/cifamerica/2011/dec/09/shale-gas-drilling-epa-fracking-water-contamination

EARTHWORKS | Water: Fracking sucks more than you think! Water Usage.
http://www.earthworksaction.org/earthblog/detail/water_fracking_sucks_more_than_you_think

Concerned About Fracking? — Part 2: Water Monitoring. Dec. 13, 2011
http://slowdownfracking.wordpress.com/2011/12/13/concerned-about-fracking-2/

Does an Old EPA Fracking Study Provide Proof of Contamination? Abrahm Lustgarten ProPublica, Aug. 4, 2011
http://www.propublica.org/article/does-an-old-epa-fracking-study-provide-proof-of-contamination

FRACKING AND PUBLIC HEALTH – THE MISSING LINK. Prepared By Batya Lewton, Coalition for a Livable West Side - Feb. 14, 2012

Missing from the Table: Role of the Environmental Public Health Community in Governmental Advisory Commissions Related to Marcellus Shale Drilling: Bernard D. Goldstein; Jill Kriesky; Barbara Pavliakova Univ. of Pittsburgh, Graduate School of Public Health, Pittsburgh, PA
http://ehp03.niehs.nih.gov/article/info%3Adoi%2F10.1289%2Fehp.1104594

Health Experts Urge Halt to Hydrofracking Expansion Until Needed Research is Done into Health Impacts PR Newswire WASHINGTON, Jan. 9, 2012
http://www.bizjournals.com/prnewswire/press_releases/2012/01/09/DC32597
Industry Called Upon to Set Up Foundation to Conduct Needed, Independent Research Leading U.S. medical experts urged today that the rapid expansion of unconventional natural gas drilling (known as "hydrofracking") for natural gas extraction be paused so that necessary research can be done into the potential harmful effects on human health.

Study needed on shale gas effects on health: group | *Reuters*
http://www.reuters.com/article/2012/01/09/us-usa-natgas-health-idUSTRE8081N020120109

Unpacking health hazards in fracking's chemical cocktail — High Country News
http://www.hcn.org/issues/43.3/unpacking-health-hazards-in-frackings-chemical-cocktail

Fracking Would Emit Large Quantities of Greenhouse Gases
http://www.scientificamerican.com/article.cfm?id=fracking-would-emit-methane

Methane and the greenhouse-gas footprint of natural gas from shale formations
http://www.eeb.cornell.edu/howarth/Howarth%20et%20al%20%202011.pdf

Toxic Contamination From Natural Gas Wells - Interactive Feature -
http://www.nytimes.com/interactive/2011/02/27/us/natural-gas-map.html

Impacts of Gas Drilling on Human and Animal Health. New Solutions, 2012
M. Bamberger & R.E. Oswald: Impacts of Gas Drilling on Human and Animal Health. In: *NEW SOLUTIONS*, Vol. 22(1) 51-77, 2012
"Without rigorous scientific studies, the gas drilling boom sweeping the world will remain an uncontrolled health experiment on an enormous scale."

EPA Proposes New Rules on Emissions Released by Fracking Nicholas Kusnetz ProPublica, July 29, 2011
http://www.propublica.org/article/epa-proposes-new-rules-on-emissions-released-by-

U.S. Energy Dept. Panel Warns of Environmental Toll of Current Gas Drilling. by Nicholas Kusnetz ProPublica, Nov. 10, 2011
http://www.propublica.org/article/energy-dept.-panel-warns-of-environmental-toll-of-current-gas-drilling-prac

New Study: Severe Health Impact of Fracking. B. Debatin. Jan. 12, 2012
http://slowdownfracking.wordpress.com/2012/01/12/health-impact-of-fracking/

Taking the Handle Off the Fracking Pump: Human Rights and the Role of Public Health Inquiry in an Age of Extreme Fossil Fuel Extraction plenary presentation .. Virginia Jan. 9, 2012.
http://gdacc.wordpress.com/2012/01/18/sandra-steingraber-national-conference-on-the-public-health-effects-of-fracking-that-was-convened-by-a-new-group-of-doctors-and-scientists-called-physicians-scientists-and-engineers-for-healthy-ener/

"Epidemiologic & Public Health Considerations of Shale Gas Production: The Missing Link" conference sponsored by Physicians Scientists & Engineers for Healthy Energy and Mid-Atlantic Center for Children's Health and the Environment Arlington. - Public health researchers and physicians not only discussed methods for documenting the human health consequences of fracking (documenting exposure pathways, using health impact assessments, developing surveys, etc.) but also called for a moratorium on drilling until safety to public health can be demonstrated.

The keynotes addresses were provided by senior officials within the U.S. Centers for Disease Control (a federal agency) and the Children's National Medical Center. You can find video documentation of the various presentations, along with powerpoint slides at the PSE website:http://www.psehealthyenergy.org/site/view/971

In the attached remarks, I also come down hard on the idea that the risks to health and environment from fracking can be successfully "mitigated." I argue that mitigation is a myth. At best, it simply delays human exposure rather than prevents it. Mitigation cannot decrease the amount of toxic material created or liberated by fracking. "Mitigation builds time bombs with longer fuses."

FRACKING – MORE SCIENTIFIC REPORTS AND WEB SITES.

Prepared By Batya Lewton, Coalition for a Livable West Side - Feb. 14, 2012

Council of Scientific Society Presidents (2010) Letter from the council to President Obama and senior administration officials, dated May 4, 2010.
http://www.eeb.cornell.edu/howarth/CCSP%20letter%20on%20energy%20&%20environment.pdf

EPA Comments on Revised Draft NYSDEC Revised dSGEIS for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs
January 11, 2012 – Enclosure
http://www.epa.gov/region02/newsevents/pdf/EPA%20R2%20Comments%20Revised%20dSGEIS%20Enclosure.pdf
http://www.epa.gov/region02/newsevents/hydro.html

Some Scientific Failings with the Draft Supplemental Generic Environmental Statement And Proposed Regulations: Comments and Recommendations
January 8, 2012
http://psehealthyenergy.org/data/dSGEIS_comments_Ingraffea_Jan_2012.pdf
Comments Submitted to the NYS Dept. of Environmental Conservation
by Anthony R. Ingraffea, Ph.D., P.E. (NYS No. 081309-0) *The Dwight C. Baum Professor of Engineering* ,Cornell University, Ithaca, NY andMember of the Board of Directors Physicians, Scientists, and Engineers for Healthy Energy, Inc.

Super Fracking Goes Deeper to Pump Up Natural Gas Production - Bloomberg News. Jan. 26, 2012
http://www.bloomberg.com/news/2012-01-11/super-fracking-goes-deeper-to-pump-up-natural-gas-production.html

Fossil fuel firms use 'biased' study in massive gas lobbying push | Environment | The Guardian
http://www.guardian.co.uk/environment/2011/apr/20/fossil-fuel-lobbying-shale-gas

Drilling Down Series. NY Times. Ian Urbina
http://topics.nytimes.com/topics/reference/timestopics/people/u/ian_urbina/index.html

Fracking Gas Drilling's Environmental Threat. ProPublica. Investigative reports
http://www.propublica.org/series/fracking

Drilling 101 – Outstanding article|
http://shaleshock.org/drilling-101/

Drilling advances prompt escalating fight in Colo. Deseret News:: Jan. 21, 2012 http://www.deseretnews.com/article/700217615/Drilling-advances-prompt-escalating-fight-in-Colo.html?s_cid=rss-14
New technology is putting oil and gas drills closer to populated areas than ever before - creating tension in Colorado over who regulates where drilling can and can't be done.

The escalating dilemma has state lawmakers considering whether to step into a standoff between energy companies and Colorado communities as the oil and gas industry creeps ever closer to neighborhoods, schools and streams. Local governments concerned with what they see as encroachment in the forms of horizontal drilling and fracking have responded by imposing new regulations on drilling rigs. The industry cried foul, prompting Attorney General John Suthers, a Republican, to warn Arapahoe and El Paso counties along Colorado's densely-populated Front Range to back off.

EPA Lists Top Fracking Concerns But Fears Data Limits May Slow Policy | Water Well Journal. Jan 2012
http://waterwelljournal.org/2012/01/epa-lists-top-fracking-concerns-but-fears-data-limits-may-slow-policy/

Feds Say Major New York Gas Pipeline Poses Safety Risk, ProPublica. Aug. 5, 2011
http://www.propublica.org/article/feds-say-major-new-york-gas-pipeline-poses-safety-risk
A recent inspection of a natural gas pipeline stretching across New York found that sections may have been installed without proper evaluation. Without changes, the pipeline could be at risk of rupturing.

Mysterious notebook fuels Ohio drilling feud. Aug. 6, 2011
http://www.foxnews.com/us/2011/08/06/mysterious-notebook-fuels-ohio-drilling-feud/

Concerned About Fracking? — Part 1: The Three Waves. By Bernhard Debatin Dec. 10, 2011. SlowdownFracking
http://slowdownfracking.wordpress.com/2011/12/10/concerned-about-fracking-1/

THE POLITICS OF FRACKING. Prepared By Batya Lewton, Coalition for a Livable West Side - Feb. 14, 2012

Bloomberg news: Obama Supports Fracking to Create 600,000 Jobs, Vows Safe Drilling for Gas
http://bloom.bg/x8zhBH
President Barack Obama pushed drilling for gas in shale rock and support for cleaner energy sources to boost the economy in his final State of the Union address before facing U.S. voters in November.

Deep Drilling, Deep Pockets. By Alex Kaplan and James Browning. May 11, 2010.
http://www.commoncause.org/atf/cf/.../MARCELLUSSHALESTUDY.PDF
The Campaign Contributions & Lobbying Expenditures of the Natural Gas Industry in **Pennsylvania**

Fracking New York Times - How Industry and the Government Reacted to an Expose By MIA STEINLE. Jan. 27, 2012
http://pogoblog.typepad.com/pogo/2012/01/the-fracking-new-york-times-how-industry-and-the-government-reacted-to-an-expose.html
In the aftermath of last summer's damaging New York Times investigation into fracking—a method of shale gas drilling lauded by investors—industry and the Department of Energy (DOE) went into damage control mode.
Internal department emails obtained by POGO through the Freedom of Information Act give insight into how DOE's Energy Information Administration (EIA) responded to the first story from Ian Urbina's "Drilling Down" series for The Times. The story itself helped bring the fracking debate into the public consciousness, by making public internal industry emails and DOE documents, which showed skepticism about fracking's promises as early as 2009.

Future of NY fracking seems to be faltering By Steve Israel 01/29/12
http://www.recordonline.com/apps/pbcs.dll/article?AID=/20120129/NEWS/201290323

What once seemed inevitable — hydraulic fracturing for natural gas in New York state in general and Sullivan County in particular — now seems much less certain.

For the Record

WOMEN'S CITY CLUB OF NEW YORK
SHAPING POLICY
improving lives

DEPARTMENT OF ENVIRONMENTAL CONSERVATION
PUBLIC HEARING ON HYDROFRACKING
TESTIMONY BY ARDEN DOWN
CHAIR OF THE ENVIRONMENT & INFRASTRUCTURE COMMITTEE
WOMEN'S CITY CLUB OF NEW YORK
February 17, 2012

Hello. My name is Arden Down, Chair of the Environment & Infrastructure Committee of the Women's City Club of New York, a nonpartisan, nonprofit, multi-issue education and advocacy organization founded in 1915. Thank you very much for the opportunity to testify on the threat that hydrofracking poses to New York City's water supply.

One of the policy priorities of the Women's City Club is to preserve the environment and protect public health from environmental threats. While we are alarmed by the danger that hydrofracking poses to the entire nation, our primary focus and concern is the safety of the New York City water supply. We strongly oppose any development that threatens the integrity or purity of our water.

Because of the continuing threats posed by hydrofracking, as confirmed by the Environmental Protection Agency and many other experts, we were surprised and dismayed by the President's endorsement of hydrofracking in his State of the Union address. For the following reasons, hydrofracking should be banned, at best, or strictly regulated and monitored, at minimum:

- The drilling process demands extraordinary amounts of water. Using millions of gallons of water is extremely irresponsible in light of the increasing scarcity of fresh water worldwide.
- The water used for fracking is mixed with chemicals that include banned diesel-based fuels to create "fracking fluid." This fluid is then pumped deep into the earth, where it is further contaminated with natural gas and naturally-occurring radioactive compounds. Some of the resulting heavily-poisoned water is recovered at ground level, and the rest disperses underground, ultimately seeping into our soil and ground water.
- The oil and gas industry has provided no assurance that the heavily polluted and frequently radioactive water that returns to the surface can be purified, nor that the industry will pay for any purification that may be possible. It is estimated today that the cost of building a water treatment plant upstate would be $10 billion. At this time, much polluted fracking waste water is dumped into open waste pits. These waste pits affect farm and grazing land, wells, and other water sources.
- After finding pollutants in waterways and groundwater due to inadequate treatment of fracking waste, the EPA stated that it will set standards for fracking waste water disposal in 2014. The WCC cannot understand why the Obama administration would permit fracking to proceed before minimum standards are established.

- It is now widely accepted that injecting large volumes of liquid deep into the rock of the earth can stress and lubricate fault lines, sometimes inducing earthquakes. Given that New York experiences earthquakes, we must be particularly mindful of the damage that hydrofracking may cause.
- The Department of Environmental Conservation's own database of hazardous substance spills over the past thirty years found 270 cases documenting fires, explosions, wastewater spills, well contamination and ecological damage related to gas drilling.
- Finally, the amount of gas that can be extracted from shale has been greatly exaggerated. The claim of a 100-year supply originated with a report released in April 2011 by the Potential Gas Committee, an organization of petroleum engineers and geoscientists. That claim has been severely challenged on the grounds of recoverability. We are never able to extract all of an oil or gas resource. For oil, a 35 percent recovery factor is considered excellent. But recovery factors for shale gas are highly variable, due to the varied geology of the source rocks. Even if we assume a *very optimistic* 50 percent recovery factor for the 550 trillion cubic feet (tcf) of potential gas (536.6 tcf from shale gas plus 13.4 tcf from coal-bed gas), that would still only amount to 225 tcf, or a 10-year supply. Added to the 11-year supply of proven reserves, domestic natural gas would last the United States just ***21 years*** at current rates of consumption.

For now, given all of the proven dangers of hydrofracking, it is up to all of us – and to our elected and appointed officials in particular – to hold industry responsible for its actions and ensure that this practice does not go ahead unless the problematic elements I have enumerated can be fully mitigated. We salute and join other organizations that are also standing up to fight the serious environmental and public health threats to New York City's water supply posed by hydrofracking.

Thank you.

The City of New York
Manhattan Community Board 1
Julie Menin CHAIRPERSON | Noah Pfefferblit DISTRICT MANAGER

For the Record

The New York City Committee on Environmental Protection
Public Hearing on

**Oversight: Examination and Discussion of
NYC Department of Environmental Protection's Comments, Entitled
"Geophysical Evaluation of Infrastructure Risks of Natural Gas Production on
New York City West of Hudson Water Supply Infrastructure,"
to the NYS Department of Environmental Conservation (DEC)
Regarding DEC's Revised Draft Supplemental Generic Environmental Impact Statement
on the Oil, Gas and Solution Mining Regulatory Program**

Testimony by
Catherine McVay Hughes, Vice-Chairperson,
Manhattan Community Board 1

**Friday, February 17, 2012, 2 p.m.
250 Broadway, 16th Floor Committee Room, New York, NY**

Good afternoon, Chairperson James Gennaro. I am Catherine McVay Hughes, Vice Chairperson of Manhattan Community Board One and I am here to testify on behalf of CB1 regarding the Examination and Discussion on the NYC Department of Environmental Protection's Technical Memorandum: Geophysical Evaluation of Infrastructure Risks of Natural Gas Production On New York City West of Hudson (WHO) Water Supply Infrastructure (December 21, 2001)[1] regarding New York State's Department of Environmental Conservation's high-volume hydraulic fracturing (HVHF) Revised Draft Supplemental Generic Environmental Impact Statement (RDSGEIS) on the Oil, Gas and Solution Mining Regulatory Program.

The content of this technical memorandum reviewing the NYCDEP Water Supply Infrastructure Outside the WHO Watershed, Existing Geophysical Data, Microseismicity Associated with HVHF, Potential for Reactivation of a Fault by HVHF Near the WHO Non-Watershed Infrastructure and Adequacy of the Tunnel Protections is alarming.

The 2011 NYSDEC ignores NYCDEP's proposed complete ban of drilling within a seven-mile buffer around the water supply infrastructure for 9 million people by proposing a 4,000-foot wide (0.75 mile) zone around the watershed boundary. In addition, the technical report concludes that the NYSDEC does not protect "the water supply infrastructure located at the edge of or outside of the watershed boundary." The subsurface geology underneath and in the vicinity of the infrastructure is much more complex than indicated in the RDSGEIS. In addition, more

[1] http://www.nyc.gov/html/dep/pdf/natural_gas_drilling/hager-richter_technicalmemorandum_20111221_hydrofrac.pdf

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recent analyses indicate that much more extensive faulting has also not been included in the RDSGEIS. Geological mapping done in the 1950's during the construction of the 75 miles of the Delaware System tunnels and aqueducts "records numerous faults, crush zones, slickensided joints, shear zones, and brecciated zones that cross critical infrastructure. The report further raises 'the possibility that one or more faults in the vicinity of the WOHNWI is seismically active" and "at least one of which could have been caused by human activity."

The report also states that, "tunnels can be damaged by seismic events with magnitudes less than 4 and that tunnels can be damaged by seismic events on faults located greater than 25 km from the tunnel." Two examples (Blackpool in the UK and Garvin County, OK) "demonstrate the possibility that HVHF treatment of horizontal drill holes in the vicinity of the critical WOHNWI could induce one or more earthquakes that the unreinforced concrete-lined water supply tunnels would not experience otherwise."

More alarming is that the "sole protection in the RDSGEIS is a 1,000-foot buffer zone from the wellhead to the tunnel" and that "permits can be issued for locations anywhere within 1,000 feet of the NY WHO Water Supply Tunnels pending a negative declaration of a site-specific SEQRA review." The report states that "the protection described is not adequate to protect the NYC water supply tunnels."

Our Community Board has passed numerous resolutions regarding hydrofracking in areas that could potentially harm our drinking water. On May 26, 2009, we called on the New York State Department of Environmental Conservation (NYSDEC) to prohibit the use of hydraulic fracturing in the New York City watershed. Our concern then and now was that hydraulic fracturing involves the injection of carcinogenic chemicals into the earth at extreme pressures. The composition of these chemicals is not publicly disclosed, and there has not yet been sufficient public review of the effects these chemicals can have on public drinking water. Without more information, we are greatly concerned that hydraulic fracturing in the New York watershed poses a serious risk of contamination to the drinking water of millions of residents in the greater New York City area.

While we recognize that hydraulic fracturing will be prohibited in the New York City (and Syracuse) watersheds, primary aquifers and state lands, we have many concerns about protecting New York City's drinking water. Our concerns include, but are not limited to:

- Contaminated hydraulic fracturing wastewater
- Wastewater treatment plants currently designed for sanitary waste
- Limited DEC staff resources (including funding and inspectors) and regulatory enforcement
- Specific funding for corrective action
- Identification of source of water to be used during the hydraulic fracturing process
- Vulnerability to earthquakes due to hydraulic fracturing
- Inadequacy of prohibiting surface drilling within 2,000 feet of public drinking water supplies and 1,000 feet of primary aquifers
- Cumulative impacts, including air quality
- Same liability for both domestic and international companies

- Reliability of shale reserve estimates

In addition, the RDSGEIS fails to take into account the recent extreme weather events that resulted in many upstate communities being flooded. With climate change there have been more powerful storms which have increased the frequency of flooding. This flooding makes hydrofracking an even greater environmental risk as drilling pits may overflow and spill their toxic contents into flooded creeks, streams and rivers that feed watersheds. Given these recent events, floodplains maps need to be updated to reflect the current data rather than using historic trends.

The RDSGEIS also fails to take into account the current glut in the natural gas markets. The wellhead price of natural gas has plummeted to $3.35 per thousand cubic feet (November 2011) from a 2008 monthly high in June 2011 of $10.79 per thousand cubic feet.[i] According to the U.S. Department of Energy, our country's supply of natural gas is sufficient for years and decades to come. We are currently drilling more gas than we can store, and we therefore see no need to rush into drilling within the boundaries of our watershed.

Also, the wastewater from natural gas drilling operations containing high levels of chloride, toxic metals, petroleum hydrocarbons and radionuclides, is already being used by several upstate municipalities as part of their road and highway maintenance programs on thousands of miles of roads for dust control, winter de-icing or roadbed stabilization. This DEC-sanctioned maintenance practice should be of grave concern to all New Yorkers since this is yet another way that the contaminants from the hydrofracking process may enter the drinking water supply. The RDSGEIS does not clarify how the millions of gallons of wastewater laced with potentially toxic chemicals will be stored and treated.

Community Board 1 passed another resolution in November 2011 calling on the NYSDEC to select the "no action alternative" described in Section 9.1 of the revised environmental impact statement to avoid potential significant adverse impacts identified in the RDSGEIS. In the event that NYSDEC does not select the "no action alternative," our resolution identifies ways in which the RDSGEIS should be revised. These include the need for an enforcement mechanism to ensure compliance with mitigation measures, the need to fund this enforcement mechanism through permits for gas companies rather than tax revenues, and the need to expand the buffer zone surrounding the NYC Watershed to at least 8 miles to mitigate substantial risks. Additionally, our resolution recommended that the RDSGEIS be withdrawn and revised to include:

- A reexamination of the 1992 GEIS, which the RDSGEIS relies on significantly despite the changes that have occurred in the last 17 years.
- A clean-up escrow fund to be financed by fees paid by gas companies to assure that when the inevitable environmental accident occurs, funds other than taxpayer funds are available to pay for the cleanup and remediation of any such accident.
- An emergency notification system should be designed and put into place to address the inevitable environmental accidents.
- A more detailed analysis of hydrofracking waste-water treatment and disposal.

- A publicly accessible website that identifies the chemicals being used on a per-operation basis, including the identification of the specific location where such chemicals are being used.
- A full disclosure of the likely negative impact from gas leasing on the ability of the lessee to mortgage or sell the property subject to the lease.
- A more detailed analysis in Section 6.8 of the RDSGEIS, which addresses socioeconomic issues, to include the potential for worker injury and disease along with mitigation measures.

Water that is clean, safe and affordable is in the interest of every New Yorker. New York City is one of the few world-class cities that do not get water from the nearest river; the city water system is one of mankind's great achievements in civil engineering, turning rainwater and gravity into the very lifeblood of our metropolis. New York State should not seek to close its budget gap in part by leasing mineral rights connected with its public lands in a manner that risks this great achievement and our environment.

We cannot forget that, "Water – by far the most valuable resource on this planet – is treated as if it did not have any value at all. We often do not even know the cost of providing it; the true number is buried under open and hidden subsidies, taxes, and the sunk costs of municipal and regional water and irrigation departments[ii]." Therefore, we are concerned that as the hydrofracking decision nears and "the energy companies have been pouring millions of dollars into television advertising, lobbying and campaign contributions" (NY Times, "Millions Spent in Albany Fight to Drill for Gas," by Thomas Kaplan, 11/25/2011), that the quality of our water is not compromised for short term financial gain – and that any water that is used during the fracking process is charged a fee that truly reflects its value.

This proposal under consideration by DEC places an unnecessary and unconscionable risk on New Yorkers, as it only limits drilling to within a thousand feet of tunnels and aqueducts that deliver water to our city, despite the requested minimum eight-mile buffer zone. Recently Delaware Governor Jack Markell announced that Delaware would vote 'no' on the current regulations for hydrofracking in the Delaware River Basin, calling instead for a full study of impacts on the Basin before proceeding. We likewise urge DEC and Governor Cuomo to proceed with extreme caution in the NYC Watershed given the grave risks that have been identified.

Thank you for the opportunity to testify today.

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[i] http://www.eia.gov/dnav/ng/hist/n9190us3m.htm

[ii] McKinsey Quarterly 2010, Number 1; Special report: "The water imperative," p. 79.

To: New York City Council
Environmental Protection Committee
Chairman James Gennaro
Special Hearing on NYCDEP rdSGEIS Comments

From: Joseph Levine
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I thank you for holding this hearing today and appreciate the opportunity to speak on the subject of hydraulic fracturing in NYS pursuant to the NYCDEP's comments regarding seismic and migration issues impacting the NYC water supply infrastructure.

Attached I submit to you the comments I submitted to the NYS rdSGEIS in January because they are particularly relevant given the focus on issues of seismic and migration concerns. Seismic and migration issues are intrinsically intertwined as they are both inherently related to joints, faults, fractures and lineaments and as Hager-Richter Geoscience states in their report, *Geophysical Evaluation of Infrastructure Risks of Natural Gas Production On The NYC West of Hudson Water Supply Infrastructure;* and I paraphrase;

The system of joints, faults and fractures that make up the structural geology of the Marcellus shale are considered critical to understanding the tectonic setting. Further comments in the report I extract and submit below, and these are to make the following point:

There is no specific safe setback distance that Hager-Richter can recommend – even though the prior phase of the NYCDEP study suggested a 7 mile buffer. This information combined with the Robert Jacobi paper titled, *Basement Faults and Seismicity in the Appalachian Basin of NYS,* which correlates seismic activity and migration to the same fault and fracture geology, would mean that migration distances of toxic fluids released as a result of fracking through migration pathways such as faults, joints, induced and naturally occurring fractures also cannot be predicted. This is certainly suggested in the USGS paper by Ryder, Trippi, et al. where they have documented migration of gases exceeding 50 miles horizontally.

Hager-Richter states;

"Hager-Richter does not recommend a specific setback distance herein because 1) there are too many uncertainties about site specific subsurface geological and geophysical conditions in the vicinity of the WHO Non-Watershed Infrastructure, and 2) the condition of the unreinforced concrete-lined water supply tunnels is unknown. The need for extra caution in the vicinity of the WOH NWI is obvious, but what constitutes an acceptable level of risk damage to the critical water supply infrastructure is more a matter of policy, not geophysics."

Based on the above findings, Hager-Richter makes the following recommendations:

"Hager-Richter recommends that horizontal drilling and HVHF treatment not be permitted along

a fault mapped in the WOH NWI due to low, but real possibility of reactivation of a fault that might experience sufficient slippage to damage the unreinforced concrete lining of the critical NYC water supply tunnels.

There is not enough geophysical information available to recommend a specific setback distance from the infrastructure along a fault mapped in the infrastructure in which horizontal drilling and HVHF should be barred. If horizontal drilling and HVHF is proposed in the vicinity of one of the faults that cross the water supply tunnels, Hager-Richter recommends that the detailed site characterization of the proposed drilling site and the area between that location and the WOH NWI be required to demonstrate that faults are not present and the results provided to NYSDEC and DEP prior to issuing a permit."

My attached prior submission to NYSDEC further details this position which is supported by the scientific community as presented in the attached reports and papers.

Respectfully submitted,
Joe Levine
NYH2O
Damascus Citizens for Sustainability

SUBMISSION TO NYS DEC DRAFT SGEIS

JANUARY 11, 2012

THE FOLLOWING DOCUMENTS ARE A COMPILATION OF REPORTS, ESSAYS, LETTERS AND SCIENTIFIC STUDIES WRITTEN BY GEOLOGISTS, HYDRO-GEOLOGISTS, ENGINEERS, AND VARIOUS GOVERNMENTAL AGENCIES REGARDING HYDRAULIC FRACTURING. THIS INFORMATION IS PRESENTED WITH A FOCUS ON MIGRATION OF FLUIDS THROUGH THE NATURAL FAULTS AND FISSURES IN THE UNIQUE NEW YORK STATE GEOLOGY THAT WILL BE INDUCED BY HYDRAULIC FRACTURING, AND THUS, THE IMPLICATIONS THIS METHOD OF FOSSIL FUEL EXTRACTION WILL HAVE ON OUR DRINKING WATER.

SUBMITTED BY JOSEPH LEVINE
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Enclosed Documents

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http://63.134.196.109/documents/10aug19_HydroQuestEPAComments.pdf

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19. HAZEN AND SAWYER, *Environmental Engineers and Scientists. Final Impact Assessment Report: Impact Assessment of Natural Gas Production in the New York City Water Supply Watershed.* DEP. December 2009.

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January 11, 2012

To: Commissioner Joe Martens
NYS Dept of Environmental Conservation
625 Broadway
Albany, NY 12233-1011

Re: **Revised Draft SGEIS 2011**

From: Joseph Levine
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My comments focus on migration of fluids and gases through natural faults and fractures in the NYS geology that will be precipitated by high volume, slick-water hydraulic fracturing. This issue is of critical importance because it will have a profound detrimental and potentially catastrophic impact on ground and surface water. There is no way to control migration of fluids and gases caused by fracking. The most recent draft SGEIS however dismisses the fact that migration of fluids and resultant contamination is a probability, although there is overwhelming scientific evidence to the contrary. Attached is a selection of reports, studies and scientific papers documenting migration of fluids and gases through faults, fractures and fissures in the naturally fractured bedrock geology of New York State.

In response to the previous draft SGEIS there was a significant body of reputable, scientific work submitted by geologists, hydro-geologists, petrochemical engineers, many environmental engineering firms and various governmental agencies that addressed the migration/contamination link. However there is no indication, based upon the attention given this subject in the draft SGEIS 2011, that this material was reviewed or considered. The following is the greater part of any reference in the draft SGEIS made on the *migration* issue. On page 11 of the Executive Summary, the following is stated;

> "Chapters 5 and 6 contain analysis that demonstrate that no significant adverse impact to water resources is likely to occur due to underground vertical migration of fracturing fluids through the shale formation. The developable shale formations are vertically separated from potential freshwater aquifers by at least 1000 feet of sandstone and shales of moderate to low permeability...That shales must be hydraulically fractured to produce fluids is evidence that these types of rock formations do not readily transmit fluids. The high salinity of native water in the Marcellus is evidence that fluid has been trapped in the pore spaces for hundreds of millions of years, implying that there is no mechanism for discharge of fluids to other formations. Hydraulic fracturing is engineered to target the prospective hydrocarbon-producing zone. The induced fractures create a pathway to the intended wellbore, but do not create a discharge mechanism or pathway beyond the fractured zone where none existed before. Accordingly, there is no likelihood of significant adverse impacts from migration of fracturing fluids."

It is in response to the above statement that I submit the attached compilation of reports that contradict the

above statement in its entirety. But in terms of "no likelihood...from migration of fracturing fluids" (stated above), I submit an excerpt from the following USGS paper; *A Regional Perspective of the Devonian Shale and Ordovician Utica Shale Total Petroleum Systems of the Appalachian Basin* (September 2011) Robert T. Ryder, et al. 1U.S. Geological Survey, Reston, VA 20192, rryder@usgs.gov

> "....For example, oil and gas generated and expelled from the Marcellus Shale in N.Y., Ohio, Pa., and W.Va. probably migrated vertically through about 1,500 to 4,000 ft of overlying shale and siltstone into Upper Devonian and Mississippian sandstone. In addition, a short time after vertical migration, large volumes of Marcellus Shale gas (from cracked oil or kerogen conversion) were expelled a short distance into underlying Lower Devonian sandstone and migrated either into adjoining anticlines or updip as far as 50 miles. Furthermore, oil and gas generated and expelled from the Utica Shale in Ohio and Pa. suggest the following migration patterns: 1) westward across-dip migration for 30 to 80 miles through about 1,000 ft of underlying Ordovician carbonate rocks before entrapment in Cambrian reservoirs, and 2) vertical migration through about 1,500 ft of overlying Ordovician shale followed by updip migration as far as 50 miles before entrapment in Lower Silurian sandstone."[i]

In addition, the NYCDEP commissioned Hazen and Sawyer Report documents migration of gases that were recorded during the construction of the NYC water tunnels – up to 7 miles through natural faults. The EPA recently documented migration of fluids containing fracking chemicals in water wells and an aquifer in Pavillion, WY. The same problems were documented in Dimmock, PA.

There are numerous detailed scientific studies on rock fracture mechanics, that prove that fluids and gases can and will predictably migrate via faults, joints and fissures, known as migration pathways in an unpredictable variety of ways, and can find their way to ground and surface fresh water resources including aquifers. The hydraulic fracturing process will (as it is designed to) stimulate movement and release of gases and fluids through existing and fracking induced pathways through the naturally fractured geology. These fluids and gases are toxic; both naturally occurring (heavy metals, deep-seated saline waters, radioactive materials and gases) and introduced toxic fracking fluids (aka slick-water).

The draft SGEIS Executive Summary Statement (above) summarily dismisses the large body of accepted scientific work on this subject or has based its conclusions on some other scientific study(s) or body of knowledge. In either case it would be valuable to the public and the scientific community if the draft SGEIS provided information or evidence that specifies what scientific research their position is based upon. This issue is so evidently a singular crucial aspect of the ultimate safety of hydro-fracking technology that appears to be without remedy. It certainly deserves proper attention and analysis.

Attached are reports from (including but not limited to) several experts and environmental engineering firms that substantiate this position. The group includes Robert D. Jacobi (whose work on mapping faults and fractures with the Geology Dept - Rock Fracture Group at The Univ of Buffalo is some of the most extensive on the subject); Hazen & Sawyer for NYCDEP, Arcadis US for the NY Watershed Inspector General, Paul Rubin, Geologist/Hydrogeologist - HydroQuest; Jeffrey Thyne, Geologist and author of the Garfield Co Hydrogeological Study; Marc Durand, geological engineering professor (Université du Québec à Montréal) whose specialty is rock mechanics and hydrogeology, among others.

This compilation of reports confirms the extensive pattern of faults and fissures in NYS (Appalachian Basin). Yet the draft SGEIS fails to reference relatively well known fault and fracture information, including the existence of up to date mapping. The draft SGEIS includes an outdated map (figure A; pg 9) that shows only a small fraction of the known actual faults in NYS (compare with Jacobi's map; figure B; pg 9). This lack of relevant and accurate documentation is incomprehensible and worthy of invalidating the study.

Some of the most extensive studies on mapping of faults and fissures in NYS have been done by Robert Jacobi. This work has been endorsed and widely accepted by the scientific community (including the Society of Petroleum Engineers – SPE, NYSERTA, and the NYSDEC) and has not been challenged by any scientific organization, and is often referred to as the most extensive, documented mapping of NYS geology. It's unacceptable that the DEC is not better informed; there is too much at stake.

The Jacobi report; *Basement Faults and Seismicity in the Appalachian Basin of NYS; Jacobi 2009*, states;

> "seismic activity is most active along the myriad pattern of faults in NYS, ...thus, it is not surprising that almost all of the seismic events in the Appalachian Basin portion of NYS can be correlated with the known and suspected faults. It appears that more faults are seismically active in NYS than previously supposed. It may be that most of the basement faults that extend to the surface rocks are seismically capable, even those that do not have historical seismicity ascribed to them. Further work will undoubtedly modify the specific locations of fault traces and their seismic capability. However, the conclusion is inescapable that a large number of faults do exist in NYS, and that several of them have been seismically active."[ii]

> Gas shales are often the origin of hydrocarbon stored in conventional reservoirs. These hydrocarbons have been expelled, migrating upward into a trap of reservoir quality rock below a sealing unit (often shale). In gas shale systems, the shale is all three: hydrocarbons are generated, stored and held in place. The preserved organic matter is "consumed" through biogenic or thermogenic processes to generate smaller chain hydrocarbons (gas or liquid). The remaining carbon that cannot be converted (dead carbon) and clay minerals form a storage mechanism through adsorption, which increases tremendously the potential storage volume. The relationship between temperature, pressure, available volume and the general attractiveness of methane (partial pressure) will define ultimate adsorbed storage capacity. Even after a great amount of generated gas is expelled out of the shale (as source rock), there can remain an enormous quantity as adsorbed gas. Gas will also reside in rock matrix pore space and fractures if there is a "seal" to keep the gas in these spaces.[iii]

I will not elaborate on seismic activity in this comment but do so for two reasons. One is that the Jacobi studies have so much to do with seismic activity, and second because of the recent reporting of earthquakes/seismic activity related to fracking (and/or injection wells) in Ohio and before that in Arkansas, Texas, England and elsewhere. The Ohio State geologist investigating the recent earthquake said that, "this could be avoided if more analysis (although costly) was performed so that wells intersecting with faults could be avoided" (Scientific American; Jan 3, 2012).

This of course is likely impossible in NYS where the faults are so densely populated with literally a matrix of criss-crossing fractures (as described by Jacobi) that it would be quite difficult – if not impossible to avoid.

> Also taken from Jacobi's report:
> Part of the multidisciplinary approach developed (by Jacobi and Fountain 1996) was the identification of fracture intensification domains (FIDs; e.g., Jacobi and Xu, 1998; Jacobi and Fountain, 2001, 2002). The FIDs are characterized by closely spaced fractures, the strike of which defines the trend of the FID. The closely spaced fractures are also commonly the master fractures, even though they may characteristically abut other fracture sets in regions outside the FID. In interbedded shales and thin sandstones in NYS, fractures within the FID that parallel the FID characteristically have a fracture frequency greater than 2/m, and commonly the frequency is an order of magnitude greater than in the region surrounding the FID.
>
> An important observation is that these seismically active faults crisscross a large portion of NYS. The high number of faults means that most cultural facilities (e.g., waste disposal sites, bridges, pipelines) are not far from a potentially seismically active fault. For example, the West Valley faults extend south to the West Valley Demonstration Project, a high- and low- level radioactive waste storage site. Similarly, the Attica – Lockport Fault passes fairly close to the Darien Lakes theme park, where some of the highest amusement rides in the Northeast are located. And one final example: in the Mohawk Valley region, the south end of the Hinckley Reservoir dam is adjacent to the Prospect Fault. Thus, it is vitally important to assess the maximum credible seismic event that can be expected along these faults.
>
> The maximum credible seismic event is extremely difficult to determine, partly because the historical recurrence rates of all earthquake magnitudes are relatively low in NYS (especially the moderate magnitude events) and because there may be a disconnect on Gutenberg – Richter curves between small events and maximum credible seismic events.

And most relevant with respect to migration from Jacobi;

> Certain sets of fracture intensification domains are marked by soil gas anomalies commonly less than 50m wide (Jacobi and Fountain, 1993, 1996; Fountain and Jacobi, 2000). In NYS, the background methane gas content in soil is on the order of 4 ppm, but over open fractures in NYS, the soil gas content increases to 40–1000+ ppm. (R.D. Jacobi / Tectonophysics 353 (2002) 75–113 p79).[iv]
>
> "The high concentration of gas in the faults is consistent with why drillers seek out the faults, because this is where hydrocarbons exist in greatest concentrations because the faults provide both a pathway and collection zone."[v] (Marc Durand)

The Executive Summary also states "Hydraulic fracturing is engineered to target the prospective hydrocarbon-producing zone. The induced fractures create a pathway to the intended wellbore, but do not create a discharge mechanism or pathway beyond the fractured zone where none existed before. Accordingly, there is no likelihood of significant adverse impacts from migration of fracturing fluids."[vi]

This statement is not accurate and cannot be scientifically supported. Some of the released gas (with luck possibly most) will migrate up the wellbore as desired. But there is no doubt that some (also possibly

most – if not lucky) will find other pathways. As per Marc Durand (below), fracking recovers only 20% of the gas in a reservoir until the well is capped due to productivity decline. The rest of the gas will migrate naturally - through the network of natural faults and fissues, including additional pathways opened up by fracking that were previously naturally sealed.

Marc Durand, geological engineering professor (Université du Québec à Montréal) whose discipline is rock mechanics and hydrogeology states (Shale Gas Info March 12, 2011);

> "Hydraulic fracturing artificially creates a network of interconnected fractures towards which the gas begins to migrate. The technique initiates the flow of gas in the deposit as happened in the classic natural gas deposits over hundreds of thousands of years, but the (fracking) technique cannot speed up the geologic process. The construction of a well and it's fracturing are completed in a few weeks; the flow begins and continues on a geologic time scale. The amount of time before the well is closed (once the rate is no longer commercially viable) represents no more than an infinitesimal portion of the geologic time. Fracking gets out only 20 per cent of the gas (in a reservoir), a figure confirmed by Canada's National Energy Board.
>
> "After maybe eight years of production, the gas companies will seal – and forget – the wells, Durand said. That means that the remaining gas (80%), will continue to release itself from the shale (post fracking). The rock formations shattered by fracking will be thousands of times more permeable, allowing the remaining 80 per cent of shale gas and underground toxic water, 10 times more salty than sea water, to continue circulating, bubbling to the surface through disused (abandoned) gas wells. Over time, methane could leak into the groundwater and gas leaks could gush, uncontrolled, into the air. Because this happens deep below, it is not visible on the surface," Durand wrote in a paper raising questions about shale gas.

Paul Rubin of Hydro-Quest makes the same case in this report (Scope of EPA Study on Hydraulic Fracturing, August 10, 2010).

> "Jacobi and Smith (2002) document the epicenters of three seismic events in Eastern Otsego County. These seismic events indicate that earth movement occurs from great depths along faults upwards to aquifers and potentially to exposure at the ground surface. The great lateral extent of these faults, and their visually observable connectivity with other faults, confirms that the process of hydraulic fracturing, which may interconnect naturally occurring faults and fractures, has a great a very real potential of causing contaminants to migrate to aquifers and surface water from localized zones across and beyond county and watershed boundaries. Fracking contaminants, once mobilized vertically along fault planes and fractures, especially under pressurized conditions, can reach freshwater aquifers. Even if all fracking fluids were comprised of non-toxic chemicals, the risk of interconnecting deep saline –bearing formations and/or radioactive fluids is not warranted. Any commingling of deep-seated waters, with or without hazardous fracking fluids is unacceptable. Documented gas excursions near existing gas fields demonstrate that vertical pathways are open. If gas can migrate to the surface it is highly likely that hydrocarbon and contaminant rich Light Non-Aqueous Phase Liquids (LNAPL's) will also reach aquifers and surface water resources. These contaminants may then also migrate to down gradient wells, principal aquifers and waterways."[vii]

So, what will be the legacy of shale gas hydraulic fracturing for NYS? Concerns regarding the aftermath are not addressed in the draft SGEIS except an oblivious assumption that the "sites" will be restored and

look nice and grassy. That is the image that industry provides. Marc Durand provides the following analysis;

Marc Durand, from *Shale Gas – A Business Plan Very Much in the Red:*

> In 20 or 30 years how much will 20,000 depleted wells, which will simply have been concealed before being bequeathed to the geographic locale, cost us per year? There is total silence on this question, because the mining and oil sector has never been concerned for what happens to the drill holes afterwards. The industry has never allocated funds for that. The newest legislation requires only the rehabilitation of the site at the end of its exploitation. Companies must restore the surface of the site but there is almost nothing for what is underneath.
>
> There are thousands of well sites at the end of their life span, hidden in the surface vegetation which have become all the more dangerous because their location has been forgotten. In the United States, there are more and more reports of victims of explosions from gas which resurfaces from old wells. In the majority of cases, it is old exploration wells dating from the beginning of the last century (Appalachia, Colorado). The problem will take on a whole new dimension shortly with the end of life of the gas wells situated in layers, which have undergone intense modification by hydraulic fracturing. The technique, newly applied on a large scale, will leave thousands of abandoned wells under inhabited zones, without anything being known of the impacts which will arise at the end of the work.
>
> Lets be clear about what we understand by the end of the life-span of a shale gas well. A working well has a life of 3-5 years. It is an optimal plan for extracting the gas as quickly as possible at the lowest cost. The output the fractured shale delivers is very high at first, then it diminishes logarithmically or exponentially. The wells are abandoned when the rate of gas is deemed unprofitable; at which point about 20% of the gas in place has been captured.
>
> In classic gas reservoirs, up to 95% of the natural gas can be captured. For shales, recoveries are expected to be around 20% because of low permeabilities, despite high- density horizontal drilling and extensive hydraulic fracturing . (National Energy Board, A Primer for Understanding Canadian Shale Gas).
>
> At the end of this period the extraction well is summarily transformed for another job or task whose sole purpose is to stop the flow of gas in the well. By means of blocking down hole plugs, cement plugs in the tubing, etc., the temporary extraction site must be turned into something permanent, the function of which is very different. In reality, practically nothing changes in the structure and composition of the well but the addition of a permanent plug. Whatever the design of the plug, the new work cannot have a drastically modified life-span. Nevertheless, these plugged wells must resist in perpetuity the pressure of the methane, which will continue to seep from the fractured shale. And let's not forget that 80% of the gas remains in the shale at the end of extraction.
>
> Underneath the inhabited plain, the Utica will have become an extremely permeable reservoir, still containing the left over methane after the skimming of the 20%. This enormous volume, 100 metres thick times 10,000 Km squared will be directly connected to the surface by 20,000 slowly corroding wells .The steel pipes and the sealing grout in an extremely saline environment will erode. This will possibly vary in speed from one well to another according to the quality of the sealing work done. The life duration of each of these wells, is the time before the deterioration is so advanced that major leaks force the authorities to intervene. From then on there will

necessarily be a cost . This cost may appear very early in the process for certain wells, as has happened in Québec with some wells whose exploitation phase hasn't even begun; but for now, the industry is still the owner of the wells and so pays the cost. This demonstrates though, that leaks occur even with brand new wells.

Figure 1 shows various routes the gas can take to reach the surface and drinking water wells. (P) The light blue letters (A,B,C) show the gas flow in the case where the drilling intersects a flaw or a long fracture. It is difficult to estimate in what proportion of wells this could occur because a detailed geological map is not readily available for the rock under the soft deposits of the St. Lawrence Valley.

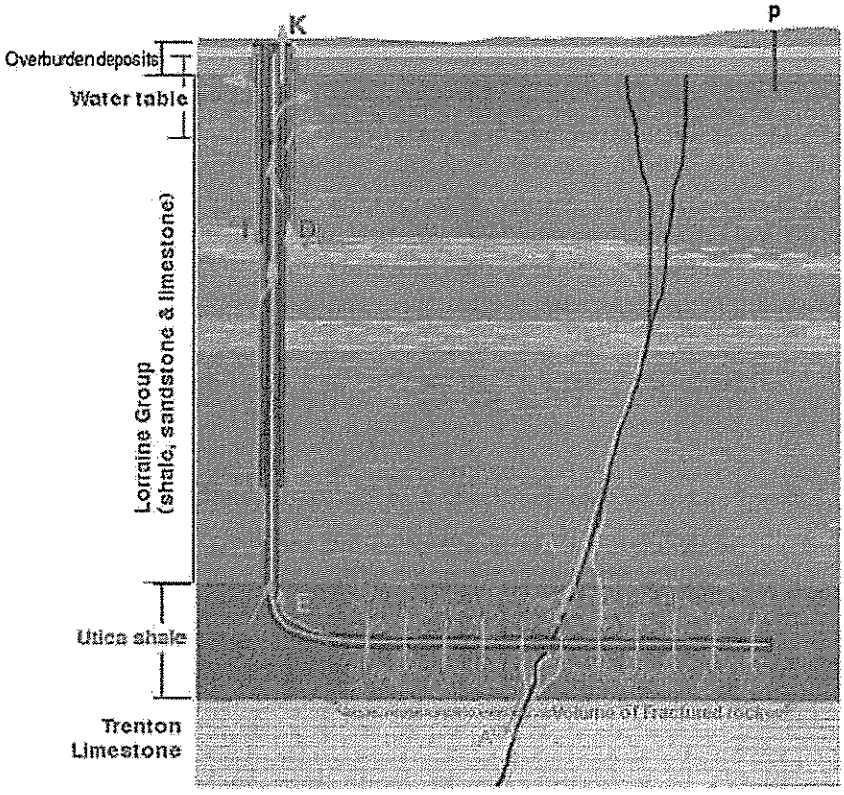

Figure 1 : possible leaks for an extraction well – capped well.

Where there is the presence of such a fracture, the injected liquid opens this route and pushes very far (A) into the Lorraine strata. The flow path is opened permanently to continue into the sandstone and other more permeable layers.

Gas leaks show up in the artesian wells and the dwellings in proximity to the fault. Note that the fracturing fluid also penetrates a great deal further than the fault in the limestone (A) The Trenton is more permeable than shale and it contains very salty water. Thus a route is opened for saline contamination. Some analyses of fracking water indicate that this type of problem has already been encountered in the first wells.

Between the pipes and the drilled rock, and between the producing pipes and the protective sheath, the quality of the placement of the grout can leave spaces : annular fractures may also form during the intensive use of the wells. So that it is a possible origin of gas leaks coming from

the wells themselves (E and K).

As well as these possibilities of leaks, at the end of the well's life, probably between 2 and 5 decades after the end of operations, more generalized leaks will begin progressively, in growing proportion to the abandoned wells. The first reasons will be : 1) the disintegration of the steels and cements of the seal. 2) the pressure of the gas which builds slowly and surely on the capping. 3) the readjustment of the pressure (more precisely, the state of the constraints) in the fractured rock will slowly readjust, shearing off or deforming locally sections of the pipes.

The Utica strata tend to inflate when exposed; the same property in the depths will tend to flow and close up the opened fractures a bit over time. The fractured shale will thus tend to lose some of its permeability; but this will not be sufficient to return it to its initial impermeability. On the contrary, these micro ruptures will contribute to the liberation of yet more methane over time.

We are dealing here with structures which will disintegrate in extremely salty environments underground far from all possibility of inspection and maintenance, in rock transformed by the operations of hydraulic fracturing. The flow of fluids, saline water and methane will become modified. All the structures linking the surface of the transformed Utica will sooner or later attain an advanced degree of decomposition. The wells will reach a state where their function as sealing devices will no longer be operational. That means what exactly? : mega-problems at each of the wells, means of mitigation to be put in place , complex studies to be undertaken to try to find a solution, BAPE commissions for each site? (see my analysis of the Mercier case in my preceding text) There will be many of the 20,000 , maybe between 250 and 500 new cases per decade in one generation. Billions to plan for in the budget of Québec.

If the heads of the wells are kept accessible for perpetuity, rather than restore the surface, one would have a less complex task, because one could sound the ground and know when catastrophe threatens. Yet no one anywhere is proposing that. It is said that the site must be restored at the conclusion of the extraction. All that means is burying and forgetting the problem until it hits us in the face. Finding a solution at that point will be an impossible task, as it is impossible to obliterate a well . The hole remains there, even if one tries to plug it with something else, that other material will never have the same properties as the shale that has been drilled and fractured. This Utica Shale has contained the gas for 400,000,000 years.
All our technology, present and future will never manage to do that well.[viii]

Regulations cannot make fracking safe; no amount of regulation can control migration of fluids released by hydraulic fracturing. This is based upon very simple physics.

Joe Levine
NYH2O / DCS / Citizens For Water

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[i] RYDER, T. ROBERT, et al. *A regional Perspective of the Denovian Shale and Ordovician Utica Shale Total Petroleum Systems of the Appalachian Basin.* AAPG Search and Discovery Article#90131, 25-27 September 2011.

[ii] JACOBI, ROBERT D., PhD, Geology, Columbia University. *Basement Faults and Seismicity in the Appalachian Basin of New York State.* November 2001, April 26, 2002.

[iii] MARTIN, JOHN P., et al. A Primer on New York's Gas Shales
http://offices.colgate.edu/bselleck/AppBasin/GasshaleMartin.pdf

[iv] JACOBI, ROBERT D., PhD, Geology, Columbia University. *Basement Faults and Seismicity in the Appalachian Basin of New York State.* November 2001, April 26, 2002.

[v] DURAND, MARC. *Shale Gas—A Business Plan Very Much in the Red.* http://www.damascuscitizens.org/Durand_shale_gas_faults.html

[vi] JACOBI, ROBERT D., PhD, Geology, Columbia University. *Basement Faults and Seismicity in the Appalachian Basin of New York State.* November 2001, April 26, 2002.

[vii] RUBIN, PAUL A., Hydroquest. *Comments on the EPA's Proposed Study of Hydraulic Fracturing.* August 10, 2010. http://63.134.196.109/documents/10aug19_HydroQuestEPAComments.pdf

[viii] DURAND, MARC. *Shale Gas—A Business Plan Very Much in the Red.* http://www.damascuscitizens.org/Durand_shale_gas_faults.html

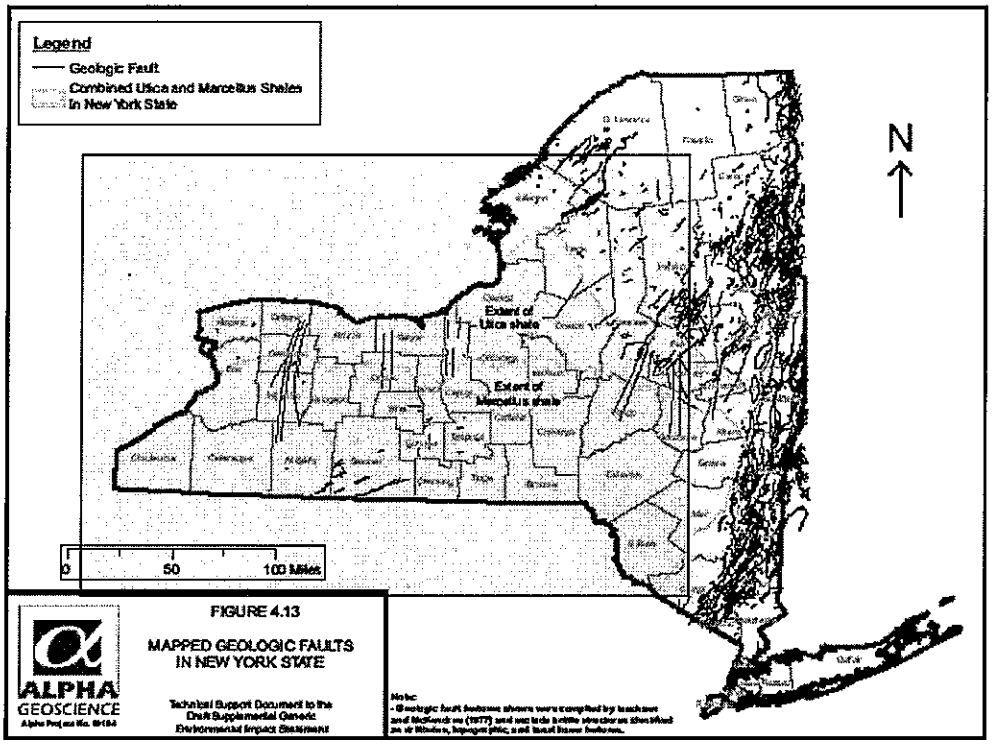

FIGURE A: Mapping used in draft SGEIS (outdated).

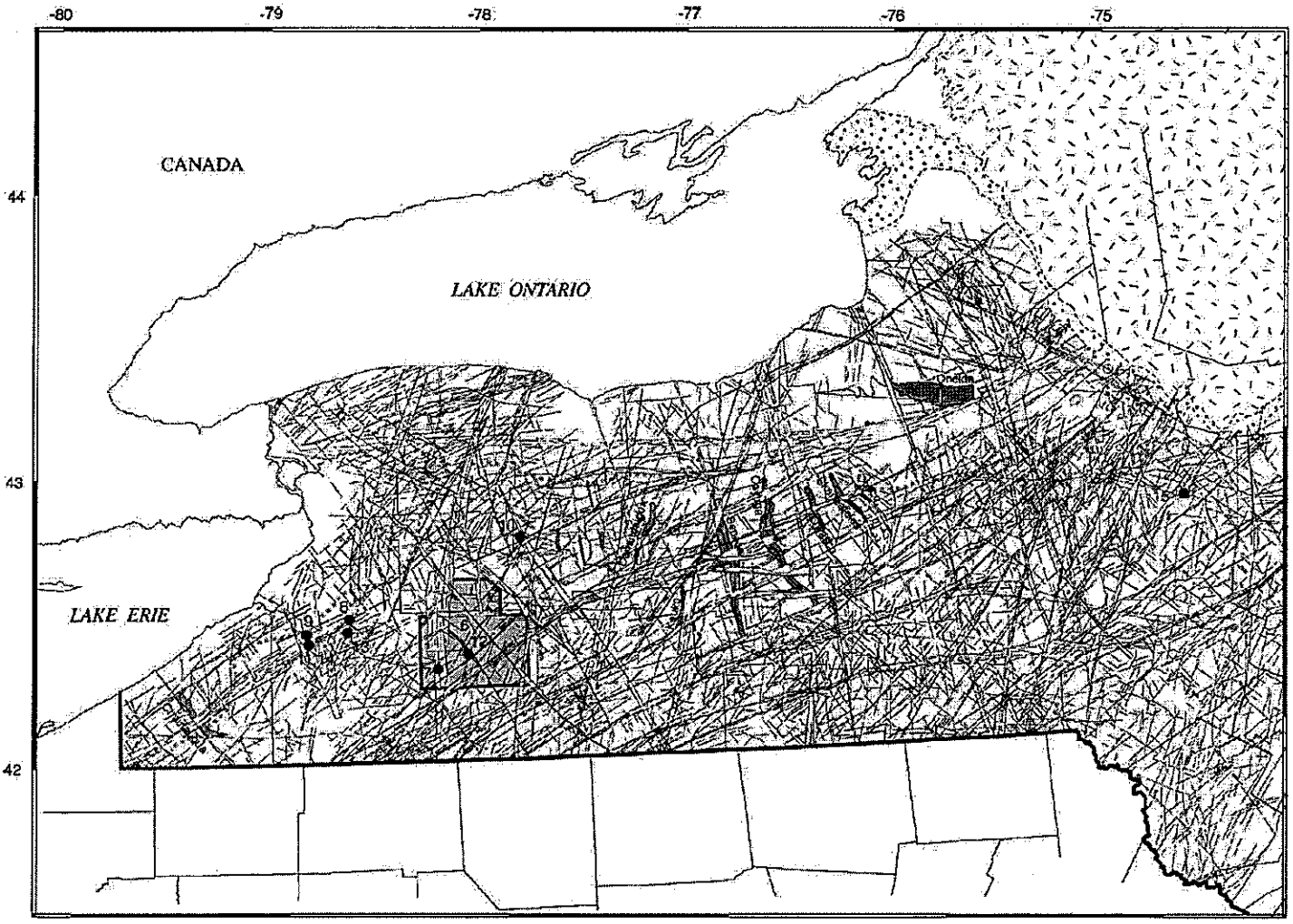

FIGURE B: Jacobi Mapping showing up to date faults and fracture information

ALBERT F. APPLETON

TESTIMONY

NEW YORK CITY COUNCIL

FEBRUARY 17,2012

HEARING ON

SEISMIC HAZARDS AND OTHER THREATS
TO THE NEW YORK CITY WATERSHED AND TO THE CRITICAL WATER INFRASTURCTURE --DAMS, AEQUEDUCTS, PUMPING STATIONS, ON WHICH THER RELIABLE DELIVERY OF WATER FROM THE WATERSHED TO WATERUSERS IN NEW YORK CITY AND WESTCHESTER COUNTY DEPENDS

250 BROADWAY
16TH FLOOR
1 PM

GOOD AFTERNOON, Chairman Gennaro, members of this Committer and Ladies and Gentlemen. I am pleased to be here in response to the Committee's request for information and assessment on this critical topic. Once again, in holding this hearing, the Committee has demonstrated the leadership in protecting New York City's interests in protecting its priceless water supply that it has shown through the last three years in the long debate that has taken place over the future of shale gas fracking in New York State.

In acknowledging that record, I want to first note the Committee's latest important initiative, its leadership in seeking the City's participation as *amicus curiae* in the litigation New York State Attorney General Eric Schneiderman has undertaken against the Delaware River Basin Commission for not conforming to the Federal NEPA process, including the preparation of a comprehensive EIS, before trying to promulgate gas fracking regulations for the Delaware River Basin, which contains the western portion of the New York City watershed. The rules as proposed by the DRBC without the benefit of the environmental analysis which we have been fortunate to have in New York City are totally incompatible with the water resource values of the Basin and would undoubtedly be cited by natural gas interests as a reason against the ban on gas fracking New York DEC has proposed. One can hear the argument now, if it is good enough for Pennsylvania and the DRBC, it should be good enough for New York. Well it isn't. And if DRBC followed the Federal law that mandated a full EIS before trying to promulgate fracking regulations they would know why. The City of New York should follow this Committee's recommendation and give a definitive response to the presiding judge's question: where is New York City, by joining this litigation as amicus curiae.

Now, speaking from my perspective as a former Commissioner of DEP, who oversaw the creation of the Catskill watershed program and who has consulted with water systems all over the world, form Shanghai to Brisbane, from Sao Paolo to Hungary, on the topics of managing their water infrastructure and preserving the watersheds that provide their source water, I want to be very clear about what this issue of earthquake risk and the associated issue of buffer zones for the City's water infrastructure is all about. It is all about risk. What risks do we as a society and a government take for what gains. What would an intelligent risk reward analysis tell us about what we should do here.

Le t me quote from the Hager Richter Technical Memorandum that was commissioned by the City as part of its review of the risks. After documenting that the West of Hudson areas critical to the City's water delivery systems are riddled with fractures, known and unknown, that are pathways for both migration of fracking fluids and methane gas and for transmission of seismic activity, they go on to state:

"Hager-Richter does not recommend a specific setback distance herein because 1) there are too many uncertainties about site specific subsurface geological and geophysical conditions in the vicinity of the WOH NWI, and 2) the condition of the unreinforced concrete-lined water supply tunnels is unknown. The need for extra caution in the vicinity of the WOH NWI is obvious, but what constitutes an acceptable level of risk damage to the critical water supply infrastructure is more a matter of policy, not geophysics."

Note what has happened here. The City's own expert engineering study states there is no scientific certainty that even the seven mile buffer zones the City has proposed will be adequate to safeguard our water infrastructure. They candidly acknowledge that this is a matter of policy.

So should we be happy with the City's approach to buffer zone policy, its seven mile and two mile with five mile enhanced areas of concern. Let us look at the issue from the perspective of policy, recalling that in any regulatory system there has to be some norm to guide applicants.

Now the risk is indisputable. The very fine engineering work the City has done, in the Hazen and Sawyer report of 2009, the supplemental analyses it submitted as part of its recent comments on the New York State draft Generic Environmental Statement and its testimony here today establishes that the seismic risk to our water system is real and that the protection DEC proposes against it, a 1000 foot buffer zone that would merely trigger a special review, is pathetically inadequate to guard against it. Let me repeat, the risk of underground migration of fracking fluid and methane gas is real, the risk of a destructive seismic event is real and thus the risk of breakdown of the system that delivers over a billion gallons of freshwater a day to New York is real. I will not t repeat the scientific material you have heard the City present on the findings of its engineering studies. Others will bring before this committee additional evidence or the extremely important material that Joe Levine of NYH20 will present later. . This following conclusion is scientifically indisputable. The Marcellus shale formations that underlies the watershed are badly fractured with long running fractures that will transmit methane and fracking fluid along their entire length and criss-crossed with small faults subject to seismic activity strong enough to disable and disrupt our water infrastructure..

Another conclusion that is scientifically indisputable is that the injection of fluids underground has been conclusively linked to seismic activity. Some details of this conclusion, exactly how it is triggered, the largest potential dimension of the quake this activity might trigger, the extent of our knowledge or of our ignorance of vulnerable faults, may be still the subject of legitimate debate, but that this kind of activity has triggered seismic activity has now been definitively established, as the British Study and the Oklahoma study cited in the City's submission have shown, not to mention incidents in Ohio, Arkansas and Texas that are highly suspect.

What could happen if any of these risks are actualized. A catastrophic poisoning of source water, or a catastrophic failure of water infrastructure. It is always the case when discussing these kind of risks that industry advocates will pooh pooh them or play to our complacency by dismissing them as groundless fears, just as Japanese experts said the Fukushima disaster could not happen. But the loss of the most important component of

New York City's drinking water clearly could happen, however unlikely. .And imagine the consequences for the city with half of its water supply immediately cut off, the social disruption, the loss of economic activity, the emergency expenses.

So the question becomes, whey is the City being asked to undertake this risk. There is no persuasive explanation in DEC's dGEIS, in fact thee is no coherent explanation at all. The most ambitious buffer zone proposals, ones going far beyond two and seven mile buffers the City has proposed, would eliminate only a small portion of the potential fracking activity in New York. Is it conceivable that a rational decision maker could conclude that the benefits of such activity, however optimistically calculated could \overweigh the risk to the public health and economic prosperity of the world's greatest metropolis that would result from a catastrophic interruption of the City's water supply. To state that premise is to refute it.

The comments above suggest that even seven miles is an inadequate buffer. What raises this concern is the recent USGS study , A Regional Perspective of the Devonian and Ordovician Utica Shale Total Petroleum Systems of the Appalachian Basin (the Rider, Trippi study) that documents that migration events of over 50 miles have happened. There are numerous reports of long distance migration of fracking pollutants such as the recent EPA Pavilion study in Wyoming.

So given a policy conclusion that any risk to the functioning of the New York City water system is unacceptable, and that the limited benefits of shale gas fracking certainly do no justify exposing the health and economic functioning of our great City to the kinds of risk of geological catastrophe that come with the nature of the underlying shale formations in the West of Hudson area near the New York City watershed, how do we pick a buffer zone area. In fairness to DEP, the demands of a regulatory system designed to compel the City to select some sort of buffer zone boundary. And certainly, given the City's commitment to protect our water infrastructure and water quality we have seen, the City's proposals, representing a quantum improvement over DEC's indefensible analysis and an almost casual indifference to the safety of our water system should strongly supported. But it is possible to suggest they do not go far enough.

If the matter was approached on the basis of the hydrogeolgical science that this debate has spurred, a 20 or 25 mile buffer zone would not be too much to request. We could also request that anyone drilling beyond the seven mile barrier but within a wider zone should be obligated to provide, by advance bonding, for any damage they cause and should be required to use chemical tracers and other devices that would enable damage to be tracked back to specific sites. Or we could also consider requiring much more scientific pre-permit documentation of underground conditions. A policy that said let's take the science seriously in determining a no risk strategy is what we should adopt.

For I must veer sideways here to highlight the language that has been used in debating the size of the buffer zone, what would be an acceptable risk? I submit that there should be no level of acceptable risk for the functioning of the New York City Water supply system. I suggest that the right policy conclusion is that any activity that cannot

demonstrate that it poses no risk to the New York City water system is unacceptable. It will argued that demonstrating no risk is an unattainable object. To that statement I day, if so, so be it. Why should the pursuit of profit by a private entity take place at the potential cost of disaster to eight million people? Are we as a society so feeble that we lack the courage to state the obvious, that there is no conceivable benefit from gas fracking that justifies any risk, however minuscule, to the water system on which the life of this City rests. Do we lack the intellectual and political backbone to say to all those who claim these risks are exaggerated or unreasonable, if you so believe provide us with the information and financial guarantees that you will pay for any damage to our precious water infrastructure that you conduct produces.

I sympathize with the predicament of DEP in responding to this set of hydrogeological realities. No one wants to appear unreasonable, or unsympathetic. In the context of the way we as a country try to answer such questions, they have made an effort to balance between protection and what the world might perceive as being reasonable. But I must insist that there is nothing reasonable about accepting any risk to New York City's ultimate infrastructure treasure. And if we are worried there is, we need to redefine reasonable.

I look forward to the work of our Committee, Chairman Gennaro, in helping us engage with these issues.

Thank you.

February 16, 2012 FOR THE RECORD

To Whom It May Concern:

As a resident of Manhattan who cherishes her clean, delicious tap water, I feel I must speak up against the grave threat to this water that is being waged by the gas industry, its political "friends," and a DEC staff that is delusional if it thinks it can safely regulate the gas industry.

Take a look at the experience of our sister state Pennsylvania in the last few years. Between 2008 and 2011, the industry drilled 4,596 new wells. In that same period, 3,355 violations were issued by the understaffed PADEP. That percentage is unacceptable in itself, and the fact is that these are only the violations that were caught and reported. Doubtless there were scores more spills, dumps, leaks and other assaults upon the environment and people's health.

Thank you NYCDEP for conducting the science to assess the threats from drilling, and for putting the Governor and the DEC on notice that our citizens will not compromise where our water security is concerned. The risks to water infrastructure from seismic fracking activities are real . Evidence of earthquakes has already been proven conclusively even as the shale "revolution" has only just begun.

Every day more proof becomes apparent of the folly of the overhyped, over-subsidized fossil fuel called shale gas. Embracing this fuel as an energy strategy takes away incentives to move towards the clean energies we so desperately need. It is up to New Yorkers to lead the way and make the hard choices.

Thank you City Council for shining a spotlight on the flawed regulatory process which is abetting the industry's infiltration of our state, and for helping DEP to stand up to this dire threat of which so many NYC citizens are completely unaware.

Sincerely,

Beth Kelley

Elizabeth Kelley
91 Central Park West #2C
New York, NY 10023

United for Action

Comments to New York City Councils Committee on Environmental Protection about the Geophysical Evaluation of Infrastructure Risks of Natural Gas Production on New York City.

Fracking is essentially a wholesale destruction of a substantial portion of the earth's crust utilizing a dirty bomb and only yields a relatively small amount of energy. According to the Economist Deborah Rogers, 80% of all wells are not even profitable, meaning that the amount of gas extracted doesn't even pay for the costs associated with drilling. The NYC's own DEP reports that approximately 350,000 to 400,000 pounds of toxic, cancer causing chemicals are put into the ground in each well.

It is preposterous to risk the vital infrastructure and water supplies of every resident of New York, and an equal number of people upstate, for a finite and backward looking, destructive energy source.

According to the NYC DEP's letter to NYS DEC, 100% of NYC's demand is currently served from aquifers underlain by the Marcellus formation. The damage due to mishaps or the triggering of uncharted faults to water infrastructure would be irrevocable. The same applies to upstate counties. There is too much at stake. Development of gas fields through fracking cannot be allowed to happen.

It is absurd and disturbing that the NYSDEC dismisses the risk of injection-induced seismic events because injection wells are separately permitted. This is a bureaucratic, not a scientific distinction. Hydraulic fracturing is an injection process. Fracking fluids and seismic events are not going to honor NYCDEC's dysfunctional bureaucratic limitations.

RDSGEIS relied in its analysis on data sets that are known to be incomplete. Given what is at risk, this is unacceptable.

Studies of injection-induced earthquakes have just gotten started, and already a link has been found between fracked vertical wells and earthquakes Oklahoma and the UK. High Volume Horizontal Fracturing is orders of magnitude more aggressive than fractured vertical wells. It is common sense to expect even greater seismic risk.

Damage to underground structures such as tunnels has been attributed to seismic events at less than 4 on the Richter Scale that took place over 25km away. Injection-related seismic events at a magnitude of 4 have been observed next door in Ohio. Damage to essential water supply infrastructure is a demonstrated risk.

Why are we even considering investing further in destructive, dirty, short term solutions like gas, oil and coal when we should be investing in the production and delivery of sustainable energy?

Besides opposing the development of gas fields, we should also stop the construction of the explosive pipelines that bring gas to market.

David Braun, United For Action

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DEBORAH E. ZOHN
New York, NY 10011
zohnwhitedove@netzero.net

Feb. 17, 2012

To: New York City Council

Re: Environmental Protection Committee - Public Oversight Hearing on DEP's comments to DEC on possible risks of natural gas production in the New York City watershed

It's incredible to me that gas companies are allowed to risk the vital infrastructure and water supplies of every resident of N Y City and upstate NY, for a finite and backward looking, destructive energy source.

All of the aquifers serving NYC's, and upstate counties, water demand is underlain by the Marcellus formation. All mishaps, or triggering of uncharted faults, to the water infrastructure would be irrevocable. There is too much at stake for the development of gas fields through fracking to be allowed to happen.

NYSDEC dismisses the risk of injection-induced seismic events because injection wells are separately permitted. Hydraulic fracturing is an injection process. Fracking fluids and seismic events are NOT going to honor NYCDEC's dysfunctional bureaucratic limitations. Studies of injection-induced earthquakes have just gotten started and already a link has been found between fracked vertical wells and earthquakes in Oklahoma and the UK. High Volume Horizontal Fracturing is more aggressive than fractured vertical wells so it makes sense that greater seismic risk can be expected.

All counties and municipalities in NY State should seek injunctive relief from irrevocable harm that hydraulic fracturing will cause if it is allowed to proceed.

Why are we even considering investing further in destructive, dirty, short term solutions like gas, oil and coal when we should be investing the production and delivery of sustainable energy.

Would medical device and drug companies be allowed to put their products on the market without thorough testing? The FDA would not allow it. How can Environmental Regulatory agencies allow gas companies to drill, by hydraulic fracturing, without proper testing?

Deborah E. Zohn
United For Action

For the Record

Gotham Gazette - http://www.gothamgazette.com/article/environment/20120207/7/3680

Is the DEC Prepared For Hydraulic Fracturing?
by Sarah Crean
07 Feb 2012

Photo by Ari Moore

While the Cuomo administration has not been definitive about its plans for hydrofracking recently, it is also unclear whether the state is adequately prepared to manage natural gas drilling and protect local drinking water supplies.

The Governor declined to mention drilling in the Marcellus Shale when he made his State of the State address on January 4th despite the fact that the written version of his address discusses hydraulic fracturing in the state's Southern Tier, where the largest deposits of natural gas are believed to exist. The state's 2012 budget does not include revenue or costs related to hydraulic fracturing activity. The Department of Environmental Conservation (DEC), the state agency that would issue drilling permits and oversee drilling related activity, received a 9% funding increase in 2012, but no allocations for new staff. The Cuomo administration did not respond to several requests for comment for this story.

The DEC is now required to review over 46,000 statements on hydrofracking received from the public and local governments, and release a finalized regulatory framework for drilling which will likely face legal challenges. Public comment on the state's revised hydrofracking impact report and drilling regulations was extended until January 11th due to the volume of statements submitted. The Draft Supplemental Generic Environmental Impact Statement (SGEIS) outlines the Cuomo administration's plans to open the New York State portion of the Marcellus Shale to natural gas drilling. Drilling in the Marcellus Shale will require hydraulic fracturing, a technique that is controversial for environmental and public health reasons. Proponents argue that drilling in the Shale will create thousands of jobs and help to revitalize the upstate economy.

According to DEC Director of Public Information, Emily DeSantis, "If the final documents determine high-volume hydraulic fracturing could move forward in New York, we could begin to review permit applications after the final SGEIS and findings statement are released." DeSantis expects the final documents to be released this year.

While the state has taken steps to minimize the possibility of large-scale water contamination, such as drawing 4,000 foot no-drilling boundaries around the Syracuse and New York City watersheds, activists and some residents contend that the state is not yet prepared to adequately protect underground and surface water supplies from the scale of drilling that is planned. The union that represents the DEC's scientific, technical and professional employees, the Public Employees Federation (PEF), along with some elected officials, has echoed this concern.

Properly Staffed?

According to the DEC, the agency has shed 800 employees, from both professional and non-professional categories, in the last 3 years. The PEF reports that the DEC currently has 3,003 employees, which represents a 21% reduction in staff since 2008.

DEC spokeswoman Emily DeSantis points out that "from the start we have recognized the need for additional staffing to oversee high-volume hydraulic fracturing operations. Our estimates indicate we will need about 140 staff in the first year and 200 staff by year 5."

Wayne Bayer, a member of the Public Employees Federation Executive Board and a 30-year veteran staff member at DEC headquarters, tries to illustrate the resources challenge that the DEC faces in properly regulating hydraulic fracturing. The agency will require an influx of specialized staff in several divisions including water, mineral resources and environmental remediation, within both DEC's central and regional offices. The DEC will need additional engineers, geologists, chemists, wildlife biologists, inspectors, attorneys and administrative staff.

According to Bayer, DEC personnel will be responsible for everything from reviewing drilling applications, to checking the strength and width of the cement encasing drilling wells, to monitoring the withdrawal of hundreds of thousands of gallons of fresh water used for drilling and ensuring that private wells and public water supplies are not diminished, to evaluating the impact of drilling activity on endangered species and local forests, to cleaning up waste water spills as they occur.

The DEC projects that as drilling in the Shale progresses, it may receive as many as 1,600 permit applications per year. Drilling in the Marcellus Shale could continue for 30 years. The state envisions annual construction of a minimum of 413 horizontal and vertical wells in a "low-development scenario", and 1,652 wells constructed annually in a "medium-development" scenario. At present, the agency has sixteen professional staff assigned to oil and gas regulation including permitting, compliance and enforcement across the state.

Aside from the question of hydraulic fracturing, there is concern that the DEC is no longer able to fully carry out its existing responsibilities due to budget cuts. After Governor Paterson ordered 209 staff cuts in October, 2010, nine environmental organizations, including the New York League of Conservation Voters and the Nature Conservancy, issued a joint statement that "the latest round of layoffs will reduce agency staff to the lowest levels since the 1980's, with serious consequences for the DEC's ability to respond to environmental hazards, not to mention critical routine functions such as monitoring air and water pollution, as well as natural resources protection and stewardship."

Wayne Bayer notes that the DEC has fallen behind on issuing new and renewal permits for industrial sites as part of its mandate to monitor the state's water and air quality. DEC just worked its way through a year- long backlog of required inspections of chemical bulk storage tanks with the help of private contractors. The agency is also behind on rewriting regulations for chemical and petroleum bulk storage because of staffing shortages in the Office of General Counsel and in the Environmental Remediation program, according to Bayer.

Consequently, the Public Employees Federation is telling lawmakers that the current moratorium on hydraulic fracturing should continue until it is certain that the DEC has adequate staff. Doug Curella,

Chief of Staff for Senator Mark Grisanti (R), Chair of the State Senate Environmental Conservation Committee, concurs: "It's important that the DEC is properly staffed before we begin the conversation. They have historically lost a lot of staff."

Where is the Money?

How will the state pay for new staff and other resources needed to manage hydraulic fracturing in the midst of a budget crisis? The DEC says that the Governor's advisory panel on hydraulic fracturing is looking at ways the state can generate revenue from the gas industry, including fees and possibly a severance tax. Emily DeSantis adds that, "we have repeatedly said we will only review the number of permits that we can responsibly oversee given staffing levels."

This position was echoed by Cherie Messore, spokesperson for the Independent Oil and Gas Association of New York (IOGA), an industry trade association. When asked about DEC's capacity, Messore responded that "the DEC will only grant as many permits as can be prudently and responsibly supervised. And we've always been an advocate for the DEC to be properly staffed to be able to do its work well."

Messore said that the association was not in a position to comment on the Cuomo administration's exploration of taxing the oil and gas industry to raise revenue. Accurately assessing the impact of targeted taxes or fees on the state's budget may not be a simple matter. Assemblymember Richard Gottfried (D), Chair of the Assembly's Health Committee, points out that "since dollars are fungible, it's always hard to measure whether dollars from a special tax are used to pay for staffing, or just to replace dollars that were lost."

As the environmental review process continues and questions mount, is hydraulic fracturing becoming a political liability for the Cuomo administration? Democratic Assemblymember Robert K. Sweeney, chair of the State Assembly's Environmental Conservation Committee, told Gotham Gazette, "It has been a political problem all along and it is becoming more so all the time. I have colleagues who are having second thoughts about the whole thing- the opposition is growing steadily and is more vocal. The potential problem for the administration is that the first time something bad happens –and something bad will happen- it will reflect directly on the Governor."

Public hearings last November on the draft report and drilling regulations attracted 6,000 attendees and standing room only crowds both upstate and downstate. Drilling opponents visibly outnumbered supporters at the Sullivan County and NYC hearings, and *The Wall Street Journal* reported that opponents outnumbered supporters by 4 to 1 at a large hearing in Binghamton, which is situated in the Southern Tier.

The oil and gas industry maintains that the Governor's plan has strong support among hard hit farmers and other landowners in the Southern Tier. Cherie Messore of IOGA observes that "when you look at the most recent polls, they are definitely very split. The areas that will be most affected by hydrofracking, in the Eastern-Southern Tier of the state, are the most supportive. People are seeing the jobs and prosperity and the good things that are happening in Pennsylvania. We'd like to see that prosperity come into New York State."

What will the DEC determine after it absorbs the 46,000 comments it received from New Yorkers regarding their views on hydraulic fracturing? And can the DEC comprehensively manage hydraulic fracturing and protect the safety of the state's drinking water at the same time? Scott Reif, spokesman for the State Senate Republicans, asserts that "If it can be done safely and responsibly than (Senate Leader) Dean Skelos would support it. Every indication is that the DEC can do it." When asked if he could specify what "every indication" meant, Reif replied, "If the DEC believes that they can do this, then we are supportive." Assemblymember Robert Sweeney is less certain. "The Governor has oversight of the DEC. The Legislature has oversight. They feel that they have some handle on it. One

can only hope that if the time comes, the DEC will be prepared."

Gotham Gazette is brought to you by Citizens Union Foundation. It is made possible by a grants from the Alfred P. Sloan Foundation, the Altman Foundation, the Fund for the City of New York, the John S. and James L. Knight Foundation, New York Times Foundation, the Charles H. Revson Foundation, the Robert Sterling Clark Foundation, the Rockefeller Brothers Fund and readers like you. Please consider making a tax-deductible contribution.

New York City Council — The Committee on Environmental Protection

Friday, Ferbuary 17, 2011 — 1:00 P.M.
The 16th Floor Committee Room, 250 Broadway, New York, NY

Oversight: The Revised Environmental Impact Statement on Hydraulic Fracturing and New York City's Upstate Drinking Water Supply Infrastructure.

To the Honorable James F. Gennaro and fellow City Council members:

My name is Michael Lebron. I am a board member of Damascus Citizens for Sustainability and a principal of New Yorkers for Sustainable Energy Solutions Statewide.

The first paragraph of the Introduction to Section 4: Potential for Reactivation of a Fault by HVHF Near the WOH Non-Watershed Infrastructure of the Hager Richter Technical Memorandum states on Page 29 that "There is no geophysical documentation to indicate that the faults mapped in the water supply tunnels do not extend to the depths of the Marcellus Shale, and similar faulting has been described in the Marcellus in Pennsylvania".

The first paragraph on page 45 of Section 6: Evaluation of the 2009 JV Recommendations states that "a seven-mile setback to drilling, measured from the tunnel to the edge of the spacing unit..." is recommended and "bases the seven-mile setback on an analysis showing that 10% of brittle structures that intersect the WOH water supply tunnels will equal or exceed 7 miles in length."

While the focus of the technical memorandum is concerned with seismic activity, the same faults, joints and fractures that transverse contiguous geological strata and that can lead to earthquakes can also serve as the transmission routes for migratory contamination. The NYC DEP and the Hager Richter Memorandum concern themselves with what MAY happen if high volume horizontal hydraulic fracturing is to be introduced into the NYC watershed area. But in increasing larger portions of Pennsylvania, we don't have to speculate. In Bradford County, multi-mile migration is not an academic fear, it is reality. Anecdotal evidence continues to accumilate.

As in September, I refer to this map that I created over a year ago and have been updating at regular intervals since, most recently on Wednesday of this week.

I created this map of private water wells that had been contaminated by gas mining activity in Bradford County because the Williamsport office of PADEP told me it did not keep systematic records of that information, that landowners and gas companies did not have to report this information if they were able to come to a resolution of contamination problems that was satisfactory to the landowner.

The data on drilled and productive gas wells is from Bradford County's own web site which they update quarterly. It is interesting to note that in the last quarter, some productive gas wells appear to have been removed from production. The data on confirmed and alleged contaminated water wells is gathered from personal observation, that of community members, and newspaper reports. While the total number I have been able to identify is now up to 98, it is suspected that the actual number is significantly higher as it has been reported that the local populations have been becoming increasingly fearful of going public with their problems.

PADEP has not been able to explain why a group of water wells in Burlington have not been contaminated by what were then the nearest gas wells 5 miles away.

PADEP has stated that a group of gas wells drilled by Chesapeake on the Welles

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property in Terry Township are responsible for contamination of nearby water wells and are the source of methane bubbling from the riverbed of the Susquehanna. The migratory pathway distance from the nearest well to the point of contamination of the riverbed is about 2 miles, and may be responsible for another point 8 miles away. A contaminated water well of a private residence that sits maybe 500 ft. high on top of a mountain with a spectacular view of the Susquehanna is about three miles out. When I visited that site in the early spring of last year, I saw bubbles coming up through the wet snow that I was standing on.

I spoke to Scott Perry, director of Mineral Resources in PADEP in September about remedial action. He said that Chesapeake had been ordered to to do a squeeze job[1]. If that failed, they would do a "wash-over"[2]. To date, the water wells in the vicinity remain contaminated, and are likely included in the federally mandated EPA study that is due to be completed in a couple years. When asked, Scott Perry would not say whether or not the drilling activity could have stimulated fractures, joints or faults in a way that created migratory pathways autonomous to the well bore. Chesapeake claims they were following the NEW PA regs to the letter on these wells, yet still had a failure.

Drilling activity in Bradford County is beginning to force many residents to abandon their homes. There is serious talk of creating "refugee camps" for families and animals. Imagine that: refugee camps in the United States of America, although I suppose we have had them for decades in the form of Indian reservations. The problem of course is: where would these camps be located in the face of unrestrained gas drilling?

People continue to become ill. I have been told that most recently there are over 30 in the Rome area, mostly women and children. And recently Carl Stiles passed away. Carl shared his little American Dream high on that hill overlooking the Susquehanna with his wife and stepdaughter and were ordered by their doctor to abandon their home one and a half years ago or face likely death from leukemia. The newspaper accounts said Carl died of intestinal cancer. The reality was that Carl took his own life because the acute, chronic head pain was too much for him to continue to bear.

Now, I am not a scientist, engineer, nor a doctor. Yes, these health effects are difficult to prove. The numbers are arguably anecdotal. But shouldn't the public ask what standard should be applied so we can somehow identify when the accumulation of anecdotal events represent the beginning of an epidemic? Since industry's own data say that 60% of all gas wells fail within 30 years, and since the state of Pennsylvania seems to insist on looking the other way, is it hyperbole too assert that we are witnessing a corporate/state policy whose net effect is now becoming genocidal in nature?

Thank you.

Michael Lebron
Damascus Citizens for Sustainability
New Yorkers for Sustainable Energy Solutions Statewide

1- also known as a *squeeze job*. squeeze n: 1. a cementing operation in which cement is pumped behind the casing under high pressure to re-cement channeled areas or to block off an uncemented zone. squeeze cementing n: the forcing of cement slurry by pressure to specified points in a well to cause seals at the points of squeeze. It is a secondary cementing method that is used to isolate a producing formation, seal off water, repair casing leaks, and so forth. Compare plug-back cementing. squeeze job n: a remedial activity whereby a cement slurry is pumped into open perforations, split casing, or a fractured formation, to effect a blockage.

2- wash over v: to release pipe that is stuck in the hole by running washover pipe. The washover pipe must have an outside diameter small enough to fit into the borehole but an inside diameter large enough to fit over the outside diameter of the stuck pipe. A rotary shoe, which cuts away the formation, mud, or whatever is sticking the pipe, is made up on the bottom joint of the washover pipe, and the assembly is lowered into the hole. Rotation of the assembly frees the stuck pipe. Several washovers may have to be made if the stuck portion is very long. washover pipe n: an accessory used in fishing operations to go over the outside of tubing or drill pipe stuck in the hole because of cuttings, mud, and so forth, that have collected in the annulus. The washover pipe cleans the annular space and permits recovery of the pipe. It is sometimes called washpipe. washover string n: the assembly of tools run into the hole during fishing to perform a washover. A typical washover string consists of a washover back-off connector, several joints of washover pipe, and a rotary shoe.

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TESTIMONY OF DANIELE GERARD, PRESIDENT
THREE PARKS INDEPENDENT DEMOCRATS
Cathedral Station P.O. Box 1316, New York, N.Y. 10025, 212-539-7602
www.ThreeParksDems.org, ThreeParksDems@aol.com
New York City Council Committee on Environmental Protection, 2/17/12

Mr. Chairman, thank you for this opportunity for Three Parks Independent Democrats to comment on the DEP's study of the DEC RDSGEIS and in favor of a statewide ban on fracking. It is our position that by exempting the New York City and Syracuse watersheds, state lands, and other primary aquifers from gas drilling by hydraulic fracturing, the RDSGEIS admits fracking cannot be done safely **anywhere** in New York. And it's not even much of an exemption; horizontal drilling could still reach areas adjacent to the watershed and affect tunnels and other infrastructure, as the DEP contracted study amply demonstrates. Moreover, the RDSGEIS does not fully cover the hazards of fracking. For example, the DEP study underscores the absence of "detailed site-specific geophysical data" (p. v) and RDSGEIS statements that are "not consistent with recent evidence of HVHF-induced seismic events" (p. vi).

Three Parks has specific comments regarding the DEP'S study and cover letter:

1. In December 2011, we met with the Governor's staff who told us the State had not conducted any studies to determine how long New York City might have to go without water under various scenarios, including pipes' being broken by blasting or seismic activity, water being poisoned, or a filtration plant's becoming necessary. Staff also told us that there was no financial guarantee that a polluter could pay to cover any damages if contamination occurred to NYC water or any other water supply in the state.

2. But Commissioner Strickland's letter clearly states: "Given the fact that almost half the population of New York State relies on NYC's unfiltered water supply, nobody, including a drilling company, the State, or other responsible entity, could provide an alternate supply of potable water while the contamination was addressed." Has the State now studied the question of how many people might be left without water and for how long? How much insurance a driller will be required to have? We hope you ask the Governor's representatives these questions. We need look no further than Dimock, PA, where deliveries of potable water to eleven families were halted in November after three years; in January 2012, the EPA began to provide water, but may stop, depending on the results of its own testing. This begs another question: Does the Governor believe there is a number of people it would be acceptable to poison in the name of extracting gas from the Marcellus Shale?

3. The Governor's office also told us there was an advisory panel set up to review staffing needs of the DEC and other agencies that would have responsibilities regarding fracking. We asked if permitting could begin without the monitors' being in place; we were told there was "no way to comment on the advisory panel." But in 2008, the DEC had 19 staff people to police over 13,000 existing conventional gas wells—how could the DEC possibly adequately monitor these and the proposed thousands of fracking wells? And although Governor's staff told us that the DEC would issue regulations sufficient to protect New York State from "realistic" accidents, he had no sense of what "realistic risk" would entail.

4. The DEP study before you today does not recommend a specific revised setback from the infrastructure beyond the 1000-foot buffer zone in which horizontal drilling and high volume hydraulic fracturing should be barred; instead, it clearly states (p. vii): "[W]hat constitutes an acceptable level of risk of damage to the critical water supply infrastructure is more a matter of policy, not geophysics." Three Parks asks the Chairman and this committee to urge Governor Cuomo to determine policy by keeping his campaign promise to "not support any drilling that would threaten the State's major sources of drinking water." That should mean **all** sources of drinking water. It would violate plain common sense for the Governor to approve fracking or for any legislator to vote in favor of it.

In closing, we would like to remind this committee that we are not the policy people, but Democratic Party volunteers who stand on street corners and at subway stops handing out leaflets when Democrats run for office. As the 2000 letters submitted with our November 2011 DEC testimony show, Governor Cuomo's constituents clearly want him to ban fracking now.

2/17/12

Joan Davis, for The Gray Panthers
300 East 39th Street.NYC 10016 (212) 681-9520

The Gray Panthers are here, today, to protest the blatent disregard for facts by those who wish to approve the practice of hydrofracking in the state of New York.

Millions of years have gone into the making of the land on which we, as a species, have developed and thrived.
And, in the few short years since the beginning of the Industrial Revolution, we have: polluted; upset eco-systems; and, ruined the health of our planet and the people on it.

The proposed drilling would have us measure success in life in terms of money, instead of in terms of health and well being. This IS STUPID as well as mis-guided.

No amount of manipulated arithmetic can overcome the facts. And, enough facts have been presented to indicate that "hydrolic fracturing is UNSAFE." Therefore, the proposed gas drilling should NOT be allowed to go forward.

~~The desire of the committee to accomodate~~ We are worried about short sighted business persons, at the expense of the public, is UNACCEPTABLE. Our modern technology is sophisticated enough to harness the sun's power. And there is also wind and thermal power available. Other nations are innovative and prove that alternate energy is the way of the future.

Our government has been subsidizing the fossil fuel industry for too long. (It has become a bad habit). Instead of this foolishness, we need to subsidize ~~alternate~~ energy, Even in the short term, this would prove financially stable. Modern technology could create enough jobs and prosperity to take us out of our current economic malaise. Then we would not have to listen to the lies of the fossil fuel industry.

We need not throw away precious WATER and AGRICULTURAL LAND for a technology which will soon be seen as insufficient. Indeed, gas drilling will soon deplete the land and be seen as pre-historic.

The Gray Panthers say, unequivocably: Gas drilling in the ~~Marsalas~~ Marcellus Shale is untenable. To quote a Dictionary of English Synonyms;

"Untenable is (1) Unmaintainable, indefensible, unsound. (2) Weak, hollow, fallacious, unjustifiable, illogical, insupportable."

The Gray Panthers hope that our message is clear.

THE COUNCIL
THE CITY OF NEW YORK

Appearance Card

I intend to appear and speak on Int. No. _____ Res. No. _____

☐ in favor ☐ in opposition

Date: 2/17/12

(PLEASE PRINT)

Name: DANIELE GERARD

Address: 355 RIVERSIDE DRIVE, 7W, 10025

I represent: THREE PARKS INDEPENDENT DEMOCRATS

Address: PO Box 1316 Cathedral Station NYC 10025

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Name: RAYMOND J. IRREIRA

Address: 14 E. 38 ST.

I represent: SELF

Address:

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Date: 2/17/2012

(PLEASE PRINT)

Name: Mary E Rupich

Address: 35-03 29th St. Astoria

I represent: Resident

Address:

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Date: 2/17/12

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Name: MAV MOORHEAD

Address: 303 PIS NYC 10113

I represent: NYHRD

Address:

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Name: JESSICA ROFF

Address: 595 President St. BKlyn, NY 11215

I represent: Food & Water Watch (and Brooklyn Food Coalition)

Address:

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Date: _____

(PLEASE PRINT)

Name: Wes Gridgam

Address: PO box C381

I represent: Catskill Mountainkeeper

Address: Youngsville NY

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Date: 2/17/2012

(PLEASE PRINT)

Name: DAVID BRAUN

Address: PO BOX 50293, BROOKLYN NY

I represent: UNITED FOR ACTION

Address: 37 GRAND AVE, BROOKLYN NY

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Date: _____

(PLEASE PRINT)

Name: ROBIN THOMPSON FRSA

Address: 45 EAST 66th ST NY, NY 10065

I represent: Royal Society of Arts in the US.

Address: _____

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THE CITY OF NEW YORK

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☐ in favor ☐ in opposition

Date: _____

(PLEASE PRINT)

Name: Beth Kelley

Address: 91 Central Pk W 2C

I represent: my family

Address: _____

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Appearance Card

I intend to appear and speak on Int. No. _____ Res. No. _____

☐ in favor ☐ in opposition

I am against Fracking! *Date:* 2-17-12

(PLEASE PRINT)

Name: Elizabeth Cohen

Address: 237 E 20 St. #4F NYC 10003

I represent: concerned citizen

Address:

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☐ in favor ☐ in opposition

Date: _____

(PLEASE PRINT)

Name: Andrew Lawrence

Address: 570 E 23 NYC 10010

I represent: Myself

Address:

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THE CITY OF NEW YORK

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☐ in favor ☑ in opposition

Date: 2/17/12

(PLEASE PRINT)

Name: MICHAEL LIBRON

Address: 37 COOPER SQ

I represent: NYH2O / NY for a SAFE ENVIRONMT

Address:

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☐ in favor ☑ in opposition

Date: 2/17/12

(PLEASE PRINT)

Name: JOE LEVINE

Address: 561 BROADWAY

I represent: NYH2O/DAMASCUS CITIZENS

Address: _____

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THE CITY OF NEW YORK

Appearance Card

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☐ in favor ☐ in opposition

Date: 2/17/12

(PLEASE PRINT)

Name: AL APPLETON

Address: _____

I represent: Former DEP COMMISSIONER

Address: _____

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THE CITY OF NEW YORK

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☐ in favor ☐ in opposition

Date: _____

(PLEASE PRINT)

Name: Catherine McVay Hughes

Address: _____

I represent: CB1

Address: _____

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☐ in favor ☐ in opposition

Date: _____

(PLEASE PRINT)

Name: Jennifer JAGER

Address: 274 Water St

I represent: _____

Address: _____

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☐ in favor ☐ in opposition

Date: _____

(PLEASE PRINT)

Name: Frieda. K. Bradlow

Address: 43 Charlton St. 10014

I represent: Community Board 2-M

Address: Wash Sq. Village

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☐ in favor ☐ in opposition

Date: _____

(PLEASE PRINT)

Name: WES GILLINGHAM, DIRECTOR

Address: _____

I represent: CATSKILL MOUNTAINKEEPER

Address: Lew Beach, New York

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☐ in favor ☐ in opposition

Date: 2/17/12

(PLEASE PRINT)

Name: BUCK MOORHEAD

Address: 236 W 27TH / NYC

I represent: NYH2O

Address: _____

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THE CITY OF NEW YORK

Appearance Card

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☐ in favor ☐ in opposition

Date: _____

(PLEASE PRINT)

Name: Eric Goldstein

Address: _____

I represent: Natural Resources Defense Council

Address: 40 West 20 St NY NY 10024

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THE CITY OF NEW YORK

Appearance Card

I intend to appear and speak on Int. No. _____ Res. No. _____

☐ in favor ☒ in opposition of fracking

Date: 2/17/12

(PLEASE PRINT)

Name: Megan Ahearn

Address: 9 Murray St NY, NY

I represent: NYPIRG

Address: same

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THE CITY OF NEW YORK

Appearance Card

I intend to appear and speak on Int. No. _____ Res. No. _____

☐ in favor ☐ in opposition

Against

Date: _____

(PLEASE PRINT)

Name: Fracking BATYA LEBTON

Address: 315 W 86 St

I represent: CLCV

Address: PO Box 23 00 78

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THE CITY OF NEW YORK

Appearance Card

I intend to appear and speak on Int. No. _____ Res. No. _____

☐ in favor ☒ in opposition

Against Fracking

Date: _____

(PLEASE PRINT)

Name: Jon Kass

Address: 473 West End Ave

I represent: CALW

Address: _____

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THE CITY OF NEW YORK

Appearance Card

I intend to appear and speak on Int. No. _____ Res. No. _____

☐ in favor ☒ in opposition against fracking

Date: 2/17/12

(PLEASE PRINT)

Name: DEBORAH ZOHN

Address: 16 W. 16th, NY, NY 10011

I represent: United for Action

Address: _____

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THE CITY OF NEW YORK

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I intend to appear and speak on Int. No. _____ Res. No. _____

☐ in favor ☐ in opposition

Date: _____

(PLEASE PRINT)

Name: Arden Dawn

Address: 969 Park

I represent: Women's City Club of NY

Address: 307 Seventh Ave 1403

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☐ in favor ☐ in opposition

Date: 2/17/12

(PLEASE PRINT)

Name: Kate Hudson

Address: Pace Law School, 78 North Broadway

I represent: Riverkeeper, Inc White Plains

Address:

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THE CITY OF NEW YORK

Appearance Card

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☐ in favor ☐ in opposition

Date: 2-17-12

(PLEASE PRINT)

Name: JOAN DAVIS

Address: 300 East 39th #5M-NY10016

I represent: GRAY PANTHERS

Address: BWEB. GRAYPANTHERSNYC.ORG

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