

**IMPACTS ON COMMUNITY CHARACTER OF HORIZONTAL DRILLING
AND HIGH VOLUME HYDRAULIC FRACTURING IN MARCELLUS
SHALE AND OTHER LOW-PERMEABILITY GAS RESERVOIRS**

Final Report

Prepared for

**THE NEW YORK STATE
ENERGY RESEARCH AND DEVELOPMENT AUTHORITY**
Albany, NY

Prepared by:

NTC
Consultants

18 Division Street
Suite 304
Saratoga Springs, NY 12866

Lisa C. Nagle, AICP
Project Manager

NYSERDA Contract #: 11170

Date: September 16, 2009

NOTICE

This report was prepared by NTC Consultants in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority (hereafter "NYSERDA"). The opinions expressed in this report do not necessarily reflect those of NYSERDA or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, NYSERDA, the State of New York, and the contractor make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. NYSERDA, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

Table of Contents

1	INTRODUCTION	2
2	SUPERCEDURE	4
3	WELL DENSITY	4
4	NOISE IMPACTS	7
4.1	Overview	7
4.2	Discussion	9
4.3	Mitigation	11
4.3.1	Pad Siting	11
4.3.2	Access Road	12
4.3.3	Multi-Well Pads	12
4.4	Conclusion	12
4.5	Summary	13
4.6	Noise Impact Summary Table	14
5	VISUAL IMPACTS	15
5.1	Overview	15
5.2	Discussion	15
5.3	Areas of Statewide Importance	16
5.4	Mitigation	17
5.4.1	Pad Siting:	17
5.4.2	Reclamation:	18
5.5	Conclusion	18
5.6	Summary	19
5.7	Visual Impact Summary Table	20
6	COMMUNITY CHARACTER IMPACTS	21
6.1	Overview	21
6.2	Discussion	21
6.2.1	Trucking:	22
6.2.2	Land Use Patterns:	23
6.2.3	Environmental justice:	23
6.3	Mitigation	23
6.4	Conclusion	24
6.5	Summary	24
6.6	Community Character Impact Summary Table	25
7	CUMULATIVE IMPACTS	26
7.1	Discussion	26
7.2	Site Specific Cumulative Impacts	26
7.3	Site Specific Cumulative Impacts Conclusions	27
7.4	Regional Cumulative Impacts	28
7.5	Rate of Development and Thresholds	29
7.6	Regional Cumulative Impacts Conclusion/Recommendation	31
7.7	Cumulative Impact Summary Table	32
8	Appendix A	A-1
9	Bibliography	B-1

PREFACE

This report is entitled Impacts on Community Character of Horizontal Drilling and High Volume Hydraulic Fracturing in Marcellus Shale and Other Low-Permeability Gas Reservoirs and has been prepared for the New York State Energy Research & Development Authority (NYSERDA) under contract #11170. As outlined in the Statement of Work, *“The objective of this work is to research, review, compile, and provide to NYSERDA a report that address issues identified in the final scope for the draft Supplemental Generic Environmental Impact Statement (dGEIS) for Natural Gas Production, which was developed by the New York State Department of Environmental Conservation (NYSDEC).”*¹ NTC Consulting was retained to *“complete a review and analysis of the cumulative impact and community character issues surrounding the use of horizontal drilling and high-volume hydraulic fracturing of tight formations, particularly of shale resources.”*²

¹ Statement of Work – Contract #11170

² Ibid

1 INTRODUCTION

The Department of Environmental Conservation is responsible for regulating the development and production of oil and gas resources in New York State. The Department has previously evaluated its oil and gas regulatory program through development of a Generic Environmental Impact Statement (GEIS) which was finalized in 1992 and sets parameters that are applicable statewide to the review of gas drilling under the State Environmental Quality Review Act (SEQRA). Natural gas exploration and production companies, and mineral rights owners, are interested in developing a potentially significant gas resource in the Marcellus Shale and other low-permeability reservoirs through the use of horizontal drilling and high volume hydraulic fracturing. This technique requires large volumes of water. The potential gas resource from the Marcellus Shale may approach 20 trillion cubic feet, which would be enough to fuel New York's demand for approximately 20 years. The revenue associated with development of this resource may exceed one billion dollars per year.

The Department has identified the action of gas development with horizontal drilling and high volume hydraulic fracturing as one which requires further review under SEQRA. The following documentation and discussion is to assist the Department's efforts to prepare a draft Supplemental GEIS (dSGEIS) in relation to "Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs." NTC was retained to review and assess the 1992 GEIS methodologies for evaluating and mitigating noise, visual, community character and cumulative impacts. In support of this effort, NTC conducted a literature review, visits to well sites under active drilling as well as producing sites, and received input from industry representatives. Working in conjunction with NYSDEC and NYSERDA the 1992 GEIS was evaluated on its adequacy in addressing and mitigating the issues and impacts of horizontal drilling and high volume hydraulic fracturing along with the development of multi-well pads. For those impacts and issues not adequately addressed, additional mitigation measures will be recommended.

New York has a long history of natural gas production. The first gas well was drilled in 1821 in Fredonia, and the 40 billion cubic feet of gas produced in 1938 remained the production peak until 2004 when 46.9 bcf were produced. More than 50 bcf have been produced every year since then.³ In 2007 there were reported to be 6,683 producing natural gas wells in New York, nearly one-half of which were in Chautauqua County.⁴ Most of these wells were drilled into shallow reservoirs utilizing "low impact" equipment and the majority of permits currently issued are for this type of development.

For certain deeper formations large scale commercially owned and operated equipment is required. These operations utilize larger, heavily built pads and normally operate on 24 hour per day schedule. The type of equipment, drilling technology, and pad design and construction techniques that will be used to develop the Marcellus shale and other low permeability gas reservoirs has been used in New York to develop plays such as the

³ Final Scope for dSGEIS (page 9)

⁴ Ibid

Trenton/Black River and Herkimer formations. The 1992 GEIS has satisfactorily addressed the issues and impacts associated with this development. What has not been previously reviewed through the GEIS process is multi-well pads and high volume hydraulic fracturing. The adequacy of the 1992 GEIS in addressing impacts with regard to these issues will be discussed herein. Where it is found to be lacking additional mitigation measures will be recommended. Enhancements to the 1992 GEIS mitigation measures will also be provided where appropriate.



Well pad under development. Source: www.naturalgas.psu.edu

2 SUPERCEDURE

New York State’s Environmental Conservation Law Article 23, Title 3 (ECL §23-0303(2), known as the “Oil, Gas and Solution Mining Law”, delegates all authority to regulate the gas and oil industry to the New York State Department of Environmental Conservation (NYSDEC). Municipalities do retain jurisdiction over local roads and their rights under the Real Property Tax Law. Municipalities are precluded from requiring the gas industry to be subjected to local ordinances, laws, and planning and zoning board review (i.e. requests for a variance, rezoning, and site plan review). Additionally, municipalities cannot adopt local noise ordinances directed at the drilling industry, nor restrict the hours of operation of gas drilling.⁵



Active Well Drilling – Source: All Consulting

3 WELL DENSITY

The following is provided as reference as the different spacing options are discussed throughout the report.

The number of wells and well sites that may exist per square mile is dictated by reservoir geology and productivity, mineral rights distribution, and statutory well spacing requirements set forth in ECL Article 23, Title 5, as amended in 2008. The well spacing requirements are based on subsurface geologic and reservoir characteristics, have no relationship to the environmental reviews and do not authorize any specific type of drilling technology; regardless of the well spacing, each well undergoes an individual review in connection with the permit process. The statute provides three statewide spacing options for shale wells:

⁵ ECL §23-0303(2)

Vertical wells – Statewide spacing for vertical shale wells provides for one well per 40-acre spacing unit. This is the spacing requirement that has historically governed most gas well drilling in the State, and many square miles of Chautauqua, Seneca and Cayuga counties have been developed on this spacing. One well per 40 acres equates to 16 wells per square mile (i.e., 640 acres). The wells within any given area will not all be drilled at once, and previously drilled sites will be reclaimed as or before new locations are drilled. Infill wells, resulting in more than one well per 40 acres, may be drilled upon justification to the Department that they are necessary to efficiently recover gas reserves. Again, however, by the time an infill well is drilled, the sites of any previously drilled wells in the 40-acre spacing unit will have been partially reclaimed. As stated in the 1992 GEIS, production sites with one well per pad typically take up only 10 to 15% of the acreage used for drilling operations. Gas well development on 40-acre spacing, with the possibility of infill wells, was the prevalent gas well development method in New York prior to the GEIS (and remains so today) and is, therefore, part of the experience upon which the 1992 Findings were based.

Horizontal wells in single-well spacing units – Statewide spacing for horizontal wells where only one well will be drilled at the surface site provides for one well per 40 acres, plus the necessary and sufficient acreage to maintain a 330-foot setback between the wellbore in the target formation and the spacing unit boundary. This provision does not provide for infill wells, so the distance between wellbores in adjacent spacing units will always be at least 660 feet. Surface locations may be slightly closer together because of the need to begin turning the wellbore some distance above the target formation. However, it is likely that this scenario will result in fewer than 16 surface locations per square mile. This conclusion is based on the fact that the horizontal leg of each wellbore within the target formation is likely to be longer than 1,980 feet, which is the distance that would result in a 40-acre rectangular spacing unit. Therefore, spacing units are likely to be larger than 40 acres, and fewer than 16 will fit within a square mile. Although the wells are horizontal, well pads during both the drilling and production phases will be similar in size to those for vertical wells. Hence, horizontal shale drilling with one well per pad would not be expected to result in a well density greater than that contemplated when the GEIS and its Findings were finalized in 1992.

Horizontal wells with multiple wells drilled from common pads - The third statewide spacing option for shale wells provides, initially, for spacing units of up to 640 acres with all the horizontal wells in the unit drilled from a common well pad. While vertical infill wells may be drilled from separate surface locations, with justification, a far smaller proportion of vertical infill wells than 15 per 640-acre unit is expected. Therefore, fewer than 16 separate locations within a square mile area will be affected. Nevertheless, to accommodate multiple wells and wellheads, the initial well pad from which multiple horizontal wells will be drilled will be larger than is typical for single-well pads. With respect to overall land disturbance, however, the larger surface area of the well pad will be offset by the need for only a single access road and gathering system to service wells on the pad. The size of a multiple well pad will likely be substantially smaller than the cumulative number of acres that would be necessary to accommodate the same number of

single-well pads within the same area. This method also provides flexibility to avoid environmentally sensitive locations within the acreage to be developed.

4 NOISE IMPACTS

This is in response to the Noise Impacts section of the Final Scope for Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas and Solution Regulatory Program – February 6, 2009

4.1 Overview

In NYS-DEC Policy DEP-00-1, noise is defined as any loud, discordant or disagreeable sound or sounds. More commonly, in an environmental context, noise is defined simply as unwanted sound⁶. The environmental effects of sound and human perceptions of sound can be described in terms of the following four characteristics:⁷

1. Sound Pressure Level (SPL may also be designated by the symbol L_p) or perceived loudness is expressed in decibels (dB) or A-weighted decibel scale dB(A) which is weighted towards those portions of the frequency spectrum, between 20 and 20,000 Hertz, to which the human ear is most sensitive. Both measure sound pressure in the atmosphere.
2. Frequency (perceived as pitch), the rate at which a sound source vibrates or makes the air vibrate.
3. Duration i.e., recurring fluctuation in sound pressure or tone at an interval; sharp or startling noise at recurring interval; the temporal nature (continuous vs. intermittent) of sound.
4. Pure tone which is comprised of a single frequency. Pure tones are relatively rare in nature but, if they do occur, they can be extremely annoying.

⁶ NYS-DEC Policy DEP-00-1 – Assessing and Mitigating Noise Impacts – Page 2 (10/06/00 – Last Revised 02/02/01)

⁷ NYS-DEC Policy DEP-00-1 – Assessing and Mitigating Noise Impacts – Page 7 (10/06/00 – Last Revised 02/02/01)



Electric Generators – Active Drilling Site: Source: NTC Consulting

While reviewing applications for natural gas wells with proposed locations close to potential receptors, NYSDEC require mitigation consistent with Program Policy DEP-00-1 entitled “Assessing and Mitigating Noise Impacts”. To aid staff in its review of a potential noise impact, the policy identifies three major categories of noise sources;

- 1) Fixed equipment or process operations;
- 2) Mobile equipment or process operations; and,
- 3) Transport movements of products, raw material or waste.

On Page 3 of its Notice of Determination of Non-Significance – API #31-015-22960-00-00, Permit 08828 (February 13, 2002), NYSDEC previously found that “Impacts associated with noise during drilling are directly related to the distance from a receptor.⁸ Drilling operations involve various sources of noise. The primary sources of noise were determined to be as follows:”⁹

1. *Air Compressors: Air compressors are typically powered by diesel engines, and generate the highest degree of noise over the course of drilling operations. Air compressors will be in operation virtually throughout the drilling of a well. However, the actual number of operating compressors will vary.*

⁸Page 3, - Notice of Determination of Non-Significance – API #31-015-22960-00-00, Permit 08828 (February 13, 2002).

⁹ Pages 4-5 - Notice of Determination of Non-Significance – API #31-015-22960-00-00, Permit 08828 (February 13, 2002).

2. *Tubular Preparation and Cleaning: Tubular preparation and cleaning is an operation that is conducted as drill pipe is placed into the wellbore. As tubulars are raised onto the drill floor, workers physically hammer the outside of the pipe to displace internal debris. This process, when conducted during the evening hours, seems to generate the most concern from adjacent landowners. While the decibel level is comparatively low, the acute nature of the noise is noticeable.*
3. *Elevator Operation: Elevators are used to move drill pipe and casing into and/or out of the wellbore. During drilling, elevators are used to add additional pipe to the drill string as the depth increases. Elevators are used on a constant basis when the drilling contractor is removing multiple sections of pipe from the well or placing drill pipe or casing into the wellbore. Elevator operation is not a constant activity and its duration is dependent on the depth of the well bore. The decibel level is low for elevator operation.*
4. *Drill Pipe Connections: As the depth of the well increases, the drilling contractor must connect additional pipe to the drill string. Most operators in the Appalachian Basins use a method known as “air-drilling.” As the drill bit penetrates the rock the cuttings must be removed from the wellbore. Cuttings are removed by displacing pressurized air (from the air compressors discussed above) into the well bore. As the air is circulated back to the surface, it carries with it the rock cuttings. To connect additional pipe to the drill string, the operator will release the air pressure. It is the release of pressure that creates a noise impact.*
5. *Noise Generated by Support of Equipment and Vehicles: Similar to any construction operation, drill sites require the use of support equipment and vehicles. Specialized cement equipment and vehicles, water trucks and pumps, flatbed tractor trailers and delivery and employee vehicles are the most common forms of support machinery and vehicles. Noise generated from these sources are consistent with other road-based vehicles. Cementing equipment will generate additional noise during operations but this impact is typically short lived and is at levels below that of the compressors described above.*

“It is important to note that noise associated with the above activities is temporary and end once drilling operations cease.”¹⁰

4.2 Discussion

The noise impacts associated with horizontal drilling and high volume hydraulic fracturing are, in general, similar to those addressed in the 1992 GEIS. Site preparation and access road building will have noise that is associated with a construction site including bulldozers, backhoes, and other types of construction equipment. The rigs and

¹⁰ Page 4, - Notice of Determination of Non-Significance – API #31-015-22960-00-00, Permit 08828 (February 13, 2002).

supporting equipment are somewhat larger than the commonly used equipment described in 1992 but with the exception of specialized downhole tools horizontal drilling is performed using the same equipment, technology and procedures as many wells that have been drilled in New York. The basic procedures described for hydraulic fracturing are also the same. Production phase well site equipment is very quiet with negligible impacts.

The largest difference with relation to noise impacts, however, is in the duration of drilling. A horizontal well takes 4 to 5 weeks of 24 hours per day drilling to complete. The 1992 GEIS anticipated that most wells drilled in New York with rotary rigs would be completed in less than one week though drilling could extend two weeks or longer.

High volume hydraulic fracturing is also of a larger scale than the water-gel fracs addressed in 1992. These were described as requiring 20,000 to 80,000 gallons of water pumped into the well at pressures of 2,000 to 3,500 psi. The procedure for a typical horizontal well requires 1 to 3 million or more gallons of water with a maximum casing pressure from 10,000 to 11,000 psi. This volume and pressure will result in more pump and fluid handling noise than anticipated in 1992. The proposed process requires 3 to 5 days to complete. There was no mention of the time required for hydraulic fracturing in 1992.

There will also be significantly more trucking and associated noise involved with high volume hydraulic fracturing than was addressed in the 1992 GEIS. In addition to the trucks required for the rig and its associated equipment, water may need to be trucked in for drilling and hydraulic fracturing, sand for proppant will need to be trucked to the site, flow back will need to be removed, and frac tanks may be brought on site if pits are not used. Estimates of truck trips per well are as follows¹:

Drill Pad and Road Construction Equipment	10 – 45 Truckloads
Drilling Rig	30 Truckloads
Drilling Fluid and Materials	25 – 50 Truckloads
Drilling Equipment (casing, drill pipe, etc.)	25 – 50 Truckloads
Completion Rig	15 Truckloads
Completion Fluid and Materials	10 – 20 Truckloads
Completion Equipment – (pipe, wellhead)	5 Truckloads
Hydraulic Fracture Equipment (pump trucks, tanks)	150 – 200 Truckloads
Hydraulic Fracture Water Trucks	400 – 600 Tanker
Hydraulic Fracture Sand	20-25 Trucks
Flow Back Water Removal	200 – 300 Truckloads

This level of trucking could lead to negative noise impacts for those living in close proximity to the well site and access road. Like other noise associated with drilling this is temporary.

Multi-well pads have the same noise issues as single well pads but the duration is even longer. The times discussed above will be required for each well drilled on the pad. Typically one to three wells are drilled, stimulated and completed and the rig is taken down and moved to another location. If the well(s) are economically viable, the rig is brought back and the remaining planned wells are drilled, stimulated and completed. Current regulations require that all wells on a multi-well pad be drilled within three years of starting the first well. This will result in someone living in close proximity to the pad having potentially adverse noise impacts intermittently for up to three years. As industry gains confidence in the production of the play, there is the possibility that all wells on a pad would be drilled, stimulated and completed consecutively. This concept will shorten the time frame of noise generation and eliminate the noise generated by one rig disassembly/reassembly cycle.

The benefits of a multi-well pad are the reduced number of sites generating noise and, with the horizontal drilling technology, the flexibility to site the pad in the best location to mitigate the impacts. Current regulations allow for one single well pad per 40-acre spacing unit or one multi-well pad per 640-acre spacing unit. This provides the potential for one multi-well pad to drain the same area that could contain up to 16 single well pads. With proper pad location and design the adverse noise impacts can be significantly reduced. See appendix A.

Multi-well pads also have the potential to greatly reduce the amount of trucking and associated noise in an area. Rigs and equipment may only need to be delivered and removed one time for the drilling and stimulation of all of the wells on the pad. Reducing the number of truck trips required for frac water is also possible by reusing water for multiple frac jobs. In certain instances it also may be economically viable to transport water via pipeline to a multi-well pad.

4.3 Mitigation

4.3.1 Pad Siting

Noise is best mitigated by distance. The further from receptors the lower the impact. The second level of noise mitigation is direction. Directing noise generating equipment away from receptors greatly reduces associated impacts. Timing also plays a key role in mitigating noise impacts. Scheduling the more significant noise generating operations during daylight hours provides for tolerance that may not be achievable during the evening hours.¹¹

As stated in 1992, many of the potential negative impacts of gas development hinge on the location chosen for the well and the techniques used in constructing the access road and well site. Before a drilling permit can be issued, DEC staff must ensure that the proposed location of the well and access road complies with the Department's spacing regulations and siting restrictions. To assist in this process DEC staff now has access to Policy Guidance Document DEP-00-1 entitled: "Assessing and Mitigating Noise

¹¹ Notice of Determination of Non-Significance – API #31-015-22960-00-00, Permit 08828 (2/13/2002).

Impacts”. If the guidance provided in DEP-00-1 is applied consistently to well pad applications, it will be possible to avoid significant noise related impacts.

4.3.2 Access Road

With the extensive trucking and associated noise that is involved with water transportation for high volume hydraulic fracturing, attention should be given to the location of the access road. When appropriate, it should be located as far as practical from occupied structures and places of assembly. The purpose is to protect non-lease holders from noise impacts associated with trucking that conflict with their property use.

4.3.3 Multi-Well Pads

As discussed in the 1992 GEIS, moderate to significant noise impacts may be experienced within 1,000 feet of a well site during the drilling phase.¹² With the extended duration of drilling and other activities involved with multi-well pads it is recommended that the pad not be located closer than 1,000 feet to occupied structures and places of assembly.. When this threshold is infringed upon, DEC can add appropriate mitigating conditions to the permit if necessary.

4.4 Conclusion

Temporary, Short-Term Noise Impacts – As discussed in the 1992 GEIS will vary with the presence of topographic or vegetative barriers such as hills, trees and tall grass or shrubs. Drilling operations are the noisiest phase of development and usually continue 24 hours a day. Noise sources during the drilling phase include various drilling rig operations, pipe handling, compressors, and operations of trucks, backhoes, tractors and cement mixing. In most instances, the closest receptor is the residence of the property owner where the well is located and the owner has agreed to the disturbance by entering into a voluntary lease agreement with the well operator. Nevertheless, when necessary because of nearby receptors (regardless of lease status), noise impacts can be mitigated by a combination of site layout to take advantage of existing topography and special permit conditions.”¹³

The 1992 GEIS found that there were unavoidable negative noise impacts for those living in close proximity to a drill site. These were determined to be short term and could be mitigated with siting restrictions and setback requirements. Given that the noise issues have been found to be similar for horizontal drilling with high volume hydraulic fracturing these findings are consistent. The extended time period does make control of the noise impacts, while still temporary, essential. Since noise control is most effectively addressed at the siting and design phase it is important that the pad be properly located and planned and horizontal drilling provides the flexibility to accommodate this. New York State DEC guidance document ‘DEP-00-01 Assessing and Mitigating Noise

¹² 1992 GEIS (Page 8-11)

¹³ Final Scope for dGEIS (page 20)

Impacts' along with a site plan and design guidelines document should be utilized for this purpose. See Appendix A. Additionally, the applicant should also be encouraged to review any applicable land use policy documents with the understanding that New York State Department of Environmental Conservation (NYSDEC) retains authority to regulate gas development.

4.5 Summary

1. Noise impacts are best mitigated through well site location and design.
2. Each well pad should be reviewed under the guidelines of DEP-00-1.
3. NYSDEC should develop and issue a "Best Practices Manual" to provide both DEC staff and industry representatives a single information source and to clarify what is expected of each applicant. See Appendix A
4. As subsequent applications are reviewed for additional wells on a multi-well pad, NYSDEC should reconfirm noise control methodologies based on actual experiences with earlier wells.
5. With the extensive trucking and associated noise that is involved with water transportation for high volume hydraulic fracturing, the access road should be located as far as practical from occupied structures and places of assembly.
6. With the extended duration of drilling and other activities involved with multi-well pads it is recommended the well pad be placed no closer than 1,000 feet to occupied structures and places of assembly. When an application is within this limit, appropriate mitigating conditions can be added to the permit if necessary.

4.6 Noise Impact Summary Table

Noise Issue	Address in 1992 GEIS	Process Enhancements	Additional Mitigation
Pad Siting/Design	Yes	<ul style="list-style-type: none"> • Utilize DEP-00-1 Assessing and Mitigation Noise Impacts Guidance Document. • Utilize best practices guidelines and standards. 	None required
Multi-Well Pad	No		Noise issues of multi-well pads are the same as for single well pads and will be mitigated in the siting and design phase. Review previous well drilling activity on pad for subsequent wells. Locate well pad no closer than 1,000 feet to occupied structures and places of assembly.
Horizontal Drilling	No		Noise issues are the same as for vertical drilling discussed in 1992 and will be mitigated in the siting and design phase.
High Volume Hydraulic Fracturing	No		Noise issues of the pad will be mitigated in the siting and design phase.
Trucking	Yes		Access road and staging area siting and design to minimize negative noise impacts.
Production	Yes		None required

5 VISUAL IMPACTS

This is in response to the Visual Impacts section of the Final Scope for Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas and Solution Regulatory Program – February 6, 2009

5.1 Overview

Aesthetic impact occurs when there is a detrimental effect on the perceived beauty of a place or structure. Significant aesthetic impacts are those that may cause a diminishment of the public enjoyment and appreciation of an inventoried resource, or one that impairs the character or quality of such a place.¹⁴

5.2 Discussion

The visual impacts associated with horizontal drilling and high volume hydraulic fracturing are, in general, similar to those addressed in the 1992 GEIS. They include drill site and access road clearing and grading, drill rig and equipment during the drilling phase, and production equipment if the well is viable. The 1992 GEIS stated that drill rigs vary in height from 30 feet for a small cable tool rig to 100 feet or greater for a large rotary, though the larger 100 foot rotary rigs are not commonly used in New York. By comparison, the rigs used for horizontal drilling will be 140 feet or greater and will have more supporting equipment. Additionally, the site clearing for the pad has increased from approximately 2 acres to approximately 5 acres. The important difference, however, is in the duration of drilling and hydraulic fracturing. A horizontal well takes 4 to 5 weeks of 24 hours per day drilling to complete with an additional 3 to 5 days for the hydraulic fracture. This compares to the approximately 1 to 2 weeks or longer drill time as discussed in 1992. There was no mention of the time required for hydraulic fracturing in 1992.

Multi-well pads will be slightly larger but the equipment used is often the same resulting in similar visual issues as those associated with a single well pad. Based on industry response, a taller rig with a larger footprint and substructure, 170' total height, may be used for drilling consecutive wells on a pad. In other instances, smaller rigs may be used to drill the initial hole and conductor casing to just above the kick-off point. The larger rig would then be used for the final horizontal portion of the hole. Typically one or two wells are drilled then the rig is removed. If the well(s) are viable, the rig is brought back and the remaining wells are drilled and stimulated. As industry gains confidence in the production of the play, there is the possibility that all wells on a pad would be drilled, stimulated and completed consecutively reducing the time frame of the visual impact. The regulations require that all wells on a multi-well pad be drilled within three years of starting the first well.

¹⁴ NYS-DEC Policy DEP-00-2 – Assessing and Mitigating Visual Impacts (7/31/00)

The benefit of the multi-well pad is that it decreases the number of pads on the landscape. Current regulations allow for one single well pad, either horizontal or vertical, per 40-acre spacing unit or one multi-well pad per 640-acre spacing unit. This will reduce the number of long term visual impacts that result from reclaimed pads and production equipment and reduce the overall amount of land disturbance. The drilling technology also provides flexibility in pad location allowing visual impacts, both long and short term, to be minimized as much as possible.

Long term visual impacts of a pad after the drilling phase are determined by whether the well is a producer or a dry hole. In either case, reclamation work must begin with closure of any pit within 45 days of cessation of drilling and stimulation. If the well is a dry hole, the entire site will be reclaimed with very little permanent visual impact unless the site was heavily forested. In this case it will take some time for trees to regrow. All that will remain at a producing gas well site is 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 may have somewhat larger equipment to handle the increased production. The remainder of a producing well site will be reclaimed with current well pads leaving as much as 3 acres for production equipment compared to less than 1 acre as discussed in 1992.



Well Pad Under Preparation (PA) – Source: www.naturalgas.psu.edu

5.3 Areas of Statewide Importance

The 1992 GEIS addressed the visual impacts of gas drilling activities to visual resources of statewide significance on a case-by-case basis during the permit review process. When a proposed activity might have a negative visual impact, appropriate mitigating conditions are added to the permit.

In its guidance document, DEP-00-2 “Assessing and Mitigating Visual Impacts”, provides an inventory of aesthetic resources. It is important to note that the Department continuously updates the guidance document adding significant scenic and aesthetic resources that have not yet been designated in New York State; therefore the document should be referenced for each application. Currently, these resources can be derived from one or more of the following categories:

1. A property on or eligible for inclusion in the National or State Register of Historic Places [16 U.S.C. §470a et seq., Parks, Recreation and Historic Preservation Law Section 14.07].
2. State Parks [Parks, Recreation and Historic Preservation Law Section 14.07].
3. Urban Cultural Parks [Parks, Recreation and Historic Preservation Law Section 35.15];
4. The State Forest Preserve [NYS Constitution Article XIV]
5. National Wildlife Refuges [16 U.S.C. 668dd], State Game Refuges and State Wildlife Management Areas [ECL 11-2105]
6. National Natural Landmarks [36 CFR Part 62]
7. The National Park System, Recreation Areas, Seashores, Forests [16 U.S.C. 1c]
8. Rivers designated as National or State Wild, Scenic or Recreational [16 U.S.C. Chapter 28, ECL 15-2701 et seq.]
9. A site, area, lake, reservoir or highway designated or eligible for designation as scenic [ECL Article 49 or DOT equivalent and APA. Designated State Highway Roadside (Article 49 Scenic Road).
10. Scenic Areas of Statewide Significance [of Article 42 of Executive Law]
11. A State or federally designated trail, or one proposed for designation [16 U.S.C. Chapter 27 or equivalent]
12. Adirondack Park Scenic Vistas; [Adirondack Park Land Use and Development Map]
13. State Nature and Historic Preserve Areas; [Section 4 of Article XIV of State Constitution.
14. Palisades Park; [Palisades Park Commission]
15. Bond Act Properties purchased under Exceptional Scenic Beauty or Open Space category.

Many resources of the above type are found within the Marcellus and other shale regions. The applicant will consult the Inventory of Aesthetic Resources in DEP-00-2 and will identify any resources that could be impacted by their project. When a resource is identified, DEC staff will consult guidance document DEP-00-2 and add appropriate mitigating conditions to the permit on a case-by-case basis.

5.4 Mitigation

5.4.1 Pad Siting:

As stated in 1992, many of the potential negative impacts of gas development hinge on the location chosen for the well and the techniques used in constructing the access

road and well site. Before a drilling permit can be issued, DEC staff must ensure that the proposed location of the well and access road complies with the Department's spacing regulations and siting restrictions. To assist in this process DEC staff now has access to Policy Guidance Document DEP-00-2 entitled: "Assessing and Mitigating Visual Impacts". Applying the regulations and siting restrictions along with the guidance provided in DEP-00-2 as appropriate to well pad applications, it will be possible to avoid significant aesthetic impacts. See Appendix A.

5.4.2 Reclamation:

Current well pads, including those for horizontal drilling with or without multiple wells, are more substantially constructed than was addressed in 1992. A significant amount of crushed stone is brought in and compacted to stabilize the pad and access road to accommodate the equipment and truck traffic. As a result, it would be beneficial in reducing long term visual impacts if the 1992 GEIS topsoil conservation and redistribution practices required upon final plugging and abandonment in agricultural districts were required for all well pads. The specific procedures are:

1. Strip-off and set aside topsoil during construction
2. Protect stockpiled topsoil from erosion and contamination
3. Cut well casing to a safe buffer depth of 4 feet below the surface
4. Paraplow the area before topsoil redistribution if compaction has occurred
5. Redistribute topsoil over disturbed area during site reclamation

The United States Bureau of Land Management's *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development* has additional reclamation procedures that would be beneficial to mitigate visual impacts. They include:

1. Re-Vegetation – Disturbed areas should be revegetated after the site has been satisfactorily prepared; site preparation should include re-spreading topsoil to an adequate depth. Native perennial species or other plant materials specified by the surface management agency or private surface owner.
2. Pipeline Reclamation – Reclamation of pipelines includes re-contouring to the original contour, seeding, and controlling for noxious weeds.
3. Well Site Reclamation – to achieve final reclamation of an abandoned well site, the area should be re-contoured to blend into the contour of the surrounding landform, stockpiled topsoil evenly redistributed, and the site re-vegetated.
4. Road Reclamation – Reclamation of roads includes re-contouring the road to the original contour, seeding, and controlling for noxious weeds.

5.5 Conclusion

The 1992 GEIS conclusion was that visual impacts from gas drilling and completion activities are primarily minor and short-term, and would vary with topography, vegetation, and distance to viewer. It also found that temporary disruptions of scenic vistas and long term changes in the landscape and the installation of production facilities

if the well is economically viable will occur. Given that the visual issues are similar for horizontal drilling with high volume hydraulic fracturing these findings are consistent. The most significant disruptions will be of a longer duration, particularly for multi-well pads but they are still short term. The positive benefit of multi-well pads, as discussed previously, is that there will be fewer of them.

Since visual impacts are most effectively addressed at the siting and design phase it is important that the pad be properly located and planned. Horizontal drilling provides the flexibility to locate the pad in the best possible location and the utilization of multi-well pads will reduce the number of visual impacts in an area. New York State DEC guidance document 'DEP-00-02 Assessing and Mitigating Visual Impacts' along with a site plan and design guidelines document should be utilized for this purpose. See Appendix A. Additionally, the applicant should also be encouraged to review any applicable land use policy documents with the understanding that New York State Department of Environmental Conservation (NYSDEC) retains authority to regulate gas development.

5.6 Summary

1. Noise impacts are best mitigated through well site location and design.
2. When aesthetic resources are identified by the applicant as being potentially impacted, DEC will consult guidance in DEP-00-2 and add necessary mitigating conditions to the permit.
3. NYSDEC should prepare a "Best Practices Manual" to provide Staff and industry access to information relative to what is expected in terms of well siting and aesthetic mitigation, and to identify instances when aesthetic mitigation would be necessary. See Appendix A
4. To aid NYSDEC in its review of these applications, DEC should encourage municipalities to identify and/or map areas of high visual sensitivity and could require additional aesthetic mitigations in these areas.
5. As subsequent applications are reviewed for additional wells on a multi-well pad, NYSDEC should reconfirm visual control methodologies based on actual experiences with earlier wells.
6. Improved reclamation procedures should be used for all well sites.

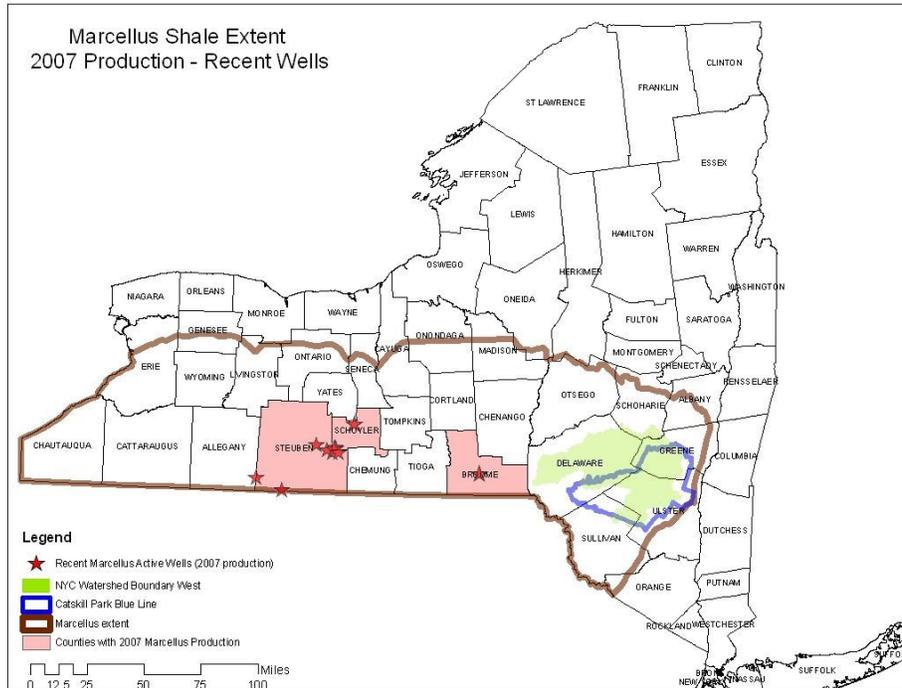
5.7 Visual Impact Summary Table

Visual Issue	Address in 1992 GEIS	Process Enhancements	Additional Mitigation
Pad Siting/Design	Yes	<ul style="list-style-type: none"> Utilize DEP-00-2 Assessing and Mitigation Visual Impacts Guidance Document. Utilize best practices guidelines and standards. 	None required
Multi-Well Pad	No		Visual issues of multi-well pads are the same as for single well pads and will be mitigated in the siting and design phase. Review previous well drilling activity on pad for subsequent wells
Horizontal Drilling	No		Visual issues are the same as for vertical drilling discussed in 1992 and will be mitigated in the siting and design phase.
High Volume Hydraulic Fracturing	No		Visual issues of the pad will be mitigated in the siting and design phase.
Production	Yes		Visual issues of the larger production areas will be mitigated in the siting and design phase.
Site Reclamation	Yes		Reclamation procedures for agricultural districts and those from BLM should be required for all well pads.

6 COMMUNITY CHARACTER IMPACTS

This is in response to the Community Character section of the Final Scope for Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas and Solution Regulatory Program – February 6, 2009

6.1 Overview



Location of Marcellus Shale – Source: NYSDEC

The Marcellus Play covers approximately 18,000 square miles of New York State. Many locations have previously experienced gas development while in others it will be a new experience. In general, the areas that have not had gas development are similar to those that have. They range from cities and villages to remote forested areas with small towns, farm lands, and many lakes and streams in between. Extensive gas development has occurred in New York in areas that have significant agriculture and tourism industries.

6.2 Discussion

Many of the community character impacts associated with horizontal drilling and high volume hydraulic fracturing are the same as those addressed in the 1992 GEIS and no further mitigation measures are required. These include:

1. The possibility of injury to humans or the environment is site access is not properly restricted to prevent accidents or vandalism
2. Temporal noise or visual impacts

3. Temporary land use conflicts are identified in the discussion of unavoidable impacts
4. Potential positive impacts from gas development identified including the availability of clean burning natural gas, generation of State and local taxes, revenues to landowners, and the multiplier effects of private investment in the State
5. Increased human activity and access to remote areas provided by the access roads as secondary impacts, with the former more intense during the drilling phase.

Community Character issues related to horizontal drilling and high volume hydraulic fracturing needing further discussion include:

6.2.1 Trucking:

Increased road use was also discussed in 1992 as a factor that may affect community character. While the trucking for site preparation, rig, equipment, materials and supplies is similar for horizontal drilling to what was anticipated in 1992 the water requirement of high volume hydraulic fracturing could lead to significantly more truck traffic than was discussed. It is estimated that each horizontal well will need between 1 to 3 million gallons or more of water for stimulation. Estimates of truck trips per well are as follows¹:

Drill Pad and Road Construction Equipment	10 – 45 Truckloads
Drilling Rig	30 Truckloads
Drilling Fluid and Materials	25 – 50 Truckloads
Drilling Equipment (casing, drill pipe, etc.)	25 – 50 Truckloads
Completion Rig	15 Truckloads
Completion Fluid and Materials	10 – 20 Truckloads
Completion Equipment – (pipe, wellhead)	5 Truckloads
Hydraulic Fracture Equipment (pump trucks, tanks)	150 – 200 Truckloads
Hydraulic Fracture Water	400 – 600 Tanker Trucks
Hydraulic Fracture Sand Trucks	20 – 25 Trucks
Flow Back Water Removal	200 – 300 Truckloads

As can be seen, trucking for hydraulic fracture equipment, water, sand and flow back removal is over 80% of the total. This trucking will take place in weeks-long periods before and after the hydraulic fracture.

Multi-well pads have the potential to reduce some of the total trucking in an area. Consecutively drilling and stimulating multiple wells from one pad will eliminate the trucking of equipment for single well pad to single well pad. Reduced water trucking is also a possibility. There is the potential to reuse flow back water for other fracturing operations. The centralized location of water impoundments may also make it economically viable for water to be brought in pipeline or means other than trucking.

As discussed in 1992 regarding conventional vertical wells, trucking during the long term production life of a horizontally drilled single or multi-well pad will be insignificant.

6.2.2 Land Use Patterns:

The spacing unit density for single well pads with horizontal drilling is the same as discussed and anticipated in 1992. This density has been experienced in New York in Chautauqua and Seneca Counties without significant changes in land use patterns. The new drilling technology should not be expected to change the 1992 GEIS findings.

As mentioned previously, there is the option, not discussed in 1992, to use multi-well pads with a 640 acre spacing unit. This option has the potential to be less of an impact on community character by significantly reducing the total area required for roadways, pipelines, and well pads. While the pad will be larger and the activity at the location will be longer than for single well pads, the fewer total sites will reduce the cumulative changes to the host community, and should minimize loss or fragmentation of habitats, agricultural areas, forested areas, disruptions to scenic view sheds, and the like.

6.2.3 Environmental justice:

This is an issue that was not addressed the 1992 GEIS. The United States Environmental Protection Agency definition is as follows: “Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. EPA has this goal for all communities and persons across this Nation. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work.” The SEQRA process provides opportunity for public input and the resulting permitting procedures will apply state wide and provide equal protection to all communities and persons in New York. The location of drilling will be determined by where the gas is located and the resulting revenues will benefit the land owners and the surrounding community.

6.3 Mitigation

One of the largest and most obvious potential impacts on community character is the issue of trucking to develop and support the natural gas industry. Under New York State Highway Vehicle Traffic Laws local municipalities retain control over their roads. This makes it important for Municipalities to monitor the NYSDEC web site for information regarding gas development in their area. Local governments (County, Town and Village) should be encouraged to be proactive in exercising their authority under New York State Highway Vehicle Traffic Laws. This would include the completion of a road system integrity study to potentially assess fees for maintenance and improvements. DEC should encourage the applicant to obtain a road use agreement with the local Municipality and/or County to be filed with the application. When there is no agreement, applications should

incorporate a trucking plan that includes estimated amount of trucking, hours of operations, appropriate off road parking/staging areas, and routes for informational purposes. Additionally, attempts to obtain a road use agreement should be documented in the application.

Recognizing DEC's authority under ECL§23-0303(2) Municipalities are precluded from requiring the gas industry to be subjected to local ordinances, laws, and planning and zoning board review. However, there can be a requirement of the permit application that the applicant attest to having reviewed any existing comprehensive, open space and/or agriculture protection plan or similar policy document(s). It will then be the responsibility of the community to monitor the application/permit process and make any concerns known to the applicant/permittee.

6.4 Conclusion

Many of the community character impacts associated with horizontal drilling and high volume hydraulic fracturing are the same as those addressed in the 1992 GEIS, and the use of multi-well pads has the potential to reduce adverse impacts. The volume of trucking and related road maintenance issues were not anticipated in 1992. Roads are under the control of local government per New York State Highway Vehicle Traffic Laws. Additionally, ECL§23-0303(2) provides DEC authority to regulate gas development. As a result, communication between local government and DEC is essential to mitigate impacts from trucking.

6.5 Summary

1. Encourage road use agreement with local Municipality
2. When a road use agreement has not been obtained, require trucking plan for informational purposes
3. Encourage review of local comprehensive, open space and/or agriculture protection plans or similar policy document(s)
4. NYSDEC should prepare a "Best Practices Manual" to provide Staff and industry access to information relative to what is expected in terms of well siting and aesthetic mitigation, and to identify instances when aesthetic mitigation would be necessary. See Appendix A.
5. As subsequent applications are reviewed for additional wells on a multi-well pad, NYSDEC should reconfirm control methodologies based on actual experiences with earlier wells.

6.6 Community Character Impact Summary Table

Community Character Issue	Address in 1992 GEIS	Process Enhancements	Additional Mitigation
Site Access	Yes		None required
Temporal Noise and/or Visual Impacts	Yes		None required
Temporary Land Use Conflicts	Yes		None required
Multi-Well Pad	No		Review previous well drilling activity on pad for subsequent wells
Horizontal Drilling	No		Community Character issues are the same as for vertical drilling discussed in 1992.
High Volume Hydraulic Fracturing	No		None required
Trucking	Yes		Encourage road use agreement between applicant and municipality. Require submission of trucking plan when not obtained.
Environmental Justice	No		SGEIS/SEQRA process provides for public input and resulting regulations equal protection.
Positive Economic Impacts	Yes		None required

7 CUMULATIVE IMPACTS

This is in response to the Cumulative Impact section of the Final Scope for Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas and Solution Regulatory Program – February 6, 2009

7.1 Discussion

Cumulative impacts are the effects of two or more single projects considered together. Adverse cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time. The 1992 GEIS defined the project scope as an individual well with a limited discussion of cumulative impacts. Chapter 18 discussed the positive economic impacts of gas development for municipalities and for the entire State. Additionally, as an unavoidable adverse impact it stated: ‘Though the potential for severe negative impacts from any one site is low. When all activities in the State are considered together, the potential for negative impacts on water quality, land use, endangered species and sensitive habitats increases significantly’.

For the purposes of the dSGEIS, cumulative impacts will be discussed from two perspectives;

1. **Site Specific** cumulative impacts beyond those considered in the 1992 GEIS resulting from multi-well pads; and,
2. **Regional** impacts which may be experienced as a result of gas development.

7.2 Site Specific Cumulative Impacts

The potential for site specific cumulative impacts as a result of multi-well pads, while real, is easily quantified and can be adequately addressed during the application review process. General areas of concern with regard to noise, visual, and community character issues are the same those of individual well pads. While the pads may be slightly larger than those used for single wells, the significant impacts are due to the cumulative time and trucking necessary to drill and stimulate each individual well.

When reviewed in 1992, it was assumed that a well pad would be constructed, drilled and reclaimed in a period measured in a few months, with the most significant activity being measured in one or two weeks for the majority of wells. By comparison, a horizontal well takes 4 to 5 weeks of 24 hour per day drilling with an additional 3 to 5 days for the hydraulic fracture. This duration will be required for each well with industry indicating that it is common for 6 to 8 wells to be drilled on a multi-well pad. Typically one or two wells are drilled and stimulated and the equipment is removed. If the well(s) are economically viable, the equipment is brought back and the remaining wells drilled and stimulated. Current regulations require that all wells on a multi-well pad be drilled within three years of starting the first well. As industry gains confidence in the

production of the play, there is the possibility that all wells on a pad would be drilled, stimulated and completed consecutively. This concept will shorten the time frame of noise generation and eliminate the noise generated by one rig disassembly/reassembly cycle.

The trucking requirements for rigging and equipment will not be significantly greater than for a single well pad, especially if all wells are drilled consecutively. Water and materials requirements, however, will greatly increase the amount of trucking to a multi-well pad compared to a single well pad. Estimates of truck trips per multi-well pad are as follows¹ (assumes two rig and equipment deliveries and 8 wells):

Drill Pad and Road Construction Equipment	10 – 45 Truckloads
Drilling Rig	60 Truckloads
Drilling Fluid and Materials	200 – 400 Truckloads
Drilling Equipment (casing, drill pipe, etc.)	200 – 400 Truckloads
Completion Rig	30 Truckloads
Completion Fluid and Materials	80 – 160 Truckloads
Completion Equipment – (pipe, wellhead)	10 Truckloads
Hydraulic Fracture Equipment (pump trucks, tanks)	300 – 400 Truckloads
Hydraulic Fracture Water	3,200 – 4,800 Tanker Trucks
Hydraulic Fracture Sand	160 – 200 Trucks
Flow Back Water Removal	1,600 – 2,400 Tanker Trucks

As can be seen, the vast majority of trucking is involved in delivering water and removing flow back. Multiple wells in the same location provide the potential to reduce this amount of trucking by reusing flow back water for the stimulation of other wells on the same pad. The centralized location of water impoundments may also make it economically viable to transport water via pipeline or rail in certain instances.

In the production phase multi-well pads are similar to what was addressed in 1992. There will be a small amount of equipment including valves, meters, dehydrators and tanks remaining on site which may be slightly larger than what is used for single wells but is still minor and is quiet in operation. The reclamation procedures are the same as for single well pads. There will be more area left for production equipment and activities however. It is anticipated that a multi-well pad will require up to 3 acres compared to 1 acre or less as discussed in 1992.

7.3 Site Specific Cumulative Impacts Conclusions

A single multi-well pad on a 640 acre spacing unit will drain the same area that could contain up to 16 single well pads. As discussed earlier the pad will be larger, the area left for production will be larger and, the duration of drilling and stimulating activities on the pad will be longer. The decrease in the number of drilling sites reduces the regional long term and short term cumulative impacts.

The 1992 GEIS found that the negative impacts associated with gas development were short term and could be mitigated with siting restrictions and setback requirements. This is also true for multi-well pads therefore the mitigation techniques discussed in the 1992 GEIS and in the previous sections of this report should be utilized. Given the extended time period involved in fully developing a multi-well pad, control of the impacts, while still temporary, is essential. As stated in 1992, many of the potential negative impacts of gas development hinge on the location chosen for the well and the techniques used in constructing the access road and well site. Before a drilling permit can be issued, DEC staff must ensure that the proposed location of the well and access road complies with the Department's spacing regulations and siting restrictions. To assist in this process, DEC staff now has access to Policy Guidance Documents DEP-00-1, "Assessing and Mitigating Noise Impacts" and DEP-00-2, "Assessing and Mitigating Visual Impacts". If the guidance provided in these documents is applied where appropriate to multi-well pad applications along with a proposed site plan and design guidelines (See Appendix A), it will be possible to avoid significant site-specific cumulative impacts. Additionally, the applicant should also be encouraged to review any applicable land use policy documents with the understanding that New York State Department of Environmental Conservation (NYSDEC) retains authority to regulate gas development.

7.4 Regional Cumulative Impacts

Other than those mentioned in the introduction of this section, cumulative impacts of gas development are not addressed in the 1992 GEIS. The level of impact on a regional basis will be determined by the amount of development and the rate at which it occurs. Accurately estimating this is inherently difficult due to the wide and variable range of the resource, rig, equipment and crew availability, permitting and oversight capacity, leasing, and most importantly economic factors. This holds true regardless of the type of drilling and stimulation utilized. Historically in New York, and in other plays, development has occurred in a sequential manner over years with development activity concentrated in one area then moving on with previously drilled sites fully or partially reclaimed as new sites are drilled. As with the development addressed in 1992, once drilling and stimulation activities are completed and the sites have been reclaimed, the long term impact will consist of widely spaced and partially re-vegetated production sites and fully reclaimed plugged and abandoned well sites.

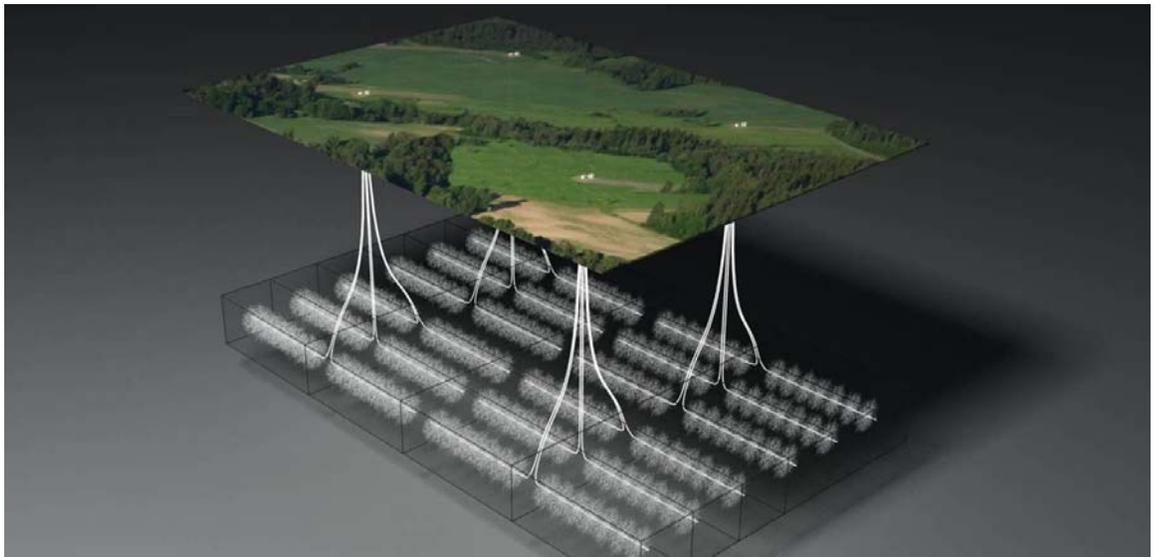
The statewide spacing regulations for vertical shale wells of one single well pad per 40-acre spacing unit will allow no greater density for horizontal drilling with high volume hydraulic fracturing than is allowed for conventional drilling techniques. This density was anticipated in 1992 and areas of New York, including Chautauqua, Cayuga and Seneca Counties, have experienced drilling at this level without significant negative impacts to agriculture, tourism, other land uses or any of the topics discussed in this report.

As discussed earlier, the density for multi-well pads, one per 640-acre spacing unit, is significantly less than for single well pads reducing the total number of disturbances to the landscape. While multi-well pads will be slightly larger than single well pads the reduction in number will lead to a substantial decrease in the total amount of disturbed

acreage providing additional mitigation for long term visual and land use impacts on a regional basis. The following table provides an example for a 10 square mile area (i.e., 6,400 acres), completely drilled, comparing the 640 acre spacing option with multi-well pads and horizontal drilling to the 40 acre spacing option with single well pads and vertical drilling.

Spacing Option	Multi-Well 640 Acre	Single Well 40 Acre
Number of Pads	10	160
Total Disturbance - Drilling Phase	50 Acres (5 ac. per pad)	480 Acres (3 ac. per pad)
% Disturbance - Drilling Phase	.78	7.5
Total Disturbance - Production Phase	30 Acres (3 ac. per pad)	240 Acres (1.5 ac. per pad)
% Disturbance - Production Phase	.46	3.75

As can be seen, multi-well pads will significantly decrease the amount of disturbance on a regional basis in all phases of development. The reduction in sites should also allow for more resources to be devoted to proper siting and design of the pad to mitigating the short term impacts that result during the drilling and stimulation phase.



Source: Chesapeake Energy

7.5 Rate of Development and Thresholds

In response to questioning, a representative for one company estimated a peak activity for all of industry at 2,000 wells per year \pm 25% in the New York Marcellus play. Other companies did not provide an estimate, listing the variables mentioned above as the reason. In Pennsylvania, where the Marcellus play covers a larger area and development has already occurred, the number of permits issued has increased in recent years as indicated in the following table. The source data provides information on the number of permits issued and is not indicative of the number of wells drilled.

Year	Marcellus Permits Issued
2007	99
2008	510
2009 (Through 8/31)	1127

SOURCE: <http://www.dep.state.pa.us/dep/deputate/minres/oilgas/RIG09.htm>

Recent development in the Barnett play in Texas, which utilizes the same horizontal drilling with high volume hydraulic fracturing that will be used in New York, has occurred at a rapid rate over the last decade. It is an approximately 4,000 square mile play located in and around the Dallas – Fort Worth area. In the eight year period from 2002 to 2008 approximately 10,500 wells were drilled.

The final scoping document summarizes the challenge of forecasting rates of development as follows:

“The number of wells which will ultimately be drilled cannot be known in advance, in large part because the productivity of any particular formation at any given location and depth is not known until drilling occurs. Changes in the market and other economic conditions also have an impact on whether and how quickly individual wells are drilled.”¹⁵

Additional research has identified that “Experience developing shale gas plays in the past 20 years has demonstrated that every shale play is unique.”¹⁶ Each individual play has been defined, tested and expanded based on understanding the resource distribution, natural fracture patterns, and limitations of the reservoir, and each play has required solutions to problems and issues required for commercial production. Many of these problems and solutions are unique to the play.¹⁷



Source: www.naturalgas.psu.edu

¹⁵ Final Scoping Document (Page 39)

¹⁶ Fractures Shale Gas Potential in New York (Page 1)

¹⁷ Ibid

“The timing, rate and pattern of development, on either a statewide or local basis, are very difficult to accurately predict.”¹⁸ As detailed in Section 2.1.6 of the Final Scoping Document “overall site density is not likely to be greater than was experienced and envisioned when the GEIS and its Findings were finalized and certified in 1992.”

The rate of development cannot be predicted with any certainty based on the factors cited above and in the Final Scoping Document. Additionally, the threshold at which development results in adverse impacts to the topics studied in this report cannot be determined since it would be subjective. Some people will feel that one drilling rig on the landscape is too many while others will want full development of the resource as quickly as possible. Research has not found any scientifically backed or measurable threshold that could be used for the topics areas discussed in this report. As a result any limit to rate of development, or setting of thresholds, would be purely subjective and indefensible.

7.6 Regional Cumulative Impacts Conclusion/Recommendation

The approach for addressing regional cumulative impacts is to focus on the proactive siting of well pads as discussed in previous sections of this report. If the location and construction of each well pad is based on ‘Best Practices’ (See Appendix A) then the potential impacts will be lessened and/or eliminated. When applications are reviewed, it is recommended that DEC examine any negative issues that have occurred on adjacent spacing units to determine if there is a potential problem in the area that needs further scrutiny.

¹⁸ Final Scoping Document (Page 39)

7.7 Cumulative Impact Summary Table

Cumulative Issue	Address in 1992 GEIS	Process Enhancements	Additional Mitigation
Multi-Well Pads	No		Review previous well drilling activity on pad for subsequent wells
Regional Impacts	Yes		Examine any negative issues that have occurred on adjacent spacing units
Trucking	Yes		Require trucking plan and encourage road use agreement between applicant and municipality.
Positive Impacts	Yes		None required

8 Appendix A

Examples of Best Management Practices for Site Development

The following list of items relates to the various aspects of site development and is intended to help guide the review of applications. Not all the elements will be required for each application. After an application is submitted and the site visit has been completed, the Department can determine the amount of information it will require from the list below. In selecting items for review, the Department should keep in mind that the applicants will also have to prepare a Stormwater Pollution Prevention Plan (SWPPP) to obtain coverage under the applicable general SPDES permit for stormwater discharges.

- (1) Proposed New Conditions
 - (a) Grading and drainage plan showing proposed topography at appropriate contour intervals. This information shall be combined as an overlay with the map of existing topography.
 - (b) Location, proposed height and use of buildings and other structures, such as retaining walls, fences, outdoor storage tanks, etc.
 - (c) Location, proposed use, design and construction materials of improvements not requiring structures, such as parking, loading and outdoor storage areas.
 - (d) Location and arrangement of site access and egress, including all paths for vehicular travel within the site. Information should include profiles and cross sections of roadways showing grades and widths.
 - (e) Location and size of water lines and appurtenances.
 - (f) Location and design of outdoor lighting fixtures and a lighting plan if proposed.
 - (g) General reclamation plan and schedule, including areas of natural vegetation to remain, the treatment of buffer areas and the location and type of trees to be planted.
 - (h) Estimated project construction schedule showing a phasing plan within the required 3 year time frame.
 - (i) Additional specifications for materials and colors.

- (j) Any other requirements which the Department might deem necessary, including but not limited to a licensed survey and as-built drawings.
- (2) All applicants shall refer to the NYS DEC Guide to Best Management Practices manual prior to submitting a site plan. The BMP manual will serve as a guide to locating well pads so as to minimize impacts on the landscape. Although these are not intended to be mandatory regulations, they can serve as a basic guide to the proper siting of well pads.

The Department should keep in mind that the applicants will also have to prepare a Stormwater Pollution Prevention Plan (SWPPP) to obtain coverage under the applicable general SPDES permit for stormwater discharges

NOTE: until the Best Management Practices manual is developed, the following can serve as a general guideline:

- (a) Location of Project and Proposed Site Features
 - i. Avoid locating rigs and structures so that they will interrupt or obscure views of the crestlines or ridgelines.
 - ii. In addition to siting the structures sensitively, consider how the building design (height, massing, etc.) will affect the visual impact of the site.
 - iii. Locate structures to have the least impact on the views of surrounding properties.
 - iv. Grading and development should preserve salient natural features such as natural terrain, waterways and other similar resources, keep cut and fill operations to a minimum and ensure conformity to existing topography so as to create the least erosion potential and adequately accommodate the volume and rate of velocity of surface runoff.
 - v. The development should be fitted to the topography and soils to create the least erosion potential.
- (b) Vegetation and Wildlife
 - i. Minimize the fragmentation of existing ecosystems such as wetlands or forests. Extensive clearing of established vegetation can increase the risk of erosion, as well as significant disruption of important ecosystems.
 - ii. The preferred well-pad should be within areas which have previously been disturbed. These areas require the least vegetative clearing, and pose less impact on the function of existing ecosystems.
 - iii. Avoid any disturbance of wildlife habitat, especially riparian corridors and wetlands.

- iv. Grading and development should preserve salient natural features such as trees and groves so as to create the least erosion potential and adequately accommodate the volume and rate of velocity of surface runoff.

- (c) Lighting
 - i. Avoid “uplights” and wall-washes, as well as lighting where the bulb is visible from the fixture.
 - ii. Light fixtures should not cast light on to the neighboring properties to the maximum extent practicable.

- (d) Stormwater
 - i. Refer to New York State Department of Environmental Conservation Stormwater Management Design Manual when designing stormwater facilities for well-pads

Bibliography

Adverse Impact Reduction Handbook – Reducing Onshore Natural Gas & Oil Exploration and Production Impacts Using a Broad-Based Stakeholder Approach. Interstate Oil & Gas Compact Commission (2008)

Adverse Impact Reduction – Stepping Lightly: Reducing the Environmental Footprint of Oil and Gas Production. Interstate Oil & Gas Compact Commission (undated)

Air Emissions and Regulations Fact Sheet. Chesapeake Energy (March 2009)

An Enduring Resource: A Perspective on the Past, Present and Future Contributions of the Barnett Shale and the Economy of Fort Worth and Surrounding Areas. Perryman Group, The (March 2009)

AOTSNY - Sample Weight Limit Local Laws. (web posting undated)

Appalachian Basin Black Shale Exploitations: Past, Present, and Future. (Power Point Presentation) John Gottschling, Regional Tech. Rep. BJ Services Company, U.S.A. (5/16 & 5/17, 2007)

Bedford, Texas – Drilling Ordinance Comparison Sheet. (undated)

Better With the Shale Than Without. Press Release: Fort Worth Chamber of Commerce (3/11/09)

BLM Q & A Fact Sheet – Roan Plateau Planning Area – Reasonable Foreseeable Development (RFD) 10/24/04)

Bounty from Below: The Impact Associated with the Barnett Shale on Business Activity in Fort Worth and the Surrounding 14-County Area. The Perryman Group, May 2007.

Bounty from Below – The Impact of Developing Natural Gas Resources Associated with Barnett Shale. Perryman Group, The (May 2008)

Chesapeake Energy – Natural Gas Development & Production – Marcellus Shale, J.E. Grey May 14, 2009.

Chesapeake/Statoil Hydro – Marcellus Black Shale. Steinar Eikaas, et al (November 2008)

Chesapeake Quick News (Newsletter). (October 2008)

City of Fort Worth, Texas – Gas Drilling Ordinance. (2008)

Colorado – House Bill 07-1252 – Concerning the Accommodation of the Rights of Surface Owners with Respect to Oil and Gas Operators.

Community Safety and Emergency Response Fact Sheet. Chesapeake Energy (March 2009)

Disposal of Spent Drilling Fluids to Publically Owned Treatment Works (POTW's). Alan A. Fuchs, NYSDEC – Division of Water (10/21/08)

Economic Impact of Barnett. Perryman Group, The (undated power point slide)

Economic Impact of the Fayetteville Shale in White County, Arkansas, The. Kathy Deck, Sam M. Walton College of Business (2008)

Economic Impact of the Oil & Gas Industry in Pennsylvania, The. Pennsylvania Economic League. (November 2008)

Economic Workforce Brief – Forecast of the Potential Impact of Increased Royalty Income on the Pennsylvania Economy 2008-1.1 (June 2008)

Environmental Resources for Tribal Energy Development – Office of Indian Energy and Economic Development. Tribal Energy and Environmental Information Clearing House (undated web site).

Evaluating the Environmental Implications of Hydraulic Fracturing in Shale Gas Reservoirs. J. Daniel Arthur, et al (2008)

Experience in Sublette County. Penn State, Ecosystem Research Group (undated power point slide)

Farmers Branch Texas – Ordinance #2946 Regulating Well Drilling. (undated)

Flower Mound Texas – Oil and Gas Drilling Ordinance Comparison Chart. (May 2007)

Forest Landowners & Natural Gas Development, Marcellus Education Fact Sheet – Penn State, College of Agriculture (2008)

Forestry – Press Release. Pennsylvania DOC – NRB (2008)

Fortuna NY DEC SGEIS Response, Rick Kessy, Fortuna Energy (May 27, 2009)

Fractured Shale Gas Potential in New York – David G. Hill and Tracy E. Lombardi & John P. Martin – undated

Gas Rights and Right of Way Leasing Pointers for Forest Owners. Cornell Cooperative Extension (12/15/08)

Gas Well Drilling Noise Impacts and Mitigation Study. Behiens and Associates, Inc. (April 2006)

Geological and Activity Overview of Appalachian Plays (Power Point Presentation).
Dan A. Billman, P.G. CPG. April 2008)

Goldbook, 4th Edition, revised 2007 – Surface Operating Standards and Guidelines for
Oil and Gas Exploration and Development. Bureau of Land Management (2007)

Hearing on The Environmental Impact of Drilling and Development of Natural Gas.
Memo to NYS Assembly – Michael P. Joy, PhD. Esq. (10/16/08)

Hydraulic Fracturing Considerations for Natural Gas Wells of the Marcellus Shale.
Daniel Arthur, P.E., et al (9/21/08)

Hydraulic Fracturing Considerations for Natural Gas Wells of the Marcellus Shale.
Groundwater Protection Council (9/23/08)

Information Gathering on Hydraulic Fracturing of Shale Formation for Gas Production.
G. Struyk., Fortuna Energy, Inc. (8/14/08)

Jonah/Anticline Fields Direct Workforce Through Three Phases. Penn State, Ecosystem
Research Group (undated power point slide)

Kentucky Erosion Prevention and Sediment Control Field Guide: Kentucky Division of
Water Nonpoint Source Section and Kentucky Division of Conservation.

Low Risk Site Handbook for Erosion Potential and Sediment Control: Vermont
Department of Environmental Conservation (2006)

Marcellus Shale Hydraulic Fracturing Fact Sheet. Chesapeake Energy (March 2009)

Marcellus Shale Play's Vast Resource Potential. T. Engelder & G. Lash (May 2008)

Modern Shale Gas Development in the U.S., A Primer. U.S. Department of Energy,
Office of Fossil Energy (April 2009)

Natural Gas and Local Governments. Timothy Kelsey, PhD, Penn State Cooperative
Extension (2009)

NYS-DEC Policy DEP-00-1 – Assessing and Mitigating Noise Impacts (10/06/00 – Last
Revised 02/02/01)

NYS-DEC Policy DEP-00-2 – Assessing and Mitigating Visual Impacts (7/31/00)

New York State – Open Space Conservation Plan (2006)

NYS Vehicle Traffic Law §1660 – Weight Limits on Town Roads. (undated)

Notice of Change to City of Grand Prairie, Texas – Code of Ordinances – Summary.
(5/6/08)

Notice of Determination of Non-Significance – API# 31-015-2290-00, Permit 08828
(February 13, 2002).

Oil & Gas Lease Sale - Pennsylvania DOC – NRB – Forestry. (September 2008)

Oil & Gas Position Statement. Pennsylvania DOC – NRB – Forestry (April 1, 2008)

Oil & Gas Program (slide show). Pennsylvania DOC – NRB – Forestry (2008)

Potential Development of the Natural Resources in the Marcellus Shale (New York,
Pennsylvania, West Virginia & Ohio). National Park Service – U.S. Department of the
Interior (December 2008).

Potential Development of the Natural Gas Resources in the Marcellus Shale – New York,
Pennsylvania, West Virginia & Ohio. (National Park Service – U.S. Department of the
Interior – December 2008)

Potential Economic Impacts of Marcellus Shale in Pennsylvania. Timothy W. Kelsey,
PhD, Penn State Cooperative Extension – (2009)

Potential Environmental Impacts Associated with Proposed Marcellus Shale Wells.
Talismann Energy, Linda Collart, Mineral Resources Supervisor (7/3/08).

Preparing for Natural Gas Development: Understanding Impacts and Protecting Public
Assets. Gas Drilling Task Force, The: (2/13/09)

Projecting the Economic Impact of the Fayetteville Shale Play 2005 – 2008. Sam M.
Walton College of Business. (May 2006)

Projecting the Economic Impact of the Fayetteville Shale Play (2008-2012). Sam M.
Walton College of Business (March 2008)

Protecting Water, Producing Gases. Mary Griffiths, Pembina Institute, Alberta Canada.
(April 2007).

Reasonably Foreseeable Development Report – Roan Plateau (Question and Answer Fact
Sheet). Bureau of Land Management (2004)

Reasonably Foreseeable Development Scenario for Oil & Gas (RFD) “Life of Area”
Forecast for ultimate development of lease - Bureau of Land Management (2004)

Reasonably Foreseeable Development Scenario for Oil and Gas Activities In the BLM White River Field Office. Bureau of Land Management (Executive Summary, Undated).

Responses to Notice of Incomplete Applications. Chesapeake Energy (3/9/09)

Responses to NY DEC SGEIS Information Requests. Chesapeake Energy (June 4, 2009)

Responses to NYDEC SGEIS Informational Request. East Resources. (5/21/09)

Responses to NYDEC SGEIS Informational Request. Fortuna (5/22/09)

Responses to NYDEC SGEIS Informational Request. Seneca (6/3/09)

Revised Policy for Reasonably Foreseeable Development Scenarios for Oil & Gas. Bryce Baslan, Division of Fluid Minerals (2008)

Roan Plateau Fact Sheet – Impacts of Oil and Gas Drilling. (7/7/04)

Rural Development Paper No. 43 – Energy Boomtowns & Natural Gas. Jeffrey Jacquet, NERCRD. (January 2009)

Santa Fe County Oil & Gas Amendment to the Santa Fe County Land Development Code. Ordinance No. 2008-19 (12/10/08)

Schlumberger – Shale Gas: Explanation of Gas Shale – Barnett Shale in the Fort Worth Basin, Texas (2005)

Shale Gas, Focus on the Marcellus Shale. Oil & Gas Accountability Project/Earthworks (June 2008)

Statement to Senate Environmental Resources and Energy Committee. Pennsylvania DOC – NRB – Forestry (2008)

Stepping Lightly: Reducing the Environmental Footprint of Oil & Gas Production. Interstate Oil & Gas Compact Commission (2008)

Summary of Public Comments on Natural Gas Leasing. Pennsylvania DOC – NRB – Forestry (2008)

Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development “Gold Book” United States Department of the Interior - BLM Fourth Edition – Revised 2007

Testimony of Michael P. Joy, Ph.D., Esq. – Hearings on the Environmental Impact of Drilling and Development of Natural Gas in New York State. (10/16/08)

Water Fact Sheet #28, Gas Drilling & Your Private Water Supply. Penn State, School of Forestry (2009)

Water Use in Marcellus Deep Shale Gas Exploration Fact Sheet. Chesapeake Energy (March 2009)

Well Drilling Details – Gas Ranch Storage Project – Appendix A.6 (undated untitled)

Well Permit Issuance for Horizontal Drilling. NYSDEC – Final Scoping Document (2009)

1980 N.Y. Op. Atty. Gen. (inf.) 209 – Office of the Attorney General State of New York Informal Opinion. (August 11, 1980)