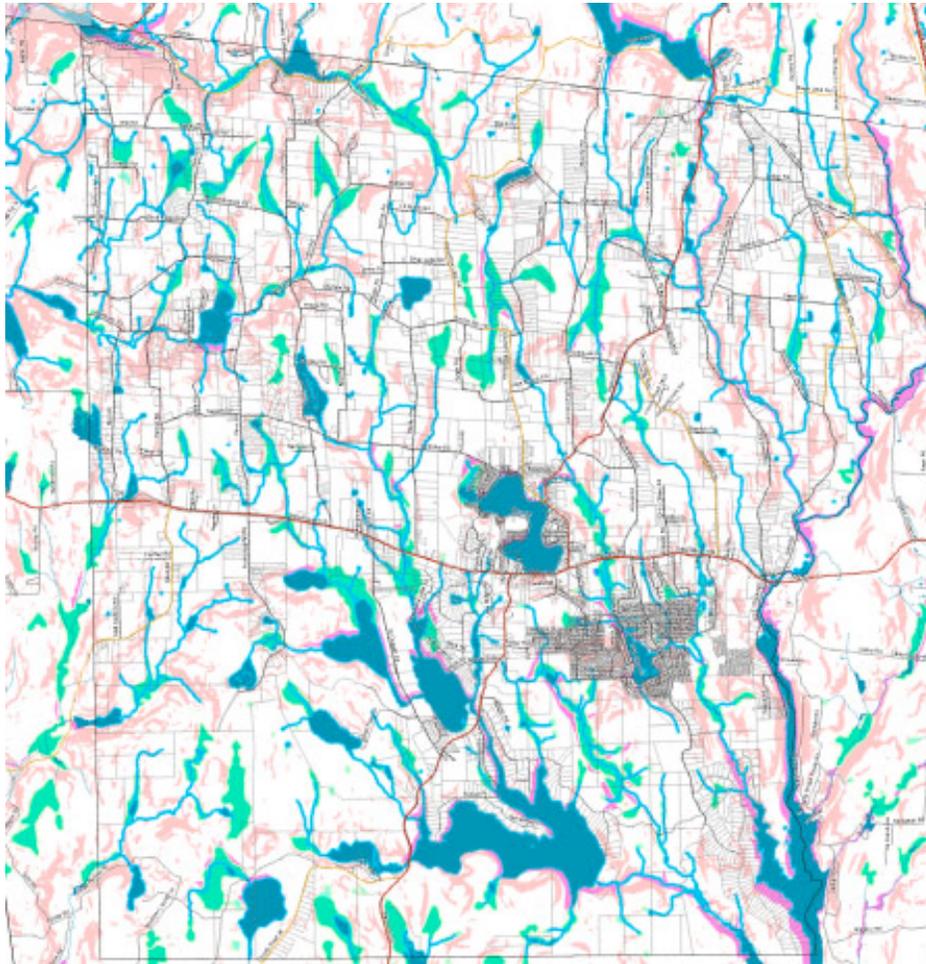


T O W N O F B E T H E L  
*Sullivan County, New York*

LAND USE ANALYSIS: HAZARDOUS OR NATURAL GAS  
AND/OR PETROLEUM ACTIVITIES & INDUSTRIAL USES



PREPARED FOR:  
TOWN BOARD OF THE TOWN OF BETHEL  
PREPARED BY:  
GREENPLAN INC.  
JANUARY 23, 2012

## Forward

The Town Board of the Town of Bethel commissioned this Land Use Analysis to help prepare for the anticipated exploitation of natural gas using hydraulic fracturing combined with horizontal drilling (HVHF). During much of 2011, the Town Board explored ways for the Town to exert local control over drilling activities and other highly polluting uses that may adversely affect the health, safety and well-being of its residents.

This document provides reliable and factual information for the Town Board on the potential environmental and community impacts of hydraulic fracturing for the natural gas that underlies the Town of Bethel and the region. The Land Use Analysis is provided in both paper and electronic forms. The electronic form (i.e. Portable Document Format or PDF file) contains hyperlinks to the studies and reports that were used in its development so readers can view the source documents that were relied upon. For readers of the paper version, the underlined words or phrases that appear are the hyperlinks available to readers of the electronic version. A webography showing the Uniform Resource Locators (URL) of these source documents is provided at the end of this Assessment in the form of endnotes. A webography is like a bibliography but of on-line documents cited using their internet addresses (i.e. URLs). Every attempt has been made to provide up to date links to the articles used. Since the internet is an ever evolving information resource, what is present on a particular website one day, may disappear tomorrow.



Photograph above is of the Marcellus Shale where it reaches the surface near Marcellus, New York  
Cover graphic depicts the multitude of water resources and other environmental constraints in Bethel, prepared for the Town Agriculture & Farmland Protection Plan by Community Planning & Environmental Associates

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# Bethel Land Use Analysis

*It is the Subcommittee's judgment that if action is not taken to reduce the environmental impact accompanying the very considerable expansion of shale gas production expected across the country – perhaps as many as 100,000 wells over the next several decades – there is a real risk of serious environmental consequences and a loss of public confidence that could delay or stop this activity.*

U.S. Department of Energy  
Secretary of Energy Advisory Board on Shale Gas Production, November 10, 2011

## A. Introduction

This Land Use Analysis has been prepared for the Town Board of the Town of Bethel. It is intended to serve as a guide for the Town's decision-makers and others on the potential impacts of natural gas development activities and other highly polluting uses. The Land Use Analysis focuses on the effects to the community from a proposed ban on "Hazardous or Natural Gas And/Or Petroleum Extraction, Exploration or Production Wastes" and related activities and uses and other defined "High-Impact Uses" (hereafter, the "Zoning Amendment"). A more complete description of the proposed action can be found in [Section C](#) below.

The Zoning Amendment, if adopted, would prohibit hazardous or natural gas and/or petroleum activities as well as other heavy industrial uses due to concerns for Bethel's health, safety, and general welfare from these potential land uses if they were to become established in the Town. Of greatest significance is the direct effect the proposed Zoning Amendment would have on current demands for tapping into the Marcellus and Utica Shale geologic formations for extraction of natural gas. At the time this Land Use Analysis was prepared, there were no operating hazardous or natural gas and/or petroleum or other high-impact and/or heavy industrial uses in the Town nor has there been any history of such activity in the Town. It is the intent of the Town Board to prevent the establishment of such uses.

The planning, environmental, engineering, and legal literature is filled with documentation of the adverse impacts of heavy industrial uses. Early large-scale atmospheric pollution has been documented from measurements taken of Greenland's ice cores for lead. The lead was deposited in Greenland, when ancient Carthaginian and Roman silver miners working in southern Spain, polluted the atmosphere more than 900 years ago. Today, there are more than 1,200 superfund<sup>1</sup> sites found throughout the country where heavy industrial uses have left countless acres of land unfit for human habitation.

New York State is currently home to almost 100 superfund sites with nearly half of them contaminating or threatening contamination of drinking water sources. Industrial operations affect the

full spectrum of environmental conditions including land, air, water, traffic, plants and animals, scenic and cultural resources, open space, energy, noise and odors, public health, community character, and community services. Oil and gas operations and ancillary uses related to such operations have likewise accounted for impacts to the same environmental conditions from the processes of drilling, stimulation, produced water, separation and dehydration, gas compression, production, refinement, storage, delivery and use. Some of the substances known to be released directly by oil and gas operations include but are not limited to hydrogen sulfide, diesel fuel, methane, benzene, toluene, ethylbenzene and xylenes (BTEX), nitrogen oxides, toxic metals, polycyclic aromatic hydrocarbons, radionuclides, heavy metals, and sulfur dioxide.

Sullivan County, with an overall population density of 76 persons per square mile, is considered a rural county. Bethel is located in the heart of the County, and is also rural with a population density of 48 persons per square mile. Sullivan County is located in the Catskill Mountains and, with its close proximity to New York City, developed historic resort-tourism and second-home industries along with agriculture and forestry. As such, it has escaped the severe impacts of heavy industrial activities to date. This is expected to change as current demands for exploitation of finite fossil fuel resources in the Marcellus and Utica shale formations becomes greater.

### **Land Use Analysis Background**

The peak of conventionally obtained natural gas production in the United States occurred in [1973](#)<sup>2</sup>. The only significant untapped sources are now [unconventional](#)<sup>3</sup> ones, such as gas that is trapped in low-permeability shale formations, tight gas sands, coal beds and hydrates. Access to these unconventional sources requires new drilling and exploration techniques known as high volume hydraulic fracturing combined with horizontal drilling ([HVHF](#))<sup>4</sup>. Both the Marcellus and Utica shale [formations](#)<sup>5</sup> lie buried deep below all of the Town of Bethel.

Due to the nation's increasing reliance on unconventional methods to extract natural gas from underground formations, over 95 percent of all new wells are now routinely treated using HVHF. According to the United States Energy Information Administration, the combination of horizontal drilling and HVHF technologies has made it possible for the gas industry to produce shale gas economically, leading to an average annual growth rate of [48 percent](#)<sup>6</sup> over the 2006 to 2010 period. Shale gas now flooding the market is apparently creating an export industry. According to an article that appeared in December of 2011 in the [Wall Street Journal](#):<sup>7</sup>

*“Once seen as a likely significant importer of natural gas—before the boom in domestic shale-gas production provided enough to meet demand—the U.S. is now emerging as a potential supplier of the fuel to nations overseas thanks to the newly tapped sources in shale. Companies are setting their sights on markets in Europe and Asia where natural gas fetches three to*

*four times the price in the U.S. According to Platt's, natural gas in Japan and South Korea fetches more than \$16 per million British thermal units, compared with a benchmark price of a little more than \$3 per million BTUs in the U.S. The companies are looking to spend billions of dollars on new terminals that could ship out about 17% of U.S. daily production, or about 11 billion cubic feet per day, according to the Energy Department.”*

Most shale gas wells are only a few years old. Production efforts, especially those in Pennsylvania that are more advanced than New York State, have a very short history in this region of the country and consequently reliable data on long-term production and ultimate gas recovery rates are [lacking](#).<sup>8</sup>

The potential for gas drilling in Bethel already exists. According to records from the Sullivan County Division of Planning & Environmental Management, as of August 22, 2011, at least one parcel in the Town of Bethel had been leased by Cabot Oil & Gas Corp. and the adjoining towns of Cochocton, Delaware, Highland and Tusten have seen a number of gas leases. At least 25 percent of the Town of Hancock in Delaware County was leased by gas companies as of April 2009. The Sullivan County Division of Planning & Environmental Management identified 54 leases on 7,906 acres of land in Sullivan County. This included four additional parcels in Bethel that were leased previously but the leases were released in 2009. According to the State Oil and Gas Database and as shown on the Google Earth image above, there have been three wells drilled in Sullivan County; one by Standard Oil Co., one by Texas Eastern Transmission Co., and one by Gulf Oil Corp. While each of the wells were identified as vertical wells, there is no further information available from the database on the wells themselves nor the formation they are drilled into.



### Sources of Information

This Land Use Analysis has been prepared as a guide for the Town of Bethel, as well as for residents and business interests. Its overriding goal is to provide objective and factual information on HVHF. Information on HVHF comes from several sources that are often in conflict with one another. This includes the following:

- The gas industry and those businesses that depend upon the gas industry. While they can be reliable sources of information on the processes and techniques of HVHF, because their [pri-](#)

[mary interest](#)<sup>9</sup> is management as for-profit corporations, some aspects of HVHF that have the potential to impact their profit margins may be downplayed or understated, avoided entirely, or exaggerated. It has been well documented that some businesses in the oil and gas industry have used their [financial](#)<sup>10</sup> resources to pay “experts” to question the [science](#)<sup>11</sup> associated with fossil fuel use. Due to the skepticism associated with these sources, they have been used with caution in this Land Use Analysis since their reports and other documents are not routinely independently reviewed (see the third bullet below) and can consist of unproven statements. In fact, some reports published by the oil and gas industry or consultants to the industry have methodologies that are deemed “proprietary” or their sources of data are not disclosed. Therefore, their results cannot be verified or reproduced by independent researchers. It is only through careful scrutiny by independent researchers that such reports can survive peer review and become accepted sources of reliable data.

 Government agencies that regulate the gas industry. The New York State Department of Environmental Conservation (DEC) is the primary regulatory agency with the authority to permit HVHF. The DEC’s role is broad in regulating water quality, air quality and the operations of the gas industry. However, the DEC’s role of protecting the environment is also tempered by the State’s declaration of policy to encourage gas development by providing for “*the operation and development of oil and gas properties in such a manner that a greater ultimate recover of oil and gas may be had...*” [§ 23-0301 of the New York State Environmental Conservation Law]. The DEC states at the outset of their most recent Revised draft Supplemental Generic Environmental Impact Statement (Revised dSGEIS) that “*The exploration and development of natural gas resources serves the public’s need for energy while providing substantial economic and environmental benefits.*” Thus, the State’s interest in fostering **gas development** activities must be recognized when reviewing the EIS documents prepared by the DEC, by its consultants (who also are known to [provide services](#)<sup>12</sup> to the gas industry), and by other State agencies involved in the preparation of the environmental impact statement (EIS) documents like the New York State Energy Research and Development Authority (NYSERDA). It should be noted that the US Environmental Protection Agency (EPA) is currently studying the environmental impacts of HVHF; initial research findings are expected in 2012 with a final report ready by 2014.

 Academic institutions are largely interested in the pursuit of knowledge and education. Research studies originating with colleges and universities can provide a reliable source of information on HVHF because these studies normally go through peer review. Peer review is a process of self-regulation by academics or professionals involving qualified individuals within the relevant field. Peer review methods are employed to maintain standards, improve performance and provide credibility. In academia, peer review is used to determine an academic paper’s suitability for publication. These sources are normally independent of financial interests in the gas industry or the advocacy interests of environmental or citizens groups and have been

heavily relied upon in this Land Use Analysis. Many research papers were recently [presented](#)<sup>13</sup> at a “Marcellus Shale Multi-State Academic Research Conference” held at the Blair County Convention Center in Altoona, PA on May 10<sup>th</sup> and 11<sup>th</sup> 2011.

- Non-governmental organizations (NGOs) are usually legally constituted organizations that include citizen groups like Catskill Citizens for Safe Energy, service organizations like Habitat for Humanity, industry trade organizations like the Independent Oil and Gas Association of New York, think tanks such as the Rocky Mountain Institute, and environmental groups such as the Environmental Defense Fund. Each of these groups advocate for a particular viewpoint. If their research efforts have been conducted in an independent manner and present facts that can be independently verified, then they can be a reliable source of information provided they properly cite sources.
- News media, such as newspapers, radio and television have historically been reliable sources of information. The Internet has spawned its own brand of new media sources including blogs and online journals; by 2008 more Americans reported getting their national and international news online than from newspapers. Other new sources include podcasts, Internet radio and news aggregators such as Google News or Fluent News. News media were traditionally reporters of fact. However, in 1996, the Code of Ethics of the Society of Professional Journalists was amended to remove “objectivity” from a section titled “accuracy and objectivity.” A new reference in the Code stated “Public enlightenment is the forerunner of justice and the foundation of democracy. The duty of the journalist is to further those ends by seeking truth and providing a fair and comprehensive account of events and issues.” While this works well for political reporting, it does not work for reporting on scientific issues when there is a consensus view by scientists. Reporters in the news media often present both sides of settled issues which can mislead readers. These sources have been used, but with caution.

This Land Use Analysis will use the above sources only when there is an abundance of evidence about the impacts of HVHF and where falsehoods can be recognized and marginalized. Where doubt exists about a particular HVHF issue that is portrayed as fact, this Analysis will point out the potential for discrepancy and lead the reader to further information on the subject. It is not the intent of this Analysis to add to the already broad body of information on HVHF. Rather, this Land Use Analysis provides decision-makers and others with as complete and realistic a picture as possible of what can be expected when HVHF gets underway in New York State so that everyone is better prepared for extraction of the natural gas that exists in the Marcellus and Utica shale regions.

The consensus seems to be that development of a natural gas industry in the Marcellus region presents economic opportunities for some, but that there are potential negative economic impacts as

well, many of which are not well understood. The State has acknowledged that there will be negative economic impacts to local government and some local businesses in their latest Revised dSGEIS and many of the economists who have studied the impact of gas development on the economy have reached similar conclusions. More research efforts on this critical issue are needed by those with real world gas industry economics experience, especially those who have a disinterested role to play, so that we can gain a fuller understanding of employment impacts, training needs, and opportunity costs, among many other areas. This Analysis provides greater details on the following topics. At a minimum, the following areas should be further investigated by the State as part of its GEIS review process:

1. What are the potential economic impacts on existing tourism facilities such as Bethel Woods Center for the Arts, the Museum at Bethel Woods, Lake Superior State Park and other tourism attractions and the second-home industry, particularly the long-term consequences and cumulative impacts of gas industrialization?
2. What are the economic impacts on agriculture, especially the dairy industry (because it relies heavily on trucking and is the predominant form of agriculture in the Town) as well as emerging organic farming and other farm industries?
3. What is the potential for short term labor shortages, as low income residents are pushed out of the region by higher paid gas workers?
4. Will there be potential increases in other wage rates with corresponding effects on existing businesses?
5. What are the full costs of road and bridge construction, improvement, and repair and how it will they paid for, as questioned by the NY State Department of Transportation?
6. Will the added costs of emergency services such as police, fire, and other emergency responders as a result of increased traffic, construction, production activities as well as accidents, spills, and other emergencies be paid for by the additional ad valorem taxes collected by local governments?
7. What will be the added costs for public and private water supply systems if additional filtration is required?
8. Will there be long term impacts on the Town's economy if it is replaced with a boom-bust economy based upon a non-renewable resource?
9. What are the potential long-term costs for providing education, housing, health care, recreation, and solid waste management to serve the added population as a result of in-migration?
10. What are the short and long term impacts on access to affordable housing if the current inventory is taken over by transient workers?
11. Will the types of growth and development envisioned by the Town, through its Comprehensive Plan and Zoning Regulations, be inhibited or thwarted by gas development activities, thereby preventing realization of such plans?

In reviewing the information provided, it is essential to understand that shale gas development in the Marcellus region is in its infancy and the scientific understanding of the relatively new technology of HVHF and its effects on humans and the environment are just beginning to emerge. There will no doubt be a wealth of information that becomes available as more researchers tackle the thorny issues associated with HVHF. This Analysis points its readers to researchers who are beginning to understand how the complex geology of the Marcellus and Utica shale formations interact with the HVHF process, affecting natural resources and communities alike. A great deal of additional research is needed to clear up the often conflicting information that is available, so that researchers, medical professionals, economists, engineers, planners, and scientists can reach a consensus on what the ultimate economic and environmental impacts will be on the Town of Bethel and the region. Based upon the current state of knowledge, no one has all of the answers.

### **New York State's Environmental Impact Statement Review Process**

In the early 1990's, a Generic Environmental Impact Statement (GEIS) was prepared by the DEC on the oil, gas and solution mining industry. A GEIS is a tool that can be used to encourage a particular type of development activity by assessing the impacts of the activity and then setting thresholds or criteria that must be followed to minimize or avoid adverse environmental impacts. If the thresholds or criteria are followed, then applicants for development permits need not conduct site-specific environmental reviews under the State Environmental Quality Review Act (SEQR).

The oil and gas industry enjoys [exemptions](#)<sup>14</sup> from provisions in the major federal environmental statutes intended to protect human health and the environment. These statutes include the Comprehensive Environmental Response, Compensation, and Liability Act, the Resource Conservation and Recovery Act, the Safe Drinking Water Act, the Clean Water Act, the Clean Air Act, the National Environmental Policy Act, and the Toxic Release Inventory under the Emergency Planning and Community Right-to-Know Act. The 2005 amendments to the Safe Drinking Water Act, that [exempted](#)<sup>15</sup> HVHF from complying with certain requirements, paved the way for HVHF to expand exponentially in natural gas regions throughout the nation.

As demands for HVHF grew, in July of 2008 the DEC began a study of HVHF and issued a draft Supplemental GEIS (dSGEIS) for public review in 2009 with public hearings held in several locations. A moratorium was put in place from June 2010 until June of 2011 but this moratorium did not affect HVHF for vertical gas or oil drilling. The moratorium is not officially in place and there was no further information available on if and when DEC expects to issue permits for HVHF as of the date this Land Use Analysis was published. Due to the significant criticism the State received on the inadequacy of the 2009 dSGEIS (more than 13,000 comments), the DEC decided to prepare a Revised dSGEIS, which was released in parts beginning in July of 2011 and in full by September of 2011.



**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 Gas Reservoirs

Lead Agency:  
NYSDEC, 625 Broadway, Albany, NY 12233

Lead Agency Contact:

Eugene Lett  
NYSDEC, 625 Broadway, 14<sup>th</sup> Floor  
Albany, NY 12233  
(518) 402-8044

Action Location: Statewide

Comments Due By: December 12, 2011

Prepared By:

NYSDEC, with Assistance from Alpha Environmental, Inc., Ecology and Environment Engineering,  
P.C., ICF International, USGS Core, NTC Consultants and Siermons/Outter LLC

Date of Completion of dSGEIS: September 30, 2009

Date of Completion of Revised dSGEIS: September 7, 2011

The Revised dSGEIS (the full [dSGEIS is available electronically](#)<sup>16</sup> but is big at 47.1 MB) on gas drilling characterizes the trend in demand for gas drilling as follows: *“The Department of Environmental Conservation (Department) has received applications for permits to drill horizontal wells to evaluate and develop the Marcellus and Utica Shales for natural gas production. To release the gas embedded in the shale formations, wells would undergo a stimulation process known as high-volume hydraulic fracturing. While the horizontal well applications received to date are for proposed locations in Broome, Cattaraugus, Chemung, Chenango, Delaware, and Tioga Counties, the Department expects to receive applications to drill in other areas, including counties where*

*natural gas production has not previously occurred. There is also potential for development of the Utica Shale using horizontal drilling and high-volume hydraulic fracturing in Otsego and Schoharie Counties and elsewhere as shown in Chapter 4. Other shale and low-permeability formations in New York may also be targeted for future application of horizontal drilling and high-volume hydraulic fracturing. . . The Marcellus Shale formation has attracted great attention as a significant new source of natural gas production. The Marcellus Shale extends from Ohio through West Virginia and into Pennsylvania and New York. In New York, the Marcellus Shale is located in much of the Southern Tier stretching from Chautauqua and Erie Counties in the west to the counties of Sullivan, Ulster, Greene and Albany in the east. According to researchers at Penn State University, the Marcellus Shale is the largest known shale deposit of gas in the world. Engelder and Lash (2008) first estimated gas-in-place to be between 168 and 500 Tcf with a recoverable estimate of 50 Tcf. While it is early in the productive life of Marcellus Shale wells, the most recent estimates by Engelder using well production decline rates indicate a 50 percent probability that recoverable reserves could be as high as 489 Tcf.<sup>17</sup> As discussed below, the US Geological Survey has recently estimated that recoverable gas reserves are far smaller than Engelder’s estimates.*

The Revised dSGEIS states that *“High-volume hydraulic fracturing, which is often used in conjunction with horizontal drilling and multi-well pad development, is an approach to extracting natural gas in New York that raises new, potentially significant, adverse impacts not studied in 1992...Also, hydraulic fracturing requires chemical additives, some of which may pose hazards when highly concentrated. The extra water associated with such drilling may also result in significant adverse impacts relating to water supplies, wastewater treatment and disposal and truck traffic. Horizontal wells also generate greater volumes of drilling waste (cuttings). The industry projections of the level of drilling, as reflected in the intense development activity in neighboring Pennsylvania, has raised additional concerns relating to community character and socioeconomics.”*

The Revised dSGEIS estimates that DEC may receive applications to drill approximately 1,700 - 2,500 horizontal and vertical wells for development of the Marcellus Shale alone during a “peak development” year. According to the DEC, an average year may see 1,600 or more permit applications but the dSGEIS does not define what is meant by a “peak development year” or an “average

year.” Development of the Marcellus Shale in New York may occur over a 30-year period and the State has assumed that the life of the wells will be around 30 years, meaning that a 60 year time horizon is anticipated for tapping and production of natural gas from the Marcellus Shale. Using the average year estimates means that up to 48,000 permit applications may be received by the State in the Marcellus Shale region alone. The DEC used this level and timeframe of development in its assumptions of potential impacts in the Revised dSGEIS. As discussed above, the Utica Shales also underlie the Town of Bethel and this potential natural gas reservoir can also be expected to be tapped in the future. Many believe that once well pads are in place for tapping the Marcellus Shale that additional wells will be drilled for tapping the Utica Shale. Although the State limits the number of wells to 16 per square mile (one well per 40 acres), this does not limit the drilling of additional wells if they are in other gas bearing formations (such as the Utica Shales) nor does it preclude downspacing, which is permitted upon justification to the DEC that additional wells are necessary to efficiently recover gas reserves.

The DEC hired a consultant to complete an estimate of the potential economic benefits of HVHF. While the consultant’s analysis calculated the total economic value of HVHF, it did not estimate the costs to local, county or State government associated with HVHF. This would normally include the costs of increased demands for community social services, wear and tear on roads, public health costs, police and fire, first responders, hospitals and the costs of the long term “bust” that occurs with extractive industries when the resource has been depleted. The potential [loss in value of homes](#)<sup>18</sup> in affected areas was not factored into the State’s analysis. The potential risks associated with properties located near gas wells, that may be unable to obtain mortgages from banks or homeowners insurance, are additional concerns that have been [documented](#).<sup>19</sup> Homeowners who have signed leases may find themselves in technical default of their mortgages, making it difficult for them to sell or refinance their home. There are other economic consequences associated with gas development activities that will be summarized later in this Land Use Analysis. The state’s Revised dSGEIS made no attempt to address this issue in its analysis of economic effects.

The State’s Revised dSGEIS looks at the potential impacts and proposed mitigation measures for those impacts on several topical areas including water resources, ecosystems and wildlife, air quality, greenhouse gas emissions, radioactive materials, socio-economics, aesthetics, noise, transportation and community character. This Land Use Analysis is not designed to provide a critique nor official comments of the Town Board of the Town of Bethel on the Revised dSGEIS. However, where the Revised dSGEIS identifies an issue but fails to characterize the potential impacts or to provide mitigation in accordance with accepted planning and environmental practices, those failures will be identified.

The state’s Revised dSGEIS proposes several measures to protect surface water, among a number of other mitigation strategies. According to the DEC, they include the following (please note the

**bold text**, which highlights how the proposed protection measures may be re-evaluated soon after their enactment):

- Well pads for HVHF will be prohibited within 2,000 feet of public drinking water wells, river or stream intakes and reservoirs **for a period of three years**, after which this distance will be reviewed and re-evaluated.
- Surface disturbance associated with HVHF, including well pad and road construction, will be prohibited on the state's 18 Primary Aquifers and within 500 feet of their boundaries **for a period of two years** after which this distance will be reviewed and re-evaluated.
- The State has proposed requiring a site specific SEQR review and an individual SPDES permit for HVHF projects at any proposed well pad within or within 500 feet of a Principal Aquifer with a review and **re-evaluation of this measure after two years**, as with Primary Aquifers.
- HVHF would be prohibited within 500 feet of private wells or a domestic use spring, unless waived by the landowner.
- HVHF would be prohibited within 100 year floodplains.
- The issuance of well permits for HVHF within wetlands would only occur when alternate locations are not available and would be subject to a site-specific SEQR review and a wetlands permit for State protected wetlands. Fuel tanks would need to be set back from wetlands by at least 500 feet.
- Site-specific SEQR reviews would be required for any well pad proposed within 150 feet of a stream, a storm drain, a lake or pond.
- HVHF would be prohibited within the Syracuse and New York City watersheds.

Curiously, the State has proposed no new standards that would govern setbacks for a gas well from a private dwelling, which is currently and which has been proposed to remain at only 100 feet, 75 feet from the traveled part of a public road and 150 feet from a public building (like a school) or area. [Some](#)<sup>20</sup> have identified these setbacks as the least restrictive in the Nation. The photo to the right from The Marcellus Effect [blog](#)<sup>21</sup> shows HVHF near a home in Dimock, PA. Setback distances are an integral component of municipal zoning regulation for land uses, especially when it involves health and safety issues. It bears mentioning that some of the drilling rigs used in the HVHF process can be as high as 170 feet tall.



The impacts of HVHF and the impacts of other important environmental issues discussed in the State's proposals, from the 2011 dSGEIS, will be outlined more fully in the topical sections below.

Where the State's assessments of impact are contradicted by published reports, those will be pointed out so readers can look deeper into the subjects.

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## **B. Regional Land Use Trends**

The Town of Bethel is a rural<sup>22</sup> community where the predominant land uses are forestry and agriculture with scattered low density residential and non-residential uses. The population density is approximately 48 persons per square mile. The principal industries, besides agriculture and forestry, are tourism and second home construction. There are currently no uses within the Town that could be classified as heavy industry, natural gas or other similar high-impact hazardous uses nor have there historically been such heavy industrial uses in the Town. In terms of surface mining industries, there are currently six permitted sand and gravel mines in the Town that together, comprise a total of 60.7 acres. One of the mines is operated by the Town of Bethel, one is operated by the Town of Liberty and the others are privately operated.

Bethel has historically straddled two of Sullivan County's most important industries - farming and vacation tourism. It surrounds the intersection of two principal arterials through Sullivan County (Routes 17B and 55) and is relatively convenient from all directions with proximity to both Pennsylvania and Interstate Route 86. The Town of Bethel possess some of the best farmland in Sullivan County and also produces some of the best hardwoods in the world. Large areas of the Town are located within New York State Agricultural Districts. There are also several processors of farm and forest products in the area that can handle virtually any agricultural or wood product.

Bethel has a uniquely appealing charm that derives from its scenery, history and natural features. Its many lakes and rural environment contribute to a distinctive community character. The Bethel Woods Center for the Arts has already established itself as a world-class performing arts center and its presence in the Town brings in other new attractions and stimulates higher quality development. The Chapin Estates development project is one example of the new development that is being attracted.

The Bethel Woods project and high-end housing developments taking place in Bethel open up opportunities for light retail enterprises such as antique stores, craft shops and other niche appeal businesses as recommended in the Town Comprehensive Plan. The Town is actively pursuing tourism and promoting outdoor recreational opportunities based on the working landscapes of the community. The Town offers beautiful wooded areas, superb hunting and fishing, attractive farms and several other features such as State Parks.

According to the Town of Bethel's 2006 Comprehensive Plan, "The second home industry will continue to be critical to the economic success of Bethel. It generates relatively low impacts on both the environment and community service demands while producing a good tax base. It is very appealing on that level, particularly when high-end housing is involved where the cost to the school system is offset by tax revenues." Bethel has had a slow to moderate rate of growth for the past 20 years. While growth from 1990 to 2000 was 18.1 percent with the Town gaining about 670 residents, it slowed between 2000 and 2010, with the Town losing 107 residents. According to the 2006 Plan, "Moderate growth, at the very least, is expected over the next 10 years as the economy grows and retirees continue to settle in Bethel. The Town is also becoming more popular as a site for high-end housing as the success of The Chapin Estate demonstrates. Economic opportunities will provide incentives for younger, working age residents to settle in the area."

But there are outside forces that have the potential to transform Bethel from a desirable rural community to a heavily industrialized community. Natural gas, buried deep below Bethel for millions of years in the Marcellus and Utica shales, is now recoverable due to new gas drilling technologies. According to the US Department of Energy, the Marcellus Shale covers an area of 95,000 square miles at an average thickness of 50 feet to 200 feet. New York's portion of the Marcellus Shale is approximately 18,750 square miles and is found very deep – over 1 mile below ground in places. To date, there are almost fifty companies that are already exploiting the Marcellus Shale for natural gas production, or have expressed interest in conducting gas drilling in the Marcellus Shale region. One company alone, [Statoil ASA](#)<sup>23</sup> of Oslo, Norway partnering with Chesapeake Energy, says it could drill as many as 17,000 natural gas wells in the Marcellus Shale field over the next 20 years. The State's Revised dSGEIS estimates, with a 50 percent probability, that there is 489 Trillion Cubic Feet (TCF) of natural gas in the Marcellus Shale.

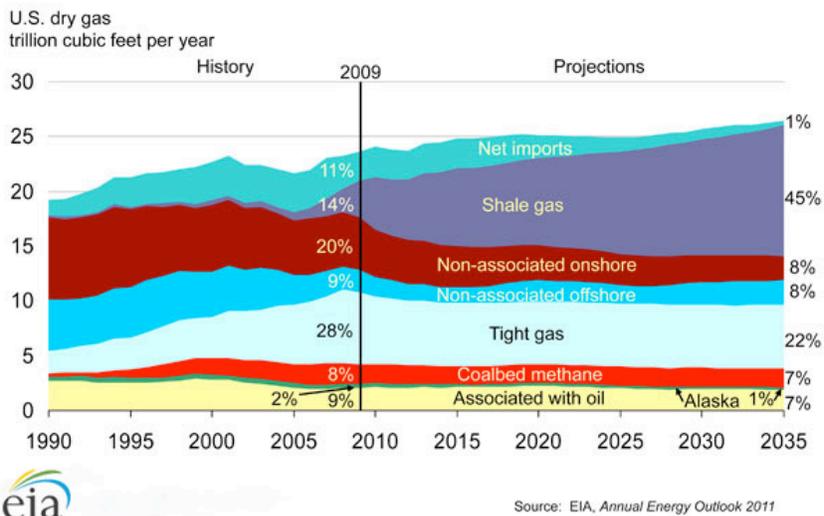
According to the United States Geological Survey, "In 2008, two professors at Pennsylvania State University and the State University of New York (SUNY) Fredonia estimated that about 50 TCF (trillion cubic feet) of recoverable natural gas could be extracted from the Marcellus Shale (Engelder and Lash, 2008). In November 2008, on the basis of production information from Chesapeake Energy Corporation, the estimate of recoverable gas from the Marcellus Shale was raised to more than 363 TCF (Esch, 2008). The United States uses about 23 TCF of natural gas per year (U.S. Energy Information Administration, 2009), so the Marcellus gas resource may be large enough to supply the needs of the entire Nation for roughly 15 years at the current rates of consumption." These estimates do not account for natural gas found in the even deeper Utica Shales.

As discussed below, the EIA in April 2011 estimated the United States possesses 827 Tcf of technically recoverable unproved shale gas resources with the Marcellus shale gas play alone, accounting for almost half with an estimated technically recoverable resource base of about 400 (Tcf). Notwithstanding the EIA estimates, the US Geological Survey, in August of 2011, released a significantly lower [estimate](#)<sup>24</sup> that the Marcellus Shale contains about 84 TCF of undiscovered, techni-

cally recoverable natural gas and 3.4 billion barrels of undiscovered, technically recoverable natural gas liquids. New York State’s estimates in the Revised dSGEIS further add to the confusion. There have been a number of [sources](#)<sup>25</sup> that have [criticized](#)<sup>26</sup> or provided [alternative views](#)<sup>27</sup> to the State’s [estimate](#)<sup>28</sup> of a 50 percent probability that there is 489 TCF of natural gas in the Marcellus Shale.

Nevertheless, interest in the Marcellus Shale formation has been likened historically to the gold rush in mid-19th century California. Potential Marcellus gas production revenues of \$16 billion to \$22 billion have been predicted in several publications. Of course, predictions are based on circumstances that can change, sometimes rapidly, depending on markets, worldwide volatility from political unrest, the assumptions that qualify the models, and most importantly the strengths and weaknesses of the studies used to make the predictions. However, the reason there is great interest in the Marcellus and Utica Shales is the current and projected demand for natural gas and the economic opportunities it represents to landowners, gas companies and others that could benefit.

Natural gas is in demand in the United States, in part, because it has become widely available (87% was produced domestically in 2009 and 97% in North America) through a network of 305,000 miles of interstate and intrastate transmission pipelines. Compared to wood, coal or oil, natural gas is convenient to use and relatively clean to burn in comparison to these other fuels. Shale gas in 2009 made up 14 percent of total U.S. natural gas supply. Production of shale gas is expected to continue to increase, and constitute 45 percent of U.S. total natural gas supply in 2035, as shown on the EIA’s chart above.



While the nation is beginning to transition to renewable energy sources such as solar, wind, geothermal and others, natural gas currently creates electricity, heats millions of homes, is a feedstock for the production of ammonia used in fertilizers, can be used as an alternate vehicle fuel source, heats water, cooks food and makes backyard barbecues possible year-round. As a fossil fuel, it is a finite resource yet demand for it is rising. Like oil and coal, natural gas was formed from the fossilized remains of dead plants and animals exposed to heat and pressure in the Earth’s crust over millions of years (for decades, the coal industry and others have referred to coal and other fossil fuels

as "buried sunshine<sup>29</sup>"). Estimates are that society today burns about 100,000 years of ancient plant growth (i.e. ancient solar energy) each year. This has created an imbalance in carbon dioxide levels in the atmosphere.

According to the DEC, more than 75,000 oil, gas and solution salt mining wells have been drilled in New York State since the late 1800's with about 14,000 wells currently active. The first natural gas well in the country was drilled in Fredonia, NY by William Hart (1821). The first commercially successful oil well in the world was drilled just south of Jamestown, NY in Titusville, PA (1859). Gas has been produced from the Marcellus Shale since 1880 when the first well was completed in the Naples field in Ontario County. The



Naples field produced 32 MMcf (million cubic feet) during its productive life and most shale gas discoveries in New York since then have been in the Marcellus Shale. The photo above from the NY State Museum Collection shows historic vertical gas drilling in Richburg, NY.

In New York, all gas wells completed in the Marcellus Shale so far are vertical wells. To date, 49 wells have been developed, 18 of these wells are active while the remainder are either inactive, plugged and abandoned, or shut-in. According to DEC records in its Oil and Gas [database](#),<sup>30</sup> three wells have been permitted in Sullivan County. The well permits were granted to Standard Oil Co., Texas Eastern Transmission Co., and Gulf Oil Corp. but no further information was available from the DEC as to which formation they were drilled into nor the target fossil fuel sought, either oil or gas. The three wells are in the adjoining Town of Thompson and the Town of Rockland.

Natural gas facilities that have recently been constructed include the Millennium Pipeline, which traverses the Town of Bethel. According to the [Millennium](#)<sup>31</sup> Pipeline Company, the Millennium Pipeline offers "Unparalleled Pathways to ... Northeast... Marcellus Shale... Traditional natural gas markets are expected to grow in the Northeast as efforts increase to improve air quality. Western New York storage development supports seasonal use of natural gas and discoveries of local gas production including Marcellus Shale gas improve optionality and reliability of natural gas. Millennium Pipeline is well positioned to deliver these benefits to gas consumers." The Millennium Pipeline went into service in 2008. Millennium makes extensive use of existing utility easements, extending from Independence in Steuben County NY to Buena Vista in Rockland County NY. Millennium, which is supplied by local production

and storage fields and interconnecting upstream pipelines, serves customers along its route in the Southern Tier and Lower Hudson Valley as well as serving several major utility customers in New England and the New York City area.

A leak in the newly constructed Millennium pipeline prompted federal officials to declare that the pipeline may pose a safety risk. On July 6, 2011, the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration sent a certified letter to Columbia Gas Transmission, LLC, which operates the Millennium pipeline, ordering the company to inspect the line and repair any problems by December 31, 2011. According to [news reports](#):<sup>32</sup> *“The section of the pipeline that is of most concern to the federal agency is that which runs from Corning to Ramapo County, a stretch that includes the Sullivan County towns of Fremont, Delaware, Cochection, Tusten, Bethel, Highland, Lumberland and Forestburgh.”*

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### C. Town Planning and Zoning

Bethel’s Comprehensive Plan was adopted in 2006 and in 2009 the Town Board adopted Zoning Amendments in response to recommendations of the Town’s Comprehensive Plan. Bethel has had Zoning regulations in place since 1979 and several other amendments were adopted since that time. This Land Use Analysis includes a review of the Town’s 2006 Comprehensive Plan as well as the proposed 2012 Zoning Amendment *“Establishing a Severability Clause; Confirming and Clarifying that any Uses not Expressly Permitted are Prohibited; Articulating Certain Explicitly Prohibited Uses; Adding Certain New Definitions, and Changing Certain Existing Definitions; and Modifying, Clarifying, and Adding to the Provisions Regarding Area and Use Variances Generally, and Use Variances Respecting Explicitly Prohibited Uses, Specifically.”* The goal of the Analysis is not to add another layer of planning to what has already been accomplished in the Town, but to bring the current state-of-the-art planning and environmental studies, regarding *“Hazardous or Natural Gas And/Or Petroleum Extraction, Exploration or Production Wastes”* and other *“High-Impact Uses”* into focus, so that the Town Board can be assured their decision-making is based upon sound planning. Henceforward, these proposed prohibited uses will be referred to simply as **“natural gas and other heavy industrial uses.”**

Local planning and zoning by towns, villages and cities is the foundation for control of land use in New York State. The State has recognized this through its enabling statutes in the Town, Village and General City Law as well as in other laws such as the Municipal Home Rule Law and the Environmental Conservation Law. DEC’s former Director of the Division of Mineral Resources, which is the agency responsible for regulation of gas wells, remarked about the role of local government agencies in the regulation of mining in New York State. When discussing mining at an Albany Law School conference he stated that *“It is important to recognize that DEC is not a land use agency, and that the authority remains at the local government level. It has always been our position that localities*

*need to determine appropriate land uses and that DEC, even if we believe that a site may not be zoned properly, will not interfere in those decisions. DEC is not a land use agency, and we must abide by the local zoning whether we agree or not.”*

Other DEC programs acknowledge the role of local government to regulate natural resources in addition to the State role. In New York State DEC’s recommended critical area protection programs, discussed in the FINAL Upstate New York Groundwater Management Program (Division of Water, 1987) document, it states that *“Land use controls are among the most important mechanisms available to effectively manage groundwater resources. Land use is a very basic determinant of potential groundwater contamination as well as of groundwater use...where protection of critical groundwater resources is a sufficiently important and valid public purpose, there appears no reason why carefully developed local land use controls should not be an essential part of a local groundwater protection program.”*

This Land Use Analysis has found that there is a material conflict between the Town Comprehensive Plan’s vision and the potential for “natural gas and other heavy industrial uses” from becoming established in the Town. When the Comprehensive Plan was adopted in 2006, there was little interest in HVHF as a heavy industrial activity in Sullivan County. Since that time, it has become apparent that there is the potential for large scale heavy industrial uses to become established in Sullivan County, as they have in Northeastern Pennsylvania, which has not had the same regulatory review process and structure as New York State. Based upon this potential conflict, the Town Supervisor designated an ad hoc committee in 2011 to work on a Zoning Amendment<sup>33</sup> to implement and strengthen the goals and vision of the Comprehensive Plan by prohibiting such uses in the Town of Bethel. Virtually all of the proposed prohibited uses (except gambling) would qualify as “heavy industry.” They include but are not limited to the following:

- Injection Well
- Land Application Facility
- Natural Gas And/Or Petroleum Exploration Activities
- Natural Gas And/Or Petroleum Extraction Activities
- Natural Gas And/Or Petroleum Extraction, Exploration Or Production Waste Disposal/  
Storage Facility
- Natural Gas And/Or Petroleum Extraction, Exploration Or Production Wastes Dump
- Natural Gas Compression Facility
- Natural Gas Processing Facility
- Non-regulated Pipelines
- Underground Injection
- Underground Natural Gas Storage
- High-Impact Uses
- Gambling

High-Impact Uses include Waste-to-Energy Facilities, Hazardous Waste Landfills, Dumps, and Industrial processes that would fall into a general definition of heavy industry, such as veneer, plywood and engineered wood product manufacturing, pulp, paper and paperboard manufacturing, petroleum and coal manufacturing, basic chemical manufacturing, pesticide, fertilizer and other agricultural chemical manufacturing, other chemical products and preparation manufacturing, clay product and refractory manufacturing, glass and glass product manufacturing, cement and concrete manufacturing, lime and gypsum manufacturing, other nonmetallic mineral product manufacturing, iron steel mills and ferro-alloy manufacturing, steel product manufacturing from purchased steel, alumina and aluminum production and processing, nonferrous metal production and processing, rubber products manufacturing, leather and allied product manufacturing, and *“Any other use likely to have a significant negative impact upon the environment; or cause or significantly contribute to an increase in mortality; or an increase in serious irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health due to the nature of its operation, materials used and/or wastes generated...”*

Heavy industry has been defined by the American Planning Association as *“A use engaged in the basic processing and manufacturing of materials and products predominately from extracted or raw materials, or a use engaged in storage of, or manufacturing processes using flammable or explosive materials, or storage or manufacturing processes that potentially involve hazardous or commonly recognized offensive conditions.”* The U.S. Department of Labor, in the Standard Industrial Classification Manual, includes Industry Group 131 (Crude Petroleum and Natural Gas) and Group 138 (Oil and Gas Field Services) under Division B: Mining. Most other heavy industrial operations are classified in Division D: Manufacturing. Examples include primary metals, chemicals, and petroleum. These would fit the general category of heavy industry. While there are many characteristics of these operations that differ significantly, they do share some common effects including the potential for economic benefits to the community in which they reside through employment and tax revenues. But, new industrial jobs not only create income for a community, they also create costs as new families move in and public services must be provided. Furthermore, industrial growth also carries with it inevitable and unavoidable adverse environmental impacts. These include significant truck traffic, noise, odors, safety hazards, unsightly conditions, loss of habitats, declines in water and air quality, to name a few topical areas. The costs of heavy industry are not always felt while the industries are in operation. The superfund sites described above have left a toxic legacy that has sometimes been paid for using tax revenues, so the actual economic costs of heavy industry are shared by all.

The principal purposes of this Land Use Analysis are to document the material conflict, and to review the potential environmental, community and economic impacts of such uses to aid the Town Board in its decision-making process. This Land Use Analysis will also:

- ▶ Provide a build-out analysis of the potential for gas well development in the Town of Bethel and the implications of such heavy industrialization of the Town, through accepted measures of impact, in categories such as loss of farmland and forestland, truck impacts on local roads, water, chemical use and wastewater disposal, employees needed by the industry, and potential effects to community services;
- ▶ Summarize the documented characteristics as well as the potential beneficial and adverse impacts associated with natural gas and other heavy industrial uses;
- ▶ Place particular emphasis on the most recent technologies being used to develop unconventional gas reserves, because over the past few years, there has been the greatest interest in exploitation of such reserves in the region and such interest is expected to grow as **all other sources of energy decline** as shown on the US Department of Energy's chart above;
- ▶ Provide a basis for the Town Board's environmental review of the proposed Zoning Amendment under the State Environmental Quality Review Act (SEQR);
- ▶ Articulate in a summary form the substantial and documented evidence that exists concerning the potential for natural gas and other heavy industrial uses to threaten the health and well-being of the community as a whole and to otherwise prevent the Town from achieving its well-established goals.

This Land Use Analysis includes an examination of the Bethel Comprehensive Plan that relates directly to the potential effects of HVHF on the Town. The Analysis demonstrates the type of planning and community character issues that New York State should be examining on a community-by-community basis. The DEC's Revised dSGEIS did not conduct such an analysis, instead using a regional summary approach for three regions in the State. While Region B included Sullivan County, at a multi-county scale, it is impossible to determine what the effects on community character will be to individual municipalities.

In the Community Character Impacts section of the Revised dSGEIS released in September of 2011, the DEC states:

*“High-volume hydraulic fracturing operations could potentially have a significant impact on the character of communities where drilling and production activities would occur. Both short-term and long-term, impacts could result if this potentially large-scale industry were to start operations. Experiences in Pennsylvania and West Virginia show that wholesale development of the low-permeable shale reserves could lead to changes in the economic, demographic, and social characteristics of the affected communities.*”

*While some of these impacts are expected to be significant, the determination of whether these impacts are positive or negative cannot be made. Change would occur in the affected communities, but how this change is viewed is subjective and would vary from individual to individual. This section, therefore, seeks to identify expected changes that could occur to the economic and social makeup of the impacted communities, but it does not attempt to make a judgment on whether such change is beneficial or harmful to the local community character.” [emphasis added]*

The failure of the Revised dSGEIS to properly assess potential impacts of HVHF on land use and community character means that municipalities are left to carry out their own analysis. Numerous court cases on community character have outlined a proper level of analysis. The SEQR regulations are explicit that “creation of a material conflict with a community’s current plans or goals as officially approved or adopted” or “the impairment...of community...character” are potentially significant adverse impacts.

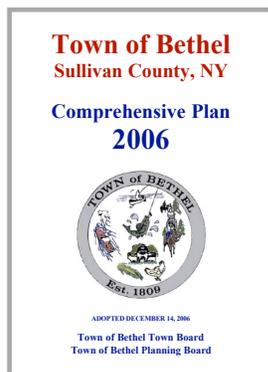
To adequately assess impacts on community character, there needs to be documentation and an evaluation of all affected municipalities that have adopted comprehensive plans and zoning regulations or other land use controls. This information is readily available from the New York State [Department of State](#).<sup>34</sup> DEC states that assessing impacts on community character is subjective. This is a false premise and is in conflict with [planning agency guidance](#)<sup>35</sup> and some of the leading [court cases](#)<sup>36</sup> on the issue of community character. A more in-depth discussion of the issue can be found in Section Q Community Character.

Some of questions that need to be considered when assessing HVHF are identified below. These are the types of questions the DEC should be answering in its dSGEIS as to whether heavy industrialization is compatible with the character of affected communities.

- 🎧 What does the Comprehensive Plan and Zoning Law say about how the Town wants to grow, protect its resources, enhance its quality of life?
- 🎧 Does the Town want to encourage all industrial development or just specific types, such as low impact businesses like agriculture and related businesses, light metal fabrication, and wood processing industries as recommended in the Comprehensive Plan?
- 🎧 Would the Town rather encourage economically viable businesses providing local jobs such as small scale home occupations, recreational industries, performing arts and tourism industries?
- 🎧 Does the Town want to remain rural with clean air and clean water?
- 🎧 Does the Town want to avoid traffic congestion?
- 🎧 Does the Town want to minimize or avoid changes to its landscapes and scenic areas?
- 🎧 Does the Town want to maintain control over the costs of providing municipal services?

- Is the Town concerned about losing its identity and sense of place if HVHF activities are poorly regulated or the Town is unable to have a meaningful effect on such activities?
- Is the Town concerned about any increases in air, light, water and noise pollution, increases in crime, and displacement of residents?
- Is the Town concerned about decreases in open space, wetlands, water resources, and wildlife including biodiversity?
- Will heavy industrialization accelerate the displacement of local residents and businesses affected by HVHF?
- Will HVHF result in an increased vacancy rate among commercial properties or lead to less of the types of development desired in the community?
- Will HVHF lead to lower property values for lands in close proximity to such operations?
- Will HVHF affect the way in which lenders treat mortgages and their continued viability? This is an issue because mortgage documents normally prohibit hazardous activity and hazardous substances on the property secured by the mortgage. There has already been attention to this issue by the [legal profession](#).<sup>37</sup> The issue doesn't just include landowners who enter into leases with gas companies, only to find out that they have violated their mortgage. It also includes adjoining landowners who are included in the compulsory integration process of gas drilling permits.

### Town of Bethel Comprehensive Plan 2006



According to the 2006 Comprehensive Plan: *“The Town of Bethel is the centerpiece of Sullivan County. It is associated with both Western Sullivan County and the traditional Catskills vacation area. It is both a farm area and a part of the Catskills vacation region. It includes large areas of open space and the relatively high density Smallwood area. It is the most prominent community along Route 17B, the link to Pennsylvania and connection to the Quickway and Mighty M Gaming attraction. The Town borders nine other Sullivan towns, including Delaware, Cohecton, Tusten, Highland, Lumberland, Forestburgh, Thompson, Liberty and Callicoon.*

*No other town is so connected to the rest of the County, so affected by County patterns of development or so influential in establishing those patterns. The impact of the Woodstock Festival on the image of the County is illustrative of this relationship. The impact of the Gerry Foundation's project to develop the Bethel Woods Performing Arts Center at this same site is likewise a harbinger of Sullivan's bright future.”*

A review of the 2006 Comprehensive Plan found that establishment of natural gas and other heavy industrial uses in the Town would be in direct conflict with a number of the adopted

goals and objectives. Such goals and objectives provide “for the immediate and long-range protection, enhancement, growth and development of the town...” [see § 272-a.2(a) of New York State Town Law]. Each of the following goals and objectives of the 2006 Plan relate directly to potential establishment of natural gas and other heavy industrial uses in the Town and if such uses were to be established, they would prevent realization of residents’ collective vision for its future:

GOAL: PROVIDE FOR THE ORDERLY DEVELOPMENT OF THE TOWN OF BETHEL, MAINTAINING ITS EXISTING MIXED-USE CHARACTER WITH A BLEND OF WORKING FARM, RECREATIONAL, RESIDENTIAL AND HAMLET COMMERCIAL LANDSCAPES.

OBJECTIVE: Reinforce the New York State Agricultural District program by using the Town Zoning Law to apply additional local protections within AG Agricultural Districts that match those boundaries.

OBJECTIVE: Use the Town's planned new zoning districts along Route 17B to encourage new development that strengthens White Lake and Kauneonga Lake as centers, increasing density in these areas and developing supportive infrastructure to accommodate this development.

OBJECTIVE: Maintain the existing low-density single family residential nature of the Town by zoning the large undeveloped areas of the Town for no more than one dwelling per 1-2 acres using the Town's RS Residential Settlement and RD Rural Development (current RF) Districts for this purpose.

OBJECTIVE: Allow for a large degree of flexibility to accommodate recreational and large-scale low-density activities (e.g. golf courses, resort hotels) by allowing them in the RD Rural Development and PAC Performing Arts Center Districts on a Special Use or Planned Unit Development (PUD) basis.

OBJECTIVE: Use the recently completed PAC Performing Arts Center District as a centerpiece illustration of desirable development patterns that offer new opportunities while preserving the attractive natural and working landscape of the Town.

OBJECTIVE: Encourage the redevelopment of existing bungalow colonies where the economics of such operation are no longer practical, allowing these sites to be reused for affordable start-up new housing where infrastructure exists to support such development.

OBJECTIVE: Create an additional zoning district or overlay zone to protect high quality conservation areas within the Town by requiring very large lots (e.g. 5 acres) in selective areas or mandating the use of the conservation subdivision technique to cluster housing and preserve valuable open spaces.

OBJECTIVE: Provide opportunities for start-up owner occupied housing within specific areas of the Town offering the necessary infrastructure or with the capacity to accommodate such infrastructure.

GOAL: PROVIDE FOR THE PROTECTION OF PUBLIC HEALTH AND SAFETY FOR ALL BETHEL RESIDENTS NOW AND IN THE FUTURE.

OBJECTIVE: Minimize development of floodplains using flood damage prevention regulations.

OBJECTIVE: Apply traffic access management techniques to the design of new driveways and roads.

OBJECTIVE: Limit the use of highly developed water bodies by motorized watercraft.

OBJECTIVE: Apply nuisance laws and other regulation to the operation of dog kennels, property maintenance and establishment of loud, high traffic or other high impact activities.

OBJECTIVE: Reduce the number of abandoned structures, poorly maintained properties and unsightly land uses by applying dumping and junkyard laws, working with property owners on an individual basis and creating incentives to correct the situations.

GOAL: PRESERVE NATURAL CHARACTER AND WORKING LANDSCAPES ALONG EXISTING HIGHWAYS WHILE PROMOTING SAFE, EFFICIENT AND UNCONGESTED CIRCULATION OF TRAFFIC.

OBJECTIVE: Establish increased setbacks, detailed site plan review, landscaping, parking and sign regulations along Routes 17-B and 55 that address their role as gateways to Bethel and Sullivan County and ensure that new development is accomplished in a manner that highlights, rather than overwhelms, existing natural and working landscapes.

OBJECTIVE: Carefully review grading plans for all projects and require new roads to be designed so as to preserve natural topography and existing tree cover and canopies along roadways, minimize cut and fill, minimize tangents and preserve and enhance views.

OBJECTIVE: Minimize curb cuts and require joint accesses to maintain free flow of traffic along major corridors and prevent safety problems.

OBJECTIVE: Encourage developers to provide for bicycling and walking as well as vehicular connections to adjacent land uses and open spaces, particularly between White Lake and Kauneonga Lake.

OBJECTIVE: Encourage the development of small convenience shopping areas in developing regions of the Town to lower the demand for routine trips and mitigate congestion impacts.

OBJECTIVE: Develop lighting and landscaping standards that soften the impacts of new land development and help maintain rural character.

GOAL: PROTECT SURFACE AND GROUNDWATER SUPPLIES FROM POLLUTION, MAINTAIN HIGH QUALITY PHYSICAL ENVIRONMENTS AND PRESERVE WILDLIFE HABITATS.

OBJECTIVE: Incorporate sewage, stormwater management and erosion/sedimentation control planning requirements in both site plan and subdivision reviews.

OBJECTIVE: Promote conservation subdivision design practices where lots are clustered to provide open space buffers trapping stormwater run-off.

OBJECTIVE: Require both public and private developers to protect ecologically sensitive areas such as eagle habitats, wetlands, trout streams and other wildlife habitats.

OBJECTIVE: Protect recreational water bodies through lake and stream monitoring and management programs.

GOAL: USE POSITIVE INCENTIVE BASED PROGRAMS TO GUIDE DEVELOPMENT.

OBJECTIVE: Incorporate flexibility into land use standards to fit individual development circumstances and offer bonuses for developers who provide additional open spaces,

dedicate conservation easements, protect important environmental features or otherwise contribute to quality forms of development using innovative measures.

OBJECTIVE: Encourage low impact home occupations and apply oversight to those features having a direct bearing upon the residential character of adjacent and nearby land uses.

GOAL: ENCOURAGE FLEXIBILITY IN DEVELOPMENT OF LAND TO FACILITATE ECONOMICAL PROVISION OF STREETS AND UTILITIES, PRESERVE OPEN SPACE AND PROVIDE VARIED HOUSING CHOICES.

OBJECTIVE: Require both passive and active open spaces where needed to complement existing recreation programs and valuable natural aspects of the Town's character.

OBJECTIVE: Encourage the use of conservation subdivision design at the sketch plan stage of subdivision approval.

OBJECTIVE: Require developers to maximize the open space value by ensuring high visibility of the open space for persons passing the site or overlooking it from nearby properties.

OBJECTIVE: Allow for new planned unit developments that provide starter housing for young working households and reflect the physical diversity of small towns by mixing housing types, lot sizes and shapes.

GOAL: PROMOTE THE ECONOMIC DEVELOPMENT OF THE TOWN OF BETHEL SO AS TO IMPROVE INCOMES, CREATE NEW BUSINESS AND EMPLOYMENT OPPORTUNITIES AND RAISE THE STANDARD OF LIVING WITHIN THE COMMUNITY.

OBJECTIVE: Work with the Sullivan County Partnership and Sullivan County IDA to provide economic incentives to attract non-gaming tourism businesses compatible with the Town's natural and working landscape character, particularly cultural and recreational enterprises that will complement the proposed Bethel Woods Performing Arts Center.

OBJECTIVE: Work with the Sullivan County Partnership and IDA to create incentives for agricultural, light metal fabrication, wood processing and similar businesses taking advantage of the Town's extensive natural resources with operations of smaller scale that complement existing mixed use character.

OBJECTIVE: Work with the Sullivan County Division of Planning to develop additional infrastructure and new industrial and business uses at the County Airport, restricting incompatible residential development within a buffered area around the facility.

OBJECTIVE: Continue developing and increasing public access to recreational resources of the Town (e.g. fishing accesses, eagle watching sites and reservoir properties) as a means of serving residents and attracting tourism.

OBJECTIVE: Support high-end second-home projects that add tourism, take advantage of the Town's natural attributes and help to balance the tax base as one element of the housing mix, balanced with starter housing.

OBJECTIVE: Use the Bethel Local Development Corporation (BLDC) encourage aesthetic and economic revitalization and promote public-private partnerships.

### Natural Gas Build-Out Analysis

The following sections will analyze and discuss the build-out analysis results based upon the potential for gas well development in Bethel. Included is an examination of the potential adverse and beneficial impacts that can be expected to a variety of relevant areas of environmental concern.



Heavy Industry (Photo: Sura Nualpradid)



NY Oil Well (Photo: investments-and-acquisitions.com)



Gas Well Drilling (Photo: NYC-DEP)

Geologists have long known about the natural gas resources of the Marcellus Shale formation. Until recently however, use of conventional vertical drilling technologies failed to provide a significant supply of natural gas from the formation. Beginning in the 1970's, the US Department of Energy funded the Eastern States Shale Project to develop new technologies to advance development of shale gas. The Project resulted in a new application of an already known technology, referred to as directional drilling. This technology uses an initial vertical drillhole at the surface and then slowly turns the drill 90 degrees to penetrate long horizontal distances, sometimes over a mile, through the Marcellus Shale bedrock. Hydraulic fractures are then created into the rock at intervals from

the horizontal section of the borehole, allowing a substantial number of high-permeability pathways to contact a large volume of rock. This technology is commonly referred to as hydraulic fracturing, hydrofracking, hydrofrac, or simply fracking and a common acronym now in wide use is HVHF (high volume hydraulic fracturing). Use of the new technology in combination with other factors has created unprecedented demands for new gas wells in the Marcellus Shale formation.

Below the Marcellus Shale formation is the Utica Shale formation. As discussed in Section B above, this formation is considered to have the potential to “become an enormous natural gas resource. Staff of the [New York State Museum](#)<sup>38</sup> have stated that “Gastem has had some recent success drilling vertical Utica wells in Otsego County...[and]...The overlay of Utica and Marcellus fairways create a potential two-for-one opportunity for drilling shale gas.” According to DEC’s well records, one vertical well has been drilled into the Utica Formation in the Town of Cherry Valley in Otsego County and another in the adjoining Town of Springfield. No further information was available at the time this Land Use Analysis was prepared on these two wells, but it is possible that both Marcellus and Utica Shale formations could be exploited either consecutively or concurrently. **While additional gas well development of the Utica Shales is likely in the future, potential build-out of the Utica Shale formation was not included in this analysis. As a result, this build-out analysis understates the overall impact from gas development activities in the Town.**

The Revised dSGEIS states that the DEC has received applications for permits to drill horizontal wells to evaluate and develop the Marcellus and Utica Shales for natural gas production. The document estimates that DEC may receive applications to drill approximately 1,700 - 2,500 horizontal and vertical wells for development of the Marcellus Shale alone during a “peak development” year and an average year may see 1,600 or more permit applications.

While it is unknown at this time how many permit applications will be filed with the DEC and approved within the Town of Bethel, it is possible to conduct a build-out analysis to determine the potential rates and densities of natural gas well development that the Town could see in the coming years in the Marcellus Shale formation. Build-out is a planning tool that estimates the impact of cumulative development upon a community’s land areas once all of the potentially developable land has been converted to the use or uses under study. No attempt has been made to conduct a build-out for other heavy industrial activities since none of these uses are currently in as high demand as natural gas development. This does not mean that they will not be developed in the Town in the future, absent amendments to the Town Zoning Law, just that any exercise aimed at estimating the extent to which heavy industries like gas processing plants, chemical or other similar operations would become established in the Town is highly speculative at this time.

With Sullivan County positioned well in relation to Interstate 86 (i.e. the former Route 17) and with good access to markets in the Northeastern Megalopolis, industrial growth in the future is possible. In fact, the presence of natural gas in the Marcellus and Utica Shale formations could induce new industrial development in the region, including Bethel, for support industries or other heavy industries that rely on the use of fossil fuels as illustrated in the photo of a Gas Processing Plant (by Halliburton) in the Burnett Shale region of north Texas.



The build-out provides a peek into the future by examining probable future gas development intensities and patterns. It helps residents and Town officials to envision the extent of gas development activities from HVHF operations. **The primary issue to consider, in light of the expected demand for gas drilling in Bethel illustrated by this build-out analysis, is whether the community priorities to sustain farmland, to preserve water resources, to nurture the tourism and second home industries and to preserve important aesthetic, recreational and historical characteristics can be realized if the scenarios presented come to fruition.** New York State Town Law has delegated to local government “*the authority and responsibility to undertake town comprehensive planning and to regulate land use for the purpose of protecting the public health, safety and general welfare of its citizens.*” [§ 272-a.1(b)].

Some argue that New York State’s Oil, Gas and Solution Mining Law supersedes “*all local laws or ordinances relating to the regulation of the oil, gas and solution mining industries.*” Gas companies are arguing in court that a prohibition on gas drilling is a “regulation” of gas drilling and is preempted. If this legal opinion prevails, it is likely that local zoning in New York State could not affect gas development activities. The build-out analysis assumes that gas wells could be developed virtually anywhere it would be allowed by the State DEC unless the lands were already developed or were protected by, for instance, a conservation easement.

However, others including the Sullivan County Division of Planning and Environmental Management, the New York City Bar Association and numerous lawyers and law firms, also argue that prohibiting gas development is not a “regulation” of the industry; this is the path that Bethel has taken. As of December of 2011, at least 70<sup>39</sup> New York cities, towns, villages and counties, seeking to limit HVHF, have already taken action. More are proposing to do so or are studying the issues. There are strong legal opinions that local government has the authority to do so as discussed further below.

If natural gas and other heavy industrial uses were to become established in the Town, then farmland, forests, scenic areas and historical resources are likely to disappear and many environmental resources will potentially become polluted or otherwise adversely affected and/or degraded. Water quality of the 27 lakes, ponds and reservoirs in the Town as well as of the Mongaup River, its tributaries, the Ten Mile River and its tributaries, principal aquifers and wetlands will potentially become polluted based upon what is known about the unavoidable adverse impacts of HVHF, unless changes are made to the Town's land use controls.

If examined in isolation, the risks and impacts from one individual well, may not be significant, but once examined cumulatively, the overall effect on the Town is significant and may be unacceptable. The build-out analysis can assist residents and decision-makers in understanding, ahead of time, the impacts heavy industrial activities can have on the community. It identifies the potential number of wells, the amount of water consumed, wastewater (flowback) generated, chemicals used, the number of acres of farmland and forests which will be converted or impacted, the number of truck trips made on local roads, potential employees needed for each well by heavy industrial uses like gas drilling and production in the future. This information can be used by Town officials to estimate the infrastructure that may need to be built, expanded or improved to accommodate the growth of industrial development. This includes the secondary growth needed by employees of the companies that attempt to develop new wells, the need to construct or reconstruct Town roads and bridges that are capable of accommodating the truck loads of 80,000 pounds or more (rigging equipment can be as heavy as 100,000 pounds) and can help Town officials and others quantify the services required by local government. The build-out analysis also helps in the selection of policy alternatives to determine whether or not to accommodate the anticipated new industrial development.

The steps to undertaking the build-out analysis are relatively straightforward. First, lands that are not suitable for gas well development, such as State parkland, are deducted from the overall Town gross acreage. While there is no regulatory prohibition on gas well development in State parks, the Revised dSGEIS states that *"Surface disturbance associated with high-volume hydraulic fracturing would not be allowed on State-owned lands administered by the Department, including but not limited to State Forests and State Wildlife Management Areas, because it is inconsistent with the suite of purposes for which those lands have been acquired. Current Office of Parks, Recreation and Historic Preservation (OPRHP) policy would impose a similar restriction on State Parks."* There is one State Park in Bethel, Lake Superior State Park and the acreage in the Town is 1409 acres. There are also hunting club lands in the Town but these were included since they are privately owned and are not currently protected. In fact, one of the parcels leased to a gas company in the Town is owned by the Excelsior Sportsmen's Club.

According to the New York State Museum's [Reservoir Characterization Group](#)<sup>40</sup> (for petroleum) there is *"Great potential for natural gas production in Marcellus and Utica Shales."* However, due to the recent dramatic increase in use of the Marcellus Shale just the past few years (primarily in Pennsylvania and other states without a moratorium on horizontal drilling combined with hydraulic frac-

turing like New York), there is little information that would allow for a characterization of the specific factors that can be used to estimate full build-out of gas production in Bethel. Therefore, build-out analysis conducted by others has been relied upon to develop the assumptions applied in this analysis of the Town of Bethel.

This includes the analysis conducted by the New York City Department of Environmental Protection (NYC-DEP), for its water supply watershed in the [Final Impact Assessment Report](#)<sup>41</sup> prepared by Hazen and Sawyer in December 22, 2009. This study was relied upon to develop reasonable assumptions that could apply to Bethel. The assumptions generated by the DEC in their Revised dSGEIS document, to estimate the number of well pads per square mile and other relevant factors, were used to estimate the potential for well development in the Town. The Nature Conservancy, in cooperation with Audubon Pennsylvania conducted a study of the impacts on forests, based upon before and after aerial photographic comparisons of gas well developments in Pennsylvania. The Nature Conservancy's report is entitled [Pennsylvania Energy Impacts Assessment Report 1: Marcellus Shale Natural Gas and Wind \(November 15, 2010\)](#)<sup>42</sup> and it was relied upon to assess the potential impacts on forests in the Town both directly (i.e. acres of land disturbed) and indirectly (i.e. acres subject to "edge effect" alteration).

The three studies used in developing the Bethel build-out, including the NYC-DEP [Report](#), the DEC's Revised dSGEIS document, and TNC [Report](#), reviewed shale gas formations around the country that have similar high potential for gas production as the Marcellus. Many of the locations used in developing multipliers and the other factors used in calculating the build-out numbers were for similar rural areas. Readers are encouraged to examine the information used by those agencies in applying the baseline multipliers and other measurement standards used by these sources and by this analysis.

The Marcellus formation is an extensive resource that occurs beneath much of the State and it has been estimated by the DEC that it will require tens of thousands of wells to fully exploit. As such, cumulative impacts from many wells constructed throughout the Town and the Region must be evaluated in order to fully characterize the potential risk from both concurrent and consecutive activities at multiple locations. This Land Use Analysis only attempts to answer the question of how much of an impact gas development will have on the Town of Bethel. The well build-out density in the Town has been combined with quantitative estimates for various activities associated with each well to develop cumulative values. **The analysis is designed to assess gas well development taking place at one point in time and space. It is not a prediction, per se, of what will occur at any particular time. For policy-makers however, it shows the consequences of taking no action to change the Town's land use controls.**

The entire process of gas well development, from site development through completion, takes approximately four to ten months for one well. Multiple horizontal wells may be drilled from one common well pad or numerous well pads. The DEC assumes in the Revised dSGEIS that most HVHF will occur on multi-well pads. One multi-well pad can accommodate eight or twelve differ-

ent wells and can recover the natural gas from a spacing unit covering a maximum of one square mile (640 acres). New York State requires that all wells from a pad must be drilled within three years of the first well, so well pad sites will likely experience a relatively high and constant level of heavy industrial activity for at least one and up to three years.

**The build-out estimated 629 wells could be developed in Bethel.** They could be drilled in a relatively intensive but short period of time or could be drilled over a period of generations as all areas in the Town that are potentially available for drilling are pursued by the gas industry. In addition, the HVHF process can be repeated multiple times over the life of a well (i.e. refracking) to restore declining gas production rates. According to Halliburton (one of the world's largest providers of products and services to the gas industry), *"It has been established that only 10% of GIP [Gas In Place] is recovered with the initial completion. Refracking the shale can increase the recovery rate by an additional 8% to 10%. Simple re-perforation of the original interval and pumping a job volume at least 25% larger than the previous frac has produced positive results in vertical shale wells."* Schlumberger, an oilfield services company for the oil and gas industries, states that *"Shale gas wells don't come on as strong as tight gas, but once the production stabilizes, they will produce consistently for 30 years or more."* Thus, the true impacts of each well that is drilled can be felt for decades as the gas resource is fully exploited. Readers should also carefully note the exclusion of wells drilled into the Utica Shale formation, which may create an additional heavy industrial demand in the Town for generations.

### **Build-out Analysis Assumptions**

The following assumptions were adapted from the research methodologies adopted by:

- ▶ The City of New York in its Final Impact Assessment Report prepared by Hazen and Sawyer in December 22, 2009
- ▶ The New York State Department of Environmental Conservation in its September 7, 2011 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 Gas Reservoirs
- ▶ The Pennsylvania Energy Impacts Assessment Report 1: Marcellus Shale Natural Gas and Wind by The Nature Conservancy and Audubon Pennsylvania
- ▶ The Manual of Build-Out Analysis by the Center for Rural Massachusetts at the University of Massachusetts at Amherst.

**Infill wells.** This analysis does not include the development of additional infill wells that can be drilled. Infill wells, resulting in more than one well per 40 acres or other spacing requirement of

the Environmental Conservation Law, may be drilled upon justification to the DEC that they are necessary to efficiently recover gas reserves. The gas industry refers to this as “downspacing” and it is a technique that is widely used in other gas formations around the nation. According to Oil and Gas Investor, “As plays become further developed and the reservoir is better understood, downspacing begins.”

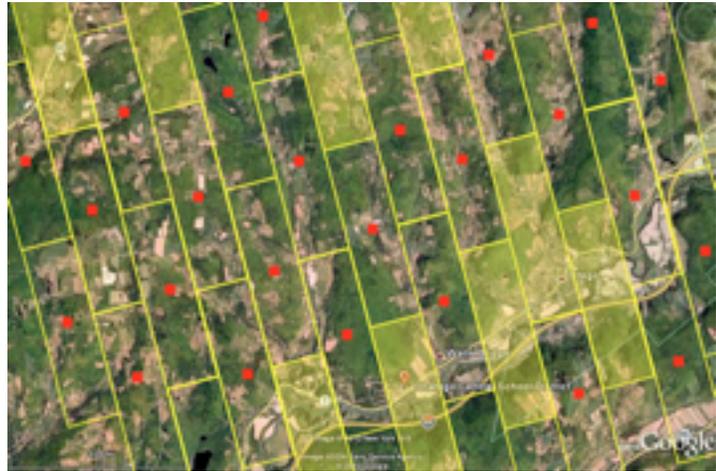
**Utica Shale and Other Gas-Bearing Formations.** This analysis has not included future development of the Utica Shale formation for natural gas since not enough information is known today about the full extent of the resource available. It is also important to note that the well spacing assumptions discussed below are not applicable when wells are drilled into different gas-bearing formations such as the Utica Shale.

**Potential Developable Land Area.** The Town of Bethel is the third largest town in land area in Sullivan County. There are a total of 57,593.59 acres (or 89.98 square miles) in the Town. Lake Superior State Park consists of 1,409 acres in the Town. This area was excluded from the analysis. There are other publicly owned lands in the Town but currently, it is unknown whether such lands could be leased to a gas company. Therefore, they have been included in the analysis. Other lands that have been excluded from the analysis include those identified in the Town’s 2006 Comprehensive Plan as Airport, Commercial, farmstead, industrial, institutional, residential, and water. Together, these lands comprise 8,773.72 acres. It is possible that some of the acreage of these latter land uses could be developed for gas development in the future but to remain conservative, they have been excluded from the build-out. This could occur especially since the State has proposed continuing its established setback to private residences at 100 feet and there is no setback distance to industrial and most other non-residential uses. The State has proposed prohibiting gas development in some sensitive areas like floodplains, and even though floodplains are located in Bethel, such areas do not constitute a significant percentage of the Town’s land area, as shown on the Buildout Environmental Constraints Map in the Town’s Agriculture and Farmland Protection Plan. Thus, the overall Town acreage that was excluded from the analysis is 10,182.72 acres which, as discussed above, is likely an understatement of those areas that could be subject to gas development activities. There may be additional areas within the Town that could be excluded from gas development activities, because they are encumbered with conservation easements. However, it is unknown to what extent compulsory integration could conflict with lands subject to a conservation easement.

The NYC-DEP Report, in conducting their potential build-out of the New York City Watershed lands in the Catskills, first established a reasonable land area that may be subject to gas leases by gas companies. The NYC-DEP analysis, for comparison purposes, used Bradford County, Pennsylvania with a population density of 54 persons per square mile, as roughly comparable to the Catskill Watershed’s population density. Bradford County, to date, has experienced mineral leasing of about 85 percent of their total land area and so the NYC-DEP conducted their build-out of the Catskill Watershed using the 85 percent factor to estimate the land area that could potentially be leased in the Watershed. Even though Bradford County’s population density is greater than Bethel’s 47 persons per square mile, if this rate of leasing activity (i.e. 85%) were to occur in Bethel, a

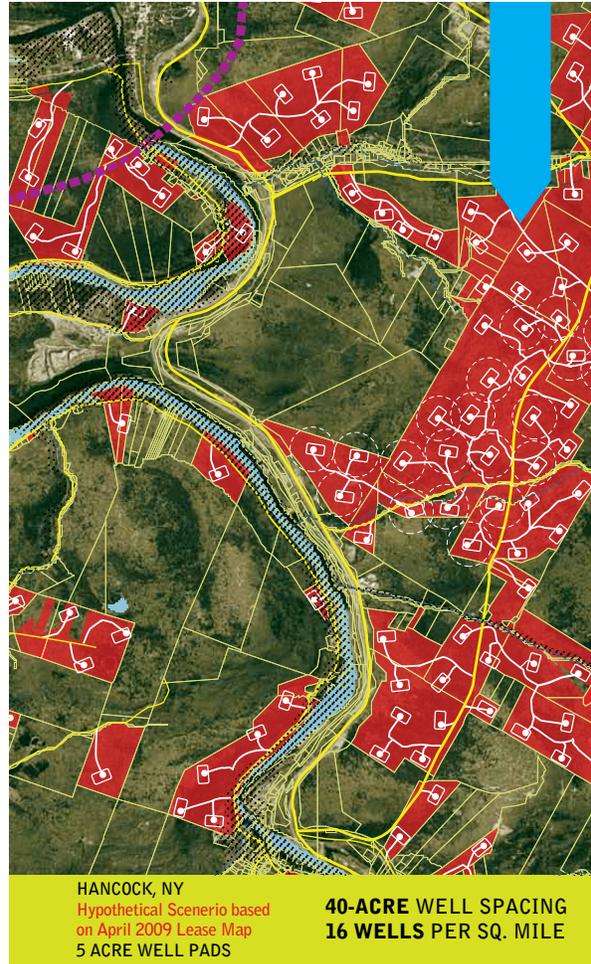
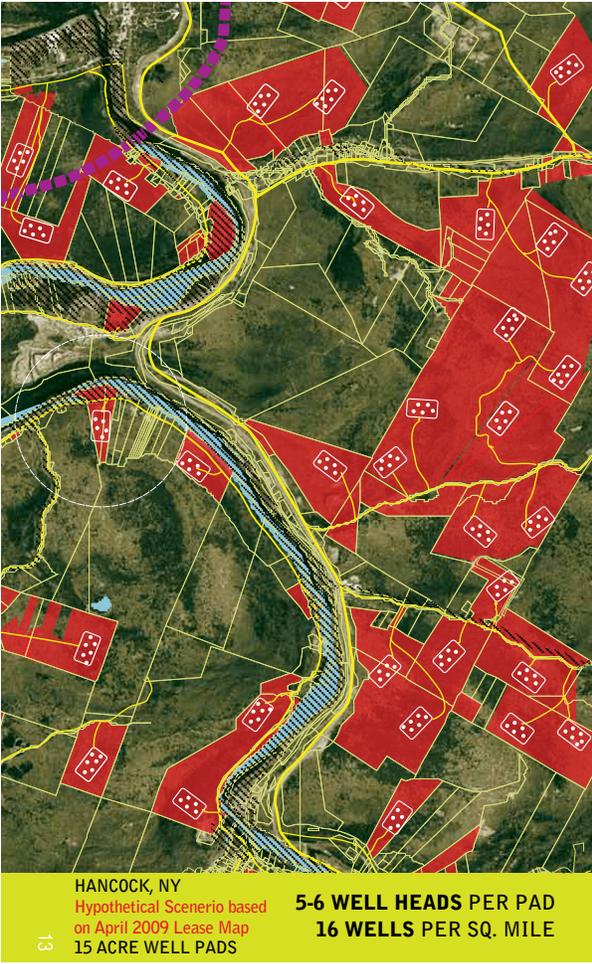
total of 40,299.23 acres (62.96 square miles) of land would potentially be available for natural gas development (i.e.  $57,593.59 - 10,182.72 = 47,410.87 * 0.85 = 40,299.23$  acres). This build-out analysis has used the 85 percent rate to estimate the total land area in Bethel that could be available if landowners were willing to enter into lease arrangements. The 85 percent rate is reasonable because Bethel is a rural town, with a population density of 47 persons per square mile and the predominant features are farms (5,798.07 acres), forests (40,614.35 acres), with a scattering of residential and non-residential development.

**Well Density.** New York State regulations allow up to 16 wells per square mile. This equates to 16 wells per 640 acres or 1 well per 40 acres. The US Energy Department has stated that “*average well spacing in the Marcellus is 40 to 160 acres per well.*” The DEC’s Revised dSCEIS indicates a lower density, approximately six to nine wells per square mile. Well densities to date in excess of three wells per square mile in other areas have been documented from shale gas plays with significantly higher localized densities. For example, Denton County, TX has a well density of 5.5 wells per square mile over approximately 400 square miles (40 percent) of the county’s land area. It has not been established that these areas have been completely developed so higher gas well densities are likely. Similarly, annual well completion rates in excess of five wells per square mile have been documented, and permit applications suggest that these rates could be higher also.



The Google Earth aerial photo above was prepared by Tony Ingraffea,<sup>43</sup> a Professor in the School of Civil and Environmental Engineering at Cornell University. It shows an overlay with the “ideal” well spacing (red dots) for a location in southern Sullivan County. According to Dr. Ingraffea, a **minimum** of eight wells per square mile will be needed to maximize gas recovery. This build-out analysis assumes that a well density of 10 wells per square mile could be developed in the future, which is less than the 16 permitted by the State. **This would equate to development of 629 wells on 63 well pads in Bethel** into the Marcellus Shales formation.

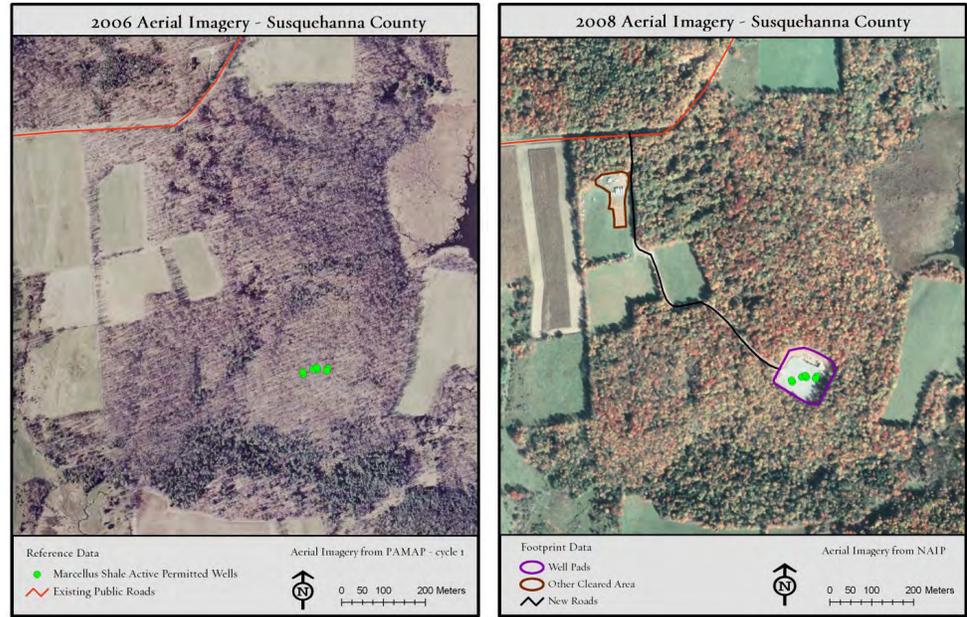
A visual build-out (shown in the following figures) was conducted for the Town of Hancock in Delaware County. While this level of gas well development may not occur in Bethel, the two images illustrate the results of visualization efforts in a similar community. The Hancock analysis assumes 16 wells per square mile, which is permitted, unless downspacing occurs as described above or unless additional wells are developed on the well pads to extract natural gas from the Utica Shale formation.



**Future Development Scenario.** This build-out analysis was conducted assuming that 85% of the Town’s available land area (i.e. minus protected lands and developed lands) could be leased, as has occurred in Bradford County, PA. This estimate is based on the best available data on industry intent for developing the resource in conformance with New York State regulations at this time, and presents a development scenario within the Town that is consistent with that observed in other areas like Bradford County. Bradford County is located approximately 60 miles from Bethel.

**Farmland and Forestland Acreage.** The Town Comprehensive Plan was used to calculate the number of acres of farmland in the Town. Based upon the data, the number of acres of farmland in Bethel is 5,798.07 acres or 17 percent of the Town’s land area. Forestland was calculated from the Town Comprehensive Plan as 40,614.35 acres or 70 percent of the Town’s land area. It should be noted that the Town’s Agriculture and Farmland Protection Plan calculates the amount of farmland in the Town at 10,141 acres, based upon assessment data. Since the lower figure has been used, the impact on agriculture may be understated.

As shown in the illustrations, The Nature Conservancy used aerial photographs from before and after development of a Marcellus gas well pad site in Susquehanna County, PA. to assess the impacts of this type of energy development. The Nature Conservancy digitized the spatial footprint of



242 gas well pad sites and associated infrastructure. According to The Nature Conservancy, “well pads occupy 3.1 acres on average while the associated infrastructure (roads, water impoundments, pipelines) takes up an additional 5.7 acres” or a total of 8.8 acres per well pad. This figure corroborates the 8.8 acre figure used by the DEC in its Revised dSGEIS, which calculated 5.12 acres for the well pad development and 3.68 additional acres for utilities and other infrastructure. The 8.8 acre figure may be an understatement of the area of site disturbance that can be expected for each gas well, depending upon numerous other factors such as accidents. According to the US Forest Service’s General Technical Report NRS-76 “Probably the most severe, and certainly the most dramatic, of the unexpected impacts are related to the drilling and hydrofracking fluids. Because there was no brine indicated within the geology of the well site, the risk to vegetation was assumed to be minimal. However, obvious and measurable damage to vegetation did occur from these fluids at three different locations . . . These symptoms were attributed to a loss of control of the drill bore on May 29, 2008, resulting in an aerial release of materials that drifted over areas immediately adjacent to the well pad and drill pit.”

Adjacent lands can also be impacted, even if they are not directly cleared. This is most notable in forest settings where clearings fragment contiguous forest patches, create new edges, and change habitat conditions for sensitive wildlife and plant species that depend on “interior” forest conditions. Forest ecologists call this the “edge effect.” While the effect is somewhat different for each species, research has shown measurable impacts often extend at least 330 feet (100 meters) from forest adjacent to an edge.” To assess the potential interior forest habitat impact, the build-out analysis assumes a 330 foot buffer into forest patches from new edges created by well pad and associated infrastructure development. For those well sites developed in forest areas or along forest edges (about half of the assessed sites), an average of 21 acres of interior forest habitat was lost.

**Water Consumption.** The volume of water required to fracture a horizontal well depends on a variety of factors, including characteristics of the target formation, the length of the lateral, and fracture goal. The photo to the right from Tioga County, PA by Dick Martin ([www.PaForestCoalition.org](http://www.PaForestCoalition.org)) shows a water impoundment holding 14.5 million gallons of water. Industry data cited in the DEC's Revised dSGEIS indicates that on the order of 3,000,000 to 8,000,000 gallons of water may be required to fracture a single horizontal well in the Marcellus formation. Professor Tony Ingraffea of Cornell University has stated that Chesapeake Energy is averaging 5.5 million gallons of water per well in Pennsylvania's Marcellus Shale play. Nevertheless, the NYC-DEP in their build-out of the Catskill Watershed assumed an average of 4,000,000 gallons of water would be consumed per well. This analysis uses the assumption that 5,000,000 gallons of water will be needed to develop each new horizontal well.



**Chemical Use.** Water and sand use have been reported by the gas industry and the US Department of Energy to comprise 98 to 99.5 percent of the fracturing fluid mixture, with the remaining 0.5 to 2.0 percent consisting of an array of chemical additives used to control fluid properties during the various stages of the fracking process. Though the proportion of chemicals in fracturing fluid is low relative to the large amounts of water required by the fracturing process, meaningful assessment of potential water quality impacts requires that chemical additives be expressed on a mass basis. This is especially important due to the toxicity of the chemicals used, as described below in the section on Water Resources. The 167 tons (334,000 pounds) of chemicals used per well figure cited by the NYC-DEP has been assumed in this analysis.

**Flowback.** After the hydraulic fracturing procedure is completed and pressure is released, the direction of fluids pumped into the well reverses and a significant flow comes back to the surface. The process and the returned chemical and water mixture are referred to as "flowback." According to the DEC's Revised dSGEIS, "Flowback water recoveries reported from horizontal Marcellus wells in the northern tier of Pennsylvania range between 9 and 35 percent of the fracturing fluid pumped. Flowback water volume, then, could be 216,000 gallons to 2.7 million gallons per well." The NYC-DEP Report cites a flowback volume of 400,000 to 2,800,000 gallons per well and for purposes of their build-out analysis, the NYC-DEP Report uses an average of 2,000,000 gallons of flowback to the surface. This analysis assumes that 20 percent of the water injected into the well will return to the surface as flowback or 1,000,000 gallons per fracturing. This flowback water and chemical mixture has been found to include not only the chemicals pumped into the well but it also contains heavy metals and radionuclides found in the bedrock that are released during the

HVHF process. According to the U.S. Geological Survey, a typical 3 million gallon hydrofrac produces 15,000 gallons of chemical waste. In existing Marcellus wells outside of New York this waste is stored on-site in large holding ponds to evaporate, be land spread if legal, or until trucks haul it to other locations, for processing and disposal, where suitable facilities exist. The flowback fluids must be contained and are subject to treatment and sometimes reuse. There are currently no sewage treatment plants in Sullivan County that have the ability to accept flowback.

**Truck Trips.** Development of natural gas resources are accompanied by a significant increase in the level of heavy truck traffic compared to current conditions. The DEC's Revised dSCEIS estimates the number of truck trips per well at roughly 900 to 1,300, approximately two-thirds of which are for water and flowback hauling. The NYC-DEP Report cites a range of 800 to 2,000 truck trips per well and for purposes of their build-out analysis, the NYC-DEP Report uses (and this analysis will assume) an average of 1,200 one-way truck trips per well. At key intersections in the Town, trips would be doubled for one loaded trip and one empty truck trip or a total of 2,400 trips per well. The trucking estimates do not account for truck trips through the Town that are generated in surrounding towns and counties as a result of HVHF activities in those locations.



Photo by Halliburton of a well pad in Burton, TX.

**Employment.** James Ladlee, Director of Penn State Cooperative Extension's Clinton County office and Larry Michael, Executive Director of Workforce and Economic Development at Pennsylvania College of Technology, have estimated the creation of Marcellus Shale jobs involving the development of the well pad itself. Several studies, including theirs, have found roughly the same statistic: statewide in Pennsylvania, preparing, drilling and beginning the production of a Marcellus Shale well will require the equivalent of 11 to 13 full-time jobs per well. This doesn't mean that

only a dozen or so people do all the work. Instead, their study found that, on average, it takes 410 individuals, across 150 different job types from roustabout and truck driver, to roughneck and mud logger to get a well up and running. But nearly all of the workers are only there for a few days or weeks at a time. Adding up the hours, it's equivalent to 11 to 13 people working on one well site for an entire year. This analysis assumes an average of 12 employees per well. These employees will require lodging and services in the community for the duration of the well drilling activity, which has been estimated to last up to three years for one well pad with six to eight wells and from four to eight months per well with one well per pad. Re-fracking of each well must also be accounted for as described above.

**A Final Build-out Analysis Caution.** As Neils Bohr, a Nobel Laureate in Physics once stated, “*Prediction is very difficult, especially about the future.*” This analysis of the extent of heavy industrial growth, principally in the development of natural gas wells, may understate the overall impact that could be experienced in the Town of Bethel. It should not be viewed as a prediction of what will occur but as an exercise that can help residents and decision-makers understand the implications of taking no action to control the possible growth of heavy industrial development that is occurring in other locations with the energy resources identified herein.

The results of the build-out calculations can be found in the following table summarizing several impact categories. The impacts of the build-out will be discussed in detail in the sections that follow the table.

Summary of the Build-out Analysis		
Impact category	Unit of Measure	Build-out Analysis Estimates
Town Area / Build-out Acreage	57,593.59 Acres	40,299.23 Acres
Number of Wells / Pad	10 Wells / 640 Acres	629 Wells
Number of Well Pads	1 Well Pad / 640 Acres	63 Well Pads
Direct Land Disturbance	8.8 Acres / Well Pad	554.4 Acres
Active Farmland Lost	10 % of Town	55.44 Acres
Direct Forestland Lost	70 % of Town	388.08 Acres
Indirect Forestland Impact	21 Acres / Well Pad	926.1 Acres
Water Consumption	5,000,000 Gallons / Well	3,145,000,000 Gallons
Chemicals Used	167 Tons / Well	105,043 Tons
Flowback Wastewater	20% of Water Injected	62,900,000 Gallons
Truck Trips (One-Way)	1,200 Trips Per Well	754,800 Trips
Full-time Equivalent Jobs	12 Per Well	7,548 "Worker Years"

**Note: Total Town Acreage is 57,593.59 acres. Developed or Park lands account for 10,182.72 acres. The remaining area used in the Build-out Analysis assumes that 85 percent of the undeveloped or unprotected areas could be subject to gas development in the future. This is computed as 40,299.23 acres.**

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#### D. Land Resources

In the past, land was viewed largely as a commodity and its only function was to enable the owner to make money. Over the past few decades, that attitude has changed. Many now think that land should only be viewed as a resource rather than a commodity. While this resource view correctly indicates the direction of the changed attitudes, it ignores the constitutional right to own land and to buy and sell it freely. Land must be treated as both a resource and a commodity. Those who view land only as a resource ignore the social and economic impact that would come with any massive restrictions on the free alienability of land. Those who view land only as a commodity ignore the decades of research that now helps us to understand the science of ecology and the benefits, including economic, of protecting nature and natural resources. The commodity view also ignores

the considerable attention that has been afforded to environmental protection and legitimate land use control regulations by the executive, legislative and judicial branches of government.

If local government wants to protect its natural resources, it must also weigh the costs and benefits of doing so. Sometimes, protecting natural resources has obvious benefits. Tourism is driven by those who visit a community because it has protected the unique qualities of its lands, waters, and other important resources. In this context, it makes financial sense to protect land resources to ensure that visitors have a positive experience with nature within their jurisdiction. Why would tourists want to flock to a community that has invested heavily in industrial operations? Many studies have now documented that preservation of natural resources and protection of open space are essential factors in helping a community retain existing jobs and to attract new ones. For instance, the Trust for Public Land in their study The Economic Benefits of Parks and Open Space found that retention of natural amenities are critical to ensuring a higher quality of life and are one of the most important components for attracting both employers and employees. Rural areas with a high quality of life tend to see more growth in small businesses.

The effects of changes in the land use makeup of the Town, if and when natural gas and other heavy industrial uses were to become established, could be dramatic and permanent. These changes were researched and characterized by the DEC in their original 1992 Generic Environmental Impact Statement (GEIS) on the Oil, Gas and Solution Mining Regulatory Program and these characteristics have been updated with the State's 2009 and 2011 Supplemental Generic Environmental Impact Statement documents. Much additional research has been conducted by others since that time.

There have been several sources used to estimate the amount of land necessary for HVHF. The DEC, the gas industry and The Nature Conservancy have each attempted to predict the overall amount of land necessary to conduct HVHF. The majority of the industry's activity centers on drilling individual gas wells for primary production. Gas operations vary in the amount of land used, their effect on local topography and the volume of soil disturbed during construction operations. In 1992, DEC estimated that *"generally access road and site construction disturb less than two acres of land."* In the 2009 and 2011 dSGEIS, the DEC increased their estimates and discussed multi-well pads *"ranging in size from 2.2 to 5.5 acres."* The amount of land necessary for the utility infrastructure to serve the well pad would add 3.68 acres for water and electrical lines, gas gathering lines and compressors. Aerial photographic research conducted in Pennsylvania by The Nature Conservancy has found similar results with well pads disturbing, on average 3.1 acres of land with an additional 5.7 acres devoted to associated infrastructure, such as roads, pipelines, and water impoundments for a total area of disturbance for each well pad of 8.8 acres. For impact analysis purposes, it is reasonable to conclude that slightly less than nine acres of land will be disturbed for construction of a HVHF well pad.

While the DEC estimated that some reclamation of the well pads will occur after the drilling phase, this should be considered only a temporary measure because refracturing of the wells could occur in the future, as discussed above. Halliburton has stated that *“It has been established that only 10% of GIP [Gas In Place] is recovered with the initial completion. Refracturing the shale can increase the recovery rate by an additional 8% to 10%.”* Therefore, this Land Use Analysis advises that for each well pad, it can be expected that up to about eight and eight-tenths (8.8) acres of land will be devoted to gas drilling, fracturing, refracturing and production for a generation or more.

Impacts associated with the siting of well operations are directly related to the location, size and land contours of each well site. The Town of Bethel has varying topography and divergent landforms punctuated with numerous surface water features. Numerous areas of steep slopes, greater than 15 percent, are shown on the Town of Bethel’s Agriculture and Farmland Protection Plan’s Environmental Constraints map. If steep slopes are proposed for HVHF drilling operations, this will involve greater regrading operations than areas with gentle slopes because a relatively flat site is required in order to accommodate the industrial operations.

Direct impacts of well pad development are virtually the same as those for all other earth moving and construction operations. Vegetation is removed, soil is regraded to accommodate the infrastructure, and then stabilized with structures or by other means. The regrading of land and conversion of soils to infrastructure uses unavoidably alters the natural soil profile. Some areas not needed permanently will be reclaimed under State regulations. However, areas that will be permanently altered for access, gas production, and gas transmission, including sufficient areas needed for refracking operations in the future, will also result in a permanent visual alteration in the Town’s landscapes. This would lead to an unavoidable impact on both land and aesthetic resources.

The build-out analysis estimated the total land area in the Town that will be directly impacted as a result of gas well development would be 554.4 acres. The direct impacts on land stem from regrading for construction of the well pad itself including accommodating drilling rigs and auxiliary equipment such as tanks or ponds (for water, fuel, chemicals, and wastewater), generators, compressors, solids control equipment (shale shaker, de-silter, de-sander), choke manifold, accumulator, pipe racks, office space, equipment maneuvering areas and other associated facilities. Roads to access well and other sites must be built, and accidents involving chemical spills as well as trucks transporting fluids and other materials increase the risk of soil contamination. In the case of heavy industry, typically raw materials must be transported away from the site for processing elsewhere. In addition to the drilling and extraction operations, the gas products must be transported. The transmission requires the construction of gathering lines, transmission lines and compressor stations, all of which can adversely impact land and other resources. The long-term adverse envi-

ronmental impacts on a property from the drilling operations will remain well into the foreseeable future.

Erosion and sedimentation result largely from site preparation and include grading operations, which often involve a failure to install erosion control measures properly. Regardless, erosion and sedimentation is unavoidable when a site is constructed in steep slope areas. Vegetation losses are unavoidable as described below. Every site must be stripped of vegetation and long-term vegetation losses are most severe when an operator fails to properly segregate topsoil from other excavated material. Topsoil takes hundreds of years to form and its loss can have serious long term impacts on the land's ability to support crops and other vegetation. Persistent erosion can also result in significant changes in the landscape. The potential for accelerated rates of erosion continues long after the construction activities are completed. When the topsoil is not set aside and redistributed properly, the topsoil layer can become buried, effectively sterilizing surface soils.

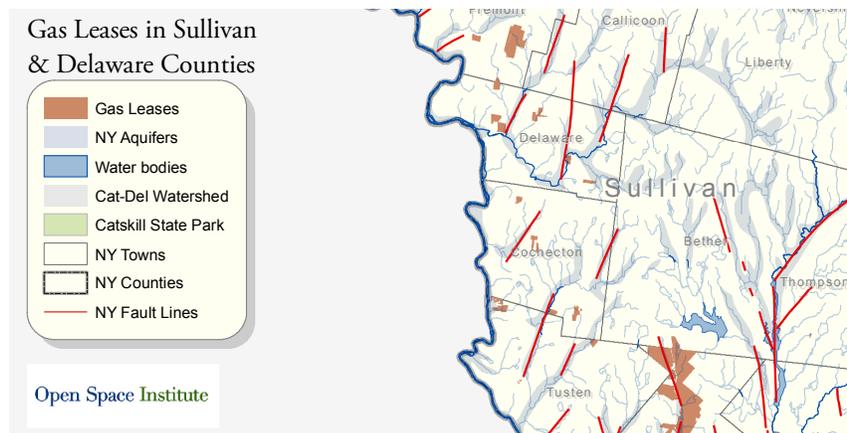
Negative environmental impacts on soil also result from accidental spills of oil, brine or chemical materials used by heavy industry or involved in drilling and production of gas wells. More than one of six wells can be [expected to leak fluids](#)<sup>44</sup> to surrounding soils according to Ronald E. Bishop, Ph.D., CHO of the Chemistry & Biochemistry Department at the State University of New York, College at Oneonta. Depending upon the type and amount of material spilled, the contaminated soil may be unable to support vegetative growth. Brine and other waste fluids high in salt can kill vegetation and retard growth for years. Similarly, oil and other petroleum products, such as diesel fuel used by machinery and in the fracking process itself, when spilled on the ground surface, can kill plants and retard new growth. With the exception of potential soil contamination from industrial activities like gas development, it should be noted that all land development activities requiring vegetation removal, regrading and then stabilization with structures, like residential or commercial development, can have similar long-term impacts on land.

The HVHF process produces drill cuttings, which are considered solid wastes. Cuttings may be managed within a closed-loop tank system or within a lined reserve pit on the site. The DEC has proposed allowing disposal of cuttings from drilling processes that use only air and/or water on-site, at construction and demolition (C&D) debris landfills. Cuttings from processes that use any oil-based or polymer-based products could only be disposed of at a municipal solid waste (MSW) landfill. The Revised dSGEIS proposes to require that a closed-loop tank system be used to manage drilling fluids and cuttings for horizontal drilling where: 1) there is no acceptable acid rock drainage (ARD) mitigation plan for on-site cuttings burial; and 2) for cuttings that, because of the drilling fluid composition used must be disposed off-site, including at a landfill.

The State's Revised dSGEIS states that *"There is a reasonable base of knowledge and experience related to seismicity induced by hydraulic fracturing. Information reviewed indicates that there is essentially no increased*

risk to the public, infrastructure, or natural resources from induced seismicity related to hydraulic fracturing. The microseisms created by hydraulic fracturing are too small to be felt, or to cause damage at the ground surface or to nearby wells. Accordingly, no significant adverse impacts from induced seismicity are expected to result from high-volume hydraulic fracturing operations.” However, there have been reports of HVHF causing seismic activity and geologists have not yet reached a consensus about the issue. Reuters reported on [November 1, 2011](#)<sup>45</sup> that “Cuadrilla Resources on Wednesday said shale gas exploration work probably triggered minor earthquakes at its drill site near Blackpool in northwest England earlier this year. ‘It is highly probable that the hydraulic fracturing of Cuadrilla’s Preese Hall-1 well did trigger a number of minor seismic events,’ a report commissioned by the company said.” Other news sources, as well as the [US Geological Survey](#),<sup>46</sup> have reported or confirmed the possibility that earthquakes have been caused by human activity. These include [Oil Price Watch](#),<sup>47</sup> [NY Times](#),<sup>48</sup> [Wall Street Journal](#),<sup>49</sup> [Fox News](#),<sup>50</sup> [Power Magazine](#),<sup>51</sup> and [others](#).<sup>52</sup> Both the U.S Army Corps of Engineers and the U.S. Geological Survey, after fifty years of [research](#),<sup>53</sup> confirmed on a federal level that that “fluid injection” introduces subterranean instability and is a contributory factor in inducing increased seismic activity. Fluid injection at the Rocky Mountain Arsenal near Denver, Colorado, is believed to be the cause of a 1967 magnitude 5.5 earthquake. The Cuadrilla Resources reported earthquakes are considered “minor” at 2.3 and 1.5 on the Richter scale and there were 48 other smaller events reported at the Preese Hall-1 well. For comparison, the August 2011 earthquake centered in Louisa County, Virginia, measured 5.8 on the Richter scale. It was felt across New York and more than a dozen other states and in several Canadian provinces.

While the DEC dismisses the potential seismic activity as “too small to be felt, or to cause damage at the ground surface or to nearby wells.” some [geologists](#),<sup>54</sup> that have conducted [research](#)<sup>55</sup> into the issue for more than a decade, have concluded otherwise and experts in Central New York have developed [educational materials](#)<sup>56</sup> to explain how induced seismicity can occur. Local officials, gas drillers, and the DEC should be aware of the geological fault lines that exist in Bethel. These can be seen on the map created in 2008 by the Open Space Institute based upon Sullivan County Planning Department data and mapping.



The Revised dSGEIS states that “The Department proposes to require, as a permit condition, that the permittee demonstrate that it has a source to treat or otherwise legally dispose of wastewater associated with

flowback and production water prior to the issuance of the drilling permit. Disposal and treatment options include publicly owned treatment works, privately owned high volume hydraulic fracturing wastewater treatment and/or reuse facilities, deep-well injection, and out of state disposal. [emphasis added] Deep well injection associated with HVHF was implicated in earthquakes in December 2011, measuring 2.7 and 4.0 on the Richter scale, in [Ohio and other locations](#).<sup>57</sup>

Bethel's proposed Zoning Amendment, that would result in prohibition of natural gas and other heavy industrial uses would in turn lead to the elimination of the impacts identified herein as a result of HVHF build-out activities.

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## E. Water Resources

*"Water promises to be to the 21st century what oil was to the 20th century:  
the precious commodity that determines the wealth of nations."*

(Fortune Magazine, Shawn Tully, May 15, 2000)

According to the DEC's Revised dSGEIS, "*New York City & Syracuse Watersheds: As the only unfiltered surface supplies of municipal water in the state, these watersheds are unique and deserve special protection to maintain their EPA Filtration Avoidance Determinations. Industrial activity, such as increased truck traffic, could impact these determinations. Losing this designation would mean New York City and Syracuse would be required to spend billions of dollars to build water filtration plants. Therefore, high-volume fracturing will be prohibited within these watersheds, within 4,000 feet of their boundaries and within 1,000 feet of NYC's sub-surface water supply infrastructure unless approval is granted after site-specific review.*" Prohibiting high volume hydraulic fracturing (HVHF) for shale gas in the New York City and Syracuse watersheds, because they are unfiltered sources of drinking water, only makes sense when other equally important water resource areas are treated similarly. Unfiltered groundwater is the source of drinking water for about 80 percent of Bethel's residents, including those with individual groundwater wells. According to [Robert W. Howarth](#),<sup>58</sup> The David R. Atkinson Professor of Ecology & Environmental Biology at Cornell, "*Given the likely spacing of wells within New York State should shale gas be developed, the majority of private drinking water wells in gas development areas seem likely to be contaminated.*" While some may consider this to be an overstatement, spills, accidents and malfunctions are likely to result in surface and groundwater contamination incidents, based upon the experiences of other regions with HVHF. However, there is a consensus of a significant number of scientists, physicians and engineers with Dr. Howarth's warnings, as evidenced by the 58 signatories to a [letter to Governor Cuomo](#)<sup>59</sup> addressing the issue.

The other 20 percent of Bethel's residents rely on community water supply systems that normally provide some level of filtering and/or treatment. However, community water filtration systems are not designed to remove the range of toxins found in typical HVHF water contamination (such as methane, benzene and other volatile aromatic hydrocarbons, surfactants and organic biocides, barium and other toxic metals, and soluble radioactive compounds containing thorium, radium, and uranium). The consensus of many scientists, physicians and engineers are that municipal filters are not [effective](#)<sup>60</sup> for protecting public health against these contaminants. The very basis of the State's proposal to prohibit HVHF in locations where unfiltered water is sourced, but allowing it in areas with filtered water systems or unfiltered groundwater wells, is potentially flawed.

The Revised dSGEIS emphasizes the risk of spills and surface water contamination from trucking accidents in unfiltered drinking water supplies. There are other sources of contamination from HVHF than trucking accidents. A significant portion of the water and chemical solution used to fracture the shale returns to the surface, first as flowback and then as production brine, both classified by DEC as non-hazardous industrial wastewater. Both liquid wastes are referred to herein as wastewater, although they may be regulated differently by the DEC. Nevertheless, thousands of flowback and production brine leaks and spills have been documented in the span of just a few years and they are unavoidable regardless of the proposed mitigation measures.

The DEC has estimated that it may receive an average of 1,600 applications for gas wells per year in the Marcellus Shale region over a 30 year period. This estimate, if it proves to be accurate, could result in 48,000 new gas wells in the Marcellus Region over the next 30 or so years. According to Ronald Bishop, Ph.D, CHO of the Chemistry and Biochemistry Department at the State University of New York, College at Oneonta, if future impacts may be inferred from historical performance, then the cumulative chemical and biological impacts from the gas industry in New York may be predicted for projects of any scope by combining incident statistics with documented health and environmental impacts. Dr. Bishop has [researched](#)<sup>61</sup> incident statistics and inferred that 10,000 gas wells would produce sediment run-off into nearby waterways of at least 80,000 tons per year. Such a level of gas well development would reasonably be expected to generate about 1,200 citations for serious regulatory violations and at least 200 incidents of groundwater contamination in the short term. Over a century, about 1,600 leaking gas wells should be anticipated. Based upon these estimates, the number of expected incidents that may be expected in the Town of Bethel and the Marcellus Shale region (from DEC estimates) are shown in the table below.

<b>Ronald Bishop, Ph.D, CHO - SUNY/Oneonta            Chemistry Biochemistry Department Analysis</b>			
<b>Chemical/Biological            Risk Assessment            Data</b>	<b>For Each 10,000            wells</b>	<b>Estimated Bethel            Buildout of 629            Wells</b>	<b>DEC Marcellus            Shale Estimated            Wells - 48,000 Over            30 Years</b>
Sediment Runoff to Waterways (tons/year)	80,000	5,032	384,000
Citations for Serious Regulatory Violations	1,200	75	5,760
Incidents of Groundwater Contamination	200	13	960
Number of Leaking Wells	1,600	101	7,680

Disposal of flowback is expected to be largely to surface waters through publicly owned sewage treatment plants (POTW). POTW’s “industrial pretreatment” permit requirements may have been designed to prevent “pass through” of pollutants, but many HVHF pollutants are hazardous, like benzene, heavy metals, radioactive materials and some of the 632 chemicals and other components used in HVHF. These substances were not likely to be in the wastestream when POTW permits were issued and such POTWs were not designed to treat them. According to the DEC, “there is questionable available capacity for POTWs in New York State to accept high-volume hydraulic fracturing wastewater.” Until POTWs or other wastewater disposal options are available, flowback disposal is an issue whether it involves filtered or unfiltered public water supply sources. Community water supply systems, like the Bethel Water Company, cannot remove dissolved contaminants. If HVHF flowback is discharged in the watershed, these dissolved contaminants have the potential to find their way into community water supply systems.

Production brine disposal options were discussed in the 1992 GEIS and these include injection wells, treatment plants and road spreading for dust control and de-icing. Any applicant for a permit to use production brine for road spreading must submit a petition to the DEC for a beneficial use determination (BUD). The DEC has stated in the Revised dSGEIS that they will not issue such permits until additional information on the naturally occurring radioactive materials (NORM) content becomes available and has been evaluated. The Revised dSGEIS states that “The NYSDOH will require the well operator to obtain a radioactive materials license for the facility when exposure rate measurements associated with scale accumulation in or on piping, drilling and brine storage equipment exceed 50 microR/hr ( $\mu R/hr$ ). A license may be required for facilities that will concentrate NORM during pre-treatment or treatment of brine.” The DEC states that radiation surveys are necessary at specified time intervals for Marcellus wells developed by HVHF since NORM content varies from well to

well. The DEC indicates that the potential for NORM in both flowback and production brine may require licensing of a facility and may be subject to discharge limitations to protect workers, the general public and the environment.

The potential impacts of HVHF on water resources include watershed impacts, water supply, water quality, and accidents, described as follows:

1. Watershed impacts

Land clearing, loss of forested cover, soil compaction, erosion and stormwater runoff are all associated with well pad construction, road and pipeline construction, and well operation. Since the Town of Bethel lies entirely within the Delaware River watershed, any water quality degradation to waters in the Town would be directed towards the Delaware River, as discussed below in [Section L Transportation](#). Loss of forested cover and soil compaction interfere with groundwater recharge and contribute to watershed impairment. Erosion and subsequent runoff have the potential to significantly contribute to degradation of surface water quality. Gas well development results in a decrease in overall watershed forest cover, and an increase in compacted impervious surfaces. The disruption of local drainage patterns caused by heavy truck traffic and other equipment on small rural roads and nonpaved cleared surfaces, including numerous wetland and small stream crossings, has the potential to substantially interfere with the ability of watersheds to provide adequate water supply and high quality water, especially when these activities occur over a large area. Surface compaction may substantially reduce the flood control capability of natural systems, especially in floodplains and wetlands. Nonpoint source pollution from stormwater runoff and erosion often results from site clearing and grading. Especially where well pads are near small wetlands or streams, the resulting cumulative impacts may be significant. On a single gas well pad site in Fernow forest, WV, a US Forest Service [study](#)<sup>62</sup> provides a conservative estimated loss of 2.3 tons of soil per 2.47 acres, measured at this single site, due to improperly installed and maintained silt fences. Any streams or wetlands in close proximity would likely be affected by this level of erosion and potential sedimentation. The potentially large amount of land cleared for well pads, pits, roads and pipelines increases the chances of widespread and cumulative sedimentation and subsequent water quality issues.

The impact on wetlands is especially significant. Bethel contains thousands of acres of wetlands and other surface water bodies as shown in the Town Comprehensive Plan and the Town Agriculture and Farmland Protection Plan. Small wetlands are some of the most ecologically and economically valuable habitats but they are also among the most threatened. Research documents a minimum 100 foot vegetated buffer is necessary for wetland water quality protection. The DEC protects only wetlands that are 12.4 acres or more and only if they appear on DEC maps. The federal government does not afford any buffer protection for smaller wetlands. However a significant

portion of wetlands are smaller in size, and cumulatively provide significant benefits including flood control, water quality improvement, and moderation of stream flows during drought. Since no protective buffer is required, these wetlands are not protected from water quality impacts. In addition, many smaller wetlands are not mapped at all or do not meet the criteria for being deemed “waters of the United States” and are not subject to US Army Corps of Engineers jurisdiction. Many of these smaller wetlands could be filled without State or federal regulatory oversight.

## 2. Water supply



Hydraulic fracturing requires the use of large quantities of water and fracturing fluids, which are injected underground at high volumes and pressure. Each well can be hydrofracked multiple times over a period of years, using anywhere from 3 to 8 million gallons of water each time. The build-out analysis assumed water consumption of 5 million gallons per well. With an average well density of 10 wells per drilling unit of 640 acres, the cumulative effect of this level of water use is significant. The build-out analysis esti-

mated that 3.145 billion gallons of water supply could be required for gas development in the Town of Bethel during the build-out. For comparison, this amount of water is more than one-third the entire volume of Toronto Reservoir (see Google Image above), which contains 8.9 billion gallons of water.

Water supply for HVHF will come from surface or groundwater resources. For example, 56 percent was sourced from groundwater and 43 percent from surface water in the Barnett shale region of Texas; 55 percent from surface water and 45 percent from local water utilities in portions of the Susquehanna basin (Pennsylvania). Water withdrawals from groundwater and aquifers are equally problematic; groundwater is the source of baseflow for most rivers and streams and supplies drinking water to a majority of the Town’s residents.

Replenishment of groundwater occurs slowly over time, depends on watershed condition (e.g. forest cover, impervious surfaces) and is affected by local conditions including drought. During times of low flow or drought, impacts of HVHF on local water supplies would be even more significant, affecting water quality, temperature, aquatic ecosystems, and recreation as well. Sufficient ground and surface water resources will be needed to support drilling operations without adversely impact-

ing existing users and habitats. The availability of water resources to supply drilling efforts in the Town of Bethel have yet to be determined.

### 3. Water quality

During hydraulic fracturing, large volumes of water mixed with various chemicals, sand and other constituents are injected deep underground. Chemicals include acids, biocides, corrosion inhibitors, defoamers, emulsifiers, gellants, resins, surfactants and viscosifiers. The Marcellus shale naturally contains high levels of salt and naturally occurring radioactive materials (NORM), some of which will dissolve in the hydrofracking fluid. Estimates are quite variable and generally range from 9 and 35 percent or more (some up to 70%) of this fluid comes back out of the well as flowback. Flowback water requiring disposal is considered industrial wastewater. The build-out analysis assumed 20 percent of the water injected would flowback to the surface and require treatment. The Revised dSGEIS states that *“to ensure that wastewater from high-volume hydraulic fracturing operation is properly disposed, the Department proposes to require that before any permit is issued the operator have Department-approved plans in place for disposing of flowback water and production brine.”*

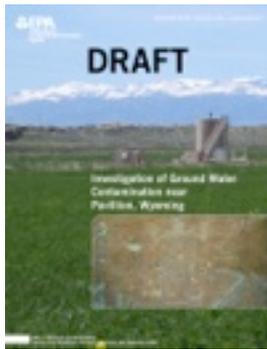
The Revised dSGEIS states in several locations that the DEC proposes to require, via permit condition and/or regulation, that flowback water handled at the well pad be directed to and contained in covered watertight steel tanks or covered watertight tanks constructed of another material approved by the Department. However, the Revised dSGEIS also states that *“The Department was informed in September 2010 that operators would not routinely propose to store flowback water either in reserve pits on the wellpad or in centralized impoundments. Therefore, these practices are not addressed in this revised draft SGEIS and such impoundments would not be approved without site-specific environmental review.”* Thus, it appears possible that flowback could be stored on-site in reserve pits or in centralized impoundments with an additional SEQR site-specific environmental review.

Flowback contains high levels of total dissolved solids (TDS) and NORMS, as well as added chemicals. According to the State’s Revised dSGEIS, *“no POTWs in New York State currently have TDS-specific treatment technologies, so the ability to accept this wastewater is limited by influent concentration and flow rates.”* The remainder of the injected fluids stays underground. Flowback is stored in tanks or pits (with a site-specific SEQR review) at the well site, recycled for use in future fracturing jobs, injected into underground storage wells, or transported to wastewater treatment facilities. Production brine may be applied to roads as a deicing agent or for dust control if a beneficial use determination (BUD) has been made by the DEC.

Although gas companies have not been previously required to disclose the chemical composition of flowback, recent research has begun to fill this information gap. A 2011 report issued by the US House of Representatives documents that between 2005 and 2009, oil and gas companies used

more than 2,500 hydraulic fracturing products containing 750 chemicals and other components. These included 652 different products that contained one or more of 29 chemicals that are: (1) known as or are a possible human carcinogen; (2) regulated under the Safe Drinking Water Act for their risks to human health; or (3) listed as hazardous air pollutants under the Clean Air Act. The Revised dSGEIS also reveals the extent of the chemicals used in the HVHF process. While only a small number of these chemicals are used in any given fracturing operation, because of limited disclosure, it is uncertain exactly which chemicals are being used. The Revised dSGEIS adds some clarity to the issue. Under the Revised dSGEIS, there will be a new requirement that operators evaluate the use of alternative hydraulic fracturing additive products that pose less potential risk to water resources. The Revised dSGEIS proposes that a project sponsor must disclose all additive products it proposes to use, and provide Material Safety Data Sheets for those products, so that the appropriate remedial measures can be imposed if a spill occurs. The DEC states that it will “publicly disclose the identities of hydraulic fracturing fluid additive products and their Material Safety Data Sheets, provided that information which meets the confidential business information exception to the Department’s records access program will not be subject to public disclosure.”

Chemicals that appeared most often include methanol, isopropanol, crystalline silica, ethylene glycol, 2-butoxyethanol, hydrotreated light petroleum distillates, and sodium hydroxide. Their properties vary. For example, 2-butoxyethanol (2-BE) is a foaming agent or surfactant in 126 products. According to EPA scientists, 2-BE is easily absorbed and rapidly distributed in humans following inhalation, ingestion, or dermal exposure. Studies have shown that exposure to 2-BE can cause hemolysis (destruction of red blood cells) and damage to the spleen, liver, and bone marrow.



A closely related substance, 2-butoxyethanol phosphate (2-BEP), was detected by the United States Environmental Protection Agency (EPA) in a [study](#)<sup>63</sup> of a gas field in Pavillion Wyoming. Results released by the EPA in its draft [November 2011](#)<sup>64</sup> and [December 8, 2011](#)<sup>65</sup> reports seem to confirm the close relationship between HVHF operations and aquifer contamination that have been suspected. Pavillion is a very sparsely settled area in rural Wyoming with no other industrial development than gas wells. The EPA is studying HVHF generally with preliminary results expected in 2012 and a final report by 2014.

In a separate study, the Pennsylvania DEP has derived a list of 54 chemicals that may be used during the process, including sixteen that affect 10 or more health effect categories (including skin, eye or sensory organs, respiratory effects; gastrointestinal or liver effects, damage to the brain, or cardiovascular effects). These include benzene, acetone, arsenic, heavy metals, bromide, sulfate, toluene, and cylenes. Hydrofracking fluids sometimes contain diesel fuel. The EPA has [stated](#)<sup>66</sup> that the use of diesel fuel in fracturing fluids poses a great threat to underground sources of drinking

water. The IOGA states that diesel fuel is not being used at this time, but once again limited disclosure makes this claim difficult to document. DEC has proposed a permit condition that would not authorize the use of diesel as the primary carrier fluid (i.e., diesel-based hydraulic fracturing).

With an average concentration of chemicals of 0.5-2.0 %, an average horizontal fracking operation using four million gallons of water may contain 20,000 to 80,000 gallons of chemicals. When this amount is multiplied by the number of wells and number of times any one well may be refracked, the cumulative amount of chemicals both below and above ground is significant. In addition, naturally occurring radioactive materials and brine from underground rock are present in varying amounts in both flowback and production brine.

The hydrofracking solution that remains underground, that can range from 30 to 80 percent, has the potential for migration into groundwater depending on rock composition and specific site characteristics. Research, such as the EPAs described above, has shown that hydrofracking fluids can make their way into local wells, as can methane from the hydrofracking process. Well failures, such as inadequate or cracked well casings can allow fracking water to [potentially contaminate](#)<sup>67</sup> drinking water supplies. Some [reports](#)<sup>68</sup> have indicated that hydraulic fracturing fluids have entered local wells in gas development areas from Wyoming to Dimock PA, to Colorado, contaminating water supplies. The presence of [methane](#)<sup>69</sup> is one indicator of such contamination; methane is a health hazard and is highly flammable. Methane is also linked to explosions and may be leaked into nearby rivers and streams.

A [peer-reviewed study](#)<sup>70</sup> by Duke University researchers, published in the Proceedings of the National Academy of Sciences, found that levels of flammable methane gas in drinking water wells increased to dangerous levels when those water supplies were close to natural gas wells. They also found that the type of gas detected at high levels in the water was the same type of gas that energy companies were extracting from thousands of feet underground, strongly implying that the gas may be seeping underground through natural or manmade faults and fractures, or coming from cracks in the well structure itself. The researchers tested 68 drinking water wells in the Marcellus and Utica shale drilling areas in northeastern Pennsylvania and southern New York State. Sixty of those wells were tested for dissolved gas. While most of the wells had some methane, the water samples taken closest to the gas wells had on average 17 times the levels detected in wells further from active drilling. The group defined an active drilling area as within one kilometer, or about six tenths of a mile, from a gas well. According to the researchers *“Our results show evidence for methane contamination of shallow drinking water systems in at least three areas of the region and suggest important environmental risks accompanying shale gas exploration worldwide.”*

The average concentration of the methane detected in the water wells near drilling sites fell within a range that the U.S. Department of the Interior says is dangerous and requires urgent “hazard

mitigation” action, according to the study. The researchers did not find evidence that the chemicals used in hydraulic fracturing had contaminated any of the wells they tested. However, the researchers cautioned that more study was needed.

#### 4. Accidents, spills and violations.

[Documentation](#)<sup>71</sup> of a variety of accidents that have occurred during the HVHF process are an essential element in overall hydrofracking impact review. Future similar accidents are highly likely based on past experience from other states, due to the nature of the hydrofracking processes, extent of proposed drilling, lack of comprehensive and consistent oversight, well siting in or near sensitive areas, and the inevitability of mechanical failure or human error. The accidents often involve water resources, thus increasing the likelihood that impacts will be transported downstream. It only takes one accident, at one site, as a result of human error or mechanical failure, to create significant ecological damage, particularly if the well is sited in a sensitive area.

A report by Riverkeeper (a not-for-profit organization concerned with clean water) entitled [Fractured Communities](#)<sup>72</sup> documents over 100 cases of environmental contamination where gas drilling resulted in adverse impacts. These include more than 20 cases of drinking water contamination in Pennsylvania; over 30 cases of groundwater and drinking water contamination in Colorado and Wyoming and more than 10 cases of surface water spills of drilling fluid in the Marcellus Shale region. It also includes more than 30 investigations of stray gas migration from new and abandoned wells in Pennsylvania, numerous illegal operations and permit violations by gas drilling companies and explosions that occurred between 2006 and 2010 that contaminated groundwater and/or surface water.

As well drilling and hydraulic fracturing activities are increasing in some states like Pennsylvania, there is a corresponding increase in the number of accidents being reported. On April 21, 2011, an apparent equipment malfunction caused a major blowout during a fracking procedure at a natural gas well in Bradford County, PA and spilled thousands of gallons of chemically contaminated water into a stream that flows into Towanda Creek and ultimately the Susquehanna River. Seven families were evacuated and farmers were advised to not allow their livestock to drink the Creek water. In addition, the Pennsylvania Land Trust Association has reviewed violations of state Oil and Gas laws by Marcellus shale well drillers in Pennsylvania between January 2008 and August 20, 2010, [finding](#)<sup>73</sup> a total of 1614 violations of state laws due to gas drilling or other earth disturbance activities related to natural gas extraction in this 2.5-year period.

The Town of Bethel has diverse water resources that provide for the domestic, commercial, and recreational needs of the community. The Town’s groundwater, surface water, and wetlands do not function as separate systems but are part of an interconnected whole. The United States Geo-

logical Survey has recently determined that approximately 60 percent of the flow in surface water streams in rural parts of New York originates from groundwater resources. A New York State Department of Environmental Conservation water quality study found that from 1992 to 2002, water quality throughout New York State declined, attributable in large part to changes in land use and the intensity of land use.

The benefits of prohibiting natural gas and other heavy industrial uses within the Town include the opportunity to protect the Town's water resources, both in quantity and in quality, by avoiding the impacts associated with such development, including erosion and runoff, forest removal and soil compaction, and contamination from spills, leaks and accidents. Agricultural operations would avoid losses due to impacts on livestock or crops. The town would also avoid expensive clean-up costs or drinking water supply replacement in the event of spills and drinking water contamination, and the town would continue to enjoy the benefits from tourism and recreation that are dependent on healthy water resources. In this case, it is likely to be less costly to prohibit these land uses than to repair damages that are likely to result from it. The savings to the Town in terms of economic expense and increased quality of life (recreation, tourism, clean drinking water) are likely to be substantial.

The protection of watersheds and their unimpaired functions includes wetlands that provide water quality improvement and flood control functions. Streams with stable, non-eroded banks and adequate flow, wetlands and ponds with intact hydrology, thriving plant and animal communities associated with these water resources, and an adequate supply of high quality water for drinking would all benefit from this prohibition of natural gas and other heavy industrial uses.

While this prohibition is not a guarantee of water resource protection, it does provide an excellent opportunity for a high level of protection- an opportunity that would be severely compromised should natural gas and other heavy industrial development proceed within the Town.

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## **F. Plants, Animals and Ecosystem Services**

*The dSGEIS concludes that high-volume hydraulic fracturing operations would have a significant impact on the environment because such operations have the potential to draw substantial development into New York, which would result in unavoidable impacts to habitats (fragmentation, loss of connectivity, degradation, etc.), species distributions and populations, and overall natural resource biodiversity. Habitat loss, conversion, and fragmentation (both short-term and long-term) would result from land grading and clearing, and the construction of well pads, roads, pipelines, and other infrastructure associated with gas drilling.*

Gas development activities affect natural systems on several levels. Such activities affect habitats, species, and ultimately ecosystems and, according to the State's Revised dSGEIS, these impacts are unavoidable. The benefits provided to human communities by ecosystem services are in turn affected. These impacts are complex due to the interconnections among species and their habitats. Changes in habitat and condition affect different species in different ways. For example, species that may be most susceptible to loss of connectivity between habitats and increased roads and traffic are those that disperse across the landscape like migrating birds and bats, and reptiles and amphibians traversing between uplands and wetlands. Certain species, such as stream salamanders and brook trout, are extremely sensitive to changes in water quality or temperature. Other species are affected by loss or changes in food supply resulting from land use impacts. Some species are found in only a very few areas within New York State, while others are found primarily within the Marcellus Shale region. Many of these species, whether they depend upon upland forests or freshwater wetlands and streams, may experience changes in behavior, reproduction, distribution, or mortality from the array of impacts associated with gas well construction and operation, associated road and pipeline construction, and flowback use and disposal. A summary of impacts, such as site clearing, removal of vegetation, construction of well pads, pits, roads, pipelines, stream and wetland crossings, associated with natural gas development activities, is provided as follows.

**Habitat fragmentation.** Natural gas development activities result in significant forest habitat fragmentation, i.e. breaking up forest cover into smaller fragments, reducing forest cover, and loss of connectivity between fragments, as shown on the aerial photograph by Carl Heilman, of a drilling area on the south side of Tionesta Creek in Western Pennsylvania. Size of habitat fragments affects which species are able to thrive within them, as different species have different habitat requirements. Tree frogs, flying squirrels and certain woodland flowers are sensitive to forest fragmentation because of changes in canopy cover, humidity and light levels. Other species at risk are those that are of conservation concern such as tree bats and woodland turtles and snakes. The clearing of forest for construction of well pads, roads and pipelines causes impacts beyond the actual acres cleared. For Bethel, the potential direct loss of forestland would be 388.08 acres and an additional indirect loss of 926.1 acres due to forest fragmentation and forest "edge effect."



In Pennsylvania, The Nature Conservancy found that the amount of forest cleared for a single well pad includes about 8.8 acres of direct disturbance as well as an additional 21.2 acres of indirect impact resulting from the increase in forest habitat “edge,” the area that extends at least 330 feet (100 meters) into adjacent forest. Impacts extend into this “edge” area for a number of reasons. Interior forest species avoid edges for different reasons. Black-throated blue warblers and other interior forest nesting birds, for example, avoid areas near edges because of the increased risk of predation. Some species, especially common species such as whitetail deer and cowbirds, are attracted to forest edges – often resulting in increased competition and predation. Invasive plants often thrive on forest edges and can displace native forest species. As large forest patches become progressively cut into smaller patches, populations of forest interior species decline, while populations of edge tolerant species increase. The increase of non-native invasive species in areas where native vegetation is removed or disturbed changes habitat and food sources for wildlife. Invasive species are often difficult and costly to eradicate and New York State maintains an active [program](#)<sup>74</sup> to prevent or mitigate invasive species.

**Wetlands and streams.** Headwater forested streams provide the greatest filtration capacity for nutrient removal. Construction activities that impair water quality, especially erosion and stormwater runoff into small streams and wetlands, also impair the functioning of these systems and their ability to support plants and animals. These impacts range from road crossings, that interrupt water flow, to road construction in streambeds. Small wetlands that lack regulatory status are particularly at risk. As documented on the [DECs website](#),<sup>75</sup> these small wetlands provide significant ecosystem functions, but are typically not protected. Degraded wetlands have impaired functions, with a resulting loss in the benefits they provide. This includes loss or degradation of vernal pools and impacts on the rare species they support.

**Increased truck traffic.** Increased truck traffic results in direct mortality for wildlife species moving across roads, especially for species that regularly move between habitat areas, such as reptiles and amphibians. This mortality can be significant, especially for species of conservation concern, considering the extent of small rural roads, their crossing of multiple habitats, and the extent of truck traffic associated with HVHF.

**Noise and light.** The operation of gas wells and gas distribution entails noise from engines, compressors, and operations of other heavy equipment on a continual basis, including lighting at night. These have been known to affect the behavior and distribution of species in the vicinity of the activities, and may affect behavior or reproductive success of certain sensitive species. Bright lights may confuse or attract migrating birds.

**Water withdrawals.** Water used for HVHF is taken from local surface or groundwater sources. Small rivers, streams, ponds, lakes and wetlands are particularly vulnerable to the changes in hy-

drology that result from these withdrawals. Small streams, especially headwaters, support a high diversity of plants and animals, including rare species. Considering that an average of five (5) million gallons of water is used per each HVHF operation, this singular amount by itself may not measurably affect larger bodies of water like White Lake or Toronto Reservoir if withdrawn over a long period of time. However, it could be devastating to a small waterway and its biological diversity. The cumulative effect, given the potential for multiple well development occurring simultaneously, also needs to be considered. Since water systems are interconnected, water withdrawn from a stream or from groundwater will impact connected and downstream water resources as well. Aquatic habitats are altered by seasonal fluctuations in water level, especially during drought. Lowered water levels increase the effect of pollutant concentration and susceptibility to higher temperatures especially during times of low flow. These impacted conditions are especially significant for sensitive stream species like trout that require cold, clean water, and stream salamanders that are sensitive to changes in water quality. Based on the Revised dSGEIS, it appears that DEC is committed to monitoring arrangements that will protect seasonal water flows, but it is not clear how they will be able to accomplish this with their limited staffing and monitoring capabilities.

**Air pollution.** Air pollutants associated with gas well sites include the volatile organic compounds that enter the air from activities at well pad sites. These are described in the section on air quality. It is likely that toxic air pollutants from emissions and from flowback pits (if approved using a site-specific SEQR review) would affect wildlife, especially vertebrates. Effects on [livestock](#)<sup>76</sup> have been recorded.

**Wastewater.** Wastewater from HVHF, consisting of both flowback and production brines, returns to the surface and is stored onsite. In addition to the chemicals added to the water prior to hydrofracking, the fracturing process adds a number of substances from the underground environment to the water that returns after fracking. As a result, flowback has very high levels of total dissolved solids, or TDS, which is the amount of material in dissolved form, including minerals, salts or metals, in a given volume of water. The amount of dissolved solids in flowback exceeds that found in typical river water; these high total dissolved solids can be a serious impairment to water quality in freshwater systems.

The combined effects of habitat fragmentation and potential release of fracturing water into streams could have significant impacts on aquatic ecosystem services. Changes in TDS can be toxic to aquatic organisms, reducing the size of biological communities and ultimately impacting fisheries and water quality. For example, studies conducted by the [Academy of Natural Sciences](#)<sup>77</sup> measured the conductivity of stream water, the abundance of certain sensitive insects and the abundance of salamanders in streams located in areas with high density drilling, low density drilling and no drilling. The results showed water conductivity almost twice as high in the high density sites as it was in the low density and reference sites, while numbers of both salamanders and sensitive in-

sects were significantly reduced in high density sites. Amphibians are especially vulnerable to changes in the environment and their absence is often an ecological "early warning" system. Aquatic insects provide a critical food source for trout. Additional water quality impacts on wetlands, streams, and ponds and the species they support are described via ongoing research as well as documentation of the consequences of spills, leaks and accidents that resulted in freshwater contamination.

**Wastewater disposal.** Hydrofracking wastewater has the potential to affect plants and animals at every step of storage, transport, or processing. A U.S. Forest Service [study](#)<sup>78</sup> documented destruction of trees and other vegetation when they came into contact with wastewater that was manually sprayed into adjacent forest from a hydrofracking wastewater pit. The same study documented changes in soil chemistry and subsequently potential impacts on soil biota. Where wastewater is processed in wastewater treatment plants that are not effective in removing salts, TDS, NORMS, and many chemicals used in HVHF, releases to surface waters from treated, yet salt enriched, wastewater can significantly affect freshwater ecosystems and the species they support.

**Accidents and violations.** The potential for contamination of streams, ponds, lakes and wetlands from hydrofracking wastewater as a result of various accidents, mechanical and human error, spills, leaks, and direct release into surface waters can be significant. Refer to the water quality section for additional information. Damage to plants and animals, habitats and ecosystems depends on the specific chemicals and other harmful constituents (e.g. salts) present in the wastewater as well as the specific characteristics of the surface waters and the types of species (including those of particular conservation concern) and their sensitivity to water quality changes.

**Cumulative impacts on ecosystem benefits and services.** The cumulative effect of forest fragmentation, loss and degradation of small wetlands and streams, increase in invasive species, and subsequent decrease in diversity of native plant and animal species is likely to be significant across the larger landscape as numerous well pads are constructed. Impacts on headwater streams and wetlands, which in many cases support a high diversity of plants and animals of conservation concern, may result from the loss of or encroachment on protective vegetated buffers (necessary for water quality protection and species' needs including nesting), soil compaction and disruption of water flow and connectivity at stream and wetland crossings, and sediment loading from stormwater runoff. These effects on wetland and stream habitats are exacerbated by additional water quality degradation from HVHF wastewater via spills, leaks, or accidents. These may be cumulatively significant within individual watersheds. The magnitude of gas well development may impair recovery of ecosystems and populations over time.

Ecosystems provide a variety of services that benefit human communities, and many of these have economic value as well. New York State provides [information](#)<sup>79</sup> about these benefits, but does not

legally protect them. A diversity of plants and animals play important roles in ecosystem functioning and thus are important to these benefits and services.

<b>Summary of HVHF Activities and Effects on Ecosystem Services</b>			
<b>Gas Well and Hydrofracking Activities</b>	<b>General Habitat</b>	<b>Impacts or Threats to Species</b>	<b>Ecosystem Services Affected</b>
Clearing and grading, removal of trees, construction of drilling pads, roads, pipelines; increased traffic; air pollution; noise; light; wastewater spills and accidents	Forest	Loss of habitat connectivity, habitat fragmentation, toxic contamination (soil or vegetation), loss of trees, nesting disturbance, increased edge habitat and changes in species; loss of interior forest species; increased invasive species	Watershed protection, stabilization of stream/river banks, water temperature moderation, air quality, biological diversity
Construction of well pad, roads, pipelines; unprotected wetland crossings; increased truck and equipment traffic; wastewater spills and accidents; withdrawal of local water supply; waste pits and leakage	Wetlands (freshwater wetlands, marsh, vernal pool) and ponds	Degradation of water quality from contaminants, toxics, stormwater runoff; increased nutrient loading; altered hydrology (including decreased water supply), loss of forested buffer and adjacent critical terrestrial habitat, nutrient and sediment loading, loss of connectivity between habitats, invasive species	Flood control, water quality improvement, groundwater recharge, recreation, education, habitat for species of conservation concern, maintenance of streamflow during drought
Road crossings; erosion and stormwater runoff from construction, spills and accidents; wastewater spills, discharges; withdrawal of local water supply; waste pits and leakage	Rivers, streams, lakes	Degradation of water quality from contaminants, toxics, stormwater runoff; increased nutrient loading; increased water temperature; water loss from withdrawal; altered streamflow esp. during drought; riparian corridor degradation and buffer loss; increase in invasive non-native species, loss of insect life as food source for fish	Watershed connections, water supply, recreation, fisheries

Sullivan County contains a high diversity of habitats and species of plants and animals. The New York Flora Atlas [documents](#)<sup>80</sup> 714 plant species in Sullivan County. There are 11 of these species that are State listed as endangered and 8 State listed as Threatened. One additional plant species is Federally threatened. The importance of plant species in the County is difficult to quantify

without site-specific information. Many rare plants are associated with freshwater wetlands, while others prefer disturbed sites such as old fields. The importance of a variety of native plants is more readily seen in the composition of habitats and the role of plants in ecosystems.

Wildlife has been more readily identified. But here too its value lies in its diversity including species of conservation concern and in the role of species in ecosystems. The Town’s habitats support a variety of wildlife species. The Town of Bethel lies entirely within the Delaware River Basin. The Delaware Basin is home to 81 of the 537 Species of Greatest Conservation Need (SGCN) in the State or about 15 percent of the SGCN statewide. Of those, 25 are in decline, 5 are stable, 8 are increasing, and 42 are of unknown status. Populations of native brook trout in the basin with unique genetic signatures are thought to have evolved in the Delaware Basin over thousands of years. There are a total of 1,900 miles of streams and rivers and 400 lakes and ponds in the basin, some of which exist in Bethel, and they provide extensive aquatic habitats for SGCN. There are 17 species that depend on coldwater streams in the basin as critical habitat. The overall water quality in the basin is excellent but prone to degradation by human development, invasive species, and atmospheric deposition.

According to the [DEC](#),<sup>81</sup> *“The most common single threat listed for species that occur in the Delaware Basin in the CWCS database is loss of habitat by human development...New development stresses existing natural resources decreasing flood protection and habitat provided by these resources and increasing siltation which affects aquatic habitat...Toxic contaminants are the second most commonly cited threat to SGCN in this basin.*

Sullivan County is likely to support many of the SGCN due to the variety of its habitats in the Delaware River watershed. The following table provides some examples.

Selected Habitats and Associated Species of Greatest Conservation Need Likely to be Found in Sullivan County	
Habitats	Examples of Species of Greatest Conservation Need*
Forests: deciduous forest, shrubland, woodland	bald eagle, black-throated blue warbler, Cerulean warbler, red-headed woodpecker, wood thrush, Louisiana waterthrush, scarlet tanager; eastern red bat, hoary bat, silver-haired bat; American woodcock, golden-winger warbler, ruffed grouse, whip-poor-will, Canada warbler, brown thrasher, prairie warbler; long-eared owl, red-shouldered hawk, northern goshawk, Cooper’s hawk, sharp-shinned hawk
Freshwater wetlands and ponds	American bittern, pied-billed grebe, king rail; four-toed salamander, wood duck, American black duck, spotted turtle; Jefferson’s salamander, blue-spotted salamander
Rivers and streams, riparian corridors	bald eagle, brook trout, dragonflies, mayflies and stoneflies; hellbender, longtail salamander, northern red salamander; mink; river otter; wood turtle; blackchin shiner, comely shiner, swallowtail shiner

Selected Habitats and Associated Species of Greatest Conservation Need Likely to be Found in Sullivan County	
Habitats	Examples of Species of Greatest Conservation Need*
Grasslands and open fields	northern harrier, upland sandpiper, horned lark, vesper sparrow, grasshopper sparrow, Henslow's sparrow

\*Including but not limited to species listed as Endangered, Threatened or Special Concern by the State of New York

Gas development activities affect habitats and the individual species that live in those habitats. Due to its affect at the landscape level, it also impacts species diversity, and the ability of ecosystems to provide the services that benefit human communities. The benefits of maintaining high biological diversity and intact ecosystems are far reaching. They include water quality and supply, sediment control, nutrient cycling, flood control, groundwater recharge, pollination of crops, habitats and gardens, rural character, air and water quality improvement, control of invasive species, recreation including fishing, hunting and birdwatching, natural areas and human health.

A landscape that is biologically diverse is more resilient to changes, and this stability helps to ensure that ecological services and benefits will continue into the future. Many of these benefits also have economic value to the County, especially within the watershed context. As stated in [Economic Benefits of Open Space Preservation](#)<sup>82</sup> by the New York State Office of the State Comptroller, 2010, “Decision-making that explicitly considers and values the positive economic effects of open space, as well as environmental and quality-of-life implications, will best serve a community’s long-term interests.”

Some of these economic benefits, noted in the report, include the control of stormwater runoff, flood control and storage, erosion control, preservation of surface water quality and stream flows, and groundwater recharge.

By prohibiting natural gas and other heavy industrial uses, the Town retains the benefits of ecosystem services and the option of providing them for future generations, and avoids the costs associated with the loss of those benefits.

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**G. Air Quality**

Air quality in Sullivan County is considered “good,” the highest classification given to air quality by the US Environmental Protection Agency (EPA). Overall air quality is better than the U.S. average, based upon the EPA’s [Air Quality Index](#).<sup>83</sup> While lead, Total Suspended Particulates (TSP) and nitrogen dioxide levels are slightly higher than the US average, other pollutants of concern, such as ozone, sulfur dioxide, and carbon monoxide, are better than the US average and roughly

comparable with New York State's average ozone levels. Ozone levels have been getting better in Sullivan County. Following several years of ozone levels higher than the US average in the first part of the last decade, they have been consistently decreasing in the County. There were no non-attainment days in Sullivan County in 2010 due to ozone or other air pollutants of concern.

Air quality impacts from HVHF include emissions from a variety of stationary and mobile sources. One of the largest sources of air pollution is engines used by trucks and heavy equipment. Air emissions from the exploration and production of shale gas include a variety of potential air pollution sources that change during different phases of operation. These include exhaust from drilling rigs; venting and flaring of natural gas; exhaust from multiple diesel-powered pumps (to achieve necessary pressure in the well); vehicular traffic; volatile chemicals that escape into the air from waste pits; fugitive emissions from leaks in pipe connections and other equipment; dehydrators that remove water from natural gas and separators that may vent large volumes of methane and volatile organic compounds (VOCs); sulfur removal systems; and diesel powered compressors and pumps operating 24 hours a day. Photo is from Squidoo.com.



A significant amount of methane, a potent greenhouse gas with a global warming potential up to 70 times greater than that of carbon dioxide, escapes into the atmosphere every year from gas fields and facilities. A recent [study](#)<sup>84</sup> from Cornell University cautions that the amount of methane released during HVHF, gas processing and transmission produces greenhouse gas emissions at least as significant as those produced by burning coal, and that overall this method has a global warming potential greater than that of conventional gas or oil.

A [report](#)<sup>85</sup> recently released by the US House of Representatives states that more than 2,500 hydraulic fracturing products containing 750 chemicals and other components were used between 2005 and 2009. These included 25 toxic chemicals that are hazardous air pollutants and that are used in various hydraulic fracturing products. 595 products contained 24 different hazardous air pollutants (pollutants that cause or may cause cancer or other serious health effects e.g. reproductive effects or birth defects, or adverse environmental and ecological effects) including hydrogen fluoride, lead, and methanol. In another [study](#),<sup>86</sup> the Pennsylvania Department of Environmental Protection identified 21 chemicals, used in hydrofracking fluid, that are readily airborne. All of them cause human health effects that affect gastrointestinal and liver systems, respiratory system, skin and eyes, cardiovascular and blood condition, brain and nervous system, kidneys, immune system, reproductive system and endocrine system. Six of the 21 are known cancer-causing agents.

While only a small number of these chemicals are used in any given fracturing operation, because of limited disclosure we can not be certain which chemicals are being used.

<b>Summary of Selected Air Pollutants Generated During HVHF</b>		
<b>Air pollutant</b>	<b>Source</b>	<b>Impacts</b>
Methane	Venting of natural gas, dehydration	Tendency to explode
Diesel Fuel	Stimulation fluids, oil-based drilling muds, engines and heavy equipment	Mixture of hydrocarbons including carcinogens
Heavy metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, zinc)	Diesel fuel exhaust	Lead is harmful to children's neurological development and can also cause health problems in adults, including reproductive problems, high blood pressure, and nerve disorders
Volatile organic compounds (benzene, toluene, ethylbenzene, xylenes, formaldehyde, etc.)	Venting and flaring of natural gas, waste pits, engine exhaust, compressors, wastewater dehydration and storage, compressor operation	React with nitrogen oxides to form ozone and smog; health effects include: cancer, reproductive and nervous system, respiratory and neurological effects
Sulphur dioxide	Engine exhaust (gasoline or diesel fuel containing sulphur), natural gas flaring	Reacts with other chemicals for form particulate pollution, with health effects including lung damage, respiratory illness, heart conditions
Nitrogen oxides	Compressor engines, flaring, exhaust from diesel and natural gas engines	React with VOCs to form ozone and smog; health effects include lung damage, respiratory illness, heart conditions, premature death.
Particulates	diesel fuel exhaust, dust from pits, venting and flaring	Health effects include respiratory illness, may combine with other air pollutants for additional health effects; particulates from diesel exhaust are carcinogenic.
Polycyclic aromatic hydrocarbons	Diesel exhaust, flaring, pits	Possible carcinogens, reproductive effects in animals
Hydrogen fluoride	Waste pits	Highly corrosive and systemic poison, causes severe health effects due to deep tissue penetration, absorption of substantial amounts may be fatal.

The cumulative effect of these contaminants is the potential for degraded air quality and subsequent effects on human health. This can be illustrated by following the impacts of just one of them, ozone, which is a commonly measured air quality indicator. Ozone is a major component of smog and a potentially harmful pollutant. It is created by sunlight reacting with chemicals found in gasoline vapors and emissions from cars and industrial activities. Besides generating an array of human health effects, ozone also has been shown to have detrimental effects on plants and ecosystems, reducing forest growth and crop yields (see Section on Agriculture).

Air pollution impacts from HVHF have been examined in areas where gas drilling has been in practice for some time. The following cases illustrate some of these impacts:

**Dallas-Fort Worth, Denton and Dallas Counties, TX.** The Dallas-Fort Worth area has seen a dramatic impact on its air quality from natural gas drilling in the Barnett Shale. A [report](#)<sup>87</sup> prepared by Southern Methodist University found that the pollutant emissions from natural gas drilling activities, per day, surpassed those produced by all of the vehicle traffic in the Dallas-Fort Worth region.

**Town of DISH, Denton County, TX.** Reports of human illness, animal illness (including neurological effects and blindness in horses), and deaths led to an air quality study of the effects of gas wells and compressor stations. The [study](#)<sup>88</sup> found the *“presence in high concentrations of carcinogenic and neurotoxin compounds in ambient air near and/or on residential properties. The compounds in the air indicate quantities in excess of what would normally be anticipated in ambient air in an urban residential or rural residential area. Many of these compounds verified by laboratory analysis were metabolites of known human carcinogens and exceeded both Short-term and Long-term effective screening levels...”* and included benzene, xylene, carbon disulfide, naphthalene, dimethyl disulphide, methyl ethyl disulphide, and pyridine metabolites. According to the study, *“The Town of DISH has virtually no heavy industry other than the compression stations. There is no other facility with the capability to produce the volume of air toxins present within miles of the Town. Fugitive emission sources of hazardous air pollutants emanating from the oil and gas sector include emissions from pumps, compressors, engine exhaust and oil/condensate tanks, pressure relief devices, sampling connections systems, well drilling (hydraulic fracturing), engines, well completions, gas processing and transmissions as well as mobile vehicle transportation emissions. Along with hazardous air pollutants (HAPs) and known carcinogenic compounds, air toxic compounds that contribute to smog formation were identified and are a known emission of gas industrial exploration, compression, processing and distribution.”*

**Sublette County, Wyoming.** This is one of the most sparsely populated counties in the continental United States and home to significant natural gas fields. The state of Wyoming recently [recommended](#)<sup>89</sup> “non-attainment” status be given by the EPA for ozone that has reached unhealthy levels due to air pollution from natural gas development.

Within the Town of Bethel, air emissions generated from gas development activities could be significant, along with subsequent effects on health, ecosystems and agriculture. Increased air emissions and ozone due to truck traffic alone could be significant. At an average of 2400 truck round-trips per well, (as per GDTFs Build-out), and further multiplied by the number of wells at build-out, the result points to a potentially significant increase in emissions and ozone levels.

By prohibiting natural gas and other heavy industrial development within the Town, Bethel would reduce the potential for elevated levels of air pollution that commonly result from such development, and would help avoid, but not eliminate, the human health impacts and costs associated with high levels of air pollution. This is because air quality can be affected by gas and other heavy industrial development in other towns surrounding or near Bethel. While other air pollution sources, for example, increased automobile traffic due to residential development, will continue to be a concern in the future, the air pollutant load from these sources will be significantly less than what could reasonably be expected to occur as a result of natural gas and other heavy industrial development in Bethel, especially from the intensive development and truck traffic associated with HVHF. Avoidance of health impacts could involve a savings in health care costs, especially those associated with some of the more toxic contaminants described in this section.

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## H. Agriculture

It is a goal of Bethel to “*create incentives for agricultural...and similar businesses taking advantage of the Town’s extensive natural resources with operations of smaller scale that complement existing mixed use character.*” The build-out analysis calculated a direct loss of active farmland in the Town of 55.44 acres. Any direct loss of farmland from natural gas and other heavy industrial development is contrary to the Town Comprehensive Plan goal to maintain the “*existing mixed-use character with a blend of working farm, recreational, residential and hamlet commercial landscapes.*” Every well pad or access road that cuts across a farm field fragments productive farmland. As farm parcels become smaller, there are fewer contiguous areas of active farming available to operating farms. Eventually farms may become too small to operate profitably. As farms go out of business, the critical mass to economically support related businesses is reduced. Loss of those businesses leaves remaining farms without nearby supply or service providers. As a result other farms will inevitably fail simply from being caught up in the spiral. According to [news reports](#),<sup>90</sup> Pennsylvania agricultural agencies report that 25 percent of farmers receiving royalty payments from gas companies discontinued farming, while another 25 percent converted from dairy farms to grazing operations.

Explosions, spills, flares and leaks from gas pipes associated with natural gas drilling, production and transmission (see Public Health below) have all been shown to have negative effects on agricul-

tural soils. One study shows that gas flaring adversely affects soil fertility, causing the soil to become more acidic and reducing total organic carbon, nitrate, and phosphate content. Another study reports that methane from pipeline leaks changed the oxygen and bacterial composition of the soil, and altered a plant's ability to fix nitrogen, to successfully complete cellulose conversion, and to maintain an adequate hydration level. Gas drilling emissions have led to increased ground level ozone. Many long-term studies also document impacts to agricultural productivity due to ground level ozone.

Livestock near gas operations drink surface water from ponds and streams, which can be contaminated from the use of fracking fluids at the surface as a result of injecting, withdrawing, collecting, storing and disposing of flowback. Small spills can have very big effects on livestock by contaminating their drinking water or the grasses that they eat. Both livestock and game are attracted to the sodium in these fluids. There are documented reports of livestock illness and death from exposure to spills. The US Forest Service has documented a significant increase in the use of pad sites by deer and bear. While not an agricultural impact, a specific goal of the Town's existing Comprehensive Plan is developing and increasing public access to recreational resources of the Town (e.e. fishing accesses, eagle watching sites and reservoir properties) as a means of serving residents and attracting tourism.

As discussed above under Water Resources, naturally occurring radioactive materials have contributed to contamination of oil and gas production areas. Uranium, radon and other radioactive decay products have been measured in the air, soils and water at or near natural gas sites. Taken up by plants, these radioactive elements can bioaccumulate in the food chain, eventually appearing in milk and dairy products if dairy farms are located nearby. Similarly, heavy metals including arsenic, barium, cadmium, chromium, lead, and mercury have been found in drilling waste and can be absorbed by plants and incorporated into the food chain as well. While it is possible to decontaminate soil, it takes a minimum of four years of specific successive plantings to get these metals out.

Recent trends in agriculture have included a movement to strengthen local and regional food markets, to establish local and regional green markets throughout New York State, and there has been considerable interest in organic and natural farming methods. State residents have become more aware that most of the food found in grocery stores travels an average of 1500 miles from farm to table. The movement away from transportation of foods from distant continents and toward locally grown food is now regarded as a long term strategy for ensuring food security.

The number of certified organic farms in New York State increased from 218 in 2002 to 590 in 2008 with a concentration of organic farms in the Marcellus Shale region. The number of actual certified organic farms represents a fraction of the farms practicing natural farming methods and

many of these farms are working towards organic certification. The local organic food market is a rapidly growing sector of New York agriculture and is highly valued by farmers market patrons in New York City, its suburbs and elsewhere around the State.

In what could become a significant issue for agriculture in Bethel as well as the remainder of the farms found in the Marcellus Shale region is the effect that hydrofracking will have on the perceptions of buyers of New York's farm products. In an open letter to Members of the New York State Senate, the New York State Assembly, Governor Patterson and Governor-Elect Cuomo dated December 8, 2010, the Park Slope Food Coop, a 15,800 member wholesale buyer of New York State agricultural products stated that it will start researching alternatives to New York State products if hydrofracking occurs on farms in the areas where they buy their agricultural products from. The Co-op, in 2010, purchased over \$1,500,000 of fruits and vegetables grown in New York State, \$500,000 of chickens and over \$400,000 of beef, lamb, and pork from New York State farms.

Agriculture is a large sector of the Town's economy. Royalties to farmers may offer short-term relief and added cash to continue to farm for those who sign gas leases. But, there is also the likelihood that once a lease is signed, the farmer will decide to close the farm, move elsewhere and simply live off the royalties from the well(s) as has occurred in Pennsylvania. But there is a great deal of evidence to suggest that unconventional shale gas extraction could ultimately damage the Town's agricultural base, as well as every other major sector of the Town's economy. Many farmers have chosen not to sign gas leases just for this reason.

The quality and marketability of locally produced agricultural products depends upon clean air and water that, as described above, could be degraded by hydrofracking and shale gas extraction. Instances of drilling-related groundwater contamination have been reported in many states including New Mexico, Wyoming, Louisiana, Pennsylvania, and West Virginia. Surface waters have also been contaminated. Sixteen cattle were reported to have died in a northwestern Louisiana field in 2009 after apparently drinking fluids near a natural gas drilling rig, according to Louisiana's Department of Environmental Quality and a report in the [Shreveport Times](#).<sup>91</sup> High levels of airborne toxic emissions have been detected in DISH, Texas, and Rifle, Colorado. Similar instances of contamination could render nearby farmland, that is not subject to leasing and drilling, unsuitable for agriculture and put those additional farmers out of business. Based upon the foregoing, it can be expected that the impacts of heavy industrial activities, associated with gas drilling and production activities, could have far reaching consequences and impacts on Bethel's farms.

Bethel's proposed Zoning Amendment adoption, that would result in prohibition of natural gas and other heavy industrial uses would in turn lead to the elimination of the impacts identified herein as a result of the build-out activities.

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## I. Visual Resources

*“Visual impacts would typically result from the introduction of new landscape features into the existing settings surrounding well pad locations that are inconsistent with (i.e., different from) existing landscape features in material, form, and function. The introduction of these new landscape features would result in changes to visual resources or visually sensitive areas and would be perceived as negative or detrimental by regulating agencies and/or the viewing public.”*

Revised dSGEIS, page 6-263

The Town of Bethel’s landscape is made up of ridges and valleys. Hamlets like White Lake, Smallwood, Kauneonga Lake, Mongaup Valley, and Bethel dot the valleys surrounded largely by agricultural and forested lands. There is one state park and 27 lakes and ponds that are important to the community. More than two-thirds of the Town is forested and about 10 percent is farmland. Bethel is a typical bucolic rural community. Tourists come to facilities in the Town in part because of the scenic lakes, rivers, valleys and hills that comprise the Town’s sense of place.

The natural beauty and rural character of the Town creates a unique quality of life for its residents and many visitors. It is what drives the tourism industry, one of Bethel’s most important economic activities. New York State estimates that every \$1.00 generated directly by tourism indirectly generates \$7.00 for the State’s economy and this includes the local residents who are employed by tourism or are benefited by the dollars tourists bring into the community. Total Tourism Spending in Sullivan County was estimated to be \$345,107,000 in 2010 (see the section on Tourism below for more information on this).

The DEC published in 2000 a Program Policy document entitled [Assessing and Mitigating Visual Impacts](#).<sup>92</sup> It is a guide to defining and assessing visual impacts. According to the document, “An ever expanding body of research has demonstrated that environmental aesthetic values are shared among the general population. This research finds that such values are not idiosyncratic, random, or arbitrary. For example, millions of people visit Niagara Falls for our shared appreciation of its beauty. Many places have been recognized for their beauty and designated through Federal or State democratic political processes, reinforcing the notion that environmental aesthetic values are shared. Recognition of aesthetic resources also occurs at local levels through zoning, planning or other public means. That these special places are formally recognized is a matter of public record.”

The policy document relies heavily on site specific visual impact assessment methodologies in offering guidance to DEC staff who must conduct such assessments. For purposes of this analysis, the document is not entirely pertinent because no specific heavy industrial developments are proposed

in Bethel to enable an assessment based upon a specific location. However, it does offer some clues as to how to assess the significance of an impact based upon certain principles including but not limited to the area affected, the size of the structure in relation to its surroundings, its location in relation to aesthetic resources, ability to screen the structure, use of lighting, and the permanence of the impact.

This analysis of the visual impacts of heavy industry is presented in a generic format using the factors outlined above as a guide. Heavy industrial activities are widely perceived as “unsightly.” None currently exist within Bethel. As illustrated in the build-out analysis, up to 629 wells on 63 well pads could potentially be developed in the Town. Therefore, most of the Town could be affected based upon the build-out.

Unless required as a condition of obtaining a drilling permit, it is not clear how the State proposes to protect visual resources from a reading of the Revised dSGEIS since no specific mitigation measures are proposed. This is usually a province of local land use controls. The State does recognize Municipal Home Rule Authority with regards to land use controls when it states in Section 1.7.5 (page 1-11 of the Revised dSGEIS) that “Applicants be required to compare the proposed well pad location to local land use laws, regulations, plans and policies to determine whether the proposed activity is consistent with such local land use laws, regulations, plans and policies.” If the applicant or local government informs the DEC of a conflict in this regard, the DEC would request additional information in considering whether significant adverse impacts relating to land use and zoning would result from permit issuance. However, the State proposes no objective standards for protecting visual resources nor does it state what DEC will do if there is a conflict.

The build-out analysis assumed that each well site and the access road to the well site would be 8.8 acres in size and that 629 wells could be potentially developed in the Town. This would account for clearing of vegetation and regrading of soils and rock. Once vegetation is removed and the pad site and access road is regraded, then the soils are generally stabilized using crushed rock which is brought in and compacted to stabilize the pad and access road to accommodate the equipment and truck traffic, and the



drill rig and equipment used during the drilling phase is brought to the site along with any production equipment once it is determined that the well is viable. The degree of visual impact of grad-

ing activities will vary depending upon whether there are gentle or steep slopes. The photograph above by Certus Strategies shows what can happen as a result of grading in steep slope areas, such as exist throughout the Town of Bethel.

Drill rigs vary in height from 30 feet for a small cable tool rig to 100 feet or greater for a large rotary rig for a vertical well. The rigs used for horizontal drilling will be like the one illustrated to the



left, 140 feet or greater, and will have more supporting equipment than for vertical wells. A taller rig with a larger footprint and substructure and 170 feet in total height, can be used for drilling consecutive wells on a pad. On well pads with multiple wells, the equipment noted above is on the site for up to three years for one well pad with six to eight wells and from four to eight months per well with one well per pad. Drill rigs are provided with lighting during the night due to the 24 hour nature of the operation.

Long term visual impacts of a pad, after the drilling phase, are determined by whether the well is a viable well or is considered a “dry hole.” In either case, reclamation work is supposed to begin within 45 days of cessation of drilling and stimulation. If the well is a dry hole, the entire site is supposed to be reclaimed. If the site was heavily forested, there will be a permanent visual impact. If the site was agricultural



land, then the reclamation process depends upon whether it can be suitably reclaimed for active agricultural use again. As discussed above under Agriculture, the success of reclamation for farming depends upon many factors that must be evaluated on a site by site basis. Was there any contamination of soils? Was the topsoil properly stockpiled, protected from erosion and then properly regraded so that its productivity can be restored? These and other questions are all relevant to the success of reclamation. The photograph above by Chesapeake Energy shows the equipment needed for a frack job in the Marcellus Shale, WV.

If the well pad is productive, then the access road must be maintained in effect permanently. Re-fracking of each well is likely, as discussed above, so much of the equipment required for this process must be brought back to the site each time it is refracked. The NYC-DEP in their build-out analysis of the Catskill Watershed lands estimated re-fracking at intervals of five to ten years over a forty year life of each well.

During the production period of a well, there will be an assembly of wellhead valves and auxiliary equipment such as meters, a dehydrator, a gas-water separator, a brine tank and a small fire-suppression tank. Multi-well pads will have larger equipment to handle the increased production. An infrastructure of pipelines<sup>93</sup> must also be constructed townwide to transport gas to markets. While most of these pipes are installed underground, a number of above ground facilities will be permanently installed with an accompanying visual impact of industrialization. Even with underground pipelines, the visual impacts are unavoidable since the above ground vegetation over the pipeline must be maintained in a trimmed condition for the life of the pipeline.

Bethel's proposed Zoning Amendment adoption, that would result in prohibition of natural gas and other heavy industrial uses would in turn lead to the elimination of the impacts identified herein as a result of the build-out activities. However, if drilling and production of gas wells occurs in towns adjacent and in close proximity to Bethel, some degradation of aesthetic resources, as viewed from Bethel, can be expected.

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## **J. Cultural Resources**

According to the Town Comprehensive Plan:

*"The Town of Bethel was founded in 1809, and is located in the heart of Sullivan County. In 1910, the old covered bridge, which had been built in 1830, was replaced with an iron bridge. This bridge is located in Mongaup Valley. This covered bridge was part of what was called the Newburgh and Cochecton Turnpike. The new bridge cut the time between Monticello and Mongaup Valley by one-third. The mid 1800's saw a hotel construction begin. The very first ones were started as wayside inns. Most were developed from farmhouses turned into boarding houses. The late 1920's, 30's, and 40's saw smaller farm owners in Bethel taking in roomers, as the hotel businesses declined.*

*In 1928, a man by the name of A.N. Smallwood came to the Town. He started a community, which he called "Mountain Lakes." It wasn't long before it became known as Small-*

*wood. Mr. Smallwood employed about 100 men during the time of the depression. This was a great economic boost for the area at that time.*

*During the 1960's in Kauneonga Lake, an entire new community of second homes appeared. This community became known as the White Lake Homes. The residents from this community have become a very important part in the social and economic life of the Town. The year 1969 was very important one in the life of the Town. First, it saw the construction of the Sullivan County International Airport in the northeast section of White Lake." "Then, one of the most amazing events in history occurred in Bethel - 'Woodstock.' It seemed to define a generation. A movie was made about it and the Town of Bethel was put on the map forever."*

While there are no State or National Register of Historic Places sites or districts found within the Town, numerous locally important historic sites and structures exist. Further, there are pre-historic and historic archaeological resources that exist in the Town. Direct adverse impacts to pre-historic and historic resources may include destruction of all or part of a pre-historic historic property, isolation from or alteration of its surrounding environment, introduction of visual, audible or atmospheric elements out of character with the property (or that alter its setting), and neglect that results in its deterioration or destruction. Primary impacts on archaeological resources may occur whenever the ground surface is disturbed by construction activities. Construction impacts consist of potential disturbances of sites with the consequent loss of scientific or historic information.

Development of or alteration to the open spaces that surround known historic or archaeological resources may diminish the historic integrity of such properties. Similarly, alteration of the character of potential historic districts by the introduction of structures, objects or land uses incompatible with the historic setting or buildings in the district would be considered an adverse impact on the cultural quality of the district.

The specific location of archeological sites is kept confidential by the OPRHP because these resources are vulnerable to looting and vandalism. General locations of sensitive areas can be identified online through the OPRHP's publicly accessible tools found on the State agency's [web site](#).<sup>94</sup> The DEC had this to say about archeology in their 1992 GEIS: *"The impacts of construction activities on archaeologic resources are more serious. Since archaeologic sites are generally difficult to detect by their surface appearance, they are more likely to be damaged during construction. Even if artifacts are salvaged before excavation begins, removal from their original location and disturbance of the site will destroy much of their value. Even with safeguards, it is possible for an archaeologic site to escape detection until construction actually begins."*

The build-out analysis has illustrated the extent to which natural gas and other heavy industrial activities would be spread out throughout the Town. Therefore, it is highly likely that natural gas

and other heavy industrial activities would cause adverse impacts on cultural resources that exist in the Town. The adverse effects include the direct adverse effects to historic resources and primary effects to archaeological resources if the well pads or access roads were in areas of archaeological sensitivity. Secondary impacts could include impacts from vibrations caused by heavily laden trucks on local roads that may pass in close proximity to locally important historic structures.

Bethel's proposed Zoning Amendment adoption, that would result in prohibition of natural gas and other heavy industrial uses would in turn lead to the elimination of the impacts identified herein as a result of the build-out activities.

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## **K. Tourism**

Tourism is one of Bethel's most important industries. According to a 2010 study of tourism in New York State by Tourism Economics entitled [The Economic Impact of Tourism in New York State](#),<sup>95</sup> tourism in the Catskills is a nearly \$1 billion industry, supporting 16,666 jobs. While tourism increased statewide by eight (8) percent in 2010, it increased even more in Sullivan County, by 10.7 percent. Tourists spent \$345,107,000 in Sullivan County in 2010 generating labor income of \$139,939,000, employing 4,565 persons, and generating \$20,939,000 in local taxes. Sullivan County is the most dependent of all of the Catskills counties upon tourism dollars with 15.7 percent of all labor income generated by visitors.

In Bethel, a major driver of tourism is [Bethel Woods Center for the Arts](#).<sup>96</sup> This is a growing world-class cultural center. Since opening its doors in 2006 through 2010, Bethel Woods has attracted over 830,000 visitors to the site of the 1969 Woodstock Festival. The Center is set on 2,000 bucolic acres in a pristine park-like setting with panoramic views.

Bethel Woods includes: 1) an award winning performing arts pavilion ("Pavilion") accommodating more than 15,000 patrons, almost 5,000 under cover and more than another 10,000 on an adjacent sloping lawn; 2) The Museum at Bethel Woods, which through exhibits, highly-claimed multi-media technologies, classrooms, and its 132-seat movie theater offers the opportunity to students, teachers, life-long learners, and other visitors to study and experience the significant cultural, social, and political events of the 1960's and the legacies of those events; 3) a 1,000 seat outdoor performing arts amphitheater known as the Terrace Stage used for cultural events; 4) an associated Museum retail shop and a light-fare café; 5) a spectacular nine-sided domed indoor Events Gallery located within the Museum building accommodating up to 400 patrons and guests for lectures, recitals, conferences, weddings, and community and corporate events; 6) a performing arts field permitted for as many as 30,000 people on the former Yasgur's Farm of Woodstock fame; 7)

outdoor and covered concession and dining areas; 8) two enclosed entertainment, service, and general purpose buildings for private or public functions or events, 9) walking trails and streams among scenic fields, clusters of wooded areas, and panoramic views; 10) parking in excess of 5,000 cars as well as for buses: and, 11) and an annual seven-week Harvest Festival highlighting local and regional crafters, farmers, and farm produce, as well as offering music and educational activities for children.

Bethel Woods directly employed or retained 65 full-time workers and an estimated 402 part-time or seasonal workers for a total of 467 directly generated positions. The total direct and indirect jobs that were generated by the Arts Center in 2010 are estimated to be 128 full-time equivalent jobs in Sullivan County and 150 full-time equivalent jobs in New York State.

In 2010, directly generated operational wages and salaries totaled approximately \$4.37 million in Sullivan County with an additional estimated \$1.46 million in indirectly generated salaries and wages in Sullivan County for a total of \$5.83 million in salaries and wages in the County. In the broader New York State economy, the operation of the Arts Center is estimated to have had a total effect from spending of approximately \$20.84 million in 2010.

Since the construction of Bethel Woods, the hamlet of Kauneonga Lake, which is the downtown district of the Town of Bethel, has been transformed from decaying, empty, dilapidated buildings along the shores of White Lake to several year-round thriving restaurants, boutique shops, dress and other shops, and a bakery, in total employing dozens of persons and revitalizing the Town of Bethel. These businesses in turn generate additional jobs for suppliers, vendors, appliance, repair shops, and contractors.

Bethel Woods has been one of the largest cultural and economic investments in the region with over \$126.62 million dollars invested in constructing it from June 2004 to October 31, 2010 (presented in 2011 dollars) and another \$14.165 million in land acquisition costs, for a total investment through October 2010 (excluding operating expenses) of \$140.825 million. There is no question that the tourism industry has been helping to revitalize the Town of Bethel.

Tourism has other positive impacts on the Town that include conservation of important natural areas, conservation of historic sites, preservation of community character, and improvement of infrastructure. These are, after all, the setting for the features that attract tourists to the Town and region in the first place.

Tourism creates more jobs per dollar of investment than heavy industries like gas production. Tourism is a labor intensive industry, compared with heavy industries like gas drilling, which is about 10 times more capital intensive than the average American industry. Moreover, tourism cre-

ates local jobs, while heavy industries like oil and gas, rely on a small, transitory workforce from out-of-state areas.

As discussed in other sections of this Land Use Analysis, heavy industrialization of Bethel from the effects of gas well and other similar developments run a significant risk of contaminated surface water, groundwater, air and soils, will create the visual impacts of an industrialized landscape in a bucolic rural community that depends on clean water, clean air, and scenic and aesthetic resources to fuel a large sector of its economy. An industrialized landscape will unavoidably transform the natural beauty of the Town, upon which the tourism industry depends. If the Town were to become industrialized, it may take time for the full effects to be felt by the tourism industry, but once tourists visit the area facilities and potentially have a bad experience due to heavy truck traffic and visually compromised landscapes, they may never come back.

If buildout occurs, tourism will be impacted by the disruption of the historic patterns of demand for motel and hotel rooms. In neighboring Pennsylvania, the gas industry has become a major consumer of hotel and motel space, reportedly renting out blocks of rooms for many months in advance. While this may represent a boom for the owners of these establishments, it will make it more difficult or nearly impossible for tourists and other visitors to find accommodations.

Supporting and growing tourism is a key component of local economic development strategies in Sullivan County, especially since the economic impact of visitor spending is about \$345,107,000 per year. Gas drilling is a specialized industry, and many well workers are transient. According to research conducted by Andrew Rumbach for the Southern Tier Central Regional Planning and Development Board and the Appalachian Regional Commission, it is likely that tourism-related businesses, such as hotels and other lodging facilities, would [benefit](#)<sup>97</sup> from the influx of gas workers. However, this may also strain the available supply and pricing of hotel and motel rooms, resulting in a reduction or loss of these resources for tourists as well as business visitors to the Town. Rumbach states:

*“The tourism “brand” of the Southern Tier is very much intertwined with agriculture; rolling hills, scenic farmlands, rural vistas, and viticulture are major contributors to the tourism draw here. Farmers markets, agricultural fairs, and family-owned restaurants can be found in almost every town and city...Supporting and growing the tourism sector is a key component of economic development strategies for the counties in the STC over the next several decades. Besides the significant tourism assets already in place, vineyards, viniculture, and wine tourism are a major focus for economic investment and growth...Though the tourism sector creates a significant number of jobs in the STC region, it is likely that the value of gas drilling, measured simply by jobs created and wages generated, will exceed the value of tourism in the short term. It is also likely that many tourism related businesses, including hotels, restaurants,*

*and shopping venues, would benefit from the influx of gas workers...These observations come with two major caveats, however.*

*First, tourism brings many non-monetary benefits to the STC region and its communities. Most important, tourism amenities improve the quality of life of residents. Restaurants, shops, parks and outdoor recreation areas, campgrounds, wineries, festivals, museums, and other related amenities are beneficial to local residents as well as visitors. These amenities also make a region more attractive for economic investment; they are some of the crucial resources that allow an area to attract economically mobile populations, like young professionals and retirees (Markusen 2003, 2004). The preservation and maintenance of rural and outdoor assets is also an important component of sustainable economic development strategies; these assets are a renewable resource for the region, and tourism creates a financial incentive to protect them.*

*Second, whereas many tourism related businesses are locally owned and operated and are thus part of a long-term economic development trajectory for the region, the employment “boom” in gas drilling will be relatively short-term and non-local...In order to gauge the true impact of gas drilling in the Marcellus Shale on tourism and tourism development, we need to look at the cumulative impact of drilling across the STC region. Individual gas wells and drilling activity, while disruptive at a local scale, will likely have very little impact on the tourism sector. Cumulatively, however, the regional industrialization associated with widespread drilling could do substantial damage to the region’s “brand,” threatening the long-term growth of tourism here. Increased truck traffic, automobile traffic, air pollution, noise pollution, and industrial accidents, decreased availability of hotel/motel rooms, campground spaces, and RV parking, negative visual impacts from multiple drilling rigs in rural view-sheds, storage facilities, gravel pits, and compressor stations, disruptions to wildlife and hunting grounds, fears over lake and stream pollution and many other associated impacts of drilling will change the character of the region from pristine and rural to gritty and industrial. If so, the region’s ability to attract tourism may be damaged in the long-term, as the perception (and reality) of the region as an industrial landscape may far outlast the employment and monetary benefits of gas drilling.”*

According to Rumbach, the Southern Tier region’s long-term ability to attract tourists could be damaged if the tourism “brand” of the region is replaced with a perception of it as an industrial landscape. This, in turn, can have greater ramifications for the economy. There are parallel comparisons that can be made for the tourism industry in the Catskills. Besides the Rumbach study, which was unanimously approved by the Southern Tier Central Regional Planning and Development Board on June 23, 2011, there has been [anecdotal evidence](#)<sup>98</sup> from other locations including

Pike County Pennsylvania. According to a news report in the [Pike County Courier](#) that quoted Sally Corrigan, director of the Pike County Community Planning Office, *"There has been a concern by those wanting to visit and vacation in Pike County whether it is safe to bring their families and children since all they have heard or know about fracking is that dangerous chemicals are being used and the drilling companies don't always comply with safety requirements. This is affecting our tourism and is a concern to area businesses,"* she said.

Industrialization has the potential to adversely affect infrastructure by the large trucks that must ply the Town's roads, and even the potential for increasing health related concerns. The effects on Bethel of heavy industrialization may mean the end of the tourism industry. Why would tourists want to visit an area where they had to contend with heavy truck traffic, blighted landscapes, and polluted resources? These questions raise substantive issues with far-reaching policy implications for the Town and region. Similar to the tourism industry is Bethel's second home industry. Recent second home developments, like The Chapin Estate and other planned communities in Bethel, could be adversely impacted because of potential purchasers' concerns over industrialization of the Town.

It is useful to note that other nearby tourism/business organizations, like the Cooperstown Chamber of Commerce, have raised concerns about the potential impacts of HVHF on their tourism economies. As provided in a Statement released from the Chamber on February 11, 2011: *"The relative contribution of natural gas from hydrofracking to either the economy or the energy needs of the region is minimal and development does not materially contribute to a sustainable national or regional energy policy...The plans for drilling pose a direct and material threat to the interests of the Chamber membership. Industrial-scale hydrofracking in the upstate region will irreparably damage the essential qualities that make the Cooperstown area an excellent place to live, raise families, farm and work. It puts at risk much of the local economy, ranging from hotel and tourism to restaurant and retail businesses, most of which are driven by the hundreds of thousands of tourists who choose to visit the region every year."*

Bethel's proposed Zoning Amendment adoption, that would result in prohibition of natural gas and other heavy industrial uses would in turn lead to the elimination of the impacts identified herein as a result of the build-out activities. However, if drilling and production of gas wells occurs in towns adjacent and in close proximity to Bethel, some degradation of aesthetic resources, as viewed from Bethel, can be expected.

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## **L. Transportation**

*"The potential transportation impacts are ominous."*

## New York State Department of Transportation

Development of heavy industrial activities, like natural gas drilling and production will be accompanied by a significant increase in the level of heavy truck traffic compared to current conditions. The build-out analysis conservatively estimates the number of truck round-trips per well at 2,400, approximately two-thirds of which are for water and wastewater (flowback) hauling. On an annual basis, the number of additional truck trips per year depends on the number of wells drilled in a given year. For full build-out of all wells in the Town of Bethel, the build-out estimated the total number of heavy truck round-trips at 1,509,600. For the reasons discussed below, that number of trips per well may be very conservative, understating the overall impact.

Any increase in the number of travel cycles in the Town will increase the risk of accidents. The risk of any accident increases substantially if it occurs with a truck carrying hazardous materials and the accident occurs in close proximity to a water feature such as Bethel's 27 lakes, reservoirs, and ponds, along the Mongaup River, or along/across one of the multitude of tributaries to the Mongaup River or Callicoon Creek, Ten Mile River or Delaware River as well as wetlands and aquifers.

Bethel has a diverse network of State, County and local roads. Large volumes of truck traffic will stress all roads. Local roads and bridges will be especially affected by trucks weighing 80,000 pounds and sometimes up to 100,000 pounds since these facilities have not been built to withstand repeated heavy truck traffic. This will increase maintenance and capital costs and will also increase the risk of accidents that result in leakage or spillage of hazardous materials. The risks associated with such spills are discussed below under Public Health.

While State highways were constructed to handle heavy traffic, the remaining road network in Bethel is maintained as either county or municipal roads. Most of these smaller roads were constructed for farm and residential access but not for industry. Municipal bridges, culverts and road beds were not designed to handle the numbers of trips nor the 40 to 50 ton loads that HVHF trucks carry. The State's Revised dSGEIS states that "*it is anticipated that the largest impacts from truck traffic would be near wells under construction or on local roadways.*" [see Revised dSGEIS page 6-310]

Trucking for the hydraulic fracture equipment, water, sand and flowback removal represents over 80 percent of the total truck traffic. This trucking takes place in weeks-long periods before and after the hydraulic fracture. It occurs during the initial hydraulic fracture and then again every time a well is refracked. Truck traffic associated with intensive industrial activity, on a relatively constant basis and over a period of decades will impact local quality of life. Trucking activity will be accompanied by provision of equipment and material supply systems (warehouses, garages, support services), gas gathering and pipeline systems, compressor stations, and waste disposal systems

to name a few of the associated facilities. The potential rate and density of heavy industrial development may cause a significant and relatively rapid industrialization of the Town.

Trucks used by heavy industrial activities like HVHF can involve convoys of 100 or more trucks to a site when it is being mobilized and demobilized. The photo to the right by James “Chip” Northrup shows truck traffic associated with well drilling in Towanda, Pennsylvania. Water and wastewater tankers can also arrive in convoys. The effects of diesel exhaust have been described above under Air. If the trucks drive on unpaved or gravel roads, which exist in the Town and which



will be constructed for well pad access, dust can also be a source of emissions. According to the [U.S. Bureau of Mines](#),<sup>99</sup> some primary concerns associated with heavy truck traffic are that large and heavy trucks start slowly, drive slowly, and stop slowly, and can interfere with other traffic; they are noisy, especially when Jake brakes<sup>100</sup> are used in hilly areas like Bethel; heavy trucks can create dusty conditions and materials can fall off the truck, possibly damaging or breaking windshields and injuring persons, and heavy trucks can damage local roads especially in the springtime when the ground thaws.

Generally, heavy trucks will work out of service yards and truck traffic will be heaviest near the yards, traveling in convoys to and from well sites. Trucking operations for drill sites is generally through the use of contract truckers that are paid by the load. Observations are that these drivers drive faster than conditions or speed limits dictate because more loads hauled means more income for the owner/driver and when especially hilly areas must be traversed, like the Town of Bethel, heavily laden trucks use downhill momentum to get uphill more efficiently. Well operations go on 24 hours of the day seven days a week so the truck traffic is non-stop.

Traffic can also be affected when roads must be crossed by pipelines. While the initial trucking activity is related to drilling, producing wells will require additional local disturbance associated with the opening up of roads and drainage ways to allow the construction of underground pipelines which will be necessary to connect the well heads to markets.

The design and construction of transmission pipelines is subject to regulation by the State Public Service Commission. But, this is not the case with gather and distribution (local service) lines. Typically all of these lines are installed underground for weather and safety related reasons. When a pipeline crosses a local road it would normally require the approval of the local Highway Superin-

tendent. During the time a road is cut open to install a pipeline, it is not available for public and emergency use. An additional concern with local roads is seismic testing. One of the practices that drillers follow involves the use of trucks with special equipment to explore the geological structure of an area through vibration or underground sound waves. The principal concern regarding this type of use relates to any restriction to traffic flow while this type of exploration is occurring and the potential for damaging local roads.

The State has no ability to enter into road use agreements with trucking operations and DEC has no regulatory authority over trucking operations associated with HVHF. Speeding tickets and safety violations are usually poorly enforced on rural roads. As of the date this Land Use Analysis was prepared, there was no offset in place for the costs associated with damage to roads, bridges, traffic crowding other users off the road, car repairs and damage to windshields. However, Bethel is one of several Sullivan County towns that formed the Multi-Municipal Gas Drilling Task Force in an attempt to address road use agreements. A model Road Use Ordinance is expected to provide the basis for future enactment of road use agreements in the Town.

In 2011, the New York State Department of Transportation prepared an internal “Discussion Paper” on the Transportation Impacts of Marcellus Shale development. Although the document is labeled as a “Draft” and was apparently prepared for internal State government use, it has been reproduced and is available for [downloading](#)<sup>101</sup> from several sources. The Executive Summary of the document is worded strongly, urging caution by all affected. This is how the document is introduced:

*“The potential transportation impacts are ominous. Assuming current gas drilling technology and a lower level of development than will be experienced in Pennsylvania the Marcellus region will see a peak year increase of up to 1.5-million heavy truck trips, and induced development may increase peak hour trips by 36,000 trips/hour. While this new traffic will be distributed around the Marcellus region this Discussion Paper suggests that it will be necessary to reconstruct hundreds of miles of roads and scores of bridges and undertake safety and operational improvements in many areas.*

*The annual costs to undertake these transportation projects are estimated to range from \$90 to \$156 million for State roads and from \$121-\$222 million for local roads. There is no mechanism in place allowing State and local governments to absorb these additional transportation costs without major impacts to other programs and other municipalities in the State.*

*This Discussion Paper also concludes that the New York State Department of Transportation and local governments currently lack the authority and resources necessary to mitigate such*

*problems. And, that if the State is to prepare for and resolve these problems it is time to establish a frank and open dialogue among the many parties involved.”*

The Revised dSGEIS has a number of errors in the calculations provided, estimating the number of truck trips generated as a result of HVHF. Some of the data presented is conflicting and in need of correction. Other data is improperly explained or labeled. There is also a lack of a full assessment of transportation impacts such as the additional truck trips needed to refracture each well or to provide for downspacing of additional wells, which is common in the industry and permitted in New York State if justified. This means that a realistic picture of the full scope of transportation impacts on New York State is not currently provided by the DEC.

Using the figures provided, New York State has estimated that gas well development will occur over a period of 30 years. Statewide, new truck trips generated annually as a result of HVHF could number 53,473,000 under a “High Development Scenario” as a result of HVHF in the initial years of gas well development, increasing to 533,360,000 truck trips per year in year 10 and continuing at that level each year until a 30 year time horizon is reached. A county by county analysis was not completed for the Revised dSGEIS so no realistic figures are available just for Sullivan County.

The State’s traffic figures assume that each well has a life of 30 years. This means that the State has projected the “boom” phase of gas development activities will last 60 years. As stated in the Revised dSGEIS, “*Because of the assumption of a 30-year development period, wells constructed in Year 30 are assumed to be productive until Year 60.*” The State’s Revised dSGEIS traffic estimates do not account for [refracking](#)<sup>102</sup> each well so the estimated truck trips are an understatement of the number of truck trips that can be expected to occur over the 60 year period. As discussed above, according to Halliburton only 10 percent of the gas in place is recovered initially and refracking is necessary. According to [some gas industry estimates](#),<sup>103</sup> refracking multiple times of 10 or more has been occurring in the Barnett Shale region. DEC’s Revised dSGEIS does not acknowledge this practice and instead states that “*Normally, hydraulic fracturing is only performed once in the life of a well.*” [See page 6-296].

Bethel’s proposed Zoning Amendment adoption, that would result in prohibition of natural gas and other heavy industrial uses would in turn lead to the elimination of some of the impacts identified herein as a result of the build-out activities. However, heavy industrial activities like gas drilling and production in other towns in the region, may still affect Bethel’s roads due to the truck traffic that inevitably must pass through the Town. See below for recommendations to address this issue.

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## M. Energy Trends

*A few hundreds of years ago, human beings discovered the genie in the bottle...coal. Coal led to oil, which inadvertently led to natural gas. These fossil fuels that our society has come to rely on for stability are simply fossilized plants; they are concentrated organic matter, concentrated energy. They allowed a relic from the past, when harvested and burned, to do the work that would take many humans to accomplish. The scale and magnitude of the work that we have been able to achieve has increased exponentially with the use of fossil fuels, but so has our ability to impact various ecosystems of the planet.*

Dennis Dimick, Executive Editor National Geographic

Fossil fuels developed over millions of years from decaying organic material like plants. They turned the sun's ancient energy into coal, oil and natural gas. Coal companies have regularly referred to coal as "buried sunshine." Each year, society burns an estimated 100,000 years of ancient plant growth meaning that we're fueling our civilization with ancient sunlight. The burning of fossil fuels have come with a price. For most of human history, carbon dioxide (CO<sub>2</sub>) levels in the atmosphere have been stable and around 275 to 285 parts per million (ppm). Beginning about 250 years ago, carbon dioxide levels began to increase, now registering at 392 ppm in 2011, increasing at a rate of about 2 ppm each year. The increases are mainly due to CO<sub>2</sub> emissions from the combustion of [fossil fuels, gas flaring, and cement production](#).<sup>104</sup> Most scientists, climate experts, and many national governments are now saying 350 ppm is the safe upper limit for CO<sub>2</sub> in our atmosphere. This is because of the "greenhouse effect" that was first described by Joseph Fourier in 1824. Then, in 1896, a Nobel Laureate chemist calculated ([see American Institute of Physics website](#)<sup>105</sup>) that if the amount of carbon dioxide in the atmosphere were to double, global temperatures would rise 9 to 11 degrees Fahrenheit. The latest scientific thinking is that a doubling of carbon dioxide in the atmosphere will raise temperatures 3 to 8 degrees Fahrenheit.

According to UCLA researchers, who [reported](#)<sup>106</sup> the results of their study of CO<sub>2</sub> in the October 8, 2009 issue of Science magazine, global CO<sub>2</sub> levels are at their highest levels in the past 15 to 20 million years. The Earth's average temperature has been increasing over the past century, with warming accelerating over the past 50 years, according to observations of temperatures globally. Of the hottest 12 years since temperatures began to be measured in the 1850s, 11 have occurred in the past 12 years. No known natural forces can account for the recent severe warming. The causes and effects of this warming trend, and the debates it has fueled, have been widely published and need not be repeated here. What is important to consider, however, is that use of fossil fuels is increasing, the pace of climate change is increasing, and governments worldwide are planning ways to both mitigate and adapt to these challenges.

The Planning profession has recognized the urgency of creating sustainable communities throughout the nation to address this issue. The American Planning Association (APA) in 2004 adopted an official [Policy Guide on Energy](#). The goal of the [Guide](#) is to help planners, and the communities and individuals they serve, to increase energy conservation and renewable energy production while significantly reducing use of non-renewable energy sources such as oil and gas. Most Americans are unaware of the large role energy plays in their everyday lives, and particularly how today's energy production and consumption are directly connected to the condition of the environment, the health of the economy, and the quality of life that will be experienced by future generations.

The Planning profession also understands the connections between use of fossil fuels and climate change. On April 11, 2011, the APA adopted an official [Policy Guide on Planning and Climate Change](#).<sup>107</sup> As stated in this [Policy Guide](#), *“The earth is getting warmer and it will continue to do so well into the future, creating a wide range of impacts that include sea-level rise, droughts, and heat waves. The key question is how fast and how severe the impacts will be and whether we can adopt policies for mitigating and adapting to these impacts.”* The General Energy Policy of the American Planning Association, its Chapters and Divisions, its 16,000 certified planners (AICP) and its 40,000 members are to “support efforts to reduce greenhouse gas emissions related to the production and use of energy in the built environment.” The policy also supports establishment of strategies to minimize the conversion of farmland and woodland for other uses because this strategy will enhance carbon sequestration, these land uses support the local economy, and they allow communities to retain rural character.

Natural gas is being widely advertised and promoted as a clean burning fuel that produces less greenhouse gas emissions than coal when burned. While less carbon dioxide is emitted from burning natural gas than from burning coal per unit of energy generated, the combustion emissions do not tell the whole story. Howarth’s [study](#)<sup>108</sup> (in conjunction with Renee Santoro and Anthony Ingraffea of Cornell) found that when there was a complete consideration of all emissions from natural gas, including the full range of emissions of greenhouse gases from using natural gas obtained by hydrofracking, that they are 2.4-fold greater than are the emissions just from the combustion of the natural gas. A [video](#)<sup>109</sup> of a gas well being finished in Pennsylvania graphically shows the extent of emissions. When the total emissions of greenhouse gases are considered, greenhouse gas emissions from hydrofracking obtained natural gas are estimated to be 60 percent more than for diesel fuel and gasoline.

An important consideration to bear in mind, in the debate over exploitation of shale gas resources, is to what extent this non-renewable resource competes with green energy technologies. It is likely that the substantial investments being made in the Marcellus Shale and other unconventional gas resources will slow the development of renewable technologies and distract politicians and the public from developing a long-term sustainable energy policy based upon non-polluting energy sources.

## N. Noise

*Studies have shown that there are direct links between noise and health. Problems related to noise include stress related illnesses, high blood pressure, speech interference, hearing loss, sleep disruption, and lost productivity.*

U.S. Environmental Protection Agency

Noise is essentially any unwanted sound. DEC's Revised dSGEIS documents the noise levels that can be expected from HVHF. While the dSGEIS states that "*Production-phase well site equipment is very quiet and has negligible impacts.*" that would not be the case with HVHF and refracking. The Revised dSGEIS projections of noise levels for HVHF are as shown in the Table below. As stated in the Revised dSGEIS, "*As discussed in the 1992 GEIS (NYSDEC 1992), moderate to significant noise impacts may be experienced within 1,000 feet of a well site during the drilling phase. With the extended duration of drilling and other activities involved with multi-well pads, the Department will review the location of multi-well pads closer than 1,000 feet to occupied structures and places of assembly and determine what mitigation is necessary to minimize impacts.*" While the Revised dSGEIS suggests some mitigation measures, there is no standard identified that would be used to consistently minimize or avoid the adverse impacts.

While recognizing the hazards of noise pollution, the State's Revised dSGEIS proposes no regulatory standard such as a decibel limit, measured at the property line. This is the standard approach municipalities use to regulate noise levels in a community. The regulation of noise is a proper function of a municipal noise regulation, but it is unknown as of the date this Land Use Analysis was prepared whether such noise regulations could apply to gas development activities. If a drilling operation is not in compliance with such a regulation, the drilling operator is normally subject to a fine.

The Table below shows the expected noise levels for the several activities associated with HVHF. The DEC does not disclose the source of the information, citing "Confidential Industry Source" so the information is not subject to verification and may not accurately reflect the full impacts of HVHF on noise levels in the Town of Bethel. It understates the noise impacts measured and reported in LaPlata County Colorado (see Table below). The Table also contrasts the projected noise levels by illustrating the US Department of Housing and Urban Development's (HUD) acceptable noise levels and those established by the EPA as benchmarks. Noise levels that exceed HUD's and EPA's standards are shown in the shaded cells.

Briefly, the threshold of human hearing is defined as 0 decibels (dBA). Very quiet conditions, such as a library are approximately 40 dBA. Noise levels between 50 and 70 dBA define the range

of normal daily activities. Anything above 70 dBA is considered noisy, and then loud, intrusive, and deafening. The dBA scale is logarithmic, meaning that each increase of 10 dBA describes a doubling of perceived loudness. Thus, the noise in an office, at 50 dBA, is perceived as twice as loud as a library at 40 dBA. A 5 dBA change in noise levels will be readily noticeable.

HUD sets exterior noise standards for residential development based upon Day-Night Sound Level values. “Acceptable” values are less than or equal to 65 dBA with a 10 dBA penalty applied to noise levels during the period from 10 PM to 7 AM. Values of 65 to 75 dBA are considered “Normally Unacceptable” while values of 75 dBA or more are considered “Unacceptable.” Interior noise levels of 45 dBA are the goal of the HUD noise levels. The US EPA also sets noise standards for the outdoor environment to protect the public from activity interference and annoyance. These noise levels should not exceed 55 dBA, which will permit spoken conversation and other activities such as sleeping, working and recreation.

<b>dSCEIS Projected Noise Levels Exceeding U.S. EPA &amp; HUD Standards</b>						
<b>Drilling Related Activity</b>	<b>Activity Duration (days)</b>	<b>Distance from Noise Source</b>				
		<b>50 feet</b>	<b>250 feet</b>	<b>500 feet</b>	<b>1000 feet</b>	<b>2000 feet</b>
Access Road Construction	3-7	89	75	69	63	57
Well Pad Preparation	7-14	84	70	64	58	52
Rotary Air Well Drilling	28-35/well	79	64	58	52	45
Horizontal Drilling	28-35/well	76	62	56	50	45
HVHF	2-5/well	104	90	84	78	72

Notes:

1. Activities that exceed the EPA’s outdoor standards and HUD’s daytime noise standards are shown in red shading. Activities that exceed EPA’s outdoor noise standards and HUD’s nighttime noise standards are shown in yellow shading.
2. The U.S. Environmental Protection Agency recommends ear protection for 8 hours of 75 dBA or more noise exposure. At 91 dBA, the daily exposure limit is 2 hours without ear protection.
3. In New York State, the setback distance for gas drilling from an inhabited dwelling is 100 feet.

To inject the required water volume and achieve the necessary pressure, up to 20 diesel-pumper trucks are operated simultaneously. Typically the operation takes place over two to five days for a single well. The drilling of a typical well pad with an average of 10 wells would mean drilling over the life of the well pad for a period of about 350 days, 24 hours a day and then HVHF for a period of 50 days, 24 hours a day. Since the State allows gas drilling up to 100 feet from a private dwelling and 150 feet from a public building or area, this means that homes located within 500 feet of a well pad would be subjected to the equivalent of a year or more of noise levels continuously ex-

ceeding the EPA’s and HUD’s standards. Some may even be exposed to noise levels that exceed the Federal Occupational Safety and Health Administration’s (OSHA) eight hour standards.

According to the Revised dSGEIS, “Most of the high-volume hydraulic fracturing would occur in quiet rural areas where the noise levels are typically as low as 30 dBA, depending on weather conditions and natural noise sources.” While the Revised dSGEIS assesses quantitative (number crunching) impacts on noise levels, it does not assess qualitative impacts on noise levels, such as the impacts that occur in “quiet rural areas” that have for centuries been accustomed to low ambient noise levels. For reference, some common noise levels can be found on the Table to the right. The “quiet rural areas” referred to by the DEC are communities whose character, based in part on a quiet rural environment, could be lost for a generation or more (i.e. the DEC’s estimated 60 year build-out) as a result of HVHF.

Common Noise Levels					
Common Outdoor Noise Levels	Noise Level (dBA)		Common Indoor Noise Levels		
Jet flyover at 1,000 feet	110	—	—	110	Rock band
Gas lawnmower at 3 feet	100	—	—	100	Inside subway train
Diesel truck at 50 feet	90	—	—	90	Food blender at 3 feet Garbage disposal at 3 feet
Noisy urban area (daytime)	80	—	—	80	Shouting at 3 feet
Gas lawnmower at 100 feet	70	—	—	70	Vacuum at 3 feet Normal speech at 3 feet
Heavy traffic at 300 feet	60	—	—	60	Large business office
Quiet urban area (daytime)	50	—	—	50	Dishwasher next room
Quiet urban area (nighttime)	40	—	—	40	Small theater (background) Library
Quiet suburban area (nighttime)	30	—	—	30	Bedroom at night Concert hall (background)
Quiet rural area (nighttime)	20	—	—	20	Broadcast & recording studio
	10	—	—	10	
	0	—	—	0	Threshold of hearing

DEC stated in the Revised dSGEIS that impacts on community character are too subjective to assess whether they are positive or negative. Loss of rural character because of a significant increase in noise levels, over what has been in place for centuries, will unquestionably impact the character of the community and neighborhood where HVHF occurs. It is undeniable that those living within 1,000 feet of a HVHF gas drilling operation will have a significant diminution in the character of their community and neighborhood, as evidenced from the change from a community where the typical background noise levels are 30 dBA to a period of potentially months and perhaps years of around-the-clock high noise levels from gas drilling activities on multi-well pad sites.

According to the US Census Bureau, American’s number one neighborhood complaint, above crime, traffic and poor public services, is noise. Noise can raise your blood pressure and change your blood chemistry. Adrenaline levels can rise from noise sources, indicating an imposition of stress. Noise is the leading cause of hearing loss in the nation. Exposure to excessive noise has been estimated to have made at least 10 million Americans a little deaf. Noise affects humans and animals in adverse ways.

The medical literature has identified the human health impacts of noise pollution on the communities surrounding oil and gas development specifically in relation to oil and gas exploration activities: drilling, well pumps, compressors, and vehicle traffic. Low frequency noise, produced from oil and gas compressors, may be of concern in the surrounding communities. A small number of studies reported the following symptoms related to low frequency noise: annoyance, stress, irritation, unease, fatigue, headache, adverse visual functions and disturbed sleep.

Traffic related noise produced from gas activity, also of concern to surrounding communities, has not been studied. Although many papers have been published in the last five years suggesting an association of cardiac health effects and noise related to traffic, these studies are restricted to urban settings. The majority of these studies reported annoyance and disturbance due to road traffic noise and associations with a higher incidence of myocardial infarctions, hypertension, ischemic heart disease, and sleep problems.

During drilling of wells, drills are operated 24 hours of the day and with multi-well pads, this can go on a year or more. Other on-site equipment can also run 24 hours of the day seven days a week. Expected noise levels, from equipment used in oil and gas activities, was measured and studied in La Plata County, Colorado. The following were reported:

<b>Equipment</b>	<b>Decibel level</b>	<b>Comparable noise</b>
Crane for Hoisting Rigs	68 dBA (500 feet from source)	Highway or Train at 50 feet
Fuel and Water Trucks	68 dBA (375 feet. from property boundary)	Highway or Train at 50 feet
Average well site	65 dBA (500 feet from source)	Industrial Area
Concrete pump for drilling	62 dBA (500 feet from source)	Industrial Area
Typical compressor station	50 dBA (375 feet from property boundary)	Background noise in Office
Pumping units	50 dBA (325 feet from property boundary)	Background noise in Office

The expected noise from natural gas and other heavy industrial uses will transform Bethel from a quite rural community to one that shares many characteristics with urban and industrial communities. Bethel’s proposed Zoning Amendment adoption, that would result in prohibition of natural gas and other heavy industrial uses would in turn lead to the elimination of the impacts identified herein as a result of the build-out activities. However, if drilling and production of gas wells occurs in towns adjacent and in close proximity to Bethel, some increases in the ambient noise levels in the entire region can be expected.

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## O. Public Health

*“The protection of drinking water sources and supplies is extremely important for the maintenance of public health, and the protection of this water use type is paramount.”*

DEC Revised dSGEIS, page 2-13

Accidental spills, leaks, and releases associated with natural gas well drilling and fracturing activities have resulted in hundreds of [documented](#)<sup>110</sup> groundwater and surface water contamination incidents across the country. Surface spills can be a relatively common occurrence at well sites because the drilling and fracturing process involves transfer of large volumes of fluids between trucks, tanks, wells, pits, and pipelines, often at high flow rates and pressures, substantially increasing the likelihood of a spill due to human error, equipment failure, or accident. Surface spills can be categorized as resulting in either acute or chronic impacts based on proximity to streams and lakes. Acute spills include accidental or intentional chemical releases that occur adjacent to or in a stream or lake. Chronic spills are considered to occur at the well site or beyond the immediate vicinity of a stream or lake.

Approximately 167 tons of chemicals are used for each well. The build-out estimated the number of tons of chemicals that would be used in the Town as 105,043 tons (210,086,000 pounds). Wastewater (flowback) contaminated with chemicals, heavy metals and radionuclides would be on the order of 62,900,000 gallons. Given the enormous volume of chemicals and wastewater that could be transported into and out of the Town and generated within the Town over a multi-decade development and production period, acute spill scenarios are realistic and should be expected to occur within Bethel. This is a natural outcome of a complex and intensive heavy industrial activity that could occur scores of times per year across the Town. This is particularly important in light of the proximity of roads adjacent to numerous streams, wetlands, lakes, reservoirs, and ponds, the heavy volume of truck traffic required to haul wastewater and chemicals and the wintertime driving conditions in the hilly countryside .

In addition to acute spills, it is reasonable to expect that development of natural gas resources in the Town will be accompanied by an increased frequency of chemical, wastewater and fuel spills at or near well pads. Site spills can be reduced through implementation of best management practices (BMPs) for pollution prevention, waste minimization, chemical handling and storage, and so on. However, even with appropriate BMPs and regulations, mechanical failures, human errors, and accidents are inevitable, [estimated](#)<sup>111</sup> to involve more than one in six shale gas wells over the next century. Impacts will be minor when on-site personnel respond quickly and limit the impacts of the incident. But significant contamination will occur when spills go undetected, plans are not followed, equipment is not maintained, and/or BMPs are not implemented. Even if most site spills are mitigated with minimal impact, the chronic occurrence of multiple spills per year over a

period of several decades can be expected to compromise public confidence in the quality of surface and local ground water as a source of potable water supplies.

Some examples of accidents include the following reports. A June 3, 2010 gas well blowout in Clearfield County, Pennsylvania, about 100 miles outside Pittsburgh, sent at least 35,000 gallons of wastewater and natural gas into the air for 16 hours. While there were no casualties, State personnel and an independent investigator concluded that the cause of the incident was untrained personnel and the failure to use proper well control procedures. The 35,000 gallons of wastewater, collected after two nearby creeks were polluted, led investigators to conclude that nearly 1 million gallons of wastewater had been released. This figure includes the uncontrolled discharge of flow-back fluids and saltwater flowing on the ground and into a tributary of Little Laurel Run, a high quality cold water fishery.

In June 2010, an explosion at a gas well in West Virginia sent seven injured workers to the hospital.

Chief Oil & Gas owns the well, which is operated by AB Resources PA, LLC. The crew had finished drilling the well and was starting the hydraulic fracturing process

when they hit a pocket of methane that caused the explosion. The explosion occurred in Marshall County, West Virginia, 55 miles southwest of Pittsburgh. The incident pictured in the photograph above occurred in Pennsylvania on February 23, 2011.



### **Blast at Chesapeake Marcellus site**

**A flash fire at a Chesapeake-operated natural gas liquids storage tank last night in south-western Pennsylvania injured three workers and forced Chesapeake to shut in production at the Marcellus shale site, the company said.**

**News wires 24 February 2011 17:28 GMT**

Fire: Chesapeake shuts in production after blast  
Image courtesy of SCANPIX/AP/WPXI.COM

On April 1, 2010 both a tank and open pit used to store hydraulic fracturing fluid caught fire at an Atlas well pad in Hopewell Township Pennsylvania. Washington County's hazardous materials team responded to the fire and a state police fire marshal ruled the blaze an accident and estimated it cost Atlas Energy \$375,000 in damages. Flames were at least 100 feet high and 50 feet wide, with the plume of black smoke visible for miles. The fire at a natural gas rig in Texas pictured to the right, from [FireDirect.net](http://FireDirect.net),<sup>112</sup> started on April 5, 2011 and took ten days to extinguish.



On December 15, 2007 an explosion occurred inside a home in Bainbridge, Ohio. Two residents in the home were not injured but the structure was damaged significantly. After investigating, the Ohio Department of Natural Resources determined that nearby HVHF operations, conducted by Ohio Valley Energy Systems Corp. in the Clinton sandstone formation, caused the explosion.

Most recently on April 20, 2011, as reported by WNEP, “Officials said thousands of gallons of fluid leaked over farm land and into a creek from a natural gas well in Bradford County [PA]. Chesapeake Energy officials said Wednesday night the leak had been contained and the situation was stable. The rupture near Canton happened late Tuesday night, contaminating nearby land and creeks. The blowout happened on the Morse family farm in LeRoy Township outside Canton, a farming community. Chesapeake Energy officials said a piece of equipment on the well failed. A major response was launched to stop the leak of frack fluid and get control of the well. Water gushed from the earth at the Chesapeake well pad for hours Wednesday. It was all hands on deck to put a stop to the leak of fracking fluid that, according to company officials, spilled thousands and thousands of gallons into nearby land and waterways. Company officials stressed no gas leaked. ‘We’ve been able to limit the flow. We’re still doing additional work to regain full control,’ said Brian Grove of Chesapeake Energy. He added there is no telling yet how much of that extremely salty water mixed with chemicals and sand has impacted the nearby Towanda Creek, but no gas has escaped into the air.”

Gas development involves use of hazardous machinery and hazardous materials. Accidents can and will happen. The DEC attempts to demonstrate in the Revised dSGEIS how the proposed regulatory arrangements will avoid such occurrences. However, they can be expected to occur if the natural gas industry becomes established in the Town despite all additional precautions and because of the inevitability of human error and mechanical failures. According to [Ronald D. Bishop](#),<sup>113</sup> PhD, Professor in the Chemistry and Biochemistry Department at the State University of New York, College at Oneonta, “If future impacts may be inferred from recent historical performance, then:

- *Between two and four percent of shale gas well projects in New York will pollute local ground-water over the short term. Serious regulatory violation rates will exceed twelve percent.*
- *More than one of every six shale gas wells will leak fluids to surrounding rocks and to the surface over the next century.*
- *Some chemicals in ubiquitous use for shale gas exploration and production, or consistently present in flowback fluids, constitute human health and environmental hazards when present at extremely low concentrations. Potential exposure effects for humans will include poisoning of susceptible tissues, endocrine disruption syndromes, and elevated risks for certain cancers.*
- *Exposures of gas field workers and neighbors to toxic chemicals and noxious bacteria are exacerbated by certain common practices, such as air/foam-lubricated drilling and the use of impoundments for flowback fluids. These methods, along with the intensive use of diesel-fueled equipment, will degrade air quality and may cause a recently described “down-winder’s syndrome” in humans, livestock and crops.*
- *State officials have not effectively managed oil and gas exploration and production in New York, evidenced by thousands of undocumented or improperly abandoned wells and numerous incidents of soil and water contamination. Human health impacts from these incidents appear to include*

*abnormally high death rates from glandular and reproductive system cancers in men and women. Improved regulations and enhanced enforcement may reasonably be anticipated to produce more industry penalties, but not necessarily better industry practices, than were seen in the past.”*

DEC’s Revised dSGEIS states that “Contamination of surface water bodies and groundwater resources during well drilling could occur as a result of failure to maintain stormwater controls, ineffective site management and inadequate surface and subsurface fluid containment practices, poor casing construction, or accidental spills and releases including well blow-outs during drilling or well component failures during completion operations. A release could also occur during a blow-out event if there are not trained personnel on site that are educated in the proper use of the BOP system.” Although the State has recognized the potential public health threats of HVHF, the Revised dSGEIS did not make any attempt to assess impacts to human health.

Accidental spills, leaks, and releases associated with natural gas well drilling and HVHF activities have occurred and are expected by the State to occur. Even though there has been [documented](#)<sup>114</sup> water resource contamination, such as has occurred in groundwater in the vicinity of gas development activities in Pavillion, WY and surface water contamination such as described above, there was no attempt by the State to [conduct](#)<sup>115</sup> a Health Impact Assessment for their Revised dSGEIS. According to the [Centers for Disease Control and Prevention](#),<sup>116</sup> Health Impact Assessment (HIA) is “A combination of procedures, methods, and tools by which a policy, program, or project may be judged in terms of its potential effects on the health of a population, and the distribution of those effects within the population.” It is recommended by the US Department of Health and Human Services as a planning resource. It is especially relevant for HVHF issues such as [water quality](#)<sup>117</sup> and [air quality](#).<sup>118</sup>

Baseline [information](#)<sup>119</sup> for a HIA has already been accomplished by the DEC and State Health Department and there is a developing [database](#)<sup>120</sup> of information on the public health impacts of HVHF. [Larysa Dyrszka](#),<sup>121</sup> MD provides a comprehensive [summary](#)<sup>122</sup> of the state of the information that does exist from testimony she provided to the NY State Assembly’s Hearing on the Potential Public Health Impacts of Hydraulic Fracturing, held on May 26th, 2011. While the State has avoided conducting a HIA, even though it was [recommended](#)<sup>123</sup> by the Council of the Medical Society of the State of New York and by [more than](#)<sup>124</sup> 250 medical experts, along with the Medical Societies of at least seven upstate counties and the regional office of the American Academy of Pediatricians, evidence suggests that it is called for and should be completed. Examples of HIAs from [Colorado](#)<sup>125</sup> and [Alaska](#)<sup>126</sup> provide a good starting point for New York State to follow.

For example, here’s what the HIA for Garfield Colorado had to say about the effects of HVHF on water quality: “Water pollution is hazardous to the public health. Garfield County Oil and Gas studies, EPA studies, and other studies demonstrate that natural gas development and production can release contaminants to domestic water supplies and compromise water quality. Individual circumstances can influence the

*potential contamination of water. In Garfield County, accidents and malfunctions have been the most common cause of water contamination from natural gas development and production. However, the Mamm Creek Hydrological Study indicates some impacts to groundwater, such as increased levels of chloride and methane, from routine natural gas operations. If a domestic water resource is contaminated, remediation is time and cost intensive and may not restore the water resource to a quality for domestic use.”*

Here’s what it said about the effects of HVHF on air quality, among many other issues addressed by the HIA: *“Air pollution is a known hazard to the public health. There is sufficient information available to indicate that even with current practices and technologies the natural gas industry produces large amounts of air pollutants. In addition, Antero’s recent well development activities on the Watson Ranch pad resulted in short term health impacts. Antero has proposed additional mitigation measures for the project in Battlement Mesa but these mitigations are as yet untested. Further mitigation measures may be needed to reduce the likelihood of health effects. As it stands, the Antero project has the potential to pollute the air and negatively impact the public health in Battlement Mesa. Many information gaps exist.”*

Bethel’s proposed Zoning Amendment adoption, that would result in prohibition of natural gas and other heavy industrial uses would in turn lead to the elimination of the impacts identified herein as a result of the build-out activities. However, it should be noted that any drilling activities in other surrounding towns that affect the upstream watersheds and air-sheds in the Town, could also adversely impact waters and air quality in Bethel.

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## **P. Energy Boomtown Effects**

Energy extraction “boom” and “bust” cycles have been studied for decades. There is a wealth of information available documenting the experiences of communities around the nation that have been transformed almost overnight into boom economies when gas extraction starts, only to be followed by a bust economy when the energy resource has been depleted. The State’s Revised dSGEIS speaks to the issue of the short-term boom but makes no attempt to estimate the costs associated with the long-term bust.

According to Penn State’s College of Agricultural Sciences Cooperative Extension, many communities in the Marcellus Shale region are currently experiencing rapid population growth and changes to daily life as natural gas development accelerates. Communities experiencing this growth have been called “boomtowns.” Previous research on these boomtowns, usually in the western United States, has documented both positive and negative impacts to economies, communities, families, and individuals.

Two recent efforts to investigate the boomtown effect in the Marcellus Shale region have been undertaken by Cornell University and The Pennsylvania State University. In Penn State's 2009 [Energy Boomtowns & Natural Gas: Implications for Marcellus Shale Local Governments & Rural Communities](#),<sup>127</sup> Jeffrey Jacquet discusses this issue as follows:

*The impacts of energy extraction on small towns were extensively studied during the 1970s and 1980s, when rural areas of the western United States underwent a period of significant energy development. While more than 25 years old, these studies represent the most recent wide-scale analysis on the effects of energy development in the United States. A number of social and economic trends emerged from this work and a so-called "Boomtown Impact Model" took shape among researchers studying the development in these rural communities. The model posits that rural communities are often overwhelmed by rapid population influxes associated with the energy development and that energy development often provides a number of unique opportunities and challenges to communities and local governments.*

*Local governments are often caught unprepared by the waves of new growth and are at a disadvantage to mitigate potential growth problems. Some of these disadvantages include a lack of information, growth volatility, lack of jurisdiction, conflict between long-term residents and new residents, resistance to new government policy or planning strategies, shortage of staff or expertise, and a lack of or lag in sufficient revenue. Boomtown research has shown that economic impacts can be mixed, as some sectors or communities will benefit much more than others. Businesses or residents not directly tied to the energy industry may have to deal with inflationary or employment pressures while not seeing gains in revenue. Job growth can be stratified, as while new jobs will be created, not all workers will be suited for or interested in these jobs. Expectations for economic benefits are often unrealistically high, and while economic and job growth does occur, these expectations are not met. A significant body of literature shows that boomtowns can harbor disproportionate increases in social problems such as crime, mental health problems, community dissatisfaction, education shortfalls, and other indicators. Research shows that certain groups of people will have different social reactions to rapid growth, depending on their stature in the community and whether they were residents before the growth occurred."*

An even more recent effort has been undertaken by Susan Christopherson, a Professor of City and Regional Planning at Cornell University and Ned Rightor, President of New Economy Dynamics LLC. Their [investigation](#)<sup>128</sup> of the issue raises a number of issues similar to the work at Penn State. As stated in their [Report](#)<sup>129</sup> summary:

*"The extraction of non-renewable natural resources such as natural gas is characterized by a "boom-bust" cycle, in which a rapid increase in economic activity is followed by a rapid de-*

crease. The rapid increase occurs when drilling crews and other gas-related businesses move into a region to extract the resource. During this period, the local population grows and jobs in construction, retail and services increase, though because the natural gas extraction industry is capital rather than labor intensive, drilling activity itself will produce relatively few jobs for locals. Costs to communities also rise significantly, for everything from road maintenance and public safety to schools. When drilling ceases because the commercially recoverable resource is depleted, there is an economic “bust” – population and jobs depart the region, and fewer people are left to support the boomtown infrastructure.”

The authors discuss the economic benefits of shale gas development as follows:

“Natural resource extraction industries typically play a small role in state economies. Their employment impact is tiny compared to industries such as retail or health services (Headwaters, 2011). On the other hand, these industries have major impacts on the regions where production takes place. Shale gas drilling does bring an economic “boom” to the regions that experience it. As drilling companies move into a community, local expenditures rise on everything from auto parts to pizza and beer. New jobs are created in hotels and retail. Landowners receive royalty payments and have extra spending money in their pockets. This increased economic activity is very welcome in Pennsylvania and New York, especially in light of the “great recession.”

But, the economic effects do not come without consequences and positive economic outcomes cannot be taken for granted according to the authors. They raise important questions that must be factored into the optimistic projections of economic benefits:

- 🎯 Who will get the jobs that are created?
- 🎯 What are the costs of shale gas drilling to the public?
- 🎯 How will the costs and benefits be distributed?
- 🎯 How will other regional industries, such as tourism and agriculture, be affected?
- 🎯 Where will the royalty money be spent?
- 🎯 How long will the boom last, and what happens when it ends?

Their investigation involved analysis of studies completed in Pennsylvania, New York and other shale gas plays around the nation in an attempt to answer these questions. Typically, the drilling phase of shale gas development usually depends on an out-of-state workforce, except for truck haulers and construction jobs. The direct employment opportunities for local residents come from the post-drilling production phase when permanent jobs are needed to maintain the natural gas infrastructure.

The Town of Bethel would need more police protection, especially for the increased truck volume and the need to enforce weight limits. Fully loaded tractor trailers on local roads result in more traffic problems and accidents requiring more fire and police protection. There are documented increases in emergency response needs, building permit applications, and arrests. The emergency response needs stem from the trucks, road conditions, drilling and truck accidents, and the population influx. Emergency response also includes the response to environmental incidents, which most communities are not prepared for.

While the local demand for goods and services increases and local businesses can benefit, prices go up not just for the temporary residents, but for long-time local residents too. Jeffrey Jacquet's study found that workers in the mining sector have higher wages than local residents and their increased demand for goods and services have the effect of increasing prices by twice the national rate over a six-year study period.

Rental housing is especially affected. As demand increases for rentals, rents increase and local renters, who cannot afford their apartment any longer, are displaced. Hotels and motels also fill up with gas workers and while the increased demand for rooms may benefit hotel and motel owners and local restaurants, it may hurt other local businesses that typically serve the interests of a more traditional clientele. In some locations, hotels may have few rooms available for the usual clientele: recreation seekers, tourists, hunters, fishermen, art and music patrons, and regular business travelers. There is also a "permanent resident exclusion" from state and local hotel occupancy taxes on longer stays of more than 90 days in New York (30 days for most counties), meaning that these guests do not pay the tax that helps support local tourism activities.

This population influx comes with short- and long-term added costs. The Town of Bethel can be expected to bear a wide range of demands for new services or increased levels of service. These include added administrative capacity, staffing levels, equipment, and outside expertise, which will all be needed to meet those demands.

The experience in Bradford County, PA is illustrative of the sometimes unexpected effects of gas drilling. When the news that the 2010 census had determined that population in the County had declined by two percent since 2000, some residents were surprised because of their experiences facing traffic congestion and rising prices, produced by the presence of the new transient population.

One of the biggest impacts of the boom phase is the fiscal effects for local road and bridges repairs and maintenance. Another Cornell [study](#)<sup>130</sup> completed by C. J. Randall points out:

*"Dust, noise, and road damage from industry truck travel are tops on the list of citizen complaints in areas where gas is extracted via shale gas drilling. A typical Marcellus well requires 5.6 million gallons of water during the drilling process, in almost all cases delivered by truck."*

*Liquid additives are shipped to the well site in federal DOT-approved plastic containers on flatbed trucks; hydrochloric acid and water are delivered – and flowback is hauled away – in tanker trucks. Millions of gallons of liquid used in the short (weeks-long) initial drilling period account for half of the estimated 890 to 1340 truckloads required per well site. Because of its weight, the impact of water hauled to one site (364 trips) is the equivalent of nearly 3.5 million car trips. Few roads at the town level in New York State have been built to withstand this volume of heavy of truck traffic.”*

The routes taken by all those trucks will be on public roads. In rural Sullivan County, the roads were never designed to withstand the volume or weight of this level of truck traffic, especially under freeze-thaw conditions. As pointed out by the New York State Department of Transportation, “The annual costs to undertake these transportation projects<sup>131</sup> are estimated to range from \$90 to \$156 million for State roads and from \$121-\$222 million for local roads. There is no mechanism in place allowing State and local government to absorb these additional transportation costs without major impacts to other programs and other municipalities in the State. Indeed, New York State is one of the very few states that does not impose a tax on [gas production](#)<sup>132</sup> leaving the question of who pays for these additional costs unanswered. Road use agreements and local Ad Valorem taxes can provide some needed local resources, but the funds flowing to towns appear unlikely to match the costs and will lag expenses by several years, and there are virtually no funds flowing to the State.

Water extraction sites must be developed to provide water for HVHF. After extraction, the gas must move to the transmission lines via local pipelines and compressor stations. Flowback wastewater must be transported to treatment facilities, which must be built to handle toxic wastes, since none currently exist in Sullivan County. While these and related facilities will be located where they are deemed most desirable by the gas industry, it may not necessarily be where drilling and production is taking place and where tax revenue is presumably being generated. This raises additional questions for local governments: Who will regulate these facilities, and monitor and enforce standards? What staffing and resources will be required? How will the money to support these efforts be provided?

The facilities typically include:

- ① “[Man camps](#)<sup>133</sup>” (essentially trailer parks or dormitories) for short-term out-of-state workers
- ① Depots for equipment
- ① Staging areas
- ① Gravel quarries
- ① Water extraction sites
- ① Wastewater treatment plants capable of handling toxic materials
- ① Injection wells

- Disposal areas (landfills)
- Gas storage facilities

These facilities and services are connected by rail spurs and heavy truck traffic. Heavy industrial facilities can have significant impacts on the economy and industries such as tourism, hunting and fishing, organic farming and agricultural sectors. Noise has been a serious concern related to compressor stations because they can produce noise levels in the 85 to 95 decibel range and can be distinctively heard from miles away. Prime contributing sources associated with excessive noise at compressor stations can include reciprocating engines, gas turbines, cooling fans and release valves. While there is [mitigation available](#)<sup>134</sup> to attenuate noise levels from compressor stations, the Revised dSGEIS does not directly address this issue. The noise levels above are at or above the federal Occupational Safety and Health Administration (OSHA) threshold of safety for an 8-hour day, and compressors work a 24-hour day. These facilities can effect adjacent property values and regional industries like tourism. Local government may have a role in the permitting of pipeline routes along rights-of-way and may also require filings and notice to abutters. These activities require expertise, administration, monitoring, and enforcement capacity, and all involve planning and public administration costs.

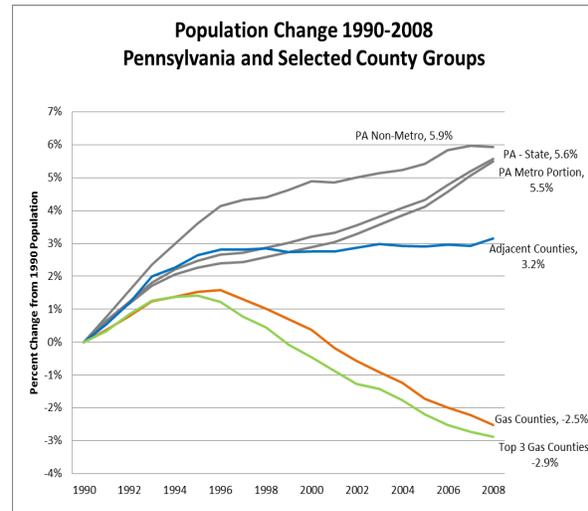
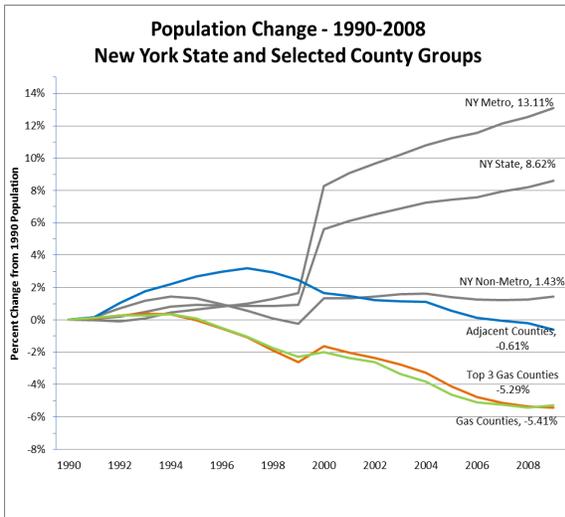
The potential loss in property values suggest that this may raise a conundrum for local governments. If HVHF comes to town, will the ad valorem taxes payable on gas wells make up for the lost tax revenue from declining assessed values on real estate. A [Report](#)<sup>135</sup> prepared for Advocates for Springfield in Otsego County suggests that it may not.

Based upon the studies of other boomtown areas, the following list summarizes the potential costs that will need to be planned for by Bethel:

- Accelerated road maintenance needs
- Traffic congestion from trucks
- Higher public safety costs
- Increased demand for health and education services
- Increased demand on public administrative services (e.g. planning and zoning, permitting, assessments, housing assistance)
- Potential loss of property tax revenues as a result of crowding out of the tourism and second home industries
- New service requirements, such as emergency response capacity and environmental monitoring and remediation.

There are other boomtown impacts of gas development activities that have been documented. According to [studies](#)<sup>136</sup> in New York and Pennsylvania conducted by Susan Christopherson of Cornell University, when compared to adjacent counties or all of non-metropolitan New York, coun-

ties with significant natural gas drilling are characterized by population loss and smaller increases in real personal income. In Pennsylvania, counties with conventional gas production (1991-2005) show similar trends. Graphs, prepared by the Cornell Department of City and Regional Planning, and that illustrate this effect can be seen below:



Other Cornell findings include personal income growing more slowly in New York gas-producing counties between 1990 and 2008. There was a 108% average growth in real personal income between 1990 and 2008 for Non-Metropolitan New York State. That growth was an average of 101% for counties adjacent to gas counties, a 99% average growth for the 10 top gas counties, and a 97% average growth for the top three gas-producing counties (Chautauqua, Chemung, Steuben). In Pennsylvania, incomes grew more slowly in gas-producing counties. Compared to all non-metropolitan counties, gas counties in Pennsylvania grew more slowly in real personal income, and slightly faster in per capita income. But compared to adjacent counties, gas counties grew much more slowly in both total and per capita income in Pennsylvania.

Some of the energy boomtown effects include those with unexpected consequences. There have always been anecdotal reports of the social consequences of oil and gas development. These have been documented to include an increase in the demands for [strip clubs](#)<sup>137</sup> and [“man camps](#)<sup>138</sup>” as shown in the photograph from pennantv.com of one in Troy, Pennsylvania below. Loss of businesses that depend on clean water may occur, as [announced](#)<sup>139</sup> in November 2011 by Ommegang Brewery near Cooperstown in Otsego County. Loss of some or all of the Town’s tourism and second home industries could also occur, as these sectors become “crowded out” by the gas industry and associated heavy industrial facilities and accompanying impacts.



"Man Camp" of RVs for drilling crews on Troy, PA fairgrounds.

Studies of the energy boomtown effects in the western states may offer some clues as to how Bethel will fare if local governments pursue gas development or work actively to control its adverse effects. According to a Headwater Economics<sup>140</sup> study entitled [Fossil Fuel Extraction as a County Economic Development Strategy: Are Energy-focusing Counties Benefiting?](#)<sup>141</sup>

*"In counties that have pursued energy extraction as an economic development strategy—places we call energy-focusing (EF) in this report—the long-term indicators suggest that relying on fossil fuel extraction is not an effective economic development strategy for competing in today's growing and more diverse western economy. When compared to their rural peer counties, EF counties suggest an analogy to the fable of the tortoise and the hare. While EF counties race forward and then falter, the non-energy peer counties grow steadily. At the finish line, counties that have focused on broader development choices are better off, with higher rates of growth, more diverse economies, better-educated populations, a smaller gap between high and low income households, and more retirement and investment income."*

There could be competition for rental housing units in the Town of Bethel. In areas of Pennsylvania where Marcellus shale drilling activity is already occurring, it has been [documented](#)<sup>142</sup> that there have been difficulties accommodating the influx of new workers. There have been [reports](#)<sup>143</sup> of large increases in rent (doubling, tripling or more) in Bradford County, Pennsylvania, as a result of the influx of out-of-area workers. There have also been "frequent reports" of landlords not renewing leases with existing tenants in anticipation of leasing at higher rates to incoming workers, and reports of an increased demand for motel and hotel rooms, increased demand at RV camp sites, and increases in home sales. Such localized increases in the demand for housing have raised concerns about the difficulties caused for existing local, low-income residents to afford housing.

Some or all of these effects can be expected to occur in Bethel, like much of the remainder of the Marcellus region, were the area become a new energy boomtown. If Bethel's proposed Zoning Amendment documents are adopted to prohibit natural gas and other heavy industrial uses this may eliminate some of the impacts identified herein as a result of the build-out activities. However, demands for housing by temporary workers are regional impacts and gas development in other locations is likely to affect Bethel. Emergency services workers, because mutual aid agree-

ments are in place, may be called upon to assist with accidents, explosions, and other emergency needs in adjoining towns. Trucking is also a regional impact so Bethel's roads and maintenance costs, as well as traffic levels and the potential for trucking accidents remain if other area towns permit these heavy industrial activities.

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## **Q. Community Character**

The DEC's Fact Sheet on the Revised dSGEIS states that: *"To mitigate potential cumulative impacts to community character, the SGEIS proposes that DEC, in consultation with local governments, may limit simultaneous development of well pads and wells in proximity to each other. This approach would also help mitigate any noise impacts, visual impacts and impacts from increased truck traffic. DEC will monitor the pace and concentration of development throughout the state and will consider additional measures to mitigate the adverse impacts at the local and regional levels. Where appropriate, and in consultation with local governments, DEC will impose specific construction windows within well construction permits to ensure drilling activity and cumulative impacts are concentrated in one specific area."* But will this offer to consult with local government result in an ability for municipalities to control their own destiny, and if desired and in conformance with a comprehensive plan, to either say no to gas drilling or to control where, when and how it occurs?

There is a close relationship between municipal comprehensive plans and generic environmental impact statements. This relationship is acknowledged in the State Environmental Review Act (SEQR) regulations [6 NYCRR 617.10(b)] as well as in New York State Village [§ 7-722.8], Town [§ 272-a.8] and General City Law [§28-a.9]. In particular, a municipal comprehensive plan may be designed to also serve as a generic EIS. In some respects, the Revised dSGEIS can be considered a land use plan that will determine the direction this new industrial use will take in New York State. It appears headed for a new regulatory and institutional arrangement that will have significant and long-term implications for a majority<sup>144</sup> of New York State's upstate communities. The State has acknowledged that it will "consider" local planning and zoning if a local government informs the DEC on a permit application that a proposed well may be inconsistent with such planning and zoning. But, the State should also acknowledge that heavy industries like gas drilling may be unwanted in a locality and home rule should be allowed to take precedence over the State's insistence that it provides *"substantial economic and environmental benefits."* in all cases.

Community character impacts relate directly to whether HVHF is compatible with municipal comprehensive planning and zoning. [Section C](#) above discusses the extent to which HVHF is incompatible with the Town of Bethel Comprehensive Plan. In particular, the analysis examined the degree to which the Comprehensive Plan would be frustrated if HVHF were to become widespread

in the Town. The Plan represents the essence of what residents envision the future of their community to be.

Communities are provided with the tools for establishing a planning process that allows them to determine their future well being. Do they desire to pursue economic development regardless of any negative impacts or are they interested in building upon an already established plan to maintain a sense of place, retain clean water and air, set aside good agricultural lands and productive forests, foster a robust tourism industry, maintain protected scenic and natural areas, keep roads relatively free from heavy congestion or from an increased risk of accidents, provide good employment opportunities in desirable sectors based upon slow and steady growth, and to ensure that these will still be available to be enjoyed by their children and grandchildren? These are some of the questions the Town of Bethel needs to ask itself when examining the effects of HVHF on the community's character.

It is instructive to provide some background here on how New York State laws and the courts have dealt with the issue of community character. As provided in the New York State Village, Town and General City laws: *Among the most important powers and duties granted by the legislature to a [village town city] government is the authority and responsibility to undertake [village town city] comprehensive planning and to regulate land use for the purpose of protecting the public health, safety and general welfare of its citizens.*<sup>145</sup> But what is community character and is it even something that can be defined let alone described? An examination of community character as part of a comprehensive plan process usually begins with an inventory of important community assets as well as natural and cultural resources. It includes identifying the types of development that the community wants to encourage or support (and those that are not desirable and should be excluded) and then establishing standards that will facilitate development to be encouraged while maintaining key community assets and resources.

When new development projects are proposed in a community by a developer or when new policies or regulations are proposed by a local legislative body for adoption, SEQR reviews must be conducted by local officials. This is no different from what the DEC has been conducting in their EIS process since 2009. It is useful to understand what the State Environmental Quality Review Act and its implementing regulations say about community character. It is an issue that must be considered by every agency conducting a SEQR review when it judges the merits of a proposal against the "Criteria for Determining Significance" found in 6 NYCRR 617.7(c). Here, it is stated "...*(iv) the creation of a material conflict with a community's current plans or goals as officially approved or adopted; (v) the impairment of the character or quality of important historical, archeological, architectural, or aesthetic resources or of existing community or neighborhood character;...(vii) the creation of a hazard to human health; (viii) a substantial change in the use, or intensity of use, of land including agricultural, open space or recreational resources, or in its capacity to support existing uses; (ix) the encouraging or attracting of a*

*large number of people to a place or places for more than a few days, compared to the number of people who would come to such place absent the action.”* Each of these four criteria suggests areas that are appropriate for consideration in any environmental assessment of impacts on community character.

The courts have also ruled on community character in a number of cases. In the *H.O.M.E.S. v. New York State Urban Development Corporation (UDC)* case, the Syracuse Carrier Dome stadium had been proposed to increase in size from 24,000 to 50,000 spectators. The court ruled that the UDC failed to consider incremental increases in traffic-related impacts such as emergency vehicle access, parking, traffic stoppage and air pollution. The Court held that the environmental review should have considered how the traffic problems would affect the existing community character. In the *Chinese Staff and Workers Association v. City of New York Hallmark* case, the issue here was the proposed construction of luxury housing in Chinatown. “Gentrification” was identified as the main impact and the State Court of Appeals held that “existing patterns of population concentration, distribution or growth and existing community or neighborhood character are physical conditions within the meaning of environment.”

In *Tompkins County in the East Coast Development v. Kay, et al.* case, the City of Ithaca Planning Board had denied site plan approval for construction of a Wal-Mart store. The Court upheld the denial based on the visual impacts to observation points of Buttermilk Falls State Park (a community character issue) but found that the Board impermissibly considered purely economic impacts of the potential competition from the store. In another similar case in the Adirondacks, in *Wal-Mart v. Planning Board for the Town of North Elba*, the Town had denied siting of a Wal-Mart Store because of the potential impacts of empty store fronts on the appearance and character of downtown. The court ruled that this was a valid concern as were the visual impacts and it was permissible for the Town Board to consider whether proposed mitigating measures in fact ameliorated adverse visual effects due to a viewshed protected by a Scenic Preservation Overlay District. The local land use law provided a basis for the denial.

As far as significance is concerned, there is also guidance from the SEQR regulations about how to determine if a significant impact exists, especially for community character issues like aesthetic/visual resources, noise, lighting, existing land use, recreation and open space, historic or archaeological resources, and health and safety. The questions to ask are whether a proposed action diminishes public enjoyment or appreciation of an inventoried resource, such as a scenic viewshed or a residential neighborhood, or if it will impair the character or quality of an inventoried place, such as a tourist attraction, park or open space.

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## R. Community Services

*“The increase in ad valorem property taxes would have a significant positive impact on the finances of local government entities...local governments would also experience some significant negative fiscal impacts resulting from the development of natural gas reserves in the low-permeability shale.”*

Revised dSGEIS, page 6-262

The State’s current EIS process will ultimately conclude with the adoption of a written Findings Statement by the DEC. The Findings Statement, by law, must: 1) consider the relevant environmental impacts, facts and conclusions disclosed in the final EIS; 2) weigh and balance relevant environmental impacts with social, economic and other considerations; and 3) provide a rationale for the agency's decision; [see 6 NYCRR 617.11(d)]. Therefore, it should be kept in mind that while a SEQR review process may outline significant adverse environmental impacts as a result of a proposed action, it also mandates that those environmental impacts be balanced with social and economic factors. The Revised dSGEIS includes a whole new section devoted to Socioeconomic Impacts, concluding that HVHF *“activities could provide a substantial economic boost for the state in the areas of employment, wages and tax revenue for state and local governments.”* The Revised dSGEIS also acknowledges that the increased HVHF activity will place a greater demand on government services. The Revised dSGEIS states that *“governments would experience some significant negative fiscal impacts....”* However, there was no attempt in the Revised dSGEIS to quantify the costs associated with these demands. Therefore, the assessment of fiscal impacts in the Revised dSGEIS should be considered incomplete.

Economic impacts are not an environmental impact *per se* but fiscal impact analysis has become commonplace in EIS documents. This is because there are patterns of population concentration, distribution or growth, community infrastructure, and existing community or neighborhood character that are all environmental areas of concern under SEQR and each of these relevant areas can be affected by economic conditions. Such factors are appropriate to study in an EIS document. Fiscal impact analysis has been around as a planning tool for decades, used by planners, economists, business interests, municipal officials, and assessors. It is the primary means to assess the consequences of development on community service delivery. The absence of a fiscal impact analysis in an EIS in this context must be considered a significant inadequacy. Town officials and municipal department heads must be aware of the public costs associated with HVHF beforehand, so that local governments can project the numbers of public employees, whether they are police, fire, public works or others, who must be hired and the kinds of municipal facilities that will be needed to serve a changing population that is expected from HVHF, even if only during the boom part of an expected boom and bust cycle.

The State's Revised dSCEIS includes an exhaustive quantitative analysis of the economic benefits of HVHF. However, the State has also characterized the negative impacts associated with HVHF in only a qualitative manner as *"potentially significant adverse impacts on local communities associated with an increase in population and increased demand for housing and community services are tied to the rate of development."* To date, the State has made no effort to assess the quantitative fiscal impacts on local governments as a result of the increased demands for community services. It is incumbent upon the State to assess and to quantify the economic and fiscal costs to local governments so that decision-makers can prepare for the changes that may occur. Of particular relevance are the cost and revenue implications that are distinctive to shale gas development outlined by David Kay in his research efforts discussed above.

Studies of HVHF in other areas show that the impacts to community services as a result of HVHF include a broad range of needs, some of which may be already available while others require local legislative action. These include but are not limited to: accelerated road construction, repair and maintenance requirements; traffic congestion from trucks requiring greater police protection; control of oversize truck loads on local roads; enforcement of State stormwater management requirements by building departments; higher public safety costs as a result of spills and accidents; increased demands for health, education, recreation, and solid waste services as a result of population growth; increased demands on public administrative services such as planning and zoning, assessments, and housing assistance; enforcement of noise pollution (if local noise regulations are in effect); permitting for opening town roads for installing pipelines; monitoring seismic testing on town roads; registration of landmen (if applicable regulations exist) who solicit lease agreements with landowners; water supply permitting for large withdrawals from community water supply systems if required by local regulations; discharge of wastewater if local community sewage treatment plants gain approval for processing of flowback; and new service requirements that may not have been previously needed in rural communities, such as emergency response capacity and environmental monitoring and remediation.

According to a [survey](#)<sup>146</sup> of local government officials in Clinton County, PA, a larger number of officials said their costs are increasing than said that their revenues are increasing as a result of Marcellus activity, which suggests that development of Marcellus shale is creating fiscal concerns in some municipalities as they try to respond to higher service needs.

Other Pennsylvania [studies](#)<sup>147</sup> have shown mixed outcomes. The data indicate that Marcellus shale development brings some positive economic activity for communities. The analysis reflected the early stages of natural gas drilling and did not include the cost impacts of Marcellus development on public services nor the impact on local government and school district tax collections since royalty and leasing income is exempt in Pennsylvania from the local earned income tax and local jurisdictions cannot levy sales taxes.

The State DEC has projected that local governments with sales tax revenue sharing could experience a substantial increase in sales tax receipts from the additional economic activity in the region and they could also see an increase in ad valorem property tax revenues. Ad valorem is a property tax on gas wells, administered in New York by the Office of Real Property Tax Services (ORPTS) and municipalities. The ad valorem tax is not a production tax or a severance tax that is tied to the gas produced. New York is one of only two states that have no production or severance tax on natural gas. The tax is valued based upon the income stream expected from the well. The Revised dSGEIS estimates that ad valorem taxes could be as high as \$1.45 million over the 30-year life of a typical horizontal well. However, the State to date has not estimated whether these increased tax revenues for local government will pay for the increase in community services necessitated by gas drilling activities. As stated on page 2-262 of the Revised sDGEIS:

*“In addition to the positive fiscal impacts discussed above, local governments would also experience some significant negative fiscal impacts resulting from the development of natural gas reserves in the low-permeability shale. As described in previous sections, the use of high-volume hydraulic-fracturing drilling techniques would increase the demand for governmental services and thus increase the total expenditures of local government entities. Additional road construction, improvement, and repair expenditures would be required as a result of the increased truck traffic that would occur. Additional expenditures on emergency services such as fire, police, and first aid would be expected as a result of the increased traffic and construction and production activities. Also additional expenditures on public water supply systems may also be required. Finally, if substantial in-migration occurs in the region as a result of drilling and production, local governments would be required to increase expenditures on other services, such as education, health and welfare, recreation, housing, and solid waste management to serve the additional population.”*

Bethel relies on volunteers for much of its local emergency service needs. Increased demands for such services may eventually lead to a demand for paid emergency responders and the Town may have to adopt a partially paid or fully paid system of fire and police protection. Increased needs for equipment also accompany such increases in demand. This will increase the cost of providing such services and is likely to increase the tax burdens on taxpayers in the Town.

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## **S. Conclusions and Recommendations**

*Among the most important powers and duties granted by the legislature to a [village town city] government is the authority and responsibility to undertake [village town city]*

*comprehensive planning and to regulate land use for the purpose of protecting the public health, safety and general welfare of its citizens.*

New York State Town, Village and General City Laws

Previous sections of this Land Use Analysis have presented a broad overview of how HVHF affects communities and the environment, based upon the experiences of other regions where HVHF for shale gas has become an established industry. The picture that emerges is one where adverse environmental impacts and both positive and negative economic impacts can occur. Some of these impacts will be immediate, others will be realized over time, perhaps generations.

However, there are a number of measures that communities can take to prepare for HVHF, assuming that it could become established in the Town of Bethel following the conclusion of the State's environmental impact studies and promulgation of new regulations on the gas industry. This Land Use Analysis has been designed to assist Bethel by gathering information to use for addressing gas drilling and related heavy industrial development.

Whether or not HVHF becomes established in the Town of Bethel, it is likely that it will in other surrounding areas based upon gas industry and State projections. Indeed, there is already anecdotal evidence that existing gas drilling in northern Pennsylvania counties, is affecting the Southern Tier and Catskills, such as increased demands for local truck drivers. While these observations are non-scientific, they do provide proof that may assist research efforts on the economic impacts of gas drilling.

The first place for Bethel to start is to address the proposed Zoning Amendment that would prohibit natural gas and other heavy industrial uses. Some communities in Sullivan County and elsewhere in the State have already taken action to prohibit heavy industrial activities like gas drilling and production.

The Town of Dryden's recent enactment of prohibitions on a variety of land uses related to natural gas and petroleum development has been challenged in the Tompkins County Supreme Court; it is expected that the case may wind its way to the State's highest court, the Court of Appeals. The decision of whether to prohibit heavy industrial activities like gas drilling is one that can only be made after consulting a municipal attorney. [Attorneys](#)<sup>148</sup> for the gas industry believe that the State's Oil Gas and Solution Mining Law preempts local zoning regulations of the industry. Other [attorneys](#)<sup>149</sup> and [legal experts](#)<sup>150</sup> believe that zoning provisions regulating land use generally, including prohibiting gas drilling in some districts like any other land use or prohibiting it entirely is not a "regulation" of the gas industry but is an incidental control resulting from a municipality's exercise of its right to determine appropriate land uses through zoning.

This Land Use Analysis does not take a position as to whether State law preempts local efforts to prohibit gas drilling. Thus, the subsection on Zoning Regulations in the Table below has been designed to address land use issues generally because gas drilling activities, regardless of their location, can cause pressures for other growth and development in all communities throughout the region that can only be effectively addressed through zoning. The many ways in which a municipality can address HVHF have been summarized below:

Municipal Action	Discussion	Further Resources
Comprehensive Plans	<ul style="list-style-type: none"> <li>▶ Review the plan, if there is a written one, to identify whether industrial activities were contemplated; prepare a comprehensive plan if there is not an adopted one</li> <li>▶ Involve the public in plan preparation or amendment</li> <li>▶ Ensure the plan reflects residents' vision for the future</li> <li>▶ Conduct natural and cultural resource mapping so that important community features are identified for protection and enhancement</li> <li>▶ Incorporate County Comprehensive Plan principles into municipal plans</li> </ul>	<p><a href="#">Tompkins County Planning Department's Gas Drilling Planning Tools</a></p> <p><a href="#">NY Department of State Local Government Services</a></p> <p><a href="#">American Planning Association</a></p> <p><a href="#">Groundwater Resource Mapping</a></p> <p><a href="#">Environmental Resource Mapper</a></p>
Zoning Regulations	<ul style="list-style-type: none"> <li>▶ Review zoning districts and uses to determine ultimate build-out of the community if there are zoning regulations</li> <li>▶ Consider using the services of a professional planner to draft zoning</li> <li>▶ Review the regulations for issues such as access, signage, landscaping, noise, lighting, building placement, natural and cultural resource protection (see Site Plan Regulations below)</li> <li>▶ Require site plan review for driveway permits to gas pad areas to minimize impacts to neighbors</li> <li>▶ Review special use permit requirements and establish standards for individual uses</li> <li>▶ Review the zoning and subdivision regulations to determine if design standards or guidelines have been developed to illustrate the types of development and neighborhoods that are desired</li> </ul>	<p><a href="#">Center for Rural Massachusetts Manual of Build-Out Analysis</a></p> <p><a href="#">NY Department of State Zoning Publications</a></p> <p><a href="#">NY Planning Federation Model Ordinances</a></p> <p><a href="#">Sullivan County Planning Department 2020 Toolbox</a></p>

Municipal Action	Discussion	Further Resources
Site Plan Regulations	Site plan regulations address development issues such as compatibility with surroundings, pedestrian and vehicle access, economic impacts, impacts on air, water, and noise, visual compatibility, geology, topography, soil characteristics, vegetation, wildlife, drainage, erosion, wetlands, flood hazards, site density, plans and elevations of structures, signs, landscaping, fencing, buffers, and utilities among other reasonable site issues	<a href="#">NY Department of State Site Development Review</a>
Local Laws	New York State Municipal Home Rule Law (MHRL) allows a community to enact local laws for "protection and enhancement of its physical and visual environment." Communities have used this State law to enact wetlands regulations, watercourse and water body protection regulations, hillsides and steep slopes protection regulations, protection of wildlife habitat, groundwater, game and game birds, scenic areas, fish, flood control, soil conservation, reforestation, timber harvesting and tree preservation, and stormwater regulations. Local laws have also been used to establish critical environmental areas as overlay districts as well as natural resource and open space protection districts (just like residential or commercial districts) under zoning.	<a href="#">New York Rural Water Association</a> <a href="#">Town of Colonie Watercourse Protection Law</a> <a href="#">Pace University School of Law</a> <a href="#">Environmental Law Reporter Open Space Protection Techniques</a>
Historic Resources	New York State General Municipal Law allows a community to enact a landmark preservation law under section 96-a of Article 5-K.	<a href="#">NY State Department of State</a>
Other Local Controls	<ul style="list-style-type: none"> <li>▶ Consider adopting local light, noise and air quality regulations</li> <li>▶ Require that landmen (representatives of drilling companies) register before operating in a community so that residents can identify individuals who are soliciting the use of land</li> </ul>	<a href="#">Noise Pollution Clearinghouse</a> <a href="#">NY Planning Federation Diesel Idling Guide</a>
Critical Environmental Areas	Designate natural and cultural resources as Critical Environmental Areas (CEA) under the New York State Environmental Quality Review Act (SEQR). Legislative boards, planning boards and zoning boards can all designate CEA's, which then require an additional level of environmental assessment in accordance with SEQR. Inform DEC of all locally designated CEA's	<a href="#">DEC's SEQR Handbook</a> <a href="#">Town of Roxbury, Delaware County CEA</a>

Municipal Action	Discussion	Further Resources
Emergency Responders	Ensure that local emergency responders are informed of the exact contents of fracking fluids at well sites and transport routes so that proper treatment can be provided in the event of spills or contamination incidents	
Roads	<ul style="list-style-type: none"> <li>▶ Plan, post, and enforce truck routes that minimize high-volume truck traffic</li> <li>▶ Devise Road Use Agreements (RUAs) or state-level fees that support road maintenance while drilling or production activity is underway</li> <li>▶ Anticipate “haul routes” to and from drilling sites based leased parcel and permit location information, and infrastructure</li> <li>▶ Undertake a comprehensive traffic impact study and document baseline roads by video/photographs of pre-development road conditions</li> <li>▶ Estimate road damage costs using AASHTO standards for equivalent single axle loads (ESALs)</li> <li>▶ Consider adopting restrictions on hours of operation on local roads for heavy industrial uses</li> <li>▶ Establish inter-municipal agreements to ensure consistent policies for mitigating heavy industry operations on roadways connecting neighboring municipalities</li> <li>▶ Require pre-use roads assessments performed by a licensed Civil Engineer, paid for by any company expecting to heavily use local roads and infrastructure</li> <li>▶ Then enact a road use law, where haulers (all heavy trucks) exceeding a certain weight are required to pay for a permit for their activities</li> <li>▶ Establish “financial undertaking agreements” (i.e., cash bond, escrow, or letter of credit) sufficient to cover the real cost of damages to local roads including infrastructure (e.g., drainage, culverts, bridges)</li> </ul>	<p data-bbox="924 417 1263 445"><a href="#">Cornell Local Roads Program</a></p> <p data-bbox="924 478 1411 533"><a href="#">Yates County Roads Preservation and Use Program</a></p> 

Municipal Action	Discussion	Further Resources
Pipelines	<ul style="list-style-type: none"> <li>▶ Require permits and inspections by the highway superintendent for road openings for pipelines to ensure alternative arrangements for the period during which the road is closed, alternative traffic circulation or by-pass routes, the listing of responsible parties for the road closing and restoration, and specifying the quality of the replacement roadway to be provided upon completion of construction</li> <li>▶ Co-locate pipelines in road rights-of-way to minimize impacts of additional land disturbances</li> <li>▶ Encourage companies to share pipelines to avoid duplication and decrease impacts while offering economies of scale</li> </ul>	<a href="#">Field Safety Guide</a>
Community Services	<ul style="list-style-type: none"> <li>▶ Create a community “task force” to act as a clearinghouse of information on HVHF</li> <li>▶ Identify “what is normal” for local communities, so that increases in demand for local government services can be noticed quickly</li> <li>▶ Identify capacities and “problem thresholds” for local government services and for private services like EMT’s</li> <li>▶ Identify jurisdiction and authority over issues of concern</li> <li>▶ Create a list of telephone numbers and email addresses for management and emergency contacts in the event of an incident at or near a drill site or established gas well</li> <li>▶ Connect with gas companies to identify ways to mitigate problems</li> <li>▶ Monitor gas well development (i.e. drill rig numbers and locations, well locations, permit trends, and production trends) using GIS mapping</li> <li>▶ Identify likely growth scenarios and monitor commercial, industrial, and residential development trends</li> <li>▶ Plan for the new growth and how it will be paid for (new fees and bond resolutions)</li> <li>▶ Continue to plan for projects, facilities, and services that will remain after gas-related growth has subsided or reversed</li> <li>▶ Plan and implement central water and wastewater systems in existing centers and priority growth areas and balance such development opportunities with open space, farmland and forestry protection strategies in rural areas</li> </ul>	<a href="#">DEC Oil and Gas Database</a> <a href="#">Sullivan County GIS Mapping</a> <a href="#">Cornell Natural Gas Resource Center</a> <a href="#">Mineral Resources Environmental Notice Bulletin</a> <a href="#">Catskill Citizens for Safe Energy</a>

Municipal Action	Discussion	Further Resources
Mobile Homes	Zoning is the most common method of regulating mobile homes. For communities that lack zoning, a free-standing regulation or local law can be enacted.	<a href="#">NY State Department of State</a>
Training	<ul style="list-style-type: none"> <li>▶ Train emergency management responders on blow-out prevention, gas flaring procedures and layout of flow lines</li> <li>▶ Encourage residents to sign up for NY Alert notifications of chemical spills or gas fires</li> <li>▶ Ensure local assessors are properly trained on the valuation and assessment of gas producing property</li> </ul>	<a href="#">NY Alert</a> <a href="#">NY State Office of Real Property Tax Services</a>
Stormwater Management	The State DEC encourages municipalities to enact local regulations for management of stormwater. The State of New York recommends that every community, whether or not it is regulated under the state/federal stormwater program, to adopt a Stormwater Management Local Law.	<a href="#">NY State Department of Environmental Conservation</a>
Intermunicipal	<ul style="list-style-type: none"> <li>▶ Consult with the County’s Soil and Water Conservation District and existing water users to determine best locations for water withdrawals</li> <li>▶ Explore options for sharing services, protecting resources on a regional basis, and treating significant land use issues similarly regardless of location</li> <li>▶ Resolve jurisdictional disputes and help coordinate permitting processes through joint meetings with local, county, state and federal representatives</li> </ul>	<a href="#">Sullivan County Soil &amp; Water Conservation District</a> <a href="#">NY State Department of State</a> <a href="#">Pace University Land Use Law Center</a>
Energy Use	<ul style="list-style-type: none"> <li>▶ Reduce energy consumption through comprehensive planning and community design that incorporates strategies for both mobile and non-mobile energy efficiency</li> <li>▶ Adopt smart growth development strategies</li> <li>▶ Streamline community alternative energy use such as wind and solar systems</li> <li>▶ Encourage programs aimed at reducing individual energy consumption</li> <li>▶ Ensure that local land-use standards proactively encourage the installation of renewable energy technologies</li> </ul>	<a href="#">American Planning Association</a> <a href="#">Rocky Mountain Institute</a> <a href="#">Smart Growth America</a> <a href="#">Environmental Protection Agency</a> <a href="#">US Green Building Council</a> <a href="#">Cornell Green Choices</a>

Additional information about HVHF can be expected to be available over time as governmental agencies, academic institutions and others continue to study the issues associated with gas drilling. Political entities have established their own fact-finding processes about HVHF. The New York State Assembly Standing Committee on Environmental Conservation and the Assembly Standing

Committee on Health held hearings in 2011 on the Health Impacts of Hydraulic Fracturing Techniques. However, it is important to understand the extent to which lawmakers may be influenced by gas companies. A Report issued in April of 2011 by Common Cause/New York entitled “[Deep Drilling, Deep Pockets](#)<sup>151</sup>” highlights the millions of dollars that have been spent by gas companies on lobbying activities designed to influence New York’s lawmakers to look favorably on HVHF. There has also been a [study](#)<sup>152</sup> completed by Common Cause on the federal level that identifies almost \$750 million spent by energy companies lobbying for HVHF between 2001 and 2011.

The DEC established a High Volume Hydraulic Fracturing Advisory Panel in July of 2011. The Panel, composed of politicians, gas industry and business representatives and environmental organization representatives, has been meeting since July of 2011 with recommendations expected in 2012.

Federal agencies are studying the issue. The US Environmental Protection Agency is in the midst of a Hydraulic Fracturing Study with the initial research findings expected in 2012 and a final report ready in 2014. This study was not available at the time this Land Use Analysis was completed. On April 12, 2011, the US Senate Committee on Energy and Public Works held a hearing on “Natural Gas Drilling: Public Health and Environmental Impacts.” A complete transcript of the hearing can be found [here](#).<sup>153</sup>

In regards to government agency actions, it should be noted that there have been quite a number of government documents, including internal documents leaked to reporters and others, that paint a picture of HVHF more ominous than official documents reveal. A good [example](#)<sup>154</sup> is the 30,000 pages of documents assembled by the [New York Times](#) from federal and state government sources. Another one cited in this Land Use Analysis is an internal “Discussion Paper” from the New York State Department of Transportation that does not appear as if it was used by the DEC in its preparation of the Revised dSGEIS. This is significant because it portrays potential impacts on transportation and highway infrastructure from a lack of State and local funding sources that is quite different from what is presented in the DEC’s Revised dSGEIS.

New York State’s Laws have long recognized the essential role that cities, towns and villages play in the regulation of land use within their borders. For more than 75 years under the State’s planning and zoning enabling acts, municipalities have been developing ways to address issues of growth, development, and protection of the public health and welfare. The State Court of Appeals addressed the issue of municipal land use control and resource extraction in a 1996 case, where it stated that “A municipality is not obligated to permit the exploitation of any and all natural resources within the town as a permitted use, if limiting that use is a reasonable exercise of its police power to prevent damage to the rights of others and to promote the interests of the community as a whole.” New York State’s Executive, Legislative and Judicial branches all have various means for addressing changes in land use,

especially when trends emerge that affect the lives and livelihood of State residents. Ultimately, it will be up to the citizens of the Town of Bethel and other jurisdictions, along with their elected representatives, to inform State government officials of their opinions on gas drilling and HVHF.

Gas drilling using HVHF is an enormously complex and potentially dangerous process, the likes of which have never been seen in most rural communities of Upstate New York. HVHF, if permitted in New York State, will have mixed economic repercussions and profound impacts on the environment, land use and community character. Based on the DEC's environmental and regulatory review process to date, including the Revised dSGEIS and the proposed [High Volume Hydraulic Fracturing Regulations](#),<sup>155</sup> it appears that local governments will not be able to rely on the State to adequately mitigate the adverse impacts of HVHF. Local government needs to understand and effectively use the various tools that are available to them to protect their community's infrastructure, land use patterns, natural and cultural resources, and community character. Local governments, residents and businesses also need to express their thoughts and opinions, to the DEC and to their State elected officials, about the regulation or prohibition of gas development.

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## ENDNOTES:

<sup>1</sup> Superfund is the name for the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. It was designed to clean up sites contaminated with hazardous substances. The law authorized the EPA to identify parties responsible for contamination and compel them to clean up the sites. Where responsible parties cannot be found, the Agency can clean up sites itself.

<sup>2</sup> [http://www.ugcenter.com/US-Shales/The-Disruptive-Shales\\_29751](http://www.ugcenter.com/US-Shales/The-Disruptive-Shales_29751)

<sup>3</sup> [http://www.eia.gov/energyexplained/index.cfm?page=natural\\_gas\\_where](http://www.eia.gov/energyexplained/index.cfm?page=natural_gas_where)

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<sup>5</sup> <http://geology.com/articles/utica-shale/>

<sup>6</sup> [http://www.eia.gov/forecasts/aeo/source\\_natural\\_gas.cfm](http://www.eia.gov/forecasts/aeo/source_natural_gas.cfm)

<sup>7</sup> <http://online.wsj.com/article/SB10001424052970203686204577112493261431530.html>

<sup>8</sup> <http://www.eia.gov/forecasts/aeo/>

<sup>9</sup> <http://www.naturalgaswatch.org/?p=970>

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<sup>12</sup> <http://www.ene.com/Markets>

<sup>13</sup> <http://www.marcellus.psu.edu/research/pdf/acadhandout.pdf>

<sup>14</sup> <http://www.earthworksaction.org/halliburton.cfm>

<sup>15</sup> <http://www.nytimes.com/gwire/2010/02/22/22greenwire-energy-industry-reps-greet-house-fracking-prob-63352.html>

<sup>16</sup> <http://www.dec.ny.gov/energy/46288.html>

<sup>17</sup> Tcf refers to trillion cubic feet and is abbreviated as Tcf or TCF.

<sup>18</sup> [http://www.dentonrc.com/sharedcontent/dws/drc/localnews/stories/DRC\\_DrillValues\\_0918.1046e9a00.html](http://www.dentonrc.com/sharedcontent/dws/drc/localnews/stories/DRC_DrillValues_0918.1046e9a00.html)

<sup>19</sup> [http://www.cce.cornell.edu/EnergyClimateChange/NaturalGasDev/Documents/PDFs/NYSBA\\_Journal\\_nov-dec2011.pdf](http://www.cce.cornell.edu/EnergyClimateChange/NaturalGasDev/Documents/PDFs/NYSBA_Journal_nov-dec2011.pdf)

<sup>20</sup> <http://www.scribd.com/doc/72545747/Worst-Fracking-Regs>

<sup>21</sup> <http://marcelluseffect.blogspot.com/2011/05/frackins-ok-as-long-as-you-dont-breathe.html>

<sup>22</sup> The New York State Legislative Commission on Rural Resources defines a rural community as one with a population density of 150 persons per square mile or less.

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- <sup>42</sup> [http://www.nature.org/media/pa/tnc\\_energy\\_analysis.pdf](http://www.nature.org/media/pa/tnc_energy_analysis.pdf)
- <sup>43</sup> Professor Ingraffea has been a principal investigator on R&D projects from the National Science Foundation, NASA, FAA, Kodak, IBM, Schlumberger, and the Gas Research Institute.
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- <sup>75</sup> <http://www.dec.ny.gov/lands/47486.html>
- <sup>76</sup> <http://www.ksla.com/global/story.asp?S=10268585>
- <sup>77</sup> <http://www.pinchot.org/gp/EffectsofMarcellusShale>
- <sup>78</sup> [http://www.nrs.fs.fed.us/pubs/gtr/gtr\\_nrs76.pdf](http://www.nrs.fs.fed.us/pubs/gtr/gtr_nrs76.pdf)
- <sup>79</sup> <http://www.dec.ny.gov/lands/49875.html#Ecosystem>
- <sup>80</sup> <http://newyork.plantatlas.usf.edu/Results.aspx>
- <sup>81</sup> [http://www.dec.ny.gov/docs/wildlife\\_pdf/alleghenytxt.pdf](http://www.dec.ny.gov/docs/wildlife_pdf/alleghenytxt.pdf)
- <sup>82</sup> <http://www.osc.state.ny.us/reports/environmental/openspacepreserv10.pdf>
- <sup>83</sup> <http://www.usa.com/sullivan-county-ny-air-quality.htm>
- <sup>84</sup> <http://www.sustainablefuture.cornell.edu/news/attachments/Howarth-EtAl-2011.pdf>
- <sup>85</sup> [http://democrats.energycommerce.house.gov/sites/default/files/documents/Hydraulic Fracturing Report 4.18.11.pdf](http://democrats.energycommerce.house.gov/sites/default/files/documents/Hydraulic%20Fracturing%20Report%204.18.11.pdf)

<sup>86</sup> [http://www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/docs/Marcellus\\_NC\\_05-06-11.pdf](http://www.dep.state.pa.us/dep/deputate/airwaste/aq/aqm/docs/Marcellus_NC_05-06-11.pdf)

<sup>87</sup> [http://www.edf.org/sites/default/files/9235\\_Barnett\\_Shale\\_Report.pdf](http://www.edf.org/sites/default/files/9235_Barnett_Shale_Report.pdf)

<sup>88</sup> [http://townofdish.com/objects/DISH\\_-\\_final\\_report\\_revised.pdf](http://townofdish.com/objects/DISH_-_final_report_revised.pdf)

<sup>89</sup> [http://deq.state.wy.us/out/downloads/Rushin\\_Ozone.pdf](http://deq.state.wy.us/out/downloads/Rushin_Ozone.pdf)

<sup>90</sup> <http://metroland.net/2011/11/22/the-farmer-and-the-well/>

<sup>91</sup> <http://tinyurl.com/6tpc97s>

<sup>92</sup> [http://www.dec.ny.gov/docs/permits\\_ej\\_operations\\_pdf/visual2000.pdf](http://www.dec.ny.gov/docs/permits_ej_operations_pdf/visual2000.pdf)

<sup>93</sup> According to the US Department of Energy, “Transporting natural gas from the wellhead to the final customer involves several physical transfers of custody and multiple processing steps. A natural gas pipeline system begins at the natural gas producing well or field. Once the gas leaves the producing well, a pipeline gathering system directs the flow either to a natural gas processing plant or directly to the mainline transmission grid, depending upon the initial quality of the wellhead product. The processing plant produces pipeline-quality natural gas. This gas is then transported by pipeline to consumers or is put into underground storage for future use.”

<sup>94</sup> <http://www.oprhp.state.ny.us/nr/>

<sup>95</sup> <http://catskillcitizens.org/learnmore/NYSTourismImpact-Catskills.pdf>

<sup>96</sup> <http://www.bethelwoodscenter.org/>

<sup>97</sup> [http://www.stcplanning.org/usr/Program\\_Areas/Energy/Naturalgas\\_Resources/STC\\_RumbachMarcellusTourismFinal.pdf](http://www.stcplanning.org/usr/Program_Areas/Energy/Naturalgas_Resources/STC_RumbachMarcellusTourismFinal.pdf)

<sup>98</sup> [http://www.strausnews.com/articles/2011/11/10/pike\\_county\\_courier/news/6.txt](http://www.strausnews.com/articles/2011/11/10/pike_county_courier/news/6.txt)

<sup>99</sup> <http://dnrweb.dnr.state.md.us:8080/FullDisp?itemid=00016235>

<sup>100</sup> This is a diesel engine braking mechanism that causes a loud “machine-gun” noise when a large truck decelerates.

<sup>101</sup> <http://tinyurl.com/75h2sz7>

<sup>102</sup> [http://www.halliburton.com/public/pe/contents/Papers\\_and\\_Articles/web/Q\\_through\\_Z/UnconventionalGas\\_H05270.pdf](http://www.halliburton.com/public/pe/contents/Papers_and_Articles/web/Q_through_Z/UnconventionalGas_H05270.pdf)

<sup>103</sup> <http://www.ingaa.org/File.aspx?id=6422>

<sup>104</sup> <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter2.pdf>

<sup>105</sup> [http://aip.org/history/climate/summary.htm#N\\_1](http://aip.org/history/climate/summary.htm#N_1)

<sup>106</sup> <http://www.sciencedaily.com/releases/2009/10/091008152242.htm>

<sup>107</sup> <http://www.planning.org/policy/guides/pdf/climatechange.pdf>

<sup>108</sup> <http://www.eeb.cornell.edu/howarth/Marcellus.html>

<sup>109</sup> <http://www.psehealthyenergy.net/resources/view/198782>

<sup>110</sup> <http://www.riverkeeper.org/wp-content/uploads/2010/09/Fractured-Communities-FINAL-September-2010.pdf>

<sup>111</sup> <http://flimarcellusconference.files.wordpress.com/2011/07/risk-assessment-natural-gas-extraction-1.pdf>

<sup>112</sup> <http://www.firedirect.net/index.php/2011/04/drilling-rig-fire-could-take-days-to-extinguish/>

<sup>113</sup> <http://63.134.196.109/documents/RiskAssessmentNaturalGasExtraction.pdf>

- <sup>114</sup> [http://www.msnbc.msn.com/id/45246260/ns/us\\_news-environment/#.Tr027GBhpjj](http://www.msnbc.msn.com/id/45246260/ns/us_news-environment/#.Tr027GBhpjj)
- <sup>115</sup> <http://water.washington.edu/Research/Articles/2000.rethinking.pdf>
- <sup>116</sup> <http://www.cdc.gov/healthyplaces/hia.htm>
- <sup>117</sup> <http://www.cdc.gov/healthyplaces/healthtopics/water.htm>
- <sup>118</sup> <http://www.cdc.gov/healthyplaces/healthtopics/airpollution.htm>
- <sup>119</sup> [http://www.dec.ny.gov/docs/permits\\_ej\\_operations\\_pdf/hodreport.pdf](http://www.dec.ny.gov/docs/permits_ej_operations_pdf/hodreport.pdf)
- <sup>120</sup> [http://www.upstate.edu/cnymph/pdf/hydraulic\\_fracturing\\_implications.pdf](http://www.upstate.edu/cnymph/pdf/hydraulic_fracturing_implications.pdf)
- <sup>121</sup> <http://psehealthyenergy.net/users/view/14205>
- <sup>122</sup> [http://www.gasdrillingtechnotes.org/uploads/7/5/7/4/7574658/potential\\_stressors\\_human\\_health\\_ld\\_2011.pdf](http://www.gasdrillingtechnotes.org/uploads/7/5/7/4/7574658/potential_stressors_human_health_ld_2011.pdf)
- <sup>123</sup> [http://www.gasdrillingtechnotes.org/uploads/7/5/7/4/7574658/nys\\_assembly\\_013\\_adam\\_law.pdf](http://www.gasdrillingtechnotes.org/uploads/7/5/7/4/7574658/nys_assembly_013_adam_law.pdf)
- <sup>124</sup> [http://www.gasdrillingtechnotes.org/uploads/7/5/7/4/7574658/250\\_medical\\_people\\_10-5-11.pdf](http://www.gasdrillingtechnotes.org/uploads/7/5/7/4/7574658/250_medical_people_10-5-11.pdf)
- <sup>125</sup> <http://www.garfield-county.com/public-health/battlement-mesa-health-impact-assessment-draft2.aspx>
- <sup>126</sup> <http://www.hiaguide.org/hia/national-petroleum-reserve-alaska-oil-development-plan>
- <sup>127</sup> <http://nercrd.psu.edu/publications/rdppapers/rdp43.pdf>
- <sup>128</sup> [http://greenchoices.cornell.edu/downloads/development/marcellus/Marcellus\\_SC\\_NR.pdf](http://greenchoices.cornell.edu/downloads/development/marcellus/Marcellus_SC_NR.pdf)
- <sup>129</sup> <http://devsoc.cals.cornell.edu/cals/devsoc/outreach/cardi/publications/loader.cfm?csModule=security/getfile&PageID=1018556>
- <sup>130</sup> [http://greenchoices.cornell.edu/downloads/development/marcellus/Marcellus\\_Randall.pdf](http://greenchoices.cornell.edu/downloads/development/marcellus/Marcellus_Randall.pdf)
- <sup>131</sup> According to DOT's Draft Discussion Paper: Transportation Impacts of Potential Marcellus Shale Gas Development, projects necessary to accommodate an annual increase of 1.5-million heavy truck trips and induced development increases in peak hour trips of 36,000 per hour.
- <sup>132</sup> <http://www.ncsl.org/default.aspx?tabid=12674>
- <sup>133</sup> <http://www.businessweek.com/ap/financialnews/D9PG5N3G0.htm>
- <sup>134</sup> <http://www.acousticalsolutions.com/natural-gas-compressor-stations>
- <sup>135</sup> <http://www.scribd.com/doc/63144744/Fiscal-Effects-of-Gas-Drilling-in-Otsego-County-NY-8-15-11-Final>
- <sup>136</sup> [http://www.greenchoices.cornell.edu/downloads/development/marcellus/Marcellus\\_Prelim\\_Results.pdf](http://www.greenchoices.cornell.edu/downloads/development/marcellus/Marcellus_Prelim_Results.pdf)
- <sup>137</sup> <http://www.ktva.com/home/outbound-xml-feeds/Strippers-Flock-to-Oil-Boom-Town-132796198.html>
- <sup>138</sup> <http://www.businessweek.com/ap/financialnews/D9PG5N3G0.htm>
- <sup>139</sup> <http://thedailystar.com/localnews/x1267472742/Ommegang-Fracking-may-force-us-to-leave>
- <sup>140</sup> An independent non-profit firm, not supported by the gas industry or by advocates against HVHF.
- <sup>141</sup> [http://headwaterseconomics.org/pubs/energy/HeadwatersEconomics\\_EnergyFocusing.pdf](http://headwaterseconomics.org/pubs/energy/HeadwatersEconomics_EnergyFocusing.pdf)

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[http://www.philadelphiafed.org/community-development/publications/cascade/77/08\\_impact-of-marcellus-shale-on-housing-needs.cfm](http://www.philadelphiafed.org/community-development/publications/cascade/77/08_impact-of-marcellus-shale-on-housing-needs.cfm)

143 [http://housingforum.phfa.org/slides/Session 14 Mike Kearney.pdf](http://housingforum.phfa.org/slides/Session%2014%20Mike%20Kearney.pdf)

144 The Marcellus and/or Utica shales underlie every county in New York State except the Adirondacks, most of the area east of the Hudson River and the New York Metropolitan area.

145 See Village Law § 7-722, Town Law § 272-a, and General City Law § 28-a.

146 [http://www.clintoncountypa.com/resources/CCNGTF/pdfs/articles/9.22.11 - Natural Gas Drilling Effects on Municipal Governments.pdf](http://www.clintoncountypa.com/resources/CCNGTF/pdfs/articles/9.22.11-Natural%20Gas%20Drilling%20Effects%20on%20Municipal%20Governments.pdf)

147 <http://pubs.cas.psu.edu/FreePubs/pdfs/ua468.pdf>

148 <http://www.westfirmlaw.com/flare/AnschutzvTownofDryden.pdf>

149 <http://www.westfirmlaw.com/flare/AmicusFilings.pdf>

150 [http://www.middlefieldny.com/Documents Forms/Docs/BSK final Memo Gas Drilling.pdf](http://www.middlefieldny.com/Documents%20Forms/Docs/BSK_final%20Memo%20Gas%20Drilling.pdf)

151 [http://www.citizenscampaign.org/PDFs/CC REPORT FINAL.pdf](http://www.citizenscampaign.org/PDFs/CC_REPORT_FINAL.pdf)

152 <http://fuelfix.com/blog/2011/11/10/energy-companies-spent-750-million-lobbying-for-hydraulic-fracturing/>

153 [http://epw.senate.gov/public/index.cfm?FuseAction=Hearings.Hearing&Hearing\\_ID=270378f4-802a-23ad-4d07-c6b1fd44510b](http://epw.senate.gov/public/index.cfm?FuseAction=Hearings.Hearing&Hearing_ID=270378f4-802a-23ad-4d07-c6b1fd44510b)

154 <http://www.nytimes.com/interactive/2011/02/27/us/natural-gas-documents-1.html#document/p1/a9895>

155 <http://www.dec.ny.gov/regulations/77353.html>