Report and Recommendations Regarding the Potential Effects of the Natural Gas Industry in Vestal

Town of Vestal Conservation Advisory Commission

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The exploitation of natural gas in the Marcellus Shale Formation by the controversial method of hydraulic fracturing (fracking) will have significant and lasting effects on the people and landscape of our Town. For this reason, the Vestal Conservation Advisory Commission (CAC) has devoted considerable effort to explore the many ramifications of natural gas hydraulic fracturing and what it might mean for Vestal residents. We present here a distillation of our understanding and concerns. We have spoken with those on both sides of the issue, but we have also made a concerted effort to gather information independently, and our analyses and conclusions reflect the understanding that we have developed. Some of the members of the CAC live in rural areas and have been offered leases from the drilling companies; others live in urban parts of the Town and do not hold drillable properties. In these regards, the Commission represents a cross section of Vestal residents.

The development of natural gas fields in the Town of Vestal will have significant effects on every resident. For some, the financial benefits may outweigh all the potential negative effects. For those who will receive only indirect financial benefits or none at all, the potential for unwelcome changes in the look and feel of living in Vestal may be the highest priority.

Economic Considerations for Individuals and the Community

The most direct economic benefits from the natural gas industry are in the form of leases and royalties paid to Vestal residents. Especially for those landholders who are of limited means or are elderly, a quick financial windfall is extremely attractive and speedy development is beneficial. However, for those with longer-term financial horizons, this may not be the best time to take gas profits. The price of natural gas in North America is severely depressed because of the oversupply created by the fracking boom and the infrastructural limitations on exporting natural gas. The marketplace has begun to temper the industry's enthusiasm for a rapid build-out of the gas fields. Because the abundance supply of natural gas from fracking is projected to last only a few decades, slower development will support much higher commodity prices over a longer period.

At each drill site, there are several distinct operational phases: drilling the well, pouring the concrete casings, hydrofracking to free the gas, gas collection for perhaps 10-30 years, and finally post-production capping of the well. The initial phases of drilling and fracking are labor intensive, as is the construction of the network of pipelines to collect the gas. These operations will provide salaries for local residents employed directly in the industry, and they may attract new residents to Vestal. The larger work force, whether temporary or permanent, will have

multiplier effects on the local economy by increasing economic activity in local stores, hotels, restaurants, and other service industries. Because our area is close to the gas fields in Pennsylvania, we already are experiencing some of the positive economic effects from the gas industry without having to experience the industrialization of our own landscape.

In assessing the economic effects of the natural gas industry, an important distinction needs to be drawn between the brief drilling-fracking phase, which requires considerable manpower, and the much longer extraction phase. Some sources estimate the long-term direct employment associated with gas extraction as less than two percent of the manpower present during drilling (Economic Impacts of Marcellus Shale in Pennsylvania: http://www.msetc.org/reports.htm). Thus the significant increase in direct employment from the gas industry will be only temporary, and both the benefits and the problems associated with this population of workers will reach a peak and then will likely decline to near pre-drilling levels. The multiplier effects of the gas industry will be in direct proportion to the number of gas industry workers present locally and will rise and fall accordingly.

An Overview of Safety: Separating Facts from Agendas

In considering motivations and priorities of the natural gas industry, it would be a mistake to view these companies as either benevolent or malevolent. They are not in business to solve our area's employment problems, to repair or upgrade our infrastructure, or to solve our nation's energy problems—they are in business to earn profits. Whatever the regulatory framework for the operation of the industry, each firm will seek to minimize its costs and maximize its profits. Therefore, it falls to the elected leaders and those appointed to enact and enforce oversight regulations to protect the interests of citizens of Vestal over both the near and long term.

The operating practices of the natural gas drilling industry continue to change rapidly. As the effects of the industry's early practices became apparent, pressure from public opinion, citizens groups and elected officials forced significant improvements that have reduced some of the adverse environmental and social impacts of the industry. For example, the use of diesel fuel in fracking fluids and uncompensated destruction of roadways are now considered to be unacceptable by both the public and the industry. Those in the industry who are attempting to address the concerns being raised, and those citizens who have contributed to this change by drawing attention to problems created by the industry, are to be commended. Although progress has been made, significant problems remain and still unrecognized problems may lie ahead.

In assessing the possible effects of the gas drilling industry on Vestal, it is difficult to find agreement on basic information needed to make accurate projections. This is true for several reasons. First, there is a great deal of seemingly conflicting information; people of different viewpoints cite either negative or positive information, depending on whether they want to raise alarms or calm fears. For example, the chemical additives currently mixed into fracking fluids are described by the industry as being a tiny percentage of the total fluid volume and many of these chemicals are said to be present in common household products, implying that the chemicals are therefore safe. Such statements are factual, but the inference is not so simple. The industry fails to draw attention to the fact that these chemicals are shipped and stored in highly concentrated forms. For example, on July 5, 2012, a leaky valve caused the release of 4,700 gallons (about 20 tons) of 15% hydrochloric acid (HCl) in Bradford Co. Pennsylvania, resulting in a fish kill and requiring the excavation and removal of contaminated soil from the site (http://stateimpact.npr.org/pennsylvania/2012/07/05/4700-gallons-of-acid-spill-at-bradford-county-

drilling-site/). In the concentrated form in which this acid is shipped, it is highly corrosive and can cause severe eye, skin, and respiratory irritation and damage; if exposed to heat (as in a tanker truck accident), HCl decomposes into a toxic gas.

Another difficulty in assessing the safety of the hydrofracking industry is that its practices have evolved over time. Some criticize the industry for past practices that are no longer being followed, as in the example of diesel oil being used in fracking fluids. But the industry also offers up assurances about technological fixes that have not been extensively tested nor widely implemented. For example, disposal of wastewater from fracking is a major challenge. An emerging partial solution is the recycling of the flowback water, but the implementation of this technique is far from being standardized. While one company claims to be able to recycle 100% of the recovered water, they also assert that their competitors can recycle only 10% (www.globalwaterintel.com/archive/12/5/general/marcellus-attracts-mobile-solutions-cost.html).

One of the most problematic concerns associated with natural gas drilling is whether there are long-term adverse health effects. These are serious, legitimate concerns, especially because the operating principle seems to be that the industry is safe unless proven to be otherwise, and few studies have been done to test whether it is indeed safe. Unless the health effects are immediate and acute, it requires years of data collection and analysis before meaningful conclusions can begin to emerge. However, industry practices change over time and vary with regional geology and state regulations, so it may be difficult to use the findings drawn from one particular set of past conditions to predict with any degree of certainty the health hazards of present and future drilling operations.

Although many important issues are clouded with uncertainty, some are not. For example, there will be very heavy highway traffic involving massive vehicles, there will be a need to rebuild roads, there will be some spills, the landscape will be altered by a grid of access roads and pipelines, and there will be a need to increase government services that would not otherwise be necessary. On the other hand, jobs will be created, some landholders will receive financial windfalls, and economic activity and tax revenues will increase for a time. It is also true that the costs and the benefits will not be equally shared by all citizens.

Specific Concerns

Below we consider some of the CAC's concerns about specific potential adverse effects from the hydrofracking industry. These fall into three general categories: environmental effects, economic effects, and quality of life effects.

<u>Potential for contamination of water supplies</u>

The wellbore, which extends thousands of feet both vertically and horizontally, provides a route through which methane, hydrogen sulfide gas, and brine containing natural contaminants, such as bromine and radium, as well as fracking fluids, can potentially move upward through non-porous rock layers into the aquifer or all the way to the surface. The pipes and casings within the hole are intended to restrict this movement. While the engineering technologies used in the gas industry are sophisticated, they are not foolproof.

Defective well casings are the most common cause of sudden problems with contamination of water wells. Although rare, the presence of natural gas in drinking water wells has been the source of some problems, including dramatic images of flames coming from kitchen faucets. In

addition to fouling the water supply, the leakage of methane gas into homes creates a hazard of catastrophic explosion and fire. The source of the gas that is responsible for documented cases of well contamination has been debated. Without question, some people have methane in their water wells independent of fracking, but clearly some homeowners had no problem with methane in their wells until gas drilling occurred. For Vestal residents on private well water, it is crucial that data on water quality, including gas contamination, be collected by independent water analysis companies before drilling is done so that baseline conditions can be determined. Then the water should be tested regularly during the drilling and fracking process.

With age and prolonged exposure to brine and hydrogen sulfide, steel pipes will corrode and concrete casings will degrade, greatly increasing the chances of uncontrolled migration of fluids and gases laterally and vertically. Hundreds of orphaned wells, dating from a time before modern regulatory regimes, are already scattered across New York State (http://www.scribd.com/doc/77582900/Orphaned-NY-Oil-and-Gas-Wells). Some of these are not mapped and, unless properly plugged, they could provide an unforeseen route from a newly fracked layer into the aquifer.

Post-production wells should be plugged and monitored; taxpayers should not bear the burden of additional abandoned wells. This is a state issue, and state regulations, properly enforced, should prevent an increase in this problem. However, it is important that local officials pressure state authorities to provide such protection.

Fracking fluid components

Fracking fluid is injected into the well under great pressure to fracture the bedrock. Chemical additives, each with a particular function, are mixed into the fracking fluid, and these additives are a source of much controversy. Usually only about 20% of the fluids put into the well are recovered, raising concerns that the residual chemicals will eventually contaminate the groundwater. A lack of transparency about the particular chemicals used has added to concerns. Among the most notorious chemicals that have been used in the fracking process is diesel fuel, which often contains the cancer-causing compound benzene. Fortunately, public outcry has resulted in an increase in transparency about the chemicals used and the prohibition of some of the most dangerous compounds.

Chemicals used in the hydrofracking process fall into as many as a dozen distinct functional categories, and for each functional category, there is a menu of particular chemicals that may be selected for use either individually or in combination (http://fracfocus.org/chemical-use/what-chemicals-are-used). For example, glutaraldehyde is one member of the biocide functional group; glutaraldehyde or other biocides are added to fracking fluids as an anti-microbial agent to kill bacteria that produce undesirable hydrogen sulfide gas. Such biocides are essential for fracking operations, but they also represent a potential threat for groundwater contamination; if present in wastewater treated in a sanitary wastewater facility, they would adversely affect the bacteria essential for nutrient stripping.

The ingredients of fracking fluids are hazardous in several different ways and at different stages in the drilling process: spillage of the unmixed chemicals, groundwater or airborne contamination from fracking, or disposal of flowback wastewater. The level of hazard for each chemical depends on the nature of the compound and the concentration at which it is transported, stored, used, and disposed of. There is no question that some of the compounds, such as hydrochloric acid, acetaldehyde, glutaraldehyde, sodium hydroxide, in their concentrated forms,

could be life threatening in a spill. It is also true that these same chemicals are used in many other industries, so the danger from spills of the concentrated chemicals is not unique to hydraulic fracking. Still, such hazards are not currently a feature of life in Vestal.

Fracking with propane avoids the need for large volumes of water and it does not generate large volumes of flowback waste. However, this approach has not yet been widely used so it remains an unproven technology, and the hauling and handling of large volumes of highly explosive propane adds a different kind of hazard.

Handling of wastes recovered from drilling and fracking

Part of the large volume of fluids injected into the well is recovered as flowback water and it contains the chemical additives injected into the well. In addition, the gas extraction process releases water from the bedrock, and this produced water has a very high salt concentration. Both flowback and produced waters have to be handled as waste. An industry publication (American Recycler vol. 15 no. 5 May 2012) succinctly summarizes the problems associated with wastewater from gas wells. "Of the 5 to 10 million gallons of fresh water consumed by the typical frack well, an average of about 20 percent flows back up to the surface, where it must be disposed of. The flowback water is contaminated with salt, heavy metals and other pollutants, making it unsuitable for disposal in freshwater lakes, rivers and aquifers."

Disposal of large volumes of highly saline, chemically contaminated wastewater is a difficult problem whose solution is not yet at hand. The most common method for disposing of drilling wastewater in other parts of the country is deep-injection wells. However, in some places deep injection has been prohibited after it was linked to an increase in earthquake activity (http://www.pennlive.com/midstate/index.ssf/2012/03/ohio_earthquakes_linked_to_dee.html). The use of deep injection wells for wastewater disposal requires appropriate geology, and the geological formations in the Northeast are generally not appropriate, therefore other mechanisms must be used. Wastewater has been spread on roadways in winter, taking advantage of the high salt content of produced water to deice the road, and it has been sprayed on dirt roads to suppress dust. However, because of the risk of contaminating surface waters, these uses have been banned or subjected to tighter regulation. Sanitary waste treatment facilities are of little value in removing pollutants in drill wastewater, and the high salinity destroys the biological components that are essential to secondary and tertiary waste treatment. Pennsylvania has allowed some public sanitary waste treatment facilities to accept fracking wastewater, but regulations have since been tightened and this practice is being discontinued.

Water delivery to each well site and removal of wastewater require hauling millions of gallons of fluids at considerable expense. The fracking industry recognizes the value of water recycling as a means of reducing the volume of freshwater used and the volume of wastewater in need of disposal. Recycling of the water recovered from the fracked well has promise. However, only about 20% of the water put into the ground for a fracking event is recovered. Even if all this wastewater is cleaned well enough to be used in the next fracking operation, millions of gallons of additional water are still needed. At present, most companies engaged in water recycling are able to reuse only a small fraction of the recovered water. Increasing the amount of wastewater that can be recycled would be highly desirable, but this is not likely to be the industry standard for some time.

Drill cuttings and drilling muds that are recovered from the well bore are dewatered and disposed of at landfills. Like the wastewater, these recovered solids have chemical constituents that could be hazardous and they need to be tracked and safely discarded.

By far, the cheapest approaches to waste disposal are illegal: spreading the untreated waste on land or discharging it into rivers. In one recent case, waste drilling muds were dumped on Pennsylvania state game lands (http://wallaby.telicon.com/PA/library/2012/2012050383.HTM). Fortunately, the culprit was quickly identified and taxpayers were not saddled with the cost of the cleanup. All levels of government need to exercise their obligations to carefully monitor the industry's activity and to strenuously enforce regulations.

Supplying water for hydraulic fracturing

Like all industries involved in fossil fuel extraction, hydrofracking has a great thirst for water. According to Cabot Oil and Gas Corporation, "A typical Cabot well in Susquehanna County requires about 3,990,000 gallons of water during the entire drilling process. Most of that is used during hydraulic fracturing, where a mixture mostly of water and sand is injected into the shale at high pressure to release more gas. We utilize an average of 3,780,000 gallons of water per well during hydraulic fracturing." (http://www.cabotog.com/pdfs/MPSAdWater1_020112.pdf).

Concerns have been raised about the withdrawal of water from streams and river, and about the traffic generated by the trucking of the water. Fortunately, the availability of water in our part of the country is relatively high, and the Susquehanna River Basin Commission regulates all withdrawals of surface water and groundwater, so the industry must negotiate with this agency to meet their water needs.

The very large volume of water required for hydrofracking accounts for the majority of the total traffic generated by the industry as the trucks shuttle between the water source and the gas wells. The concerns about the traffic generated by all aspects of the gas industry will be discussed in some detail below.

Stormwater runoff, steam bank erosion and other ecological concerns

Vestal has long had a problem with stream bank erosion, but over the last several years, major storms have caused extensive damage. Excessive runoff caused property damage and required the expenditure of considerable public funds to riprap stream banks and roadside drains. Natural gas drilling pads are required to contain stormwater runoff and some companies utilize the water collected in their containment for fracking. If those practices are followed universally, the well pads themselves should not add to runoff, at least from "average" storms. However, the creation of many miles of access roads with compacted soils and loss of forest cover on the pads and the right-of-ways of the pipeline network will increase stormwater runoff, which will increase stream bank erosion in Vestal.

Pipelines will be required to move the natural gas from the wells to storage or distribution facilities. The network of pipelines will require stream crossings, the construction of which will be a source of erosion. It is important that stream crossings be located to minimize erosion and that there be sufficient setbacks of all other pipelines and access roads from stream banks to protect the integrity of the stream corridor. Town authorities should be involved in the regulation, planning, siting, and monitoring of such construction.

In addition to the adverse effects of the networks of access roads and pipelines on water runoff, these corridors will also cause extensive forest fragmentation, with adverse effects on those species of wildlife that require large tracts of contiguous forest.

Damage to roadways, bridges, and other taxpayer-supported infrastructure

The gas industry has acknowledged the problem of roadway damage caused by the high volume of traffic of their heavily loaded trucks. When required to do so, companies have entered into agreements that protect local citizens from bearing the cost of damage to roads and bridges. Rather than waiting until such damage occurs and hoping that companies can be coaxed into repairing the damage, the Town should insist on such an agreement as a precondition of providing permits.

The continuous flow of gas industry trucks could causes delays for all other traffic, including school buses and emergency vehicles. The much greater traffic of large, heavily burdened trucks on two-lane roads is an increased hazard to motorists, pedestrians and bicyclers, and it creates a need for more law enforcement activity to assure the safety of residents and travelers served by these roads.

The safety of both the industry drivers and their vehicles are causes of concern. The single greatest cause of fatalities in the oil and gas industry has been highway crashes (more than 300 in the last decade). Truckers working for the oil and gas industry receive exemptions from highway safety rules, allowing them to work longer hours than drivers in other industries; this exemption is believed to be a contributing factor to an abnormally high rate of accidents (New York Times May 14, 2012; http://www.nytimes.com/2012/05/15/us/for-oil-workers-deadliest-danger-is-driving.html). The condition of the vehicles being driven is also a concern: "data from the Pennsylvania State Police indicates that 40 percent of 2,200 oil and gas industry trucks inspected from 2009 to this [2012] February were in such bad condition that they had to be taken off the roads" (New York Times May 14, 2012; http://www.nytimes.com/2012/05/15/us/for-oil-workers-deadliest-danger-is-driving.html).

The influx of drill rig workers in some areas has been associated with a spike in certain kinds of unsafe and illegal behavior, especially drunk driving (http://marcellusdrilling.com/2011/08/marcellus-areas-see-increase-in-drunk-driving-lesser-crimes/). An increase in such behavior represents a safety hazard for all citizens.

The increased demands that will be placed on law enforcement agencies needs to be anticipated and addressed. In addition, the potential for roadside spills of hazardous materials and for gas well fires creates a need to provide first responders with training and equipment that they may not yet have.

Other regulatory issues

Drilling and fracking work is typically an around-the-clock operation, requiring strong illumination at night and producing considerable noise at all hours. It is highly likely that Vestal's Noise Ordinance will be violated, and that there will be complaints from residents about noise and light pollution. The Town will have to contend with these problems. Another concern is the effect of light pollution on the Kopernick Observatory. This educational facility is a valuable asset for Vestal and the surrounding communities. Its rural location was chosen in part because of the low level of light pollution. The light environment will change if drill pads are sited near the observatory.

If post-production wells are not capped and monitored properly, leakage can cause long-term problems. Escrow accounts would augment the good will of the companies with financial protections for Vestal taxpayers. Promises are being made by drilling companies to restore the landscape as near as possible to its pre-drilling state. These promises should be translated into firm legal commitments that can be enforced by future elected officials.

Quality of life in Vestal

Industrialization of the landscape and the effects on quality of life are legitimate concerns for those who value the rural character of most of Vestal. Many residents choose to live in less developed parts of the Town because they value the kind of environment that exists there now. For them, even if hydrofracking is proven to be entirely safe, they will be adversely affected by the proximity of industrial activity. It must also be recognized that there will be lost economic value associated with the decrease in both the quality of life and the scenic value of the landscape.

Natural gas extraction from the Marcellus Shale will be a temporary, non-renewable industry. The duration and intensity of the problems attendant to the industry will be a function of how many wells are developed and at what pace. Once the gas field is fully in production, the populations of workers and the associated problems and benefits will decrease significantly. The productive life of a well is in the range of 30 years, but the potential for contamination from wells is not limited to the useful life of the well, and the alteration of the landscape will persist for generations.

It is unclear whether the permitting process can be done in a manner that would minimize the damage to the look and feel of our Town, but that should be a goal.

When is the right time?

Natural gas drilling is not a "now or never" proposition. All usable shale gas deposits will, at some time, be tapped. Two significant factors need to be weighed in considering when is the best time to extract the gas: the developmental state of extraction technologies and market value.

The shale gas industry has always provided assurances that the procedures they employ are safe and that the environmental impacts are minimal, but experience and public scrutiny have led to significant improvements in both materials and methods used. New York will benefit by learning from the past successes and failures of the industry in other jurisdictions; however, some aspects of the industry in New York will require less tested approaches. As described earlier, the geology of the Northeast requires different methods of wastewater disposal, and therefore new technologies are still in the process of being developed. Radically different methods, such as fracking using propane, are being explored, and deploying them would reset the clock on testing and experience. It is only prudent to expect that all technologies used in New York be carefully scrutinized and refined so that we can be assured they will cause the least possible harm to our citizens and our environment.

As mentioned earlier, the current price of natural gas in North America is severely depressed because of oversupply. To expedite the extraction of natural gas in the present depressed market is to sell an irreplaceable resource at a discounted price.

Recommendations to the Town Board

The Vestal Conservation Advisory Commission strongly recommends that the following actions be taken *before* allowing natural gas drilling in the Town of Vestal. The rationale for each action can be found in the body of the report. Recommendations are listed in no particular order.

1. Enact regulations requiring that a minimum setback from all stream corridors be observed when pipelines and access roads are designed and built. The setback should be large enough that the stream banks will not be damaged during construction work or from erosion caused by increased runoff during or after construction.

2. Require that all roads and bridges to be used by gas industry vehicles be assessed to determine their condition. It should be the responsibility of the gas companies these roads be brought up to and maintained at a level that will handle the peak volume and weight of vehicular traffic associated with the natural gas operations. We understand that gas companies now typically engage in such agreements, but the Town should have thorough baseline information on road conditions before entering into an agreement.

3. Evaluate the adequacy of the current staffing, training, and equipment needs of emergency workers who would have to respond to accidents or spills associated with the gas industry, and develop strategies to meet any unfulfilled needs that are identified.

4. Generate an estimate of the personnel needs, as well the budgetary consequences, of the additional Town employees that will be required to monitor the increase in traffic, enforce regulations, and fulfill other predictable needs stemming from the activities of the gas industry. This might take the form of a supplemental budget that would be considered alongside a motion to approve gas drilling in the Town.

5. Have available for Town employees and residents the operational plans for wastewater disposal and information about the haulers responsible for this work.

6. Work with the school district and gas companies to anticipate and address the effects of greatly increased road traffic on the scheduling of school bus routes and on the safety of the buses that will share roads with gas company truckers.

7. Expressly prohibit the spreading or discharge of any wastewater or other drilling or fracking wastes within the Town.

8. Promote the monitoring of water quality for all landowners who are dependent on private water wells. The drilling companies should be strongly encouraged to provide independent water analysis of private water wells for all residents within two miles of a gas well. Analysis should be performed before drilling begins, annually, and anytime an abrupt change in water quality is detected. This service should continue as long as fracking is occurring in the Town.

9. Encourage by zoning regulation the recovery of the landscape to a more natural state following the cessation of gas extraction.

10. Require escrow accounts to protect taxpayers from the potential cost of dealing with abandoned or improperly capped wells.

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