

Minutes of March 10, 2014, meeting of the Marcellus Shale Safe Drilling Initiative Advisory Commission
Approved April 14, 2014.

The Commission held its 26th meeting at The Maryland Department of the Environment and at the Garrett County Health Department (via webinar hookup and conference line) on March 10, 2014 beginning at 10:00 am. In attendance at the MDE location were Chairman David Vanko and Commission members Steve Bunker, Jeff Kupfer, Cliff Mitchell, Paul Roberts, Nick Weber and Harry Weiss. At the Health Department location were Commissioner James Raley, Mayor Jamison and Ann Bristow. Staff of state agencies and members of the public were present at both locations.

Chairman Vanko called the meeting to order and explained the webinar protocol. The Commissioners introduced themselves.

Minutes of the February 10, 2014, minutes were discussed. Several suggestions were made concerning clarifications and additions. It was decided that the minutes would be revised and re-circulated in advance of the April meeting, at which time they would be considered again.

The first speaker was John Grace, Division Chief of MDE's Water Supply Program, Source Protection and Appropriation Division at MDE. He discussed groundwater flow patterns and the influence of pumping wells. He said that the focus of his talk would not be on methane movement, but rather on releases of flowback and other substances that might occur at the surface. He made the initial remark that setbacks do not eliminate risk from contamination that originates at the surface, but can reduce or minimize the risk. Groundwater is complicated and a single setback distance cannot provide risk minimization in all situations.

Using [slides](#), he explained the general pattern of groundwater flow in the Appalachian Plateau, where water moves from high head to low head, which is often related to elevation. Water generally wants to stay in the formation in which it moves most easily. Major joints can have an influence on water flow.

He explained the differences among the zones of influence, contribution and transport. The zone of influence is that area where the water table is lowered as a result of pumping; it can be represented by contour lines. Drawdown contours are not symmetrical because the formation is not uniformly transmissive in all directions. The zone of contribution is that area of the aquifer that "contributes" to the pumping well. This water is captured by the pumping well. The asymmetry of the zone of contribution is influenced by the fact that the water table itself is higher upgradient than downgradient of the pumping well. The zone of transport is a way of representing when groundwater in the zone of contribution will reach the pumping well. The lines represent equal travel time and can show the area of water that will reach the well in one year, ten years, etc. Commissioner Mitchell asked if there is a vertical component to the zone of capture. Mr. Grace said that it would depend on the geology.

Commissioner Roberts asked whether the zone of influence would be determined as part of the CGDP. The answer was no, but that groundwater quality in the vicinity of a proposed well pad would be monitored for at least two years before a well could be drilled on that pad.

Chairman Vanko used slide 3 of 5 of Mr. Grace's presentation to address the situation of a private domestic water well. He suggested that perhaps the State could establish a large uniform setback distance between a proposed gas well and a drinking water well, but allow the gas well to be established closer if the applicant for the gas well permit performed a hydrogeologic study that demonstrated that the gas well would be outside the drinking water well's zone of influence. Commissioner Mitchell asked

if any state has established such a setback. Commissioner Kupfer said he thought that no state had done this, but that most states have some sort of waiver provision. Commissioner Weber asked how one would do such a hydrogeologic study. Chairman Vanko said that it could be done with a fair degree of accuracy.

Mr. Grace noted that private wells have very little zone of influence and are basically capturing the water that flows by. Slide 3 of 5 is more relevant to public wells. Wells pumped continuously or nearly-continuously for long periods of time at a significant rate, such as municipal wells, develop cones of depression that can draw water from distances in every direction, not just upgradient. Private domestic wells, in contrast, pump intermittently and at relatively low rates, and do not develop a cone of depression. These private wells essentially withdraw groundwater in the immediate vicinity of the well that is flowing by them from upgradient. He said that theoretically, one could map the zone of influence for a private well, but that it generally would not go beyond the property boundary. You could try to do the hydrogeologic study, but there is only so much you can know.

Commissioner Weber asked why a well might run dry. Mr. Grace said that a well's ability to produce water depends on many factors. A shallow well in the top of an aquifer could easily become dry in a drought year, whereas a deeper well may not. It may also depend on how many fractures a well intercepts.

Mr. Grace said that there are ways to estimate how fast groundwater flows. On slide 2 of 5, rainfall percolating into the ground would not discharge for 42 years; obviously this depends on the geological setting. Commissioner Bunker asked whether groundwater flows differently depending on the aquifer. Mr. Grace said that groundwater generally follows Darcy's law, which relates the velocity of flow to the hydraulic gradient, the hydraulic conductivity of the aquifer formation, and the thickness of the saturated portion of the aquifer. In fractured rock reservoirs, groundwater can move several feet a day. It moves slower in shales than in sands. . The rate would be faster closer to the pumping well.

Commissioner Bristow said that when hydraulic fracturing is carried out, you create more fractures. Wouldn't you have to repeat the hydrogeologic study after every frac? Richard Ortt, head of the Maryland Geological Survey said this would be discussed in more detail in his presentation, but that the answer was no. Mr. Grace has been talking about freshwater, which occurs in the upper hundreds of feet. Shales are deeper and are water poor. Because hydraulic fracturing occurs deep below the aquifer, the fractures created do not reach the drinking water aquifers.

Mr. Grace then talked about the town of Accident. Accident had found elevated levels of naturally occurring arsenic in its water supply. It developed a new test well to look at the effect of continuous pumping of the test well on existing well. On slide 4 of 5, the dashed line shows the contour of the 10 foot drawdown as a 90-day extrapolation of a 72 hour pump test. This is good evidence of the zone of influence, but does not define the zone of contribution. The ridge and valley topography complicates the situation, and must be taken into account in interpreting the data. Determining the zone of contribution would require a great deal of additional work and expense. In the case of Accident, a setback of 2,000 feet from the municipal wells would help protect the wells, but defining the zone of contribution would be the best way to protect the well from activity at the land surface that could contaminate the well. A setback of 1,000 feet will reduce the risk, but there could be a private drinking water well downgradient that would ultimately be impacted by the spill if it enters groundwater.

Requiring secondary containment for spills and best practices, together with setbacks, will reduce the risk.

Commissioner Weber asked about the percolation rate of a spill. If there were imperfect well casing that allowed gas to escape at the surface, could the gas rise through fractures? Mr. Grace said that he was not an expert on methane migration.

Mr. Grace moved to slide 5 of 5, which depicts the source water protection area for the community water system serving Mountain Lake Park. The source water for the town includes both springs and wells. The delineated area was drawn along the top of the slope in some areas to protect the springs. Commissioner Mitchell asked if the area is protected in perpetuity. Mr. Grace said that the county protects the area somewhat, but not all potential contamination sources are excluded; in particular, onsite sewage disposal systems (septic systems) are allowed. It is not a risk free zone, but a risk reduction zone. Under the proposed setbacks, no well pads would be allowed within 1,000 feet of a wellhead protection area. Mr. Grace said that about 75% of Garrett County is on private wells. A setback of 1,000 or 2,000 feet would give you time to address a surface spill and therefore reduces the risk of contamination of the source water.

Commissioner Roberts said that methane is the big issue – not surface spills. Mr. Grace said that you can't establish a setback to protect against methane until you really understand how the methane could get into the drinking water aquifer. Commissioner Vanko noted that setbacks are one strategy for mitigation of risk. Commissioner Roberts said that beyond 2500 feet and after one year, there is no mitigation for groundwater contamination. Dr. Christine Conn noted that there was no presumption of causation beyond that point, but there are other avenues and tools. Commissioner Roberts said that the mitigation plan requires a more robust discussion. He was not satisfied that we have fully addressed the issue.

The next speaker was Richard Ortt, the Director of the Maryland Geological Survey. Although his topic is fracture growth, he wanted to make some preliminary comments on methane migration. He said that he and others have been looking at the studies of methane in groundwater, and that the existing literature is inconclusive on the question of whether natural gas wells are responsible for elevated levels of methane in nearby groundwater. More studies are needed.

Mr. Ortt addressed the question of how far fractures from high volume hydraulic fracturing (HVHF) extend. The technique of HVHF uses water to shock the rock apart and sand to keep it open. The geology of western Maryland is compressional. Without something to prop new fractures open, vertical fractures induced during hydraulic fracturing would close up due to the compression. Fractures occur perpendicular to the direction of least compressive force. The available information does not support the idea that fractures in the Marcellus shale could propagate to the surface. At a depth of 5,000 feet, fractures will develop vertically at first because of the weight of the overburden. At shallower depths, the overburden force is lessened, and the fractures would deflect to the horizontal. Based on observations from Pennsylvania and our understanding of the geology in western Maryland, we do not anticipate that fractures will propagate to the surface. When asked at what depth the fractures would begin to bend to the horizontal, Mr. Ortt said that it would depend on the nature and orientation of bedding planes within and between the sedimentary rocks. The stress can be released. He doesn't know the exact extent of the fractures but does not expect fractures to intersect shallow drinking water aquifers.

Chairman Vanko noted that the only area where it is suspected that fractures induced by HVHF have migrated to drinking water aquifers was Pavilion, Wyoming. There HVHF occurred within 500 to 700 feet of the base of the drinking water aquifer. He said it seemed crazy to perform HVHF with less than thousands of feet of separation. He said that fractures generally stay within the shale and there is no reason to think they will reach the surface.

Commissioner Kupfer asked about the length of the fractures. Mr. Ortt said that we are digesting other people's research, but it appears that fractures extend a few hundred feet or at most, 3,000 feet.

Commissioner Roberts said that no one is suggesting that fractures would reach the surface or drinking water aquifers, but rather that fractures induced by HVHF might intersect a fault. Mr. Ortt said that the CGDP would require a study to investigate the existence of faults. Commissioner Roberts said that Bradford County, PA, is highly faulted and he thought that intersection of faults was a likely mechanism for contamination. Dr. Conn said that the Departments were going to propose that mapping existing faults would be an additional requirement of the CGDP. Mr. Ortt said that the map would be a three dimensional map, not a planar map. Commissioner Bristow asked when this was decided. Ms. Kenney suggested that a discussion of this be deferred to the update on best practices and response to comments.

Because some of the speakers needed to leave, the floor was opened for public comment.

- Patrick Hammond said that he had worked with Mr. Grace for ten years. Mr. Grace had set up the source water protection program, but with limited information. The information requires interpretation. He described projects he had been involved in Taneytown and Poolesville, where the cone of depression extended for 2 or 3 miles from the pumping well. A consultant who did work at Poolesville had neglected to include data from some private wells about a mile from the pumping well. The area that was delineated was too small, and impacts occurred a year later when some of these private wells ran dry. Mr. Hammond said that accurate mapping will require very expensive testing and modeling, and that data was needed to get beyond the interpretation of geologists. There is too much variability and error in the existing method. He suggested looking at superfund sites in New Jersey to get a better idea of the potential for surface contamination in fractured rock areas. He mentioned specifically the Fair Lawn Superfund site, where the USGS performed a study to define areas of influence or capture zones from the existing pumping municipal wells. On a different topic, he said he had given a presentation at the 2012 Groundwater Symposium in which he compared the Jackson paper with the Molofsky paper. He said that he had found errors in the Molofsky paper in the relationship of methane concentration to topography and the isotopic analysis. He thinks that high levels of methane do not occur naturally. The only study is the one done at Dimock, PA.
- Dr. Donald Helm, a retired expert in geology and land subsidence offered comments. He said that the generalizations about deep vertical fractures that bend to the horizontal at lesser depth are true, but that counter examples have been observed. Fractures have reached the surface from 1,000 feet, crossing aquifers and lakebeds. The mechanism is lateral extension or expansion at depth that does not change to horizontal. Layers may not resist shear or lateral movement, so propagation is upward. This factor must be accounted for. Be forewarned, he said, this has been observed in China and the United States.

- Eric Robison of Citizen Shale said that the CGDP may lead to more wells per pad. Would this increase the likelihood of communication between the wellbores? Mr. Ortt said that communication with poorly abandoned wells is an issue, and that the CGDP will address it. He said that regardless of the density of wells, drillers will have to stay away from existing wells or improperly abandoned wells. Mr. Robison then asked if there were two gas wells at equal distance from a drinking water well that became contaminated, could you differentiate between the two gas wells to establish the source. Mr. Grace said that if both wells were in the capture zone, you would have to find something unique to one of the gas wells. He said that turbidity would be difficult to attribute. Turbidity or muddiness in the drinking water well could be caused by pressure changes, not a release of contaminants. Mr. Robison asked if a monitoring well could be of use. Mr. Grace said maybe, but the monitoring well might not tell you much depending on how many fractures the drinking water well intercepted. Dave Bolton of the Maryland Geological Survey observed that in the fractured rock area, flow is through the fractures and very hard to trace, unlike the coastal plain aquifers. Commissioner Weber noted that in New York, the USGS recommended nested wells upgradient and downgradient of gas wells.

- Paul Durham said that he understands the state's position to be that it is hard to establish a setback because of incomplete information, and that a setback buys you time. It would be desirable to detect a problem before contamination is found in a drinking water supply. He suggested that the state require shallow monitoring wells downgradient of the well pad to detect contamination earlier. The wells could be installed in concert with a seismic survey and the CGDP. Mr. Grace said that monitoring wells that would be sampled pre-drilling and post-drilling might detect a problem. Chairman Vanko said that the Departments are looking at the feasibility of requiring monitoring wells. Commissioner Kupfer said that this is becoming standard practice among companies, especially where there is a presumption of liability. He said the Center for Sustainable Shale Coalition had a performance standard for such monitoring. Mr. Durham asked if this was what Chairman Vanko was suggesting earlier. Chairman Vanko said no; what the state has done for public water supply is good. Monitoring wells are different. Essentially you would collect a time series of water quality information. Mr. Durham said that a combination of a monitoring plan and setback might be appropriate. Commissioner Weiss suggested that monitoring might be good to detect contamination from surface spills and failure of casing and cement through the drinking water aquifer. The issues of setbacks and the placement of the monitoring wells are different. Commissioner Bunker said that the idea of a good setback with reductions only if the company made a demonstration is worth considering. Commissioner Mitchell said it would be helpful to review a hydrogeological study and asked Mr. Grace to provide a link. [The link, provided after the meeting, is http://www.mde.state.md.us/programs/Water/Water_Supply/Source_Water_Assessment_Program/Pages/Programs/WaterPrograms/water_supply/sourcewaterassessment/index.aspx. Mr. Grace suggested an EPA [publication](#), Handbook: Ground Water and Wellhead Protection, for additional background.] Commissioner Roberts said that he was pleased to see a broader discussion of the setback issues, including hydrogeological studies, monitoring plans, and installing monitoring wells. This should be required as part of the baseline monitoring. He said that setbacks are the paramount issue and the state needs to study it and communicate better.

- Elizabeth Hoffman asked whether the fracking fluid that remains in the ground might somehow move back up to the surface through a degraded borehole. Mr. Grace said that this was a valid point that needs to be studied. The density of fracking fluid may make it buoyant. Chairman Vanko said that this is a little like injection wells. Commissioner Bunker asked why liquid would rise. Mr. Grace said that an interesting question would be how frac fluid would behave if it were injected into brine. Would it rise and, if so, how far. He said that there would need to be a pathway, such as pore spaces that are interconnected. Chairman Vanko said that the frac fluid would be affected by diffusion and mixing. Mr. Grace's thesis project involved injecting brine into fresh water in a simulated sand aquifer. The injected brine stayed intact. Density makes a difference.

The next speaker was Tom Levering, Director of MDE's Office of Emergency Preparedness and Planning. Mr. Levering said that he was gathering information and had approached his counterparts in West Virginia and Pennsylvania to obtain information. Pennsylvania contacts confirmed that training for firefighting on a drill rig is necessary, and that there had been an increased incidence of traffic accidents. He also contacted and met with representatives of numerous groups with responsibility for some aspects of emergency preparedness in western Maryland. These groups have already begun planning for Marcellus shale drilling. Allegany County has a hazmat team, but Garrett County does not.

In Allegany and Garrett Counties, the primary need is for funding so that the program can be developed, necessary equipment obtained and personnel trained before there is an incident requiring response. The local fire and rescue personnel have had general fire training and training for high angle rescue. (High angle rescue would include rescuing a person from a steep slope or a high structure, such as a drill rig.) Various training opportunities exist. For example, Shale Training & Education Center, known as ShaleTEC, is a collaboration between Pennsylvania College of Technology and Penn State Extension. It offers Emergency Responder Training specific to the oil and gas industry. Because the first responders in Garrett and Allegany Counties are volunteers with other jobs, it may not be feasible to send them to multi-day training; an alternative would be to "train the trainers." Volunteers may not be able to remain at the scene of an incident for an extended period of time, so it is necessary to plan for relief teams. Mr. Levering said he would like to see representatives from drilling companies to be permanent members of the local planning councils. MDE has expertise in radiation.

Specialized emergency teams will be required for catastrophic events such as well blowouts or well fires. These teams may be located anywhere in the US and could take hours to a day to reach the site. It has been suggested that a regionally-based team would be able to respond more quickly.

Mr. Levering expressed confidence that the state could handle commercial vehicle inspections and enforcement, based on past experience. Pennsylvania state police have pledged support for traffic inspections to keep unsafe trucks and drivers off the road, as well as enforcement for overweight loads.

Commissioner Mitchell asked whether we are equipped to deal with pipelines. Mr. Levering said that Maryland has sufficiently trained and equipped personnel, but his seven emergency responders would be coming from Baltimore. The response time to western Maryland could be 3 hours.

Chairman Vanko asked if he had heard anything from West Virginia. Mr. Levering said that he had contacted them and was waiting for a response. Chairman Vanko asked if a regional response team might be formed. Mr. Levering said that mutual agreements are possible.

Commissioner Weber asked when Garrett County will get a hazmat team. He was answered by John Frank, Director of Public Safety and Emergency Management for Garrett County. He said that there were seven people on the hazardous materials team. They had received training at Garrett College. His greatest concern is support for the volunteer emergency personnel. He mentioned the need for upfront funding and training at all levels on trigger points, radiation meters, containment, and exposure protection. He suggested that there be a mechanism for recovery of response costs from the responsible party.

Commissioner Bristow asked for an estimated budget. Mr. Levering said it could be put together on a county or agency basis. The equipment budget would be relatively straightforward, but the training budget would be harder.

Commissioner Roberts commented on truck issues. He said Pennsylvania had done a good job on bonding of overweight trucks. He urged the counties to require bonding. Mr. Frank said there was a need for transportation planning and inspection and enforcement of commercial vehicles.

Commissioner Bunker asked about the need for a registry of chemicals. Mr. Frank said that they need information on chemicals, including first aid. Commissioner Bunker asked about the chemical registry bill. Mr. Levering had not been involved in any discussions of this bill. Mr. Frank said that he would like to get chemical information and would support the bill. Commissioner Kupfer said that there was no need for a new data base to get information on chemicals to first responders. The Material Safety Data Sheets are available to emergency responders and have the information they need.

Commissioner Weber said that the State should consider banning the use of chemicals that are carcinogens, teratogens or very toxic.

Ms. Kenney spoke about trade secrets and chemical disclosure. At a previous meeting, a commenter suggested that we look at practices in Alaska, California and Illinois. She had done that, and also reviewed a recently released draft report from the Secretary of Energy Advisory Board's Task Force report on FracFocus 2.0. A set of slides is available on MDE's website outlining the provisions from those states. The last slide is a strawman proposal that will be discussed at the next meeting.

Work is proceeding on the response to comments. The Departments hope to have a draft of the responses to comments by the next meeting.

Commissioner Weber asked where Maryland is on the risk analysis, which he said should have been done before deciding on best practices. Ms. Kenney said that the two were part of an iterative process. The state is on track for the risk assessment. A DNR/MDE work group had been formed. The work plan projects completion in June.

Ms. Kenney then showed a slide of bills introduced into the General Assembly this year that related in some way to Marcellus Shale. MDE's and DNR's positions on each bill appear on the slide.

Commissioner Mitchell commented on HB 1030, Public Health - Hydraulic Fracturing Chemicals - Information and Fund. He said that the Department of Health and Mental Hygiene had submitted a letter of information to the Environmental Matters Committee on this bill. He said that DHMH thought the intent of the bill was laudable, but that it would anticipate the work of the Advisory Commission, in particular as to which agency should have custody of the chemical information. He noted that the bill would establish a fund that could be used for two purposes: 1) outreach and education, and 2) to

compensate individuals who were injured by Marcellus shale gas development. He said that the latter use of the fund presupposed a lot of knowledge that we don't have yet. There is a difference between a letter of information and a letter of concern. The letter of information carries no implication on the question of whether the Department would support the bill.

Commissioner Roberts asked why the Departments supported SB 535, the severance tax bill – do we think the rate is appropriate? Ms. Kenney said that the Departments were comfortable with the tax rate of 2.5%; under the RESI scenarios, that tax would raise \$10 million within the first 5 or 6 years. This was the amount estimated to provide water to a small town that lost its water supply. This, combined with the Financial Assurances bill passed in 2012, assures that money will be available if a cleanup is required.

Chairman Vanko asked if the Commission wanted to submit a letter on the severance tax bill. There was a discussion of the rate, but the only conclusion was that the Commission had not reached consensus on the rate.

Commissioner Weber said that money is not enough to compensate victims. Commissioner Bristow discussed the far reaching impacts of the chemical spill into the Elk River. She said that the company responsible for that spill is insolvent. If a spill like that occurred on the Potomac, it could impact the water supply all the way to the District of Columbia. She does not feel that the financial mitigation options are adequate.

The public was then invited to comment.

- Eric Robison asked how the county emergency response needs would be met. Will there be a pre-development fee? Ms. Kenney said that funding options would be explored.
- Nadine Grabania asked if it is too late for the Commission to submit a letter or comment that the severance tax rate in the pending bill should be reevaluated. Commissioner Weiss, who had chaired the legislation subcommittee of the Commission, said that the consensus was that the legislature should figure out the appropriate fee. Commissioner Bunker said that the uses of the fund should be expanded beyond mitigation to address natural resource impacts such as stream restoration and land conservation. [Staff subsequently reviewed the pending legislation with Commissioner Bunker and they agreed that the bill would allow the fund to be used to support mitigation of natural resource damages.] Commissioner Bristow said that she feels the studies should be completed before a severance tax is established. She suggested that the Commission write a letter to say it is unhappy with MDE's letter of support for the 2.5% severance tax. Commissioner Kupfer said the Advisory Commission had completed its discussion of the severance tax and it was not a good idea to revisit the issue. Commissioner Roberts said that the agencies had declined to figure out the appropriate tax rate. Commissioner Bristow said she has been asked why the Commission is taking so long. She responded that there is data coming in all the time, and that we cannot possibly finish by August 1, 2014. Chairman Vanko noted that the legislature could adjust the tax rate in the future.

The meeting adjourned about 4:00 pm.