



November 17, 2014

Ms. Brigid Kenney  
Senior Policy Advisor  
Maryland Department of the Environment  
1800 Washington Blvd.  
Baltimore, MD 21230

Re: Comments of the Natural Resources Defense Council Regarding “Assessment of Risks from Unconventional Gas Well Development in the Marcellus Shale of Western Maryland”

Dear Ms. Kenney:

Thank you for the opportunity to review the “Assessment of Risks from Unconventional Gas Well Development in the Marcellus Shale of Western Maryland,” dated October 2014 (hereafter the “Risk Assessment”). On behalf of our over 9,000 members in Maryland, enclosed please find the Natural Resources Defense Council’s (NRDC) comments and recommendations on the basis of that review.

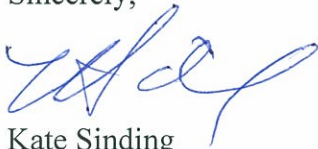
NRDC commends the Maryland Departments of the Environment and Natural Resources for conducting a thorough Risk Assessment, and one which proposes the imposition of a number of important best practices to reduce the risks associated with hydraulic fracturing. Overall, however, as set forth in detail in the enclosed comments, we find that the Risk Assessment underestimates short-term, long-term, and cumulative risks and consequences (including human health impacts) of Marcellus Shale exploration and development in Maryland.

In addition, as you know, in July 2014, the Maryland Institute for Applied Environmental Health School of Public Health at the University of Maryland completed its study titled “Potential Public Health Impacts of Natural Gas Development and Production in the Marcellus Shale in Western Maryland” (hereafter the “Public Health Impacts Study”). That study concluded there was a substantially higher risk associated with unconventional gas development in the Marcellus Shale than that found in the Risk Assessment. Indeed, the Public Health Impacts Study found that development of the Marcellus Shale would result in a high or moderately high likelihood of adverse impacts to public health in eight research areas: air quality; occupational health outcomes; healthcare infrastructure; water and soil quality; Naturally Occurring Radioactive Materials; industrial noise; social determinants of health; and cumulative impacts, including to disadvantaged communities and vulnerable subpopulations.

Taken together, the Risk Assessment and Public Health Impacts Study confirm there is insufficient technical and scientific data to confirm that human health risk and consequences to the public can be eliminated or managed to an acceptable level. NRDC therefore recommends that Maryland continue its existing moratorium on Marcellus Shale development until potential health impacts and the extent to which they can be mitigated, if at all, can be more fully understood.

Again, we thank you for this opportunity to review the Risk Assessment and are available to address any questions you may regarding our comments.

Sincerely,

A handwritten signature in blue ink, appearing to read 'K. Sinding', written in a cursive style.

Kate Sinding  
Senior Attorney and Deputy Director, New York Program

Encl.

cc: The Honorable Martin O'Malley (w/o encl.)

**Comments Submitted to  
Maryland Department of the Environment**

**Regarding**

**“Assessment of Risks from Unconventional Gas Well Development  
in the Marcellus Shale of Western Maryland,” October 2014**

By  
Natural Resources Defense Council

**November 17, 2014**

Prepared with the assistance of  
Susan Harvey, Harvey Consulting, LLC

## Table of Contents

Introduction.....	3
Overall Recommendations.....	7
Air Pollution.....	13
Seismic Data Collection.....	18
Well Blowouts .....	20
Setback Distances .....	22
Fracturing Additives and Fluids.....	24
Fracturing Fluid and Produced Water Flowback .....	25
Spill Risk.....	26
Drilling Fluids and Cuttings.....	27
Plugging and Abandonment of Existing Wells.....	28
Noise .....	29
Visual Impacts .....	30
Variances.....	31
Storage Tank & Container Risk Mitigation .....	31
Groundwater Contamination.....	32
Financial Impact.....	32
List of Acronyms .....	33
Appendix A:	NRDC’s detailed technical recommendations submitted on January 12, 2012, regarding the Revised Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program, Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Reservoirs, issued September 7, 2011 (“RDSGEIS”), as well as on the then-proposed regulations, issued September 28, 2011.
Appendix B:	NRDC’s detailed technical recommendations submitted on January 11, 2013, regarding the Revised Proposed Regulations for High-Volume Hydraulic Fracturing (“HVHF”) in New York State (Revised Proposed Express Terms 6 NYCRR Parts 52, 190, 550-556, 560 and 750).
Appendix C:	Onshore Seismic Exploration Practices & Model Permit Requirements, Report to Sierra Club and Natural Resources Defense Council, Prepared by Harvey Consulting, LLC. , January 20, 2011.

## Introduction

These comments present the Natural Resources Defense Council's (NRDC's) comments on and recommendations for improving Maryland's "Assessment of Risks from Unconventional Gas Well Development in the Marcellus Shale of Western Maryland," dated October 2014 (hereinafter referred to as "Risk Assessment").<sup>1</sup>

In 2011, Governor O'Malley's Executive Order 01.01.2011.11 established Maryland's Marcellus Shale Safe Drilling Initiative. An Advisory Commission was established to assist state policymakers and regulators in determining whether, and if so how, gas production from the Marcellus Shale could be accomplished without unacceptable risks of adverse impacts to public health, safety, the environment, and natural resources.

The Executive Order directed that a three part study be conducted to examine whether gas production can be accomplished without unacceptable risk, including: Part I (recommendations regarding sources of revenue and standards of liability for damages caused by gas exploration and production), Part II (recommendations for best practices for all aspects of natural gas exploration and production in the Marcellus Shale in Maryland);<sup>2</sup> and, Part III (recommendations regarding the potential impact of Marcellus Shale drilling in Maryland). NRDC provides comments on this Part III study (Maryland's Marcellus Shale Risk Assessment).

A substantial portion of Maryland's Marcellus Shale Risk Assessment relies on the work completed by New York State for its Marcellus Shale Environmental Impact Statement. Maryland cites the *New York State Revised Draft Supplemental Generic Environmental Impact Statement (RDSGEIS)* as a primary reference used in developing Maryland's Marcellus Shale Risk Assessment.<sup>3</sup> NRDC has been an active participant in the scientific and technical review of NYS's RDSGEIS.

While NRDC supported some of the technical and scientific work completed in the NYS's RDSGEIS, NRDC provided New York State with extensive, detailed, technical, scientific, and regulatory recommendations to improve the NYS (RDSGEIS) and its Revised Proposed Regulations for High-Volume Hydraulic Fracturing (Revised Proposed Express Terms 6 NYCRR Parts 52, 190, 550-556, 560 and 750). In sum, NRDC has recommended New York State continue the Marcellus Shale drilling moratorium until potential health impacts and the extent to which they can be mitigated can be more fully understood. NRDC provides a complete set of recommendations made to New York State as appendices to these comments (Appendices A-C), and recommends Maryland consider these best practices, while maintaining a moratorium on new hydraulic fracturing to permit the science regarding health impacts to more fully mature.

Although Maryland identified a number of best practice mitigation measures that would be useful for reducing Marcellus shale gas exploration and production risk in Phase II of Maryland's Marcellus Shale

---

<sup>1</sup> Assessment of Risks from Unconventional Gas Well Development in the Marcellus Shale of Western Maryland, prepared by Maryland Department of the Environment and Maryland Department of Natural Resources, October 2014.

<sup>2</sup> Marcellus Shale Safe Drilling Initiative Study, Part II, Interim Final Best Practices, prepared by Maryland Department of the Environment and Maryland Department of Natural Resources, July 2014.

<sup>3</sup> Maryland Risk Assessment, October 2014, Executive Summary, Page 4.

Safe Drilling Initiative Study,<sup>4</sup> and adopted some of the mitigation measures and planning assumptions proposed by New York State, there are additional mitigations proposed in Maryland's Public Health Impacts Study and in NRDC's comments (herein) that have not been incorporated.

Best practices identified by Maryland have not yet been incorporated into regulation (and therefore are not guaranteed). Incorporation of these additional best practices will reduce risk. But the question remains: "Will these best practices reduce the risk below an "unacceptable" level?"

Best practices will not eliminate human health risk to Maryland residents because high-volume, hydraulic fracturing is not risk-free, accidents happen, human error is inevitable, and there is no guarantee these practices will be used or be effective in all cases. Nor is there any guarantee that there will be adequate regulatory resources appropriated to ensure that any practices promulgated as regulations will be properly implemented or enforced.

Maryland's public identified a number of major concerns with the proposed Marcellus Shale exploration and development, including impacts to: (1) agriculture, (2) education and schools, (3) environmental protection, (4) housing availability and values, (5) infrastructure and investment, (6) economic and fiscal sustainability, and (7) property rights.<sup>5</sup> However, the Risk Assessment and Public Health Impacts Study, combined, only addressed two of the seven major topics (e.g., agriculture, education and schools, and environmental protection). Neither the Risk Assessment nor the Public Health Impacts Study (discussed below) answered the question: "are impacts to agriculture, housing availability and values, infrastructure and investment, economic and fiscal sustainability, and property rights unacceptable?"

Maryland's recently issued "Potential Public Health Impacts of Natural Gas Development and Production in the Marcellus Shale in Western Maryland," dated July 2014 (hereinafter referred to as "Public Health Impacts Study"),<sup>6</sup> concluded there was a substantially higher risk associated with Unconventional Natural Gas Development and Production (UNGDP) than found in the Risk Assessment. The Public Health Impacts Study found a:

- **High Likelihood** that changes in air quality will have a negative impact on public health in Garrett and Allegany Counties (areas likely for potential Marcellus Shale Gas Exploration and Development);
- **High Likelihood** of adverse occupational health outcomes (while Marcellus Shale exploration and development will bring the possibility of new jobs, those who work these jobs are at greater risk of harmful occupational exposures than many other industries in Maryland);
- **High Likelihood** of adverse impacts to the healthcare infrastructure (due to expected increase in long-term migrant workers relative to population size);
- **Moderately High Likelihood** of negative impacts on water and soil quality, especially because of the larger fraction of the populations relying on well water in the potentially affected regions;

---

<sup>4</sup> Maryland Department of the Environment, Part II of the Marcellus Shale Safe Drilling Initiative Study (Best Practices for Gas Production in the Marcellus Shale in Maryland), July 11, 2014.

<sup>5</sup> Regional Economic Studies Institute, Towson University, Maryland, Impact Analysis of the Marcellus Shale Safe Drilling Initiative, Prepared for the Maryland Department of the Environment, May 23, 2014.

<sup>6</sup> Potential Public Health Impacts of Natural Gas Development and Production in the Marcellus Shale in Western Maryland, Maryland Institute for Applied Environmental Health School of Public Health, University of Maryland, College Park, July 2014, Page xx.

- **Moderately High Likelihood** of adverse impacts from Naturally Occurring Radioactive Material (NORM);
- **Moderately High Likelihood** of adverse impacts from industrial noise on public health;
- **Moderately High Likelihood** of adverse impacts on the social determinants of health (e.g., increased accidents and fatalities due to increased industrial traffic, increases in violent crime, other crimes, sexually transmitted diseases, mental health problems, and substance abuse);
- **Moderately High Likelihood** of net negative impact to the cumulative exposure/risk (concluding that: “significant evidence suggests that disadvantaged communities are disproportionately exposed and are more vulnerable to the effect of these hazards. Based on this, it is reasonable to assume that the combined effect of UNGDP related hazards described in this report may be higher than the simple sum, and that the impact will be more pronounced in disadvantaged communities and will be disproportionately felt by vulnerable subpopulations such as property owners without mineral rights, elderly, children, and individuals with preexisting diseases”).

There is some overlap between the Risk Assessment and the Public Health Impacts Study topics. The Risk Assessment and Public Health Impacts Study both addressed air quality, water and soil quality, NORM, and noise impact. However, the Risk Assessment concluded there was a lower risk and impact in almost every category than found by the Public Health Impacts Study. And the Public Health Impacts Study (in most cases) recommended a longer list of best management practices to mitigate risk than are listed in the Risk Assessment for those same topics. The Risk Assessment differs in that it never reaches a conclusion about whether there will be “unacceptable risks” to air quality, water and soil quality, and human health.

Overall, NRDC finds the Risk Assessment underestimates short-term, long-term, and cumulative risks and consequences (including human health impacts) of Marcellus Shale exploration and development in Maryland. Risk and consequences are both born by the public, while the economic benefit of Marcellus gas production will largely benefit corporate interests. NRDC also finds the Risk Assessment does not meet its stated objective of determining whether there will be “unacceptable risks.”

NRDC also finds the Risk Assessment did not adequately address financial risk. Maryland’s Phase I and II Study work recommends improvements in taxation and financial assurance (bond and liability insurance), and the possibility of a enacting a law creating a rebuttable presumption radius around Marcellus Shale exploration and production activities. These requirements are not, however, currently bound by statute or regulation, and may be insufficient to address short-term, long-term, and cumulative impacts that may occur to humans and the natural environment, despite Maryland’s best efforts. For example,

*“...The Departments considered, but ultimately did not recommend, the option of imposing strict liability on permittees for damages caused to non-surface owners and surface owners under whose land no drilling is done (so-called “innocent bystanders”). Some Commissioners strongly prefer to see such a recommendation, noting their view that hydraulic fracturing is an “abnormally dangerous activity” subject to strict liability. Some other Commissioners strongly oppose this.”<sup>7</sup>*

---

<sup>7</sup> Maryland Department of the Environment, Part I of the Marcellus Shale Safe Drilling Initiative Study, December 2011, page E-3.

Therefore, “innocent bystanders” suffering adverse impacts from shale gas development in Maryland are left to fight gas corporations in court to seek remedies to protect their health and welfare, and/or fund medical remedies to alleviate health consequences that may occur. These are “unacceptable risks” and “unacceptable consequences” for the affected public.

Maryland’s study work confirmed the amount of taxes collected and financial assurance required is not sufficient to ensure the public remains whole today and in the future. There remains the risk that companies will have accidents that exceed Maryland’s proposed financial assurance requirements, that exceed a company’s insurance limits, or that companies may go bankrupt, requiring public taxpayer funds at a local, state, or federal level to remedy the damage. These are “unacceptable risks” and “unacceptable consequences” for the affected public.

In addition to carrying the burden of increased risk and consequences, the public may also be burdened with increased taxes required to increase police, emergency response, road repair, and address other potentially unfunded cost impacts to the community. While short-term increases in local income and potential increased tax base may offset some of that burden, in the long-term there remains substantial uncertainty about the potential human health impacts from unabated or unremediated air, water, and land pollution, and adverse impacts to property value and quality of life. In sum, these are “unacceptable risks” with little reward for the majority of the public. The public carries the burden of venturing into the unknown, and the potential for adverse human health consequences, with little upside. As explained in Maryland’s Phase I study findings:

*“...there are there are few meaningful remedies for those who do not own their mineral rights, but are nevertheless injured in some way by the activities.”<sup>8</sup>*

*“...there are few meaningful remedies for neighboring residents, landowners, or businesses whose lands are not directly involved in drilling, but who may incur damage....a patchwork of common law tort claims provides the main source of remedies for these injured parties. Availability of a remedy differs depending on the situation and even when an injury seems to fall within one of the recognized torts, certain elements may be difficult for the injured party to prove under the circumstances.”*

Therefore, despite the best efforts of responsible companies implementing best practices known today, high-volume, hydraulic fracturing is not risk-free, accidents happen, human error is inevitable. Best practices known today (at this early stage) may not be prove to be the best that they could be if additional time were taken to further understand the risks and refine technology.

The Risk Assessment attempts to assign risk probability using data from other gas development projects, however, the risk probability will be a function of actual experience and qualifications of personnel, and the actual age, condition, and maintenance of equipment used, and other reservoir and site specific factors that were not taken into account. The Risk Assessment does not provide a description or name companies interested in developing the Marcellus, therefore, the corporate risk was not evaluated.

The work complete by Maryland, thus far, is a good initial start. NRDC is impressed by the amount of research completed, and recommendations to adopt scientifically and technically sound best management

---

<sup>8</sup> Maryland Department of the Environment, Part I of the Marcellus Shale Safe Drilling Initiative Study, December 2011, page 19.



practices. However, NRDC finds the Risk Assessment still needs work, and our comments make a number of recommendations for improvement.

In total, the study confirms there is insufficient technical and scientific data to confirm that human health risk and consequences to the public can be eliminated or managed to an acceptable level. Until Maryland can confidentially verify that human health risk and consequences to the public can be satisfactorily addressed, the risk of Marcellus Shale exploration and development in Maryland remains at an unacceptable level to the public. Therefore, NRDC recommends Maryland continue the Marcellus Shale drilling moratorium until potential health impacts and the extent to which they can be mitigated can be more fully understood.

## Overall Recommendations

**1. Definition of Unacceptable Risk.** The stated primary objective of the Risk Assessment is to determine whether, and if so how, gas production from the Marcellus Shale in Maryland could be accomplished without unacceptable risks of adverse impacts to public health, safety, the environment, and natural resources. Yet the term “unacceptable risk” is never defined. Remarkably, a report with a primary objective of assessing “unacceptable risks” only uses the term three places in the entire 241 page report. And, the risk assessment methodology (Executive Summary Pages 4-7) does not include methods designed to reach a conclusion about whether there are – or are not – “unacceptable risks.” Instead, the report assigns risk but never decides whether that risk is “unacceptable” to the public.

Risk and consequences are both born by the public, while the economic benefit of Marcellus gas production will largely benefit corporate interests. While the public carries the burden of increased risk and consequences, it may also be burdened with increased taxes required to increase police, emergency response, road repair, and address other potentially unfunded financial impacts to the community. Short-term increases in local income and potential increased tax base may offset some of that burden; however, in the long-term there is substantial uncertainty about the potential human health impacts that may occur from unabated or un-remediated air, water, and land pollution.

What may be an “acceptable” risk to a corporation is not likely “acceptable” to the public. This is especially true for the majority of the public that are not employed in the gas industry, or likely to benefit from lease sales, or other economic transactions, and who are weighted with the burden of increased risk and consequences. For example, the Risk Assessment does not answer what level of increased asthma, respiratory disease, cancer mortality, noise, visual impact, or water contamination (etc.) is “acceptable” for the majority of the public.

Recommendation: NRDC recommends the Risk Assessment:

- Define the term “unacceptable risk” and include that definition and a process to reach that conclusion in the Risk Methodology Section of the study (Executive Summary Pages 4-7).
- Define and assess “unacceptable risk” from the point of view of the majority of the public that are not likely to yield economically gain from Marcellus Shale exploration and development.
- Include a section on risk tolerance and acceptable risk. This section should and explain that “medium and high” risk probability and “moderate to serious” consequences are not acceptable risks for the public.
- Ensure each chapter arrives at a solid conclusion about whether the risk is or is not “unacceptable.”

- 2. Risk Reduction Analysis and Recommendation.** The Risk Assessment includes a mix of Best Management Practices (BMPs) that are included in Maryland and federal regulation and proposed BMPs (from Phase II of Maryland's work)<sup>9</sup> that have not been included in regulation, but does not include many new recommendations to further reduce risk beyond those already identified. There is very little analysis of risk reduction that can be achieved through additional BMP adoption. In these comments, NRDC identifies additional BMPs that could further reduce risk that were not, but should be, examined. For example, the Risk Assessment did not evaluate use of larger setback distances to reduce risk, and instead only examined the setback distances previously proposed in Phase II.

Recommendation: The Risk Assessment should evaluate additional BMPs, beyond those identified by Maryland in Phase II, to further reduce risk.

- 3. Clarity Needed on Mitigation Already in Regulation vs. Proposed.** The Risk Assessment includes a mix of BMPs that are included in Maryland and federal regulation and proposed BMPs that have not been included in regulation. The Risk Assessment is not clear on which mitigation measures are already found in regulation and which are only at the proposal stage.

The Risk Assessment assumes all proposed BMPs will be implemented and enforced, and concludes (in most cases) that risk is low if BMPs are implemented. However, a substantial number of BMPs proposed for UNGDP including Marcellus Shale exploration and development are not included in current regulations and are not guaranteed or enforceable at this time.

Additionally, the Public Health Impact Study appears to have assumed all the BMPs proposed in the Best Practices Study would be implemented. If this is not the case, both the Risk Assessment and the Public Health Impacts Study baseline assumptions about BMPs need to be revised.

Recommendation: Both the Risk Assessment and Public Health Impacts Study should more clearly explain which BMPs are included in Maryland and federal regulation and which are only at the proposal stage. Both studies should clearly explain if they are recommending additional BMPs over those proposed in Maryland's Best Practices Study.<sup>10</sup> The Risk Assessment should identify additional BMPs and make specific recommendations to further reduce risk.

- 4. Best Management Practices Should Be Codified in Regulations.** Maryland identified a number of important BMPs; however, it has not yet amended its regulations to include the proposed BMPs. Nor has it provided funding to administer oversight, inspection, or enforcement of the proposed BMPs. For example, Maryland's Best Practices Study report states:

*Maryland regulations could be amended to reflect the new best practices or the new best practices could be required by provisions in an individual well permit.<sup>11</sup> [Emphasis added.]*

The Risk Assessment assumes all proposed BMPs will be implemented and enforced, and concludes (in most cases) that risk is low if BMPs are implemented. However, a substantial number of BMPs

---

<sup>9</sup> Maryland Department of the Environment, Part II of the Marcellus Shale Safe Drilling Initiative Study (Best Practices for Gas Production in the Marcellus Shale in Maryland), July 11, 2014.

<sup>10</sup> Marcellus Shale Safe Drilling Initiative Study, Part II, Interim Final Best Practices, prepared by Maryland Department of the Environment and Maryland Department of Natural Resources, July 2014.

<sup>11</sup> Maryland's Interim Final Best Practices Study, July 2014, Page 2.

proposed for UNGDP are not included in current regulations and are not guaranteed or enforceable at this time. Instead, these BMPs are only listed as ones that “could” be required.

It has been NRDC’s experience that a proposed BMP that has not yet been codified is only a proposed BMP, and is not a public guarantee of what will actually be required or enforced. While NRDC supports codification of all proposed BMPs if and when shale development proceeds, we anticipate industry opposition to some of the BMPs and a rigorous debate during the codification process. A Risk Assessment based on an uncertain BMP adoption and codification outcome is premature. For example, if some BMPs are not codified, the Risk Assessment findings would further underestimate the risk.

Without minimum requirements codified in regulations, the public is not assured that Maryland will adopt and enforce all the proposed BMPs and there is the potential for lower standards to be used on individual projects or permits without opportunity for public review. An updated regulatory framework provides operators with clear, consistent rules to work from; regulatory staff with simplified instructions for implementation; a public process for input; and a more orderly and safe exploration and development process for Maryland.

Additionally, the Public Health Impact Study appears to have assumed all the BMPs proposed in the Best Practices Study would be implemented. If this is not the case, both the Risk Assessment and the Public Health Impact Study baseline assumptions about BMPs need to be revised.

Recommendation: The Risk Assessment should clearly state that it assumes both full implementation and full enforcement of all proposed BMPs. NRDC recommends Maryland formally include the proposed BMPs (and others recommended in our comments) in revised regulations, along with adequate funding to administer BMP oversight, inspection, and enforcement. The Risk Assessment should also make clear that Maryland would need to complete a revised Risk Assessment if it decides not to fully implement and enforce the proposed BMPs.

- 5. Risk Assessment Underestimates Risk in Some Categories.** There are inconsistencies between Maryland’s Public Health Impact Study and Risk Assessment conclusions. In general, the Risk Assessment underestimates the risk. For example, the Public Health Impact Study concluded UNGDP will negatively impact air quality and will have a negative impact on public health in Maryland (air quality was given a high hazard ranking); yet, the Risk Assessment generally concluded the air pollution risks were low to moderate for most pollutant impact categories.

Recommendation: NRDC recommends Maryland revise its Risk Assessment to include the higher risk findings documented in the Public Health Impact Study.

- 6. Public Health Impact Study BMP Recommendations.** Maryland’s Public Health Impact Study made a number of BMP recommendations to mitigate risk that were not included in the Risk Assessment because the studies were completed in parallel.

Recommendation: NRDC recommends Maryland revise its Risk Assessment to include BMPs recommended in the Public Health Impact Study.

- 7. Include Additional BMP Recommendations Contained in these Comments.** Maryland identified a number of valuable BMPs that should be codified. NRDC has been closely following BMPs for UNGDP development, and throughout these comments has identified additional BMPs for inclusion.

NRDC has also provided a complete set of our comments provided to New York State (NYS) on the same topic.

Recommendation: NRDC recommends Maryland consider inclusion of the additional BMPs listed in these comments to supplement those already identified by Maryland's study efforts.

- 8. Risk Ranking Methodology Underestimates Overall Risk.** Table 3 of the Risk Assessment<sup>12</sup> provides a color coded Risk Ranking Methodology formulation that underestimates overall risk. Table 3 assigns an overall risk ranking using the same “low,” “moderate,” and “high” risk definitions assigned in the risk probability Table 2. Yet, the definitions of “low,” “moderate”, and “high” risk defined in the risk probability (Table 2) cannot be the same as the definition of a combined, overall “low”, “moderate”, or “high” risk that considers **both** risk probability and consequence (Table 3).

Take for example a risk with a **low probability** (new gas pipeline weld failure), but a **serious consequence** such as a fire and explosion in a nearby neighborhood (where “serious consequence” is defined as a major adverse impact on people or the environment; could affect the health of persons in a large area; extensive or permanent environmental damage). Table 3 proposes to assign a low probability risk with a serious consequence an **overall “moderate” risk ranking**. Yet, an overall risk ranking of moderate underestimates the risk because it downgrades the potential consequence rating of “serious” to a “moderate” level; yet the consequence severity does not actually change even if the event probability is low. Therefore, it is not appropriate to downgrade the overall risk by combining an event probability with consequence severity.

Problems with the proposed overall risk ranking methodology (Table 3) is compounded by using the same nomenclature and definitions (low, medium and high) for both probability (Table 2) and overall risk (Table 3). If the Risk Assessment continues to show a combined overall risk, different nomenclature and definitions should be used to describe overall risk that takes into account risk probability and risk consequence. To achieve this end, we recommend use of the terms “acceptable risk” and “unacceptable risk” in Table 3 to describe the overall risk, instead of the terms low, medium and high. For example, the Table 3 matrix should list the term “unacceptable risk” in the red boxes where there is a medium or high risk probability and a moderate to serious consequence for that risk. This approach will aide Maryland in meeting its primary objective of identifying unacceptable risks.

Recommendation: The Risk Assessment should list risk probability and risk consequence and not attempt to combine an overall risk factor, unless that risk factor uses the highest risk element in that combination and reaches a conclusion about whether the risk is “unacceptable.” Table 3 should use the terms “acceptable risk” and “unacceptable risk” to describe the overall risk, instead of the terms low, medium and high.

- 9. Risk Ranking Confidence Level.** The text of the Risk Assessment identified a number of risks where there was inadequate or incomplete information to assess the risk level. Yet the Risk Assessment did not include a risk ranking confidence level scale or make recommendations for securing improved data to increase the confidence interval.

Recommendation: The Risk Assessment would benefit from inclusion of a risk ranking confidence

---

<sup>12</sup> Maryland Risk Assessment, October 2014, Executive Summary, Page 7.

level scale of 1-5, or similar (such as the following), and by including a summary list of inadequate or incomplete information that needs to be obtained or further studied.

1. Very High confidence in the judgment based on a thorough knowledge of the issue, the very large quantity, and quality of the relevant data and totally consistent relevant assessments.
2. High confidence in the judgment based on a very large body of knowledge on the issue, the large quantity, and quality of the relevant data and very consistent relevant assessments.
3. Moderate confidence in the judgment based on a considerable body of knowledge on the issue, the considerable quantity, and quality of relevant data and consistent relevant assessments.
4. Low confidence in the judgment based on a relatively small body of knowledge on the issue, the relatively small quantity, and quality of relevant data and somewhat consistent relevant assessments.
5. Very Low confidence in the judgment based on small to insignificant body of knowledge on the issue, quantity, and quality of relevant data and/or inconsistent relevant assessments.

**10. TOP Down Best Available Technology (BAT) Process.** Maryland's proposed BMPs include a "TOP Down BAT Process" for the control of air pollution. Maryland proposes:

*The Department of the Environment intends to require top-down Best Available Technology (BAT) for the control of air emissions. This means that the applicant will be required to consider all available technology and implement BAT control technologies unless it can demonstrate that those control technologies are not feasible, are cost prohibitive or will not meaningfully reduce emissions from that component or piece of equipment. BAT emissions control technology will be mandatory for workovers. MDE will analyze top-down BAT demonstrations from applicants and approve the applicants BAT determination before a permit is issued. This builds on the EPA STAR program, and therefore a separate requirement to participate in this voluntary EPA program is not needed. MDE will also require a rigorous leak detection and repair program.*

NRDC supports the use of a "TOP Down BAT Process"; however, it has been our experience that the outcome of such a process is highly dependent on how the regulator the terms "feasible" and "cost prohibitive."

Recommendation: NRDC recommends Maryland codify the "TOP Down BAT Process" in regulation and define the term feasible to mean all technology that is commercially available, and define the term cost prohibitive.

**11. Industrial Activity Level.** Both the Risk Assessment and the Public Health Impact Study assume a certain amount of industrial activity in the UNGDP (if approved). However, there is no certainty that the maximum industry activity levels assumed would not actually be exceeded, unless Maryland sets industrial activity level limitations. In some cases, the level of industrial activity was determined to pose increased risk and potential health impacts, and limitations on the peak amount of industrial activity in any one area could be an important mitigation measure that has not been included.

Recommendation: NRDC recommends Maryland set maximum allowable levels of activity that would prevent "unacceptable" risks.

**12. Prohibited Activities.** Both the Risk Assessment and the Public Health Impact Study assume a certain amount of industrial activity in the UNGDP (if approved), and make assumptions about activities that might be prohibited. However, there is no certainty about the assumed prohibitions for the public until Maryland formalizes prohibitions. For example, both studies assume centralized impoundments would be prohibited, but this prohibition is not codified.

Recommendation: The Risk Assessment should clearly state that it assumes both full implementation and full enforcement of all proposed prohibitions. NRDC recommends Maryland codify a list of prohibited activities and uses to provide public confidence that these “unacceptable” risks are remedied and will be enforced. The Risk Assessment should also make clear that Maryland would need to complete a revised Risk Assessment if it decides not to fully implement those prohibitions.

**13. Baseline Data Collection.** Both the Risk Assessment and the Public Health Impact Study include assumptions about current baseline data. Additional baseline data collection is needed in the areas proposed for UNGDP before completing these study findings.

Recommendation: NRDC recommends the Risk Assessment include a summary list of baseline data that needs to be collected prior to completing the study.

**14. Chemical Use Limitations.** Maryland has not set limits on the type of chemicals that can be used in hydraulic fracturing, drilling muds, or at gas drilling and production sites that are protective of human health and the environment (with the exception of diesel). Therefore, there is no assurance that the Risk Assessment is based on a representative set of chemicals that would actually be used, representing the worst case scenario or even a representative amount impacts/risk that would actually occur. For example, if hydraulic fracturing treatments are conducted in poorly constructed wells, there exists a potential for groundwater contamination. The use of safe treatment additives provides any extra layer of protection in the event that human error or mechanical malfunction creates a pathway for those additives to reach groundwater. Reducing the toxicity of chemical additives by listing prohibited additives mitigates the impact of both surface and groundwater pollution if it occurs.

Recommendation: NRDC recommends Maryland set chemical use limits and the Risk Assessment and the Public Health Impact Study be revised to incorporate those limits. Maryland should adopt a list of prohibited additives, and a list of non-toxic additives that are acceptable, with supporting toxicological data. The list of prohibited additives should be based on the known list of chemicals currently used and Maryland should institute a rigorous technical and scientific review process to evaluate newly proposed additives to determine if they should be added to the prohibited list.

In addition to a list of prohibited chemicals, Maryland should develop a list of recommended and approved additives that have been scientifically and technically reviewed by the state and confirmed to pose little or no risk to human health or the environment. This list would provide industry with a simplified list of chemicals for use. Any chemical not found on this list, or on the list of prohibited chemicals, could be proposed by industry for future use. New chemicals should be subject to an in-depth scientific and technical justification and risk assessment review process before being added to the approved chemical list for Maryland.

No chemical should be used until Maryland has assessed whether it is protective of human health and the environment, and has determined whether it warrants inclusion on the list of prohibited additives. The burden of proof should be on industry to demonstrate, via scientific and technical data and

analysis, and risk assessment work, that the chemical is safe.

**15. Risks Not Assessed.** Appendix A of the Risk Assessment provides a “Risk Ranking Summary Chart.” A substantial number of risks listed in the chart were Not Assessed (NA); therefore, the Risk Assessment is incomplete. In some cases, the risk was not assessed because it logically didn’t apply to that phase of operations (e.g., gathering lines are not present during site preparation); however, in other cases the risk should have been assessed, but was not (e.g., contamination of soil, ground water, or surface water from a fuel or chemical spill during production operations).

**Recommendation:** NRDC recommends Maryland revise the Risk Assessment to make clear when risks were not assessed because the risk was not present during that phase of operation, and assess the risk that are currently listed as Not Assessed (NA) that should be assessed for a complete risk assessment.

## Air Pollution

Maryland’s Public Health Impact Study concluded there is a **high likelihood** that UNGDP will negatively impact air quality and will have a negative impact on public health in Maryland (air quality was given a high hazard ranking).<sup>13</sup> The study cites emerging findings in peer-reviewed journals:

*...linking exposure to air pollution associated with UNGDP increased risk of subchronic health effects, adverse birth outcomes including congenital heart defects and neural tube defects, as well as higher prevalence of symptoms such as throat & nasal irritation, sinus problems, eye burning, severe headaches, persistent cough, skin rashes, and frequent nose bleeds among respondents living within 1500 feet of UNGDP facilities compared to those who lived >1500 feet.*<sup>14</sup>

Yet, the Risk Assessment recommends setbacks of only 1,000’ from homes and public buildings.

The Public Health Impact Study concluded:

*The extent of the impact will be based on population vulnerability, proximity to the sites, and the success of public health prevention strategies implemented by the State and local communities and control measures taken by the industry to minimize exposures.*<sup>15</sup>

The Risk Assessment concluded air pollution risk was high even with best practice in place:

*There is a high probability of air pollution emissions during all UGWD (Unconventional Gas Well Development) phases even with BMPs in place.*<sup>16</sup>

The Risk Assessment also concluded that there was insufficient data to determine consequences:

---

<sup>13</sup> Maryland Public Health Impact Study, July 2014.

<sup>14</sup> Maryland Public Health Impact Study, July 2014, Page xx.

<sup>15</sup> Maryland Public Health Impacts Study, July 2014, Page xxi.

<sup>16</sup> Maryland Risk Assessment, October 2014, Appendix B, Page 43.

*...most of these high probability emissions result from multiple, oftentimes overlapping combustion sources that for several sources (mobile sources, hydraulic fracturing pumps, and compressor emissions) have insufficient data or modeling information to reasonable determine consequences.<sup>17</sup>*

The Public Health Impact Study appears to have assumed all the BMPs for air pollution control and monitoring proposed in Maryland's Best Practices Study would be implemented. The Public Health Impact Study also recommended a number of additional BMPs for air pollution control and monitoring that are not included in the Risk Assessment. A summary is provided in the table below:

Best Management Practice Recommendation (BMP)	Public Health Impacts Study <sup>18</sup>	Best Practices Study <sup>19</sup>
<b>Hazardous Air Pollutant Mitigation:</b> Require assessment of air quality and other potential health impacts and propose strategies to protect the community and workers from exposure to hazardous air pollutants.	X	Not Addressed
<b>Minimum Setback Distance:</b> Require a minimal setback distance of 2000 feet from well pads and from compressor stations not using electric motors. The Risk Assessment assumes 1,000' vs. the Public Health Impacts Assessment that recommends at least 2,000'.	2,000'	1,000'
<b>Fugitive Emissions:</b> Require assessment of impact on and a monitoring plan for potential fugitive emissions from existing and historic gas wells within the horizontal extent of the fractured area.	X	Not Addressed
<b>Closed Tanks:</b> Require that all UNGDP materials and wastes be stored in closed tanks; open pits shall only be used for storage of fresh water.	X	X
<b>VOC Storage Tank Emission Control.</b> Require storage tanks for all materials other than fresh water and other UNGDP equipment to meet EPA emission standards to minimize VOC emissions.	X	Not Addressed
<b>Monitoring:</b> Require an air monitoring plan (to collect baseline and operational data). Include source apportionment that allows UNGDP signal to be separated from the local and regional sources. Conduct air monitoring in a manner to capture both acute and chronic exposures, particularly short-term peak exposures.	X	Not Addressed
<b>Odor:</b> Establish a panel consisting of community residents and industry personnel to actively address complaints regarding odor.	X	Not Addressed
<b>Cover Trucks:</b> Require all trucks transporting dirt, drilling cuttings to be covered.	X	Not Addressed
<b>Storage Tank Emission Control.</b> EPA recently updated the 2012 standards for storage tanks. 78 Fed. Reg. 58416 (September 23, 2013). The Departments propose to require that all new natural gas operations in Maryland meet these standards upon startup.	X	X
<b>Electric Motors:</b> Require electrically powered motors wherever possible; do not permit use of unprocessed natural gas to power equipment. This recommendation is designed to reduce VOCs and PAHs emissions from drilling equipment and compressors.	X	X
<b>Green Completions:</b> Require green completions for new and re-fractured wells.	X	X

<sup>17</sup> Maryland Risk Assessment, October 2014, Appendix B, Page 43.

<sup>18</sup> Maryland Public Health Impacts Study, July 2014, Pages xxv through xxvii.

<sup>19</sup> Maryland Best Management Practices Study, July 2014, Pages 41-42.



Best Management Practice Recommendation (BMP)	Public Health Impacts Study <sup>20</sup>	Best Practices Study <sup>21</sup>
<b>Flaring:</b> Flaring is allowed for safety or if the content of the flammable gas is low. Operators must either use raised/elevated flares or an engineered combustion device with a reliable continuous ignition source, which have at least a 98 percent destruction efficiency of methane. No pit flaring is permitted. Flaring may not be used for more than 30-days on any exploratory or extension wells (for the life of the well), including initial or recompletion production tests, unless operation requires an extension. Flares shall be designed for and operated with no visible emissions, except for periods not to exceed a total of five minutes during any two consecutive hours.	X	X
<b>Ultra-Low Sulfur Fuel:</b> All on-road and non-road vehicles and equipment using diesel fuel must use Ultra-Low Sulfur Diesel fuel (maximum sulfur content of 15 ppm).	X	X
<b>Engine Idling:</b> All on-road vehicles and equipment must limit unnecessary idling to 5 minutes. Except for engines necessarily kept in ready reserve, a diesel nonroad engine may not idle for more than 5 consecutive minutes.	X	X
<b>EPA Engine Standards:</b> All trucks used to transport fresh water or flowback or produced water must meet EPA Heavy Duty Engine Standards for 2004 to 2006 engine model years, which include a combined NOx and NMHC (non-methane hydrocarbon) emission standard of 2.5 g/bhp-hr.	X	X
<b>TOP Down BAT:</b> The Department of the Environment intends to require top-down Best Available Technology (BAT) for the control of air emissions. This means that the applicant will be required to consider all available technology and implement BAT control technologies unless it can demonstrate that those control technologies are not feasible, are cost prohibitive or will not meaningfully reduce emissions from that component or piece of equipment. BAT emissions control technology will be mandatory for workovers. MDE will analyze top-down BAT demonstrations from applicants and approve the applicants BAT determination before a permit is issued. This builds on the EPA STAR program, and therefore a separate requirement to participate in this voluntary EPA program is not needed. MDE will also require a rigorous leak detection and repair program.	X	X

NRDC made a number of important BMP recommendations to New York State (see Appendices A and B for more detail) that Maryland should additionally consider. Those BMPs are summarized in the table below.

<sup>20</sup> Maryland Public Health Impacts Study, July 2014, Pages xxv through xxvii.

<sup>21</sup> Maryland Best Management Practices Study, July 2014, Pages 41-42.

Best Management Practices (BMPs) not Considered/Included	Public Health Impact Study <sup>22</sup>	Best Practices Study <sup>23</sup>
<p><b>Leak Detection and Repair.</b> Ensuring tightly sealed flow connections, and performing leak detection and corrective action should be required and an enforcement program implemented. The following BMPs should be considered:</p> <ul style="list-style-type: none"> <li>• Leak Detection and Repair (LDAR) programs including acoustic detectors and infrared technology to detect odorless and colorless leaks;</li> <li>• Use of low bleed pneumatic instruments, instrument air, electric or solar powered control devices;</li> <li>• Use of dry centrifugal compressor seals;</li> <li>• Use of smart automation plunger lifts for liquid unloading; and</li> <li>• Early installation of pipelines; and</li> </ul>	Not Addressed	Not Addressed
<p><b>Concurrent Drilling Rig Operations on Same or Nearby Pad.</b> Air pollution impacts could exceed those anticipated in Maryland's Studies if limits on concurrent rig operation are not established in regulation.</p>	Not Addressed	Not Addressed
<p><b>Chemical Use Limitations:</b> Maryland has not set any limit on the type of chemicals that can be used in hydraulic fracturing. Therefore, there is no assurance that the air quality impact and risk analysis is based on a representative set of chemicals that would actually be used, representing the worst case scenario or even a representative amount of air pollution that would actually occur. Chemical use limits should be set and the risk and health assessment studies should be revised to incorporate these limits.</p>	Not Addressed	Not Addressed
<p><b>Industrial Activity:</b> Set limitations for peak industrial activity in any one area.</p>	Not Addressed	Not Addressed
<p><b>Venting:</b> While the proposed TOP Down BAT process may result in venting prohibitions, the proposed BMPs do not include specific prohibitions on direct venting, except for tank venting. Maryland should consider limits on the maximum amount of gas that can be vented per well.</p>	Not Addressed	Not Addressed
<p><b>Dehydration Unit Emission Controls:</b> While the proposed TOP Down BAT process may result in dehydration unit emission controls, the proposed BMPs do not include specific prohibitions on dehydration unit emission controls, especially for small units that may fall below the federal EPA NESHAP requirements. Please see NRDC's attached comments to NYSDEC for a more detailed list of dehydrator emission controls.</p>	Not Addressed	Not Addressed
<p><b>HAP Storage Tank Emission Control.</b> The Public Health Impacts Study proposed VOC emission control for storage tanks, but does not include specific proposed standards for Hazardous Air Pollutant (HAP) emission control, but does proposed future study of potential mitigation. NYSDEC's work showed annual HAP emission from flowback fluids could exceed major quantities of HAPs.</p>	Not Addressed	Not Addressed
<p><b>Natural Gas Powered Engines vs. Diesel Where Electric Power Grid is not installed.</b> Maryland proposed the use of electric power where installed; NRDC agrees. However, in areas where an electric power grid is not installed NRDC recommends the preferential use of natural gas powered engines over diesel engines.</p>	Not Addressed	Not Addressed

<sup>22</sup> Maryland Public Health Impacts Study, July 2014, Pages xxv through xxvii.

<sup>23</sup> Maryland Best Management Practices Study, July 2014, Pages 41-42.

Best Management Practices (BMPs) not Considered/Included	Public Health Impact Study <sup>24</sup>	Best Practices Study <sup>25</sup>
<p><b>Biofuel Use.</b> In cases where electricity and natural gas cannot be used, the use of biodiesel should be considered. Biodiesel blends of up to 20 percent (B20) can generally be used in diesel engines without any modification, although minor modifications are sometimes required for blends above 5 percent (B5). Higher level blends such as B80 or even full biodiesel (B99 or B100) are currently being used for many applications and should be investigated as well. Biofuel use would achieve much higher GHG reductions, up to 67 percent on average. Priority should be given to biodiesel produced from recycled oils and waste products.</p>	Not Addressed	Not Addressed
<p><b>Greenhouse Gas Emission Mitigation Plan and Offsets.</b> Maryland is considering whether it is feasible to require permittees to estimate the remaining methane emissions and offset them with greenhouse gas credits. Maryland proposes that if this occurs, the permittees will have to estimate and report emissions to the State annually.<sup>26</sup> However, this BMP is only under consideration and does not include a requirement to implement GHG emission mitigation. Maryland should require a GHG Mitigation Plan that provides for measureable emissions reductions and includes enforceable requirements. The GHG Impacts Mitigation Plan should list all Natural Gas STAR Program best management technologies and practices that have been determined by EPA to be technically and economically feasible, and operators should select and use the emission control(s) that will achieve the greatest emissions reductions. The GHG Impacts Mitigation Plan should be submitted and approved prior to drillsite construction, GHG controls should be installed at the time of well construction, and Maryland should conduct periodic reviews to ensure that GHG Impacts Mitigation Plans include state of the art emission control technologies. Further, the extent of compliance with adopted emission mitigation control plans should be documented throughout the well's potential to emit GHGs.</p>	Not Addressed	Not Addressed
<p><b>Energy Consumption.</b> The choice of energy efficient systems and practices can minimize electricity consumption, and reduce air pollutant impacts.</p>	Not Addressed	Not Addressed
<p><b>Additional Flaring Mitigation:</b> Maryland has identified some useful flaring BMPs, however, these additional BMPs should be considered:</p> <ul style="list-style-type: none"> <li>• Minimize the risk of flare pilot blowout by installing a reliable flare system;</li> <li>• Ensure sufficient exit velocity or provide wind guards for low/intermittent velocity flare streams;</li> <li>• Ensure use of a reliable ignition system;</li> <li>• Minimize liquid carry over and entrainment in the gas flare stream by ensuring a suitable liquid separation system is in place; and</li> <li>• Maximize combustion efficiency by proper control and optimization of flare fuel/air/steam flow rates.</li> </ul> <p>Maryland should also reconsider the proposal to allow flaring for up to 30-days on any exploratory or extension wells. Exploration flaring can be limited to a few days necessary to safely test the well. NRDC's comments to NYSDEC recommended a maximum of three-days flaring, unless justified for unavoidable safety reasons.</p>	Not Addressed	Not Addressed

<sup>24</sup> Maryland Public Health Impacts Study, July 2014, Pages xxv through xxvii.

<sup>25</sup> Maryland Best Management Practices Study, July 2014, Pages 41-42.

<sup>26</sup> Maryland Best Management Practices Study, July 2014, Pages 41-42.

Best Management Practices (BMPs) not Considered/Included	Public Health Impact Study <sup>27</sup>	Best Practices Study <sup>28</sup>
<p><b>Hydrogen Sulfide Detection and Protection:</b> Hydrogen sulfide (H<sub>2</sub>S) is a deadly gas. Require operators to conform to the American Petroleum Institute Recommended Practice 49 (API RP49) for Drilling and Well Servicing Operations Involving Hydrogen Sulfide and API RP 55 Oil and Gas Producing and Gas Processing Plant Operations Involving Hydrogen Sulfide, both standards include procedures to protect employees and the public. Operators should be required to follow H<sub>2</sub>S detection and handling procedures to protect employees and the public. Initial H<sub>2</sub>S testing should be conducted at each drillsite. Subsequent test frequency should be based on the results of initial testing. H<sub>2</sub>S levels can increase over time as gas fields age and sour. When H<sub>2</sub>S is present, nearby neighbors, local authorities, and public facilities should be notified, and provided information on the safety and control measures that the operator will undertake to protect human health and safety. In cases where elevated H<sub>2</sub>S levels are present, audible alarms should be installed to alert the public when immediate evacuation procedures are warranted.</p>	Not Addressed	Not Addressed
<p><b>Pollution Control for NORM Waste Treatment:</b> Require pollution control devices (e.g. filters and bubblers) for smelter stacks treating Naturally Occurring Radioactive Material (NORM) waste to reduce airborne radiation</p>	Not Addressed	Not Addressed

**Recommendation:** NRDC recommends Maryland revise the Risk Assessment to match the high hazard ranking determination in the Public Health Impacts Study, and include additional BMPs recommended by NRDC and in the Public Health Impacts Study. NRDC also recommends that Maryland collect additional data and conduct air pollutant modeling it identified as insufficient to understand the potential consequences at this time. The Risk Assessment should make a clear conclusion as to whether or not increased industrial air pollution will be an “unacceptable risk.”

As an example, NRDC completed a more detailed analysis of air pollution control BMPs in the table above to provide Maryland with an example of how BMPs recommended in Maryland’s BMP Study, Public Health Impacts Study, Risk Assessment, and those recommended by NRDC to NYS can be compared. This level of detailed analysis was not completed for each risk topic in these comments due to the short time period allotted for public comment.

It would be useful for Maryland to make a similar list for each risk factor in the final Risk Assessment to ensure all viable BMPs were considered and included. Maryland should explain in its final Risk Assessment all BMPs recommended and should either include those BMPs or explain why they were not included.

### Seismic Data Collection

The Risk Assessment concludes seismic data collection risk is low; yet the Risk Assessment does not make clear the amount of seismic data collection that may be required for UNGDP operations in Maryland. Instead, the Risk Assessment was based solely on a single application made by one company in a rural (not heavily forested) area, with the potential for limited landscape disturbance. There was no data included to verify that this single seismic data acquisition study was, or would be, typical of Maryland’s seismic data collection needs for UNGDP.

<sup>27</sup> Maryland Public Health Impacts Study, July 2014, Pages xxv through xxvii.

<sup>28</sup> Maryland Best Management Practices Study, July 2014, Pages 41-42.

Significant surface impacts can be caused by extensive tree and vegetation removal to create straight cutlines to run seismic equipment. Lines need to be cut to run mechanical vibration equipment or set explosives to generate the seismic waves, and other seismic lines are cleared to set geophones to measure the seismic reflection. The width of each cutline depends on the seismic survey method used, but can be on the order of 20'-50' wide where large seismic equipment units are required. Depending on existing development, infrastructure, and access in the area planned for onshore seismic exploration, a seismic operator may need to build access roads, set up temporary camps and establish helicopter landings to bring in personnel and equipment. While new lower impact seismic data collection procedures are available, some historic onshore seismic operations have resulted in impacts to the environment by:

- Creating new, wide, straight seismic cutlines. Seismic cutlines involve cutting trees and creating surface disturbance to flora, fauna, soils and watercourses. In some cases, wide roads and clearings are needed for seismic equipment, helicopter landings and work camps, and are created by using bulldozers, hydro axes, and large construction equipment;
- Causing temporary or permanent loss of habitat and ecological populations;
- Disrupting mating, nesting, spawning and migration routes;
- Removing vegetation that results in increased erosion and changes in surface hydrology;
- Siting camps, helipads, equipment storage and cutlines based on logistical convenience, and lowest cost, without consideration for sensitive biological areas, historic and cultural resources, and local community impacts and concerns;
- Creating new and long-term use travel corridors for predators;
- Creating new access routes into the forest for all-terrain vehicles, snowmobiles and off-road trucks that may result in increased hunting and poaching in areas where these activities would otherwise be prohibited or limited;
- Generating noise and light disturbances near animal and human populations;
- Introducing non-indigenous species via seismic and construction equipment;
- Damaging fish and wildlife habitat by surface disturbance and stream crossings;
- Contaminating soils and surface and subsurface water resources due to spills;
- Creating pollution through poor solid waste, human waste and wastewater management practices; and
- Adversely impacting visual aesthetics (“visual scarring”) due to the wide cutlines required to transport in seismic survey equipment.

BMPs are needed to prevent and mitigate these impacts. In 2011, NRDC funded a study of onshore seismic exploration practices and model permit requirements.<sup>29</sup> This study is enclosed as Appendix C for Maryland’s consideration.

**Recommendation:** NRDC recommends Maryland revise the Risk Assessment to include a technically supported estimate of the amount and type of seismic data collection that would be required for UNGDP, and estimate the amount of landscape disturbance (e.g., tree and forest removal, soil, crop, and grass

---

<sup>29</sup> Onshore Seismic Exploration Practices & Model Permit Requirements, Report to Sierra Club and Natural Resources Defense Council, Prepared by Harvey Consulting, LLC. , January 20, 2011.

damage, etc.). NRDC also recommends Maryland consider the 23 seismic data collection BMP recommendations included in Appendix C of our comments.

## Well Blowouts

The Risk Assessment cited an incident rate for offshore gas well blowouts of 1.2 blowouts per 1,000 wells drilled,<sup>30</sup> and concluded the probability of a well blowout was “low”<sup>31</sup> and the consequences of a blowout would be “minor.”<sup>32</sup> NRDC disagrees with this assessment.

Data included in Maryland’s own Risk Assessment confirms that blowouts are a reasonably foreseeable significant impact of at least 1.2 well blowouts per 1,000 wells drilled. The blowout data cited does not meet Maryland’s definition of a low probability risk (defined as a well blowout that “rarely happens under ordinary conditions; not forecast to be encountered under foreseeable future circumstances in view of current knowledge and existing controls on gas extraction.”)<sup>33</sup> Nor does it meet Maryland’s definition of a “minor” consequence (defined as a “slight adverse impact on people or the environment; causes no injury or illness”).<sup>34</sup>

Additionally, the Risk Assessment did not include a hazard identification analysis that assessed the worst-case scenario for blowout radius along with the associated spill, explosion, and fire hazard impact zone. The Risk Assessment recommends a 1,000’ setback in most instances from homes and public buildings, but does not provide scientific and technical justification for the propose setback distance to demonstrate how that distance would protective of the nearby sensitive receptors in a blowout, fire, or explosion at a nearby gas operation.

The Risk Assessment examined well blowout risk using offshore gas well blowout data, rather than onshore gas well blowout data. Using offshore data underestimates the actual number of onshore well blowouts for exploration wells. Data published by the Society of Petroleum engineers shows that, on average, a blowout occurs in 7 out of every 1,000 onshore exploration wells, not 1.2.<sup>35</sup> This risk statistic is applicable to Marcellus and other low-permeability gas reservoir drilling exploration and appraisal drilling proposed for Maryland and is 5.8 times higher than the risk factor used in Maryland’s Risk Assessment.

Blowout rates data collected in California from 1991 to 2005 showed less frequent blowouts for onshore gas production wells (compared to exploration wells) where more information is known about the reservoir, well control is optimized, and personnel are more experienced in site-specific conditions. This study estimated 1 blowout per 2,500 wells drilled.<sup>36</sup> However, this study is almost 10 years old, and Maryland should compile onshore blowout data for more recent Marcellus Shale wells drilled on the east coast. For example:

<sup>30</sup> Maryland Risk Assessment, October 2014, Appendix B, Page 21.

<sup>31</sup> Maryland Risk Assessment, October 2014, Appendix D, Page 17.

<sup>32</sup> Maryland Risk Assessment, October 2014, Appendix A, Table 15, Page 24.

<sup>33</sup> Maryland Risk Assessment, October 2014, Executive Summary, Page 6.

<sup>34</sup> Maryland Risk Assessment, October 2014, Executive Summary, Page 7.

<sup>35</sup> Rana, S., Environmental Risks- Oil and Gas Operations Reducing Compliance Cost Using Smarter Technologies, Society of Petroleum Engineering Paper 121595-MS, Asia Pacific Health, Safety, Security and Environment Conference, 4-6 August 2009, Jakarta, Indonesia, 2009.

<sup>36</sup> Jordan, P.D., and Benson, S. M., Well Blowout Rates in California Oil and Gas District 4- Update and Trends, Summary of Well Blowout Risks for California Oil and Gas District 4, 1991-2005, Table 1

- 2010: Chief Oil and Gas uncontrolled flow-back blowout in Bradford County, Pennsylvania causing more than 1000' radius of dead vegetation around the well pad.<sup>37</sup>
- 2010: EOG Resources well blowout at the Punxsutawney Hunting Club well in Clearfield County, Pennsylvania, lasting 16 hours, spilling an estimated 1,000,000 gallons of fracturing fluid, requiring evacuation of the areas and contaminating a large area of forest lands.<sup>38</sup>
- 2011: Talisman Energy well blowout in Tioga County, Pennsylvania, contaminating the well pad and nearby state forest with fracturing fluids.<sup>39</sup>
- 2011: Chesapeake Energy Marcellus well blowout in Bradford County, Pennsylvania spilled thousands of gallons of fracture treatment fluid over “containment walls, through fields, personal property and farms, even where cattle continue[d] to graze.”<sup>40</sup>
- 2014: Chevron well blowout in Pittsburgh in Dunkard Township, Pennsylvania resulting in a major fire.<sup>41</sup>

Hydrocarbon reservoirs can contain large quantities of gas and formation water, which can be released into the surrounding environment during a well blowout, resulting in significant damage to nearby properties. For example, California’s 1991-2005 blowout study showed that: 25% of the blowouts affected more than 25 acres; the average blowout lasted 18 hours; and the maximum blowout length was 6 months.<sup>42</sup>

Methods to control a gas well blowout can require significant water withdrawals – from 500,000 to 6,000,000 gallons per day. Well control experts may also use foam and dry chemicals to respond to a blowout. Controlling a well blowout can create large volumes of waste. Rig-deluge operations create large pools of water that can transport oil, chemicals, fuels, and other materials toward lower elevation drainage areas. These risks were not addressed.

Blowout risk is a function of the drilling company’s experience in drilling the target formation; equipment quality; personnel experience; and maintenance, testing, and repair practices. The Risk Assessment is silent on these risk factors and is silent on the type and experience of the companies likely to drill Marcellus Shale wells in Maryland.

Recommendation: NRDC recommends Maryland:

- Revise the Risk Assessment to use more current onshore well blowout risk data, specifically for Marcellus Shale wells drilled on the east coast.

---

<sup>37</sup> Pennsylvania Department of Environmental Protection (2010f) “Marcellus Shale inspections/violations 2010 Inspection comment ID 1887635” <http://www.dep.state.pa.us/dep/deputate/minres/oilgas/OGInspectionsViolations/OGInspviol.htm>

<sup>38</sup> “Gas Well Blowout Under Control in Clearfield County”, WJAC TV, 2010, <http://www.wjactv.com/news/news/gas-well-blowout-under-control-in-clearfieldcount/nD4kX/>.

<sup>39</sup> “Talisman Cited for Gas Well Blowout” <http://thetimes-tribune.com/news/gasdrilling/> talisman-cited-for-gas-well-blowout-1.1095503#axzz1doztpMg8

<sup>40</sup> Pennsylvania Fracking Spill: Natural Gas Well Blowout Spills Thousands of Gallons of Drilling Fluid, The Huffington Post, April 20, 2011.

<sup>41</sup> Green County Shale Well Continues Burning, Pittsburgh Post-Gazette, February 12, 2014. <http://www.post-gazette.com/local/south/2014/02/11/Gas-well-explodes-in-southeastern-Greene-County/stories/201402110126>.

<sup>42</sup> Jordan, P.D., and Benson, S. M., Well Blowout Rates in California Oil and Gas District 4- Update and Trends, Summary of Well Blowout Risks for California Oil and Gas District 4, 1991-2005.

- Include a hazard identification analysis that assesses the worst-case scenario for blowout radius along with the associated spill, explosion, and fire hazard impact zone to provide scientific and technical justification for the proposed setback distance to demonstrate how that distance is protective of the nearby sensitive receptors.
- Assess blowout risk at a medium level (defined as a well blowout that “occurs occasionally or could potentially occur under foreseeable circumstances if management or regulatory controls fall below best practices”) <sup>43</sup> and list the consequences of a blowout ranging from moderate to serious (not minor).
- Revise the Risk Assessment to address blowout risks related to a drilling company’s experience in drilling the target formation; equipment quality; personnel experience; and maintenance, testing, and repair practices for companies likely to drill Marcellus Shale wells in Maryland.
- The Risk Assessment should make a clear conclusion as to whether or not increased industrial air pollution will be an “unacceptable risk” at the proposed setback distance of 1,000’ from homes and public buildings, or whether large setbacks should be used to make the risk acceptable to the public.

### Setback Distances

The Risk Assessment proposes the use of setbacks ranging in distance from 450’ to 2,000’ (relying only on Maryland’s prior 2014 BMP Phase II Study recommendations) without any analysis of the risk associated with using those proposed setback distances or the risk reduction that can be achieved using larger distances (larger setbacks reduce risk). The Risk Assessment did not include scientific and technical justification for each proposed setback distance, nor did it demonstrate how that distance is protective of the nearby sensitive receptors. Nor were setback distances recommended for all sensitive receptors, as shown in the summary table below.

In contrast, the Public Health Impact Study recommended more work be completed to verify if Maryland’s proposed setback distances are adequately protective of public health, including consideration of prevailing winds and topography.<sup>44</sup> The Public Health Impact Study also recommended a larger setback of at least 2,000’ from well pads and compressor stations (not using electric motors) to private homes, schools, and public buildings.

The Risk Assessment did not appear to take into account that directional drilling technology enables wells to be drilled to a bottom-hole location at 3-5 miles<sup>45</sup> away from a wellhead. In directional drilling, it is now common for the horizontal displacement of the bottom hole location to be several times the total vertical depth (TVD) of the well. For example, a well with a vertical depth of 5,000’ could have a bottom hole horizontal displacement of 10,000-15,000’ from the drill site, or more. A well with a vertical depth of 7,000’ could have a bottom hole horizontal displacement of 14,000-21,000’ from the drill site, or more. Given the flexibility afforded by spacing units that may vary in shape, from square to rectangular, and that surface drillsites need not be located over the spacing unit, well operators utilizing directional drilling technology have a greater ability to select surface drillsite locations that optimize distance from sensitive public and private resources.

<sup>43</sup> Maryland Risk Assessment, October 2014, Appendix D, Page 15.

<sup>44</sup> Maryland Public Health Impacts Study, July 2014, Pages xxv.

<sup>45</sup> Well step-out distance that can be achieved will depend on well depth.



NRDC recommended that Maryland increase a number of setback distances. A complete set of setback recommendations can be found in Appendix B; however, a summary is included in the table below for comparison.

Proposed Setback Distance From Edge of Drill Pad to:	Public Health Impacts Study	Best Practices Study <sup>46</sup>	NRDC Appendix B
<b>Aquatic Habitat</b> (unless otherwise listed below)	Not Addressed	450'	660'
<b>Stream, River, Lake, or other Surface Water</b>	Not Addressed	Not Addressed	3000'
<b>Special Conservation Areas</b>	Not Addressed	300'-600' Note 1	4,000'
<b>Perimeter of a Wellhead Protection Area or Source Water Assessment Area for a Public Water System for which a Source Water Protection Area has been delineated.</b>	Not Addressed	1,000'	4,000'
<b>Private Drinking Water Well.</b>	Not Addressed	2,000'	4,000'
<b>Primary Aquifers that are sources for private water wells.</b>	Note 2	Not Addressed	4,000'
<b>Wetlands</b>	Not Addressed	Not Addressed	300'
<b>Agricultural Lands</b>	Not Addressed	Not Addressed	1,320'
<b>500 Year Flood Plain</b>	Not Addressed	Not Addressed	Well pad prohibited
<b>Private Homes (homeowners who did not sign a lease or consent to drilling nearby)</b>	2,000' from wellpads & compressor stations without electric motors 1,000' from compressor stations with electric motors	1,000	1,320'
<b>Schools</b>	2,000' from wellpads & compressor stations without electric motors 1,000' from compressor stations with electric motors	1,000	1,320'
<b>Other Public Buildings</b>	2,000' from wellpads & compressor stations without electric motors 1,000' from compressor stations with electric motors	Not Addressed	1,320'

Note 1: Appendix F of the Risk Assessment, lists 300' setback from all permanent infrastructure to all cultural and historical sites, State and Federal parks, trails, wildlife management areas, scenic and wild rivers, and scenic byways; whereas, other sections of the Risk Assessment recommend a 600' setback for Special Conservation Areas.

Note 2: Prohibit well pads within watersheds of drinking water reservoirs and protect public and private drinking water wells with appropriate setbacks (setback distance not specified).

**Recommendation:** NRDC recommends Maryland revise the Risk Assessment to:

- Provide scientific and technical justification for each setback distance proposed to demonstrate how that distance is protective of the nearby sensitive receptor, including blowout radius, spill trajectory,

<sup>46</sup> Maryland Best Management Practices Study, July 2014, Pages 41-42.

explosion hazards, other industrial hazards, fire code compliance, prevailing winds, topography, human health, agricultural health, and quality-of-life factors.

- Examine risk reductions that can be achieved by increasing setback distances.
- The Risk Assessment should make clear conclusions as to whether the proposed setback distances present an acceptable level of risk.

### Fracturing Additives and Fluids

The Risk Assessment section on Fracturing Additives and Fluids (Appendix E) concludes risk quantification is difficult:

*...because the chemical mixture that composes fracturing fluid is proprietary, there are very few peer reviewed studies that establish relationships between fracturing fluid concentration and effects to ecological or human health.<sup>47</sup>*

The Risk Assessment cites recent studies that reported livestock health problems and mortality caused by fracturing fluid spills, as well as health problems to humans and wildlife exposed to fracturing chemicals (because many chemicals are classified as respiratory toxicants, immunotoxicants, and carcinogens). Yet the Risk Assessment concludes it cannot arrive at a specific “risk” factor for these chemicals because the chemical concentrations are not known:

*...a specific risk associated with these chemicals cannot be properly quantified because the concentrations of fracturing fluid chemicals are unknown.<sup>48</sup>*

Alternatively, the Risk Assessment assumes that all fracturing additives are harmful to people and environmental receptors, making no effort to examine setting any limit on the type of chemicals that can be used in hydraulic fracturing, drilling muds, or at gas drilling and production sites that are protective of human health and the environment.<sup>49</sup> The Risk Assessment proposes to allow any chemical to be used, even if it is known to be harmful.

In this case, the Risk Assessment just accepts and assigns a risk, but does not evaluate methods for reducing the risk. For example, the Risk Assessment concludes hydraulic fracturing chemicals spilled to surface water could have “severe” ecological effects, but does not recommend methods to reduce risk such as chemical type and use limits:

*If an incident resulted in the release or spill of drilling fluid additives, transporting directly into a stream the contaminated surface water could significantly impair water quality and adversely affect the health of aquatic life.<sup>50</sup>*

In another example, the Risk Assessment points out the lack of full disclosure of chemical components of hydraulic fracturing fluid additives may hinder mitigation and remediation actions in the event of

<sup>47</sup> Maryland Risk Assessment, October 2014, Appendix E, Page 4.

<sup>48</sup> Maryland Risk Assessment, October 2014, Appendix E, Page 4.

<sup>49</sup> Maryland Risk Assessment, October 2014, Appendix E, Page 5.

<sup>50</sup> Maryland Risk Assessment, October 2014, Appendix E, Page 4.

accidental spills,<sup>51</sup> but only makes a limited recommendation to improve chemical disclosure requirements to reduce these risks.

In Appendix H, the Risk Assessment proposes to require operators to provide a complete list of chemicals and concentration data, although the operator can request the state to withhold this information from the public if a claim of trade secret is made.<sup>52</sup> This is an “unacceptable risk” to the public. The public should have access to information on chemicals used that could potentially impact their drinking/groundwater. Lack of access to accurate chemical and concentration data could slow or lengthen the time to detect or confirm contamination, or impede proper medical treatment.

**Recommendation:** The Risk Assessment states the lack of access to accurate chemical and concentration data can slow or lengthen the time to detect or confirm contamination, or impede proper medical treatment. These risks could result in serious consequences and would not likely be “acceptable” to adversely affected public.

NRDC recommends Maryland set chemical use limits and the Risk Assessment and the Public Health Impact Study be revised to incorporate these limits. Please see Appendices A and B of NRDC’s comments for detailed recommendations on chemical use limits and pre-fracture notice and disclosure of chemicals (to both the Department and the landowner).

More specifically NRDC recommends that Maryland:

1. Develop a list of prohibited fracture treatment additives based on the known list of chemicals currently used in hydraulic fracturing.
2. Develop a list of non-toxic additives that are acceptable, with supporting toxicological data.
3. Develop a process to evaluate newly proposed hydraulic fracturing chemical additives to determine whether they should be added to the prohibited or acceptable lists.
4. Require the burden of proof to be on industry to demonstrate, via scientific and technical data and analysis and risk assessment work, that any newly proposed hydraulic fracturing chemical is safe.
5. Prohibit any chemical from use in a hydraulic fracturing treatment until Maryland has assessed the industry’s toxicity studies and other documentation concerning the impact of the chemical on human health and the environment and has determined whether or not it warrants inclusion on the list of prohibited hydraulic fracturing chemical additives.
6. Periodically test hydraulic fracturing fluid used on actual stimulation jobs to ensure that the chemicals used are the same ones allowed.

### Fracturing Fluid and Produced Water Flowback

NRDC supports Maryland’s proposed fracturing fluid and produced water flowback BMPs that require:

- Close-loop systems of above-ground tanks and containers to collect, handle and transport the waste;
- A plan for waste handling, treatment and disposal;

---

<sup>51</sup> Maryland Risk Assessment, October 2014, Appendix E, Page 7.

<sup>52</sup> Maryland Risk Assessment, October 2014, Appendix H, Page 4.

- Use of recycling to the maximum extent practicable;
- A prohibition on Publicly Owned Treatment Works (POTW) accepting fracturing fluid and produced water flowback wastewater until EPA has proposed treatment standards; and
- Improved recordkeeping and reporting requirements.

While the Risk Assessment is clear that reserve pits and impoundments will be prohibited at the well pad, it is unclear if Maryland plans to prohibit centralized impoundments (it appears this may be what Maryland intended, however this should be made clear). NRDC supports centralized impoundment prohibition, to reduce the risk of air pollution (especially the release of hazardous air pollutants) and to reduce the risk of water and soil pollution.

Recommendation: NRDC recommends Maryland review and include additional BMPs for produced water and flowback found in Appendices A and B of NRDC's comments.

### Spill Risk

Spill risk and likelihood is a function of company's experience; equipment quality; personnel qualifications and experience; and maintenance, testing, and repair practices. The Risk Assessment is silent on risk factors associated with the companies likely to operate Marcellus Shale wells in Maryland. More information should be provided on the type and track-record of the companies likely to operate in Maryland.

One method to mitigate risk that was not considered is to require that out-of-state environmental compliance records be disclosed as a condition of permitting (including disclosure of all permit applicants' compliance records, including at a minimum all prior administrative or judicial enforcement actions or criminal proceedings against the applicant and all denials of permits in any state). This BMP will provide Maryland with additional information on the companies' past practices and will allow Maryland to make an informed decision on permit approval, denial, or the need for additional mitigation to reduce risk.

The Risk Assessment assumes there is an 8% likelihood of a spill or leak at every stage of the UGWD resulting in an estimated 12 to 36 spill incidents for the low to high UGWD scenarios.<sup>53</sup> Incongruously, in the same section, the Risk Assessment then concludes that soil, surface water, and ground water contamination from drilling wastes will "rarely" occur if best practices are implemented. The Risk Assessment then lists the risk probability of drilling waste contamination as "low" (defined as a spill that "rarely happens under ordinary conditions; not forecast to be encountered under foreseeable future circumstances in view of current knowledge and existing controls on gas extraction.")<sup>54</sup> NRDC disagrees with this conclusion. A "rare" event would have a probability near 0%, not 8%.

The Risk Assessment did not assess the risk of improper waste treatment and disposal. The Risk Assessment examined the risk of transporting the waste to an "appropriate" treatment facility, but did not examine the very real risk – already being experienced elsewhere, including Pennsylvania – that there are insufficient "appropriate" treatment facilities available, requiring waste to be temporarily stockpiled (with

<sup>53</sup> Maryland Risk Assessment, October 2014, Appendix D, Page 10.

<sup>54</sup> Maryland Risk Assessment, October 2014, Executive Summary, Page 6.

potential to leak or leach into groundwater), or the risk of improper waste treatment and disposal techniques.

Recommendation: NRDC recommends Maryland:

- Revise the Risk Assessment to include a BMP that requires out-of-state environmental compliance records be disclosed as a condition of permitting.
- Increase the spill risk from “low” to “moderate” based on an estimated 8% spill frequency; and
- Assess the risk of improper waste treatment and disposal.

## Drilling Fluids and Cuttings

NRDC supports Maryland’s proposed BMPs that require:

- Freshwater aquifer zones to be drilled using air or fresh water;
- Drilling fluids to be contained in a closed-loop tank and piping system;
- No well pads in the watersheds of public drinking water reservoirs;
- Drilling fluids and cuttings to be stored and handled using above ground tanks, surrounded by a secondary containment system capable of holding the largest tank contents; and
- Preparation of site-specific emergency response plans, including experts and equipment, among other things.<sup>55</sup>

Recommendation: While Maryland identified and incorporated a number of valuable BMPs, NRDC recommends Maryland consider including the following additional BMPs, to further reduce risk. These BMPs are further explained in detail in Appendices A and B, including:

- Use of an impervious drill pad liner. Maryland proposes that drill pads be underlain with a synthetic liner with a maximum hydraulic conductivity of  $10^{-7}$  centimeters per second (which is not impervious).<sup>56</sup>
- A requirement to use drilling muds with the lowest mercury and heavy metal concentrations commercially available. The most common weighting agent used is barite. U.S. Department of Energy studies show that barite contains mercury (1ppm-10ppm Hg, depending on its origin).<sup>57</sup> Mercury concentrations can be reduced by using thermal methods, leaching with dilute acids, or selecting barite with naturally occurring lower concentration levels of mercury. Drilling muds may also contain the heavy metal cadmium, leading the EPA to establish cadmium concentration limits in drilling muds for muds disposed offshore.<sup>58</sup>
- The use of compressed air and Water Based Mud (WBM) for drilling through the protected groundwater zones is best practice, as long as Maryland also sets limits on the type of additives that can be mixed in the WBM formulation. WBM additives used when drilling through the protected

<sup>55</sup> Maryland Risk Assessment, October 2014, Appendix D.

<sup>56</sup> Maryland Risk Assessment, October 2014, Appendix D, Page 7.

<sup>57</sup> <http://www.fossil.energy.gov>, “Mercury Removal from Barite for the Oil Industry.”

<sup>58</sup> U.S. Environmental Protection Agency, Development Document for Effluent Limitation Guidelines and New Source Performance Standards for the Offshore Subcategory of the Oil and Gas Extraction Point Source Category, EPA 821-R-93-003, 1993.

groundwater zones should be limited to additives that are bio-degradable, are non-toxic, and do not bio-accumulate.

- Provide specific instruction for the proper treatment and disposal of drilling muds and cuttings, especially those containing heavy metals and Naturally Occurring Radioactive Material (NORM). Drilling muds may contain mercury, metals, NORM, oils, and other contaminants. This is especially true for Marcellus Shale operations where NORM is present in the shale drill cuttings and mud mixture.
- Waste should be removed from the drilling location and properly disposed at an approved waste disposal facility capable of handling the quantity and type of waste generated.
- Prohibit drilling mud and cutting spread on agricultural fields.
- Prohibit the onsite burial of drill cuttings and waste muds. Maryland proposes to allow some onsite drill cutting disposal if the cutting do not show elevated levels of radioactivity, sulfates, salinity, and other criteria.<sup>59</sup>

### Plugging and Abandonment of Existing Wells

A known and serious risk factor for groundwater contamination is the potential for a hydraulic fracture to connect (underground) with an improperly abandoned well that could potentially create vertical pathways for contamination to reach Underground Sources of Drinking Water (USDWs). Inadequate bonding, insolvent operators, and limited state funding are typically identified as the reasons for long backlogged lists of existing wells that have not been properly plugged and abandoned.

Maryland's Risk Assessment concludes there are serious adverse consequences from chemicals that are mobilized to groundwater through old wells and faults.<sup>60</sup> However, the Risk Assessment does not provide information on the number of existing wells that have not been properly plugged and abandoned in Maryland, or examine the risk they pose in the areas proposed for Marcellus Shale development. The assessment does not reach a conclusion as to whether this is an "unacceptable risk."

The Risk Assessment does include a BMP requiring operators to include a geological investigation in their applications identifying the location of nearby wells, but does not require those wells (if improperly abandoned or potentially a risk hazard) to be plugged and abandoned before issuing a permit for a new well.

Recommendation: NRDC recommends Maryland revise the Risk Assessment to include:

- Quantitative data on the presence and risk of improperly plugged and abandoned wells in the area proposed for Marcellus Shale gas exploration and development;
- A risk mitigation measure that would require all new operators to verify that all its existing wells that are no longer operational are properly plugged and abandoned before a permit is issued for new Marcellus Shale wells;
- A risk mitigation measure that would require operators applying for a permit to drill a new well nearby an improperly P&A'd well to either locate the well's owner and arrange for the well to be P&A'd or the company to P&A the well before a permit is approved.

<sup>59</sup> Maryland Risk Assessment, October 2014, Appendix D, Page 27.

<sup>60</sup> Maryland Risk Assessment, October 2014, Appendix H, Page 14.

- Include NRDC recommendations for properly plugging and abandoning a well (see Appendices A and B).

## Noise

The Risk Assessment includes conflicting data on noise impacts. The assessment cites the World Health Organization's recommendation for sound levels to be less than 30 dBA indoors and less than 45 dBA outdoors for intermittent noise, noting noise above these levels can make it more difficult to fall asleep, and resulting in adverse physiological effects.<sup>61</sup> Incongruously, the assessment includes a table that concludes community reaction to noise below 55 dBA "is considered no more important than various other environmental factors" (see Table 2). These data conflict for noises above 30 dBA indoors and 45 dBA outdoors.

Table 7 of the noise assessment shows that the World Health Organization's recommendation for sound levels of 30 dBA (indoors) and 45 dBA (outdoors) cannot be achieved even if human receptors are located 2,000 feet away. Nor can Maryland's daytime noise limit be achieved when high-volume hydraulic fracturing operations are conducted with human receptors located 2,000 feet away, or during nighttime road construction.

The Risk Assessment also cites Maryland's noise standards, explaining there are limits of 55 dBA (night) and 65 dBA day for residential areas and up to 90 dBA for construction and demolition activities during day time. There is no explanation as to why these standards exceed the World Health Organization's recommendation for sound levels of 30 dBA (indoors) and 45 dBA (outdoors).

While NRDC supports Maryland's proposed BMP to require the applicant to submit a noise mitigation plan, and requirement that a company use the lowest noise generating power source, it appears this noise plan would only need to meet Maryland's less restrictive (noisier) standards that are known to disturb human sleep and cause adverse physiological effects.

The Risk Assessment proposes a setback distance of only 300 to 1,000 feet, which would be insufficient to reduce noise impacts below Maryland's regulations. Increased setback distances beyond 2,000 feet would be needed.

The Risk Assessment did not provide compressor station noise data in Table 7. Compressor noise data should be added, especially since the Public Health Impact Assessment found it to be significant for compressors not using electric power.

Overall, the Risk Assessment concludes that most noise impacts have a low to medium probability. This is not correct. Industrial noise types listed in Table 7 are known to occur and are verifiable. Noise risk should be ranked as a high risk (which is defined in this assessment as a risk that "occurs frequently under ordinary conditions"). The Risk Assessment concludes consequences of noise impacts range from low to moderate, and in most cases the assessment rounds the overall combined risk down to an overall "low" risk rating, underestimating the overall risk.

In contrast, the Public Health Impacts Study concluded that:

---

<sup>61</sup> Maryland Risk Assessment, October 2014, Appendix F, Page 3.

*Environmental noise associated with UNGDP was identified as a top concern among residents of Western Maryland.*

*While there are not any epidemiologic studies on UNGDP noise, we know from other industries that long-term exposure to environmental noise has been associated with a myriad of health outcomes, including stress and annoyance, sleep disturbances, hypertension, and cardiovascular disease. Noise levels can be reduced by distance, enforcement of regulatory standards, and use of sound reduction technologies.*

*Based on prior evidence regarding negative impact of noise exposures and noise monitoring results from UNGDP sites that included our own monitoring results from WV, we conclude that there is a **Moderately High Likelihood** that UNGDP related changes in noise exposure will have negative impacts on public health in Garrett and Allegany Counties.<sup>62</sup>*

The Public Health Impacts Study recommended setbacks of 1,000' for compressor stations using electric motors and sound barriers, and 2,000' for all others. The study was silent on setbacks required for drilling, well pad construction and hydraulic fracturing operations.

There is no impact assessment relating to the risks and consequences for a homeowner that is attempting to sell or rent its property while industrial noise impacts are present. Inability to rent or a sell a home due to nearby industrial impacts (at a price that could have been obtained prior to industrial noise being present), may be an "unacceptable impact" to a property owner.

Recommendation: NRDC recommends the Risk Assessment:

- Recommend the World Health Organization noise limitations be adopted as a BMP for areas impacted by UNGDP.
- Recommend increased setbacks to ensure such noise limits can be met.
- Expand Table 7 to show the distance (beyond 2,000') needed to comply with existing Maryland noise regulations and to meet the World Health Organization's noise limitations, and include noise from compressor stations.
- Recommend restrictions on industrial activities during the evening and night nearby human receptors to improve quality of life for nearby residents.
- Require noise monitoring as a risk reduction measure to ensure noise levels are continuously monitored and maintained below required levels.
- Assess the risks and consequences to a homeowner that is attempting to sell or rent its property while industrial noise impacts are present.

## Visual Impacts

The Risk Assessment concludes that most visual impacts are "minor" (defined as only a slight adverse impact on people).<sup>63</sup> The visual impact assessment is incomplete and does not address possibility of

<sup>62</sup> Maryland Public Health Impacts Study, July 2014, Page xxii.

<sup>63</sup> Maryland Risk Assessment, October 2014, Appendix F.



scenic view blocking, short-and long-term property value loss, and long-term or irreparable visual scarring of wide forest/vegetation cutlines required to transport in equipment and create well pads, roads, and staging pads.

There is no impact assessment relating to the risks and consequences to a homeowner that is attempting to sell or rent its property while visual impacts are present. Inability to rent or a sell a home due to nearby industrial impacts (at a price that could have been obtained prior to industrial noise being present), may be an “unacceptable impact” to a property owner.

There are no BMPs recommended to camouflage industrial structures or equipment (especially equipment that will be installed and operated over long periods).

Recommendation: The visual impact assessment section should be expanded to more accurately describe the visual impacts expected, including photographs of Marcellus Shale drilling operation next to private homes (within the short setback distances currently recommended by Maryland). Photographs can be obtained from other states that have already experienced these adverse impacts.

NRDC recommends the Risk Assessment assess the visual impacts from the point of view of a nearby neighbor that will suffer the visual impacts. BMPs should be recommended to mitigate these impacts.

NRDC further recommends that the Risk Assessment evaluate the risks and consequences to a homeowner that is attempting to sell or rent its property while industrial noise impacts are present.

## Variations

The Risk Assessment is silent on the potential for, and the increased risk associated with, variations. Variations to proposed BMPs and regulations are common in most states. Once regulations are codified to protect human health and the environment, NRDC generally opposes state agencies granting regulatory variations because variations increase risk to humans and other sensitive receptors.

Recommendation: NRDC recommends regulatory variations not be approved. However, if a variance is considered, NRDC recommends a mandatory public hearing, supported by scientific and technical information supporting the reason for the variance and an analysis of any increased risk. This process will allow Maryland and its public to make informed comments and an informed decision on whether to grant the variance.

## Storage Tank & Container Risk Mitigation

The Risk Assessment identified closed-loop tank and container systems as an important BMP to reduce the risk of spills, air pollution, and contamination. However, the Risk Assessment did not consider additional risk reduction benefits of alarms, inspections, shut-off devices and leak detection systems.

Recommendation: NRDC recommends Maryland require the follow BMPs to reduce risk:

- Storage tank inspections and alarm systems including periodic fuel tank inspections to examine structural conditions and document corrosion or damage;
- Installation of high-liquid-level alarms that sound and display in an immediately recognizable manner;

- Installation of high-liquid-level automatic pump shutoff devices, which are designed to stop flow at a predetermined tank content level; and
- A means of immediately determining the liquid levels of tanks.

## Groundwater Contamination

Groundwater contamination by hydraulic fracturing fluids is a reasonably foreseeable impact that requires mitigation. Well construction failures, engineering design flaws, human error, mechanical malfunctions, and chemical spills all are reasonably foreseeable events, and have occurred at Marcellus Shale operations in other states. The Risk Assessment correctly identifies the vast number of chemicals present in drilling and fracturing fluids and the lack of precise information on composition as a risk factor. The assessment also acknowledges the risk of potential groundwater contamination, and assigns the highest risk factors to chemicals mobilized through natural faults and old wells.

The Risk Assessment correctly identifies the consequences of groundwater contamination as “serious” but assigns a low risk probability. The risk assessment ranking table (found in Appendix H pages 13-14, but not numbered) lists the probability of all groundwater contamination as low, except for methane contamination through failed casing and cement, and contamination due to deep well injection. NRDC does not agree the risk of groundwater contamination is “low.” Groundwater contamination has been attributed to operational failures at various Marcellus Shale gas development operations in Pennsylvania, including operations by Cabot Oil & Gas Corporation, Catalyst Energy, Inc., and Chesapeake Energy Corporation. See Appendix B of NRDC’s comments for more detail and citations. The Risk Assessment should at least assign this risk a “medium” probability (defined as a risk that could potentially occur under foreseeable circumstances if management or regulatory controls fall below best practice standards).

Recommendation: The Risk Assessment should increase the risk probability for groundwater contamination or provide scientific and technical data to support the low probabilities assigned.

Additionally, NRDC recommends Maryland compare its list of recommended BMPs for well construction design (casing and cementing practices), hydraulic fracture treatment design, post-drilling and post-hydraulic fracturing well monitoring, confining layer analysis, and groundwater monitoring (baseline and post development monitoring) to those recommended by NRDC in Appendices A and B, which are substantially more extensive, and include a complete set of BMPs based on those recommendations to reduce groundwater contamination risk.

## Financial Impact

The Risk Assessment did not examine the financial impact risk to the public of UGWD. While Maryland (in earlier studies) examined the potential to increase bonding and insurance requirements, the proposed increases still do not guarantee that the State of Maryland or the impacted public would be made whole in the event a serious consequence materializes. This is an unacceptable risk.

Recommendation: The Risk Assessment should examine financial risk impacts to both the State of Maryland and the affected public and make recommendations for reducing that risk, including legislation that requires a combination of bonding and insurance that guarantees payment of the full costs and risks of long-term monitoring; publicly incurred response and cleanup operations; site remediation and well abandonment; and adequate compensation to the public for adverse impacts (e.g., water well contamination, medical treatment compensation). Financial assurance amounts set pursuant to the

legislative amendments should apply to each well, with no aggregate cap for multiple wells, and the amounts should be indexed to inflation to reflect changes in actual costs.

### List of Acronyms

API.....	American Petroleum Institute
API RP .....	American Petroleum Institute Recommended Practice
AQ.....	Air Quality
BMP.....	Best Management Practice
BOP.....	Blow-out preventer
BTEX.....	benzene, toluene, ethylbenzene, and xylenes
EPA.....	Environmental Protection Agency
ERP .....	Emergency Response Plan
GHG.....	Greenhouse Gases
H <sub>2</sub> S .....	Hydrogen Sulfide
HAP .....	Hazardous Air Pollutants
HVHF.....	High Volume Hydraulic Fracturing
LDAR.....	Leak Detection and Repair
NA.....	Not Assessed
NORM .....	Naturally Occurring Radioactive Material
NRDC .....	Natural Resources Defense Council
NYS .....	New York State
NYSDEC .....	New York State Department of Environmental Conservation
P&A .....	Plug & Abandonment
POTW .....	Publically Owned Treatment Works
RDSGEIS .....	Revised Draft Supplemental Generic Environmental Impact Statement
REC.....	Reduced Emission Completions
USDW.....	Underground Sources of Drinking Water
USEPA.....	United States Environmental Protection Agency
UNGWD .....	Unconventional Natural Gas Well Development
WBM .....	Water Based Mud