NEW YORK STATE OF OPPORTUNITY

Department of Environmental Conservation

# Chapter 7

# Mitigation Measures

## Final

## Supplemental Generic Environmental Impact Statement

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## Chapter 7 – Mitigation Measures


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# Chapter 7 EXISTING AND RECOMMENDED MITIGATION MEASURES

Many of the potential impacts identified in Chapter 6 are addressed by existing regulatory programs, both within and outside of the Department. These are identified and described in this chapter, along with recommendations for additional mitigation measures to address additional potential significant adverse environmental impacts from high-volume hydraulic fracturing, which is often associated with horizontal drilling and multi-well pad development. These additional recommended mitigation measures, if adopted, can be imposed as enhanced procedures, permit conditions and/or new regulations. In addition, the proposed EAF Addendum in Appendix 6 contains a series of informational requirements, such as the disclosure of additives, the proposed volume of fluids used for fracturing, the percentage weight of water, proppants and each additive, and mandatory pre-drilling plans, that in some instances may also serve as mitigation measures. As with Chapter 6, this Supplement text is not exhaustive with respect to mitigation measures because it incorporates by reference the entire 1992 GEIS and Findings Statement and the mitigation measures identified therein. This chapter identifies and discusses:

1) mitigation of impacts not addressed by the 1992 GEIS (e.g., water withdrawal); and
2) enhancements to GEIS mitigation measures to target potential impacts associated with horizontal drilling, multi-well pad development and high-volume hydraulic fracturing.

Although every single mitigation measure provided by the 1992 GEIS is not reiterated herein, such measures remain available and applicable as warranted.

## 7.1 Protecting Water Resources

The Department is authorized by statute to require the drilling, casing, operation, plugging and replugging of oil and gas wells and reclamation of surrounding land to, among other things, prevent or remedy "the escape of oil, gas, brine or water out of one stratum into another" and "the pollution of fresh water supplies by oil, gas, salt water or other contaminants."[410]

[410] ECL §23-0305(8)(d).

In addition to its specific authority to regulate well operations to protect the environment, the Department also has broad authority to "[p]romote and coordinate management of water resources to assure their protection, enhancement, provision, allocation and balanced utilization . . . and take into account the cumulative impact upon all of such resources in making any determination in connection with any . . . permit . . ."[411]

### *7.1.1 Water Withdrawal Regulatory and Oversight Programs*

Existing jurisdictions and regulatory programs address some concerns regarding the impacts related to water withdrawal that are described in Chapter 6. These programs are summarized below, followed by a discussion of three methodologies for mitigating impacts from surface water withdrawals. These are DRBC's method, SRBC's method and the Natural Flow Regime Method (NFRM), which is preferred by the Department for purposes of the development of gas reserves as described in this document and are proposed to be enforced as permit conditions until further regulatory guidance or regulations are formally adopted. Mitigation of cumulative impacts is also addressed.

#### *7.1.1.1 Department Jurisdictions*

*Degradation of Water Use*

Currently, the Department's regulatory authority to regulate water withdrawals outside the Great Lakes Basin and Long Island is limited to withdrawals for public water supply purposes. However, the Department proposes to require as a permit condition that applicants identify the source of the water it intends to use in high-volume hydraulic fracturing operations and report annually on the aggregate amount of water it has withdrawn or purchased. Furthermore, the Department also intends to require that permittees employ the NFRM, as described below, as a mitigation measure to avoid degradation of water quality due to water withdrawals from high-volume hydraulic fracturing.

The Water Resources bill, which was recently passed by both houses of the legislature and awaits the Governor's signature to become law, would extend the Department's authority to regulate all water withdrawals over 100,000 gpd throughout all of New York State. This bill

[411] ECL §3-0301(1)(b).

applies to all such withdrawals where water would be used for high-volume hydraulic fracturing. Withdrawal permits issued in the future by the Department, pursuant to the regulations implementing this law, would include conditions to allow the Department to monitor and enforce water quality and quantity standards and requirements. These standards and requirements may include: passby flow; fish impingement and entrainment protections; protections for aquatic life; reasonable use; water conservation practices; and evaluation of cumulative impacts on other water withdrawals.

*Public Water Supply* - New York State currently regulates public drinking water supply ground and surface water withdrawals through the public water supply permit program.[412] These limited water supply permit programs help to protect and conserve available water supplies.

*Other Water Withdrawals* - The Department also regulates non-public water supply withdrawals in Long Island counties from wells with pumping capacities in excess of 45 gpm. (ECL 15-1527). All water withdrawals within New York's portion of the Great Lakes Basin of 100,000 gpd or more (30-day average) must register with the Department (ECL 15-1605). Also, all withdrawals within New York's portion of the Delaware and Susquehanna River basins greater than 100,000 gpd must have the approval of the respective basin commission. Although they may be subject to the reporting and registration requirements described below, surface and ground water withdrawals that are not on Long Island and not for drinking water supply currently are unregulated unless the withdrawals occur within the lands regulated by the DRBC and the SRBC. Surface water withdrawals are subject to the recently enacted narrative water quality standard for flow promulgated at 6 NYCRR § 703.2. This water quality standard generally prohibits any alteration in flow that would impair a fresh surface water body's designated best use. Determination of an appropriate passby flow needs to be done on a case by case basis. However, guidance to clarify the application of the narrative water quality standard for flow has not yet been issued. For the purpose of this revised draft SGEIS only, the Department proposes to employ the NFRM via permit condition as a protection measure pending completion of guidance.

[412] ECL Article 15, Title 15.

*Water Withdrawal Reporting* - Pursuant to Title 33 of Article 15 of the ECL, any entity that withdraws, or that has the capacity to withdraw, groundwater or surface water in quantities greater than 100,000 gpd must file an annual report with the Department. Inter-basin diversions must be reported on the same form.

*Water Withdrawal Regulations*

The Department primarily addresses the withdrawal of water and its potential impacts in the following regulations:

- 6 NYCRR Part 601: Water Supply;
- 6 NYCRR Part 602: Long Island Wells; and
- 6 NYCRR Part 675: Great Lakes Withdrawal Registration Regulations.

The requirements of 6 NYCRR Part 601 pertain to public water supply withdrawals and include an application that describes the project (map, engineer's report and project justification) and the proposed water withdrawal. The applicant is required to identify the source of water, projected withdrawal amounts and detailed information on rainfall and streamflow.

The purpose of 6 NYCRR Part 675 is to establish requirements for the registration of water withdrawals and reporting of water losses in the Great Lakes Basin. Part 675 is applicable because a portion of the shale formations being considered for potential high-volume hydraulic fracturing is located within the Great Lakes Basin. Registration is required for non-agricultural purposes in excess of 100,000 gpd (30-day consecutive period). An application for registration of a withdrawal in the Great Lakes basin is required and addresses location and source of withdrawal, return flow, water usage description, annual and monthly volumes of withdrawal, water loss and a list of other regulatory (federal, state and local) requirements. There are also additional requirements for inter-basin surface water diversions.

*Protection of Aquatic Ecosystems*

In addition to provisions in the Water Resources Law regarding protection of aquatic ecosystems, the Environmental Conservation Law includes other programs that protect aquatic habitat. With respect to disturbances of surface water bodies such as rivers and streams,

equipment or structures such as standpipes may require permits under Article 15 of the ECL. The Department has authority to control the use and protection of the waters of New York State through 6 NYCRR Part 608, Use and Protection of Waters. This regulation enables the agency to control any change, modification or disturbance to a "protected stream," which includes all navigable streams and any stream or portion of a stream with a classification or standard of AA, AA(t), A, A(t), B, B(t) or C(t), and "navigable waters." 6 NYCRR Part 608 regulates the use and protection of waters in the state, and has subparts that address the protection of fish and wildlife species. Under Part 608.2, "No person or local public corporation may change, modify or disturb any protected stream, its bed or banks, nor remove from its bed or banks sand, gravel or other material, without a permit issued pursuant to this Part." The Department reviews permits for changes, modifications, or disturbances to streams with respect to potential environmental impacts on aquatic, wetland and terrestrial habitats; unique and significant habitats; rare, threatened and endangered species habitats; water quality; hydrology; and water course and water body integrity. Part 608 does not regulate disturbances of the many streams classified as "C" or below.

*7.1.1.2 Other Jurisdictions - Great Lakes-St. Lawrence River Basin Water Resources Compact*

The Great Lakes-St. Lawrence River Basin Water Resources Compact (Compact) was signed into law on October 3, 2008 through Public Law 110-342. The Great Lakes-St. Lawrence River Basin Water Resources Council (Council), whose membership includes eight Great Lakes States, was established by the Compact on December 8, 2008. The Compact prohibits the bulk transport of water from that basin in containers larger than 5.7 gallons. In addition, effective December 8, 2008, the Compact[413] prohibits any new or increased diversion of any amount of water out of the Great Lakes Basin with certain limited exceptions. Also, any proposed new or increased withdrawal of surface or groundwater that will result in a consumptive use of 5 million gpd or greater averaged over a 90-day period requires prior notice and consultation with the Council and the Canadian Provinces of Ontario and Quebec.

Within five years of the effective date of the Compact, New York State must implement a program that ensures that, all new and increased water withdrawals must comply with the

[413] ECL Article 21, Title 10.

Compact's Decision-Making Standard, Section 4.11, which establishes five criteria all water withdrawal proposals must meet, including:

1) The return of all water not otherwise consumed to the source watershed;

2) No significant adverse individual or cumulative impacts to the quantity of the waters and water-dependent natural resources;

3) Implementation of environmentally sound and economically feasible water conservation measures;

4) Compliance with all other applicable federal, state, and local laws as well as international agreements and treaties; and

5) Reasonable proposed use of water.

The Great Lakes Council does not have regulatory authority similar to that held by SRBC and DRBC to review water withdrawals and uses and require mitigation of environmental impacts. However, the Council has specific authority for the review and/or approval of certain new and increased water withdrawals. Review by the Council will require compliance with the Compact's Decision-Making Standard and Standard for Exceptions.

#### *7.1.1.3 Other Jurisdictions - River Basin Commissions*

The SRBC and the DRBC are interstate compact entities with authority over certain water uses within discrete portions of the State. New York is a member of the Board of these river basin commissions. Those commissions with regulatory programs which address water withdrawals are described below, and mitigation measures provided by those programs are incorporated into subsequent sections.

Table 7.1 is a summary of relevant regulations for each of the governmental bodies with jurisdiction over issues related to water withdrawals. Any amount of surface water withdrawn to develop shale formations requires the approval of the SRBC and DRBC within their respective river basins. In response to increased gas drilling in Pennsylvania, SRBC has recently amended its regulations to further address gas drilling withdrawals and consumptive use. In addition to surface water withdrawals, SRBC and DRBC control diversions of water into and out of their respective basins. While ECL 15-1505 prohibits transport of water out of New York State via

pipes, canals or streams without a permit from the Department, it does not specifically prohibit such transport by tanker truck. Neither SRBC nor DRBC control transfers of water from state-to-state within their basins.

*Delaware River Basin Commission Jurisdictions*

*Degradation of a Stream's Use* - Section 3.8 of the DRBC's Compact states "No project having a substantial effect on the water resources of the basin shall hereafter be undertaken by any person, corporation or governmental authority unless it shall have been first submitted to and approved by the Commission, subject to the provisions of Sections 3.3 and 3.5. The Commission shall approve a project whenever it finds and determines that such project would not substantially impair or conflict with the Comprehensive Plan and may modify and approve as modified, or may disapprove any such project whenever it finds and determines that the project would substantially impair or conflict with such Plan." DRBC regulations work collectively to protect Delaware River Basin streams from sources of degradation that would affect the best usage. The DRBC Water Code[414] provides the regulations, requirements, and programs enacted into law that serve to facilitate the protection of these water resources in the Basin.

*Reduced Stream Flow* - Potential impacts of reduced stream flow associated with shale gas development by high-volume hydraulic fracturing in the Delaware River Basin are under the purview of the DRBC. The DRBC has the authority to regulate and manage surface and ground water quantity-related issues throughout the Delaware River Basin. The DRBC requires that all gas well development operators complete an application for water use that will be subject to Commission review. The DRBC primarily uses the following regulations, procedures and programs to address potential impacts of reduced stream flow associated with a water taking:

[414] 18 CFR Part 410.

Table 7.1 - Regulations Pertaining to Watershed Withdrawal (Revised July 2011)[415]

| Agency | Potential Impacts of Reduced Stream Flow | Denigration of Stream's Designated Best Use | Potential Impacts to Downstream Wetlands | Potential Impacts to Fish and Wildlife | Potential Aquifer Depletion |
|---|---|---|---|---|---|
| DRBC | Water Code §2.50.2.A<br>Water Code §2.1.1<br>Water Code §2.5 | Water Code, 18 CFR 410<br>DRBC Compact | Water Code §2.350 | Water Code §2.1.1<br>Water Code §2.200.1<br>Water Code §3.10.2.B<br>Water Code §3.10.3.A.2<br>Water Code §3.10.3.A.2.e<br>Water Code §3.30.4.A.1<br>Water Code §2.1.2<br>Water Code §3.10.3.A.2.b<br>Water Code §3.20<br>Water Code §3.30<br>Water Code §3.40<br>Water Code §3.30.4.A.1 | Water Code §2.50.2.A<br>Water Code §2.20 |
| NYSDEC | 6 NYCRR §665<br>6 NYCRR §670<br>6 NYCRR §671<br>6 NYCRR §672<br>6 NYCRR §701 | 6 NYCRR §608<br>6 NYCRR §666<br>6 NYCRR §701 | 6 NYCRR §663<br>6 NYCRR §664<br>6 NYCRR §665 | 6 NYCRR §595<br>6 NYCRR §608<br>6 NYCRR §666 | 6 NYCRR §601<br>6 NYCRR §602 |
| SRBC | Reg. of Projects §806.30<br>Reg. of Projects §801.3<br>Reg. of Projects §802.23 | Reg. of Projects, 18 CFR §801, §806, §807, §808 | Reg. of Projects §801.8<br>Reg. of Projects §806.14 | Reg. of Projects §806.23.b.2<br>Policy 2003_1<br>Reg. of Projects §801.9<br>Reg. of Projects §806.14.b.1.v.C | Reg. of Projects §806.23.b.2<br>Reg. of Projects §806.12<br>Reg. of Projects §806.22 |

[415] Adapted from Alpha, 2009.

- Allocation of water resources, including three major reservoirs for the NYC Water supply;
- Reservoir release targets to maintain minimum flows of surface water;
- Drought management including water restrictions on use, and prioritizing water use;
- Water conservation program;
- Passby flow requirements;
- Monitoring and reporting requirements; and
- Aquifer testing protocol.

*Impacts to Aquatic Ecosystems* - DRBC regulations concerning the protection of fish and wildlife are located in the Delaware River Basin Water Code.[416] In general, DRBC regulations require that the quality of waters in the Delaware basin be maintained "in a safe and satisfactory condition…for wildlife, fish, and other aquatic life" (DRBC Water Code, Article 2.200.1).

One of the primary goals of the DRBC is basin-wide water conservation, which is important for the sustainability of aquatic species and wildlife. Article 2.1.1 of the Water Code provides the basis for water conservation throughout the basin. Under Section A of this Article, water conservation methods will be applied to, "reduce the likelihood of severe low stream flows that can adversely affect fish and wildlife resources." Article 2.1.2 outlines general requirements for achieving this goal, such as increased efficiency and use of improved technologies or practices.

All surface waters in the Delaware River Basin are subject to the water quality standards outlined in the Water Code. The quality of Basin waters, except intermittent streams, is required by Article 3.10.2B to be maintained in a safe and satisfactory condition for wildlife, fish and other aquatic life. Certain bodies of water in the Basin are classified as Special Protection Waters (also referred to as Outstanding Basin Waters and Significant Resource Waters) and are subject to more stringent water quality regulations. Article 3.10.3.A.2 defines Special Protection Waters as having especially high scenic, recreational, ecological, and/or water supply values. Per

[416] 18 CFR Part 410.

Article 3.10.3.A.2.b, no measureable change to existing water quality is permitted at these locations. Under certain circumstances wastewater may be discharged to Special Protection Areas within the watershed; however, it is discouraged and subject to review and approval by the Commission. These discharges are required to have a National Pollutant Discharge Elimination System (NPDES) permit. Non-point source pollution within the Basin that discharges into Special Protection Areas must submit for approval a Non-Point Source Pollution Control Plan.[417]

Interstate streams (tidal and non-tidal) and groundwater (basin wide) water quality parameters are specifically regulated under the DRBC Water Code Articles 3.20, 3.30, and 3.40, respectively. Interstate non-tidal streams are required to be maintained in a safe and satisfactory condition for the maintenance and propagation of resident game fish and other aquatic life, maintenance and propagation of trout, spawning and nursery habitat for anadromous fish, and wildlife. Interstate tidal streams are required to be maintained in a safe and satisfactory condition for the maintenance and propagation of resident fish and other aquatic life, passage of anadromous fish, and wildlife. Groundwater is required to be maintained in a safe and satisfactory condition for use as a source of surface water suitable for wildlife, fish and other aquatic life. It shall be "free from substances or properties in concentrations or combinations which are toxic or harmful to human, animal, plant, or aquatic life, or that produce color, taste, or odor of the waters."[418]

*Impacts to Wetlands* - DRBC regulations concerning potential impacts to downstream wetlands are located in the Delaware River Basin Water Code[419] addressed under Article 2.350, Wetlands Protection. It is the policy of the DRBC to support the preservation and protection of wetlands by:

1) Minimizing adverse alterations in the quantity and quality of the underlying soils and natural flow of waters that nourish wetlands;

2) Safeguarding against adverse draining, dredging or filling practices, liquid or solid waste management practices, and siltation;

[417] DRBC Water Code, Article 3.10.3.A.2.e.

[418] DRBC Water Code, Article 3.40.4.A.1.

[419] 18 CFR 410.

3) Preventing the excessive addition of pesticides, salts or toxic materials arising from non-point source wastes; and

4) Preventing destructive construction activities generally.

Item 1 directly addresses wetlands downstream of a proposed water withdrawal.

The DRBC reviews projects affecting 25 acres or more of wetlands.[420] Projects affecting less than 25 acres are reviewed by the DRBC only if no state or federal review and permit system is in place, and the project is determined to be of major significance by the DRBC. Additionally, the DRBC will review state or federal actions that may not adequately reflect the Commission's policy for wetlands in the basin.

*Aquifer Depletion* - DRBC regulations concerning the mitigation of potential aquifer depletion are located in the Delaware River Basin Water Code (18 CFR Part 410). The protection of underground water is covered under Section 2.20 of the DRBC Water Code. Under Section 2.20.2, "The underground water-bearing formations of the Basin, their waters, storage capacity, recharge areas, and ability to convey water shall be preserved and protected." Projects that withdraw underground waters must be planned and operated in a manner which will reasonably safeguard the present and future groundwater resources of the Basin. Groundwater withdrawals from the Basin must not exceed sustainable limits. No groundwater withdrawals may cause an aquifer system's supplies to become unreliable, or cause a progressive lowering of groundwater levels, water quality degradation, permanent loss of storage capacity, or substantial impact on low flows or perennial streams (DRBC Water Code, Article 2.20.4). Additionally, "The principal natural recharge areas through which the underground waters of the Basin are replenished shall be protected from unreasonable interference with their recharge function" (DRBC Water Code, Article 2.20.5).

The interference, impairment, penetration, or artificial recharge of groundwater resources in the basin are subject to review and evaluation by the DRBC. All operators of individual wells or groups of wells that withdraw an average of 10,000 gpd or more during any 30-day period from the underground waters of the Basin must register their wells with the designated agency of the

[420] DRBC Water Code, Article 2.350.4.

state where the well is located. Registration may be filed by the agents of operators, including well drillers. Any well that is replaced or re-drilled, or is modified to increase the withdrawal capacity of the well, must be registered with the designated state agency (Delaware Department of Natural Resources and Environmental Control; New Jersey Department of Environmental Protection; the Department; or the PADEP (DRBC Water Code, Article 2.20.7).

Groundwater withdrawals from aquifers in the Basin that exceed 100,000 gpd during any 30-day period are required be metered, recorded, and reported to the designated state agencies. Withdrawals are to be measured by means of an automatic continuous recording device, flow meter, or other method, and must be measured to within 5 % of actual flow. Withdrawals must be recorded on a biweekly basis and reported as monthly totals annually. More frequent recording or reporting may be required by the designated agency or the DRBC (DRBC Water Code, 2.50.2.A).

*SRBC Jurisdictions*

*Degradation of a Stream's Use* - The SRBC has been granted statutory authority to regulate the conservation, utilization, development, management, and control of water and related natural resources of the Susquehanna River Basin and the activities within the basin that potentially affect those resources. The SRBC controls allocations, diversions, withdrawals, and releases of water in the basin to maintain the appropriate quantity of water. The SRBC Regulation of Projects[421] provides the details of the programs and requirements that are in effect to achieve the goals of the commission.

*Reduced Stream Flow* - The SRBC has the authority to regulate and manage surface and ground water withdrawals and consumptive use in the Susquehanna River Basin. The SRBC requires that all gas well development operators complete an application for water use that will be subject to its review. The SRBC primarily uses the following regulations, procedures and programs to address potential impacts of reduced stream flow associated with a water taking:

- Consumptive use regulations;

[421] 18 CFR, Parts 801, 806, 807, and 808.

- Mitigation measures;
- Conservation measures and water use alternatives;
- Conservation releases;
- Evaluation of safe yield (7-day, 10-year low flow);
- Passby requirements;
- Monitoring and reporting requirements; and
- Aquifer testing protocol.

*Impacts to Aquatic Ecosystems* - SRBC regulations concerning the protection of fish and wildlife are located in the SRBC Regulation of Projects.[422] In general, the Commission promotes sound practices of watershed management for the purposes of improving fish and wildlife habitat (SRBC Regulation of Projects, Article 801.9).

Projects requiring review and approval of the SRBC under §§ 806.4, 806.5, or 806.6 are required to submit to the Commission a water withdrawal application. Applications are required to contain the anticipated impact of the proposed project on fish and wildlife (SRBC Regulation of Projects, Article 806.14.b.1.v.C). "The Commission may deny an application, limit or condition an approval to ensure that the withdrawal will not cause significant adverse impacts to the water resources of the basin."[423] The SRBC considers water quality degradation affecting fish, wildlife or other living resources or their habitat to be grounds for application denial.

Water withdrawal from the Susquehanna River Basin is governed by passby flow requirements that can be found in the SRBC Policy Document 2003-1, "Guidelines for Using and Determining Passby Flows and Conservation Releases for Surface-water and Ground-water Withdrawal Approvals." A passby flow is a prescribed quantity of flow that must be allowed to pass a prescribed point downstream from a water supply intake at any time during which a withdrawal

[422] 18 CFR Parts 801, 806, 807, and 808.

[423] SRBC Regulation of Projects, Article 806.23.b.2.

is occurring. The methods by which passby flows are determined for use as impact mitigation are described below.

*Impacts to Wetlands* - Sponsors of projects requiring review and approval of the SRBC under §§ 806.4, 806.5, or 806.6 are required to submit to the Commission a water withdrawal application. Applications are required to contain the anticipated impact of the proposed project on surface water characteristics, and on threatened or endangered species and their habitats.[424]

*Aquifer Depletion* - Evaluation of ground water resources includes an aquifer testing protocol to evaluate whether well(s) can provide the desired yield and assess the impacts of pumping. The protocol includes step drawdown testing and a constant rate pumping test. Monitoring requirements of ground water and surface water are described in the protocol and analysis of the test data is required. This analysis typically includes long term yield and drawdown projection and assessment of pumping impacts.

#### *7.1.1.4 Impact Mitigation Measures for Surface Water Withdrawals*

*Protecting Stream Flows –DRBC Method*

DRBC has the charge of conserving water throughout the Delaware basin by reducing the likelihood of severe low stream flows that can adversely affect fish and wildlife resources and recreational enjoyment (18 CFR Part 410, section 2.2.1). The DRBC currently has no specific passby regulation or policy. Prescribed reservoir releases play an important role in Delaware River flow. The DRBC uses a Q7-10 flow for water resource evaluation purposes. The Q7-10 flow is the drought flow equal to the lowest mean flow for seven consecutive days, that has a 10-year recurrence interval.

The Q7-10 is a flow statistic developed by sanitary engineers to simulate drought conditions in water quality modeling when evaluating waste load assimilative capacity (e.g., for point sources from waste water treatment plants). Q7-10 is not meant to establish a direct relation between Q7-10 and aquatic life protection.[425] For most streams, the Q7-10 flow is less than 10% of the

[424] SRBC Regulation of Projects, Article 806.14.

[425] Camp, Dresser and McKee, 1986.

average annual flow and may result in degradation of aquatic communities if it becomes established as the only flow protected in a stream.[426]

*Protecting Stream Flows – SRBC Method*

The SRBC requires that passby flows, i.e., prescribed quantities of flow that must be allowed to pass a prescribed downstream point, be provided as mitigation for water withdrawals. This requirement is prescribed in part to conserve fish and wildlife habitats. "Approved surface-water withdrawals from small impoundments, intake dams, continuously flowing springs, or other intake structures in applicable streams will include conditions that require minimum passby flows. Approved groundwater withdrawals from wells that, based on an analysis of the 120-day drawdown without recharge, impact streamflow, or for which a reversal of the hydraulic gradient adjacent to a stream (within the course of a 48-hour pumping test) is indicated, also will include conditions that require minimum passby flows."[427] There are three exceptions to the required passby flow rules stated above:

1) If the surface-water withdrawal or groundwater withdrawal impact is minimal in comparison to the natural or continuously augmented flows of a stream or river, no passby flow will be required. Minimal is defined by SRBC as 10 % or less of the natural or continuously augmented 7-day, 10-year low flow (Q7-10) of the stream or river;

2) For projects requiring Commission review and approval for an existing surface-water withdrawal where a passby flow is required, but where a passby flow has historically not been maintained, withdrawals exceeding 10 % of the Q7-10 low flow will be permitted whenever flows naturally exceed the passby flow requirement plus the taking. Whenever stream flows naturally drop below the passby flow requirement plus the taking, both the quantity and the rate of the withdrawal will be reduced to less than 10 % of the Q7-10 low flow; and

3) If a surface-water withdrawal is made from one or more impoundments (in series) fed by a stream, or if a ground-water withdrawal impacts one or more impoundments fed by a stream, a passby flow, as determined by the criteria discussed below or the natural flow, whichever is less, will be maintained from the most downstream impoundment at all times during which there is inflow into the impoundment or series of impoundments.

[426] Tennant 1976a,b.

[427] SRBC, Policy 2003-01.

In cases where passby flow is required, the following criteria are to be used to determine the appropriate passby flow for SRBC-Classified Exceptional Value (EV) Waters, High Quality (HQ) Waters, and Cold-Water Fishery (CWF) Waters; For EV Waters, withdrawals may not cause greater than 5 % loss of habitat. For HQ Waters, withdrawals may not cause greater than 5 % loss of habitat as well; however, a habitat loss of 7.5 % may be allowed if:

1) The project is in compliance with the Commission's water conservation regulations of Section 804.20;

2) No feasible alternative source is available; and

3) Available project sources are used in a program of conjunctive use approved by the Commission, and combined alternative project source yields are inadequate.

For Class B,[428] CWF Waters, withdrawals may not cause greater than a 10 % loss of habitat. For Classes C and D, CWF Waters, withdrawals may not cause greater than a 15 % loss of habitat. For areas of the Susquehanna River Basin not covered by the above regulations, the following shall apply:

1) On all EV and HQ streams, and those streams with naturally reproducing trout populations, a passby flow of 25 % of average daily flow will be maintained downstream from the point of withdrawal whenever withdrawals are made;

2) On all streams not covered in Item 1 above and which are not degraded by acid mine drainage, a passby flow of 20 % of average daily flow will be maintained downstream from the point of withdrawal whenever withdrawals are made. These streams generally include both trout stocking and warm-water fishery uses;

3) On all streams partially impaired by acid mine drainage, but in which some aquatic life exists, a passby flow of 15 % of ADF will be maintained downstream from the point of withdrawal whenever withdrawals are made;

4) Under no conditions shall the passby flow be less than the Q7-10 flow; and

5) The SRBC is currently reevaluating the passby requirements described above and draft changes will likely be proposed sometime in 2011.

[428] Water classifications referenced in this section are those established by State of PA which are not equivalent to NYS stream classifications.

*Protecting Stream Flows - NFRM*

The NFRM is an alternative to the current DRBC and SRBC methods and establishes a passby flow designed to avoid significant adverse environmental impacts from withdrawals for high-volume hydraulic fracturing; specifically impacts associated with: degradation of a stream's best use and reduced stream flow including impacts to aquatic habitat and aquatic ecosystems. The Department proposes to require the NFRM as a permit condition and mitigation measure to ensure that water withdrawals, including those from the Delaware and Susquehanna River basins, in connection with high-volume hydraulic fracturing do not result in any significant adverse environmental impacts.

To assure adequate surface water flow when water withdrawals are made, provisions would be required to be made to provide for a passby flow in the stream, as defined above. In general, when streamflow data exist for the proposed withdrawal location, the passby flow is calculated for each month of the year using monthly flow exceedance values. Monthly flow exceedance value describes the percentage probability that the calculated streamflow statistic will be exceeded at any time during the month. For example, the Q60 monthly flow exceedance value is the calculated instantaneous flow that will be exceeded 60% of the time during a specific month. As described below, appropriate flow exceedance values will vary by month and will depend on the watershed size upstream from the water withdrawal.

The purpose of the NFRM is to provide seasonally adjusted instream flows that maintain the natural formative processes of the stream while requiring only minimal to moderate effort to calculate. Once adequate streamflow records are obtained, flow exceedance values are easily calculated. The foundation of the NFRM is based on the New England Aquatic Baseflow Standard.[429] Commonly referred to as the ABF, or New England Flow Policy, this method is a component of the broader U.S. Fish and Wildlife Service's New England Flow Policy. The basic assumption of the method is that varying flows based on monthly flow exceedance values are appropriate for maintaining differing levels of habitat quality within the stream and that the time periods for providing different levels of flow are appropriate based on life stage needs of the aquatic biota. Natural hydrologic variability is used as a surrogate for biological, habitat, and use

[429] Larsen, 1981.

parameters including: depth, width, velocity, substrate, side channels, bars and islands, cover, migration, temperature, invertebrates, fishing and floating, and aesthetics.

The objective of the NFRM is to retain naturalized annual stream flow patterns (hydrographs) and otherwise, avoid non-naturalized flows that may degrade stream conditions and result in adverse impacts.[430] Native aquatic species possess life history traits that enable individuals to survive and reproduce within a certain range of environmental variation. Changes in channel morphology and aquatic habitat that exceed this range of variation will result in community shifts that are detrimental to the native aquatic ecosystem. Flow depth and velocity, water temperature, substrate size distribution and oxygen content are among the myriad of environmental attributes known to shape the habitat that control aquatic and riparian species distributions. Fluvial processes maintain a dynamic mosaic of aquatic habitat structures which create environmental factors that sustain diverse biotic assemblage; therefore, maintaining a natural flow regime is recognized as a primary driving force within riverine ecosystems. The survival of native species and natural communities is reduced if environment flows are pushed outside the range of their natural variability due to the resultant shifts in community structure. The NFRM manages our natural aquatic resources within their range of natural variability that maintains diverse, resilient, productive, and healthy ecosystems. The result is that passby flows calculated under this method emulate the natural hydrograph, including flushing flows that define and maintain the stream habitat suitable for aquatic biota. Research by Estes[431] and Reiser et al.[432] supports the need for these channel-maintaining flows.

There are limitations associated with the NFRM that must be considered, as it assumes a relationship to the stream biology. Data on historic stream flows must be of a sufficient duration and quality to represent the natural flow regimes of the stream[433] as prescriptions for passby flows are only as good as the hydrologic records on which they are based. Beyond concerns over the quality of available hydrologic data, data that are not based on natural flow conditions (e.g.,

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[430] IFC, 2004.

[431] Estes, 1984.

[432] Reiser, et al., 1988.

[433] Estes, 1998.

releases from dams) will influence the calculation of passby flows and may not support fishery management objectives.

## A. PASSBY FLOW METHODOLOGY: GENERAL CASE

Watersheds and associated waterways each have distinctive natural flow patterns with variable magnitude, duration, timing, and rate of change of flow rates and water levels. The NFRM preserves the inherent intra-annual variability associated with a natural flow pattern through the use of Q75 and/or Q60 monthly exceedance values for establishing passby flows as described below. The specific flow exceedance values of Q75 and Q60 were selected by Department staff using best professional judgment, based on research conducted by the State of Michigan (Zorn et al. 2008). The scientific framework for the Michigan work is the relationship between streamflow reductions and projected impact on resident fish populations. Regulatory decisions in Michigan regarding surface or groundwater withdrawals are designed to avoid an adverse resource impact to local stream ecosystems. Although Michigan methods vary from those described here, Michigan's requirements equate to flow exceedance values of approximately Q75 and Q60.

Waterways with substantial artificial alteration of stream flow by dams, weirs, bypasses, diversions, and water withdrawals or augmentation are different from waterways without manmade modifications to flow. As such, methods for determining appropriate passby flows are different for water bodies with "altered flow" and for water bodies with "natural flow." The instream flow requirements would be calculated in accordance with the methods described in the following sections depending on whether the flow is natural or altered, and gaged or ungaged.

### 1. Waterways with "Natural Flow"

Waterways that are not subject to substantial artificial modification of stream flow by dams, weirs, bypasses, diversions, and water withdrawals or augmentation would be considered to have "natural flow". The method for computing the passby flows at a specific project site depends on whether the project is located on a gaged or an ungaged waterway, as described below.

<u>Gaged Waterways</u> - If the proposed water withdrawal project location is on a waterway with a USGS streamflow gage, and if the project site's drainage area is between 50 and 200% of the

drainage area of the stream at the reference gage, a weighted flow exceedance estimate for the project site can be computed by using the drainage area ratio method. Streamflow statistics for a given month are estimated by:

$$Q_p = (A_p/A_g) \times Q_g$$

where $Q_p$ is the flow exceedance value at the project site, $Q_g$ is the flow exceedance value at the reference stream gage, $A_p$ is the drainage area above the project site, and $A_g$ is the drainage area above the reference stream gage. This equation assumes that the streamflow per unit area at the project site and reference gage are equal for any given month. Watershed drainage areas can be determined using the USGS StreamStats tool accessible at http://water.usgs.gov/osw/streamstats/ssonline.html.

Passby flows in gaged waterways with natural flow would be maintained such that:

a. when the watershed drainage area upstream from the water withdrawal location is greater than 50 square miles, the monthly passby flows would equal the monthly Q75 flow for the months of October through June and Q60 for the months of July through September; or

b. when the watershed drainage area upstream from the water withdrawal location is less than 50 square miles, the monthly passby flows would equal the monthly Q60 flow.

If the proposed water withdrawal project site is on a gaged stream but the site's drainage area is not between 50 and 200% of the drainage area of the stream at the gage, the passby flow should use the higher of the exceedance value estimates determined from either the reference gage in the watershed or the regional regression equation for ungaged waterways described below.

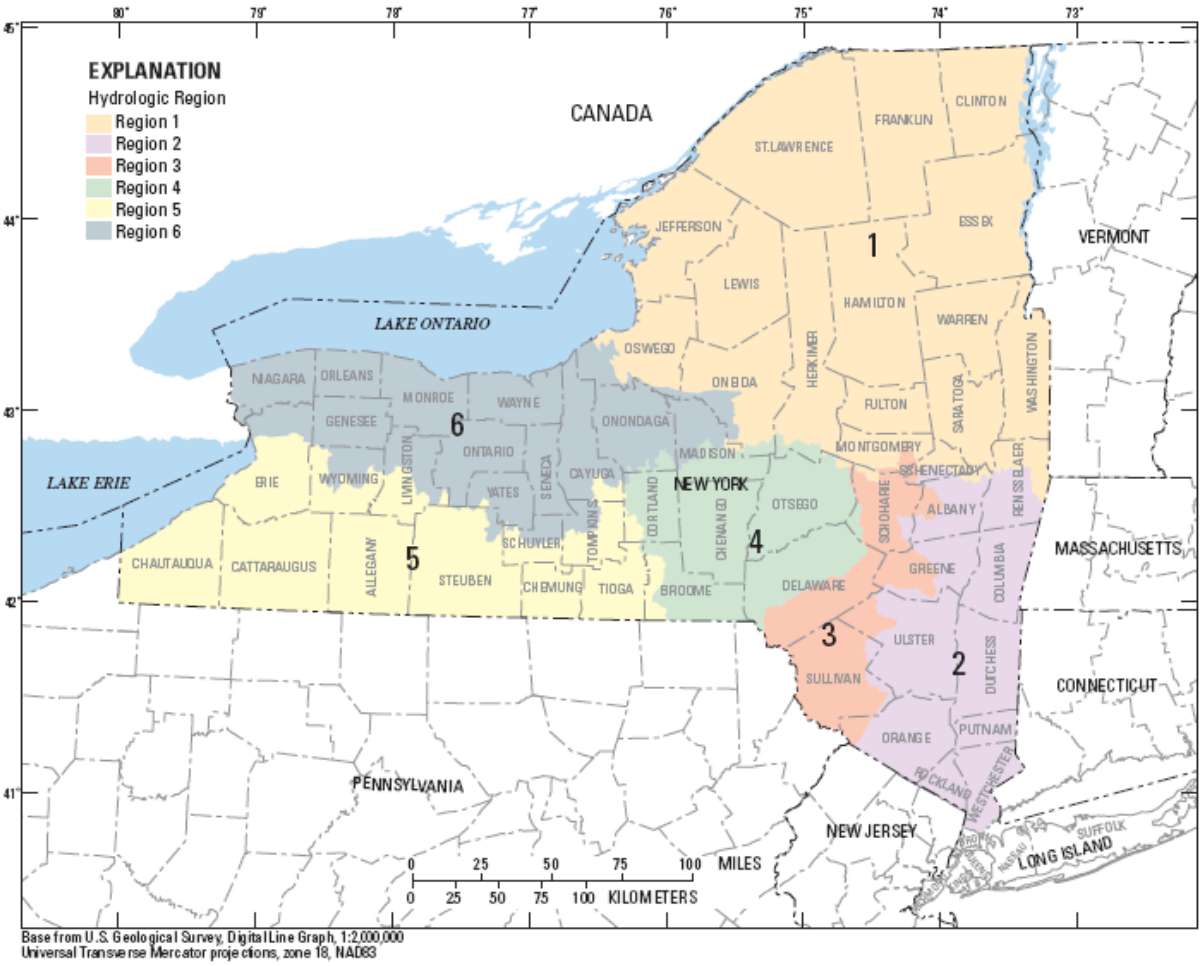
Ungaged Waterways - If the proposed water withdrawal project site is on a waterway that does not have an acceptable USGS streamflow gage as described above, passby flows can be determined using a regression analysis described in Department guidance documents.[434,435] Regression equations for estimating monthly flow exceedance values based on watershed areas

[434] DFWMR 2010.

[435] DFWMR 2010.

have been established for six hydrologic regions across New York State (Figure 7.1).[436] Monthly passby flows, in cubic feet per second (cfs), can be calculated for project sites on ungaged waterways by multiplying the upstream drainage area by the appropriate regional coefficient from Table 7.2, below. These coefficients reflect the same principles described in paragraphs 1.a and b, directly above. If the upstream drainage area lies entirely within a single hydrologic region, the calculation is straightforward. If, however, the drainage area extends into multiple hydrologic regions, flows would be calculated based on the percentage that lies within each hydrologic region. The resulting passby flow is the weighted sum of the values derived from each hydrologic region within the entire upstream drainage area.

Figure 7.1 - Hydrologic Regions of New York (New July 2011) (Taken from Lumia et al, 2006)




[436] Lumia et al. 2006.

Table 7.2 - Regional Passby Flow Coefficients (cfs/sq. mi.) (Updated August 2011)

| REGION | Drainage Area (mi²) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adirondack | < 50 mi² | 1.17 | 1.02 | 1.54 | 3.19 | 1.75 | 0.99 | 0.64 | 0.48 | 0.47 | 0.83 | 1.36 | 1.32 |
| | > 50 mi² | 0.97 | 0.86 | 1.19 | 2.57 | 1.39 | 0.76 | 0.64 | 0.48 | 0.47 | 0.64 | 1.07 | 1.09 |
| Lower Hudson | < 50 mi² | 1.30 | 1.27 | 1.97 | 1.99 | 1.21 | 0.62 | 0.36 | 0.24 | 0.20 | 0.41 | 0.89 | 1.48 |
| | > 50 mi² | 0.97 | 0.90 | 1.57 | 1.58 | 0.94 | 0.47 | 0.36 | 0.24 | 0.20 | 0.25 | 0.64 | 1.09 |
| Catskill | < 50 mi² | 1.23 | 1.07 | 1.93 | 2.57 | 1.48 | 0.77 | 0.44 | 0.28 | 0.32 | 0.61 | 1.51 | 1.63 |
| | > 50 mi² | 0.93 | 0.81 | 1.37 | 2.04 | 1.15 | 0.56 | 0.44 | 0.28 | 0.32 | 0.40 | 0.94 | 1.21 |
| Susquehanna | < 50 mi² | 1.23 | 1.11 | 1.94 | 2.28 | 1.09 | 0.55 | 0.35 | 0.23 | 0.22 | 0.39 | 1.00 | 1.49 |
| | > 50 mi² | 0.94 | 0.84 | 1.49 | 1.85 | 0.81 | 0.42 | 0.35 | 0.23 | 0.22 | 0.27 | 0.64 | 1.15 |
| Southern Tier | < 50 mi² | 1.02 | 0.92 | 1.77 | 2.07 | 0.85 | 0.42 | 0.29 | 0.21 | 0.20 | 0.40 | 0.85 | 1.33 |
| | > 50 mi² | 0.66 | 0.50 | 1.34 | 1.49 | 0.67 | 0.32 | 0.29 | 0.21 | 0.20 | 0.28 | 0.44 | 0.99 |
| Lake Plains | < 50 mi² | 0.93 | 1.00 | 1.66 | 1.46 | 0.69 | 0.34 | 0.22 | 0.17 | 0.17 | 0.25 | 0.52 | 1.01 |
| | > 50 mi² | 0.68 | 0.75 | 1.20 | 1.13 | 0.55 | 0.28 | 0.22 | 0.17 | 0.17 | 0.18 | 0.31 | 0.69 |

The passby flow requirement described above, if imposed via permit condition and/or regulation, would fully mitigate any potential significant adverse impact from water withdrawals associated with high-volume hydraulic fracturing in “Natural Flow” waterways.

2. Waterways with “Altered Flow”

Waterways would be considered to have “altered flow” if more than 25 % of the drainage area above a proposed project is upstream of a dam, weir, bypass, diversion, or other controlled artificial flow modification.[3] Watershed drainage areas can be determined using the USGS StreamStats tool accessible at http://water.usgs.gov/osw/streamstats/ssonline.html. Passby flows within altered waterways would be determined on a case-by-case basis using Department staff’s best professional judgment. Wherever possible, passby flows in altered waterways will provide flow patterns that emulate the annual flow hydrograph that would occur in the absence of all artificial flow alterations. The passby flow requirement, if imposed via permit condition and/or regulation, would mitigate any potential significant adverse impact from water withdrawals associated with high-volume hydraulic fracturing in “Altered Flow” waterways.

## B. ALTERNATIVE PASSBY FLOWS

Alternative passby flows for water withdrawals associated with high-volume hydraulic fracturing that differ from those determined using the methodology described above may be approved on a case-by-case basis to protect endangered or threatened species in accordance with 6 NYCRR Part 182.

### *Protecting Other Surface Waters*

As previously discussed in Chapter 6, water withdrawals from surface water bodies can have a direct impact upon aquatic habitats and other water users by the reduction of water volumes and levels. Smaller water bodies will see the greatest visible impact but even small level changes to large water bodies can sometimes be detrimental. A "safe or dependable" yield analysis is typically conducted for public water supplies to ensure the availability of water during extended drought conditions while also considering potential environmental impacts. Parameters such as stream inflow, usable storage volume, existing withdrawals, evaporation and precipitation amounts during prolonged drought periods arc used to calculate the amount of water that can be expected to be available for additional withdrawals. This same methodology can be applied to all types of withdrawals, including those to be used for hydraulic fracturing purposes. The key difference between public water supply and withdrawals for hydraulic fracturing is timing. Public water supplies typically require that a source be available at all times while other uses such as hydraulic fracturing may have the flexibility to limit their water withdrawals to times when surplus water is available.

### *Evaluation of Withdrawals from Surface Water Bodies*

All withdrawals from surface water bodies will be evaluated to determine the impacts upon water quantity and level changes during extended drought conditions. The Department intends to require permittees to evaluate surface water bodies using the following equation:

$$\Delta V = I + P - W - E - R$$

Where $\Delta V$ = maximum change in storage, I = inflow into water body, P = precipitation onto water surface, W = existing and proposed water withdrawals, E = evaporation from water

surface, and R = releases from water body. In some cases such as ponds, factors such as R may equal zero. The resulting maximum change in storage value (ΔV) shall be used to compute corresponding maximum water-level drawdowns. Site-specific SEQRA reviews should be conducted for withdrawals from ponds and lakes. Acceptable drawdown levels will be determined by Department on a case by case basis.

In accordance with the Department's Pump Test Recommendations, wetlands located within 500 feet of a proposed water withdrawal require monitoring during the pump test. Lowering of groundwater levels at or below a wetland is considered to be a significant impact.

#### *7.1.1.5 Impact Mitigation Measures for Groundwater Withdrawals*

The Department's DOW Recommended Pump Test Procedures for Water Supply Applications (http://www.dcc.ny.gov/lands/5003.html) will be used to evaluate proposed groundwater withdrawals for high-volume hydraulic fracturing.

As stated in the testing guidance, test results will be analyzed to evaluate:

- Impacts on neighboring water supplies

  Neighboring water supplies could be impacted if pumping of wells for Marcellus drilling requirements results in significant drawdown at offsite supplies. Site specific SEQRA reviews should be conducted for withdrawals from groundwater within 500 feet of private wells.

- Affects to the local groundwater basin

  The local groundwater basin can be similarly impacted resulting in lowering of groundwater levels. The range of impacts could vary from a lowering of water levels to a lowering of water levels to below pump intakes or to complete dewatering of wells.

- Impact on wetlands

  Impacts to water levels in wetlands could result in degradation of habitat. Site-specific SEQRA reviews should be conducted for withdrawals within 500 feet of wetlands if pump test results show the withdrawal could have an influence on the wetland.

- Well Capability

  Test results will establish the maximum pumping rate of the well independent of impacts.

- Surface water impacts (passby flows)

  Passby flows are required to:

  - protect aquatic resources,
  - protect competing users,
  - protect instream flow uses,
  - limit adverse lowering of streamflow levels downstream of the point of withdrawal.

The Department proposes to impose requirements regarding passby flows as stated in this document. With those mitigation measures in place there would be no significant adverse impacts from water withdrawals made in connection with high-volume hydraulic fracturing and associated horizontal drilling.

#### *7.1.1.6 Cumulative Water Withdrawal Impacts*

The SRBC (February, 2009) stated that "the cumulative impact of consumptive use by this new activity (natural gas development), while significant, appears to be manageable with the mitigation standards currently in place." The extent of the gas-producing shales in New York extends beyond the jurisdictional boundaries of the SRBC and the DRBC. New York State regulations do not currently address water quantity issues in a manner consistent with those applicable within the Susquehanna and Delaware River Basins with respect to controlling, evaluating, and monitoring surface water and ground water withdrawals for shale gas development. The application of the NFRM to all water withdrawals to support the subject hydraulic fracturing operations would comprehensively address cumulative impacts on stream flows because it will ensure a specified minimum passby flow, regardless of the number of water withdrawals taking place at one time. Accordingly, significant adverse cumulative impacts would be addressed by the NFRM described above because each operator of a permitted surface water withdrawal would be required, via permit condition and/or regulation, to estimate or report the maximum withdrawal rate and measure the actual passby flow for any period of withdrawal.

### *7.1.2 Stormwater*

The principal control mechanism to mitigate potential significant adverse impacts from stormwater runoff is to require the development, implementation and maintenance of Comprehensive SWPPPs. SWPPPs address the often significant impacts of erosion, sedimentation, peak flow increase, contaminated discharge and nutrient pollution that is associated with industrial activity, including construction of well pads that would be required for high-volume hydraulic fracturing. This is commonly required through the administration of the Department's SPDES permits (individual or general) for stormwater runoff, which require operators to develop, implement and maintain up-to-date SWPPPs. To assist this effort, the Department has produced technical criteria for the planning, construction, operation and maintenance of stormwater control practices and procedures, including temporary, permanent, structural and non-structural measures. A successful Comprehensive SWPPP employs engineering concepts aimed at preventing erosion and maintaining post-development runoff characteristics in roughly the same manner as the pre-development condition. Many adverse impacts can be avoided by planning a development to fit site characteristics, like avoiding steep slopes and maintaining sufficient separation from environmentally sensitive features, such as streams and wetlands. Another basic principle is to divert uncontaminated water away from excavated or disturbed areas. In addition, limiting the amount of soil exposed at any one time, stabilizing disturbed areas as soon as possible, and following equipment maintenance, rapid spill cleanup and other basic good housekeeping measures will act to minimize potential impacts. Lastly, measures to treat stormwater and control runoff rates are described in the SWPPP.

A Comprehensive SWPPP that is well developed, implemented, maintained and adapted to changing circumstances in strict compliance with the Department's permit conditions and associated technical standards should act to heighten the beneficial aspects of stormwater runoff while minimizing its potential deleterious impacts.

The Department has determined that natural gas well development using high-volume hydraulic fracturing would require a SPDES permit to address stormwater runoff, erosion and sedimentation. The SPDES permit will address both the construction of well pads and access roads and any associated soil disturbance, as well as provisions to address surface activities associated with high-volume hydraulic fracturing for natural gas development. Additionally,

during the production of natural gas, the Department will require coverage under the SPDES permit to remain in effect and/or compliance with regulations. The Department proposes to require SPDES permit conditions, a Comprehensive SWPPP, and both structural and non-structural Best Management Practices (BMPs) to minimize or eliminate pollutants in stormwater. The Department is proposing the use of a SPDES general permit for high-volume hydraulic fracturing (HVHF GP), but the Department proposes to use the same requirements in other SPDES permits should the HVHF GP not be issued. The Department proposes to publish the proposed HVHF GP for public review and comment simultaneously with the formal public comment period on this document. A summary of the SPDES permit conditions follows.

Activities which are exposed to stormwater which will potentially take place during the development of a well pad may include:

- Well Drilling and Hydraulic Fracturing;
- Vehicle and Equipment Storage/Maintenance;
- Vehicle and Equipment Cleaning;
- Fueling;
- Material and Chemical Storage;
- Chemical Mixing, Material Handling, Loading/Unloading;
- Fuel/Chemical Storage Areas;
- Lumber Storage or Processing; and
- Cement Mixing.

Proposed required BMPs include, but not limited to, a combination of some or all of the following, or other equally protective practices:

- Identification of a spill response team and employee training on proper spill prevention and response techniques;
- Inspection and preventive maintenance protocols for the tank(s) and fueling area;

- Procedures for notifying appropriate authorities in the event of a spill or significant pit failure;
- Procedures for immediately stopping the source of the spill and containing the liquid until cleanup is complete;
- Ready availability of appropriate spill containment and clean-up materials and equipment, including oil-containment booms and absorbent material;
- Disposal of cleanup materials in the same manner as the spilled material;
- Use of dry cleanup methods and non-use of emulsifiers or dispersants;
- Protocols for checking/testing stormwater in containment area prior to discharge;
- Conducting tank filling operations under a roof or canopy where possible, with the covering extending beyond the spill containment pad to prevent rain from entering;
- Use of drip pans where leaks or spills could occur during tank filling operations and where making and breaking hose connections;
- Use of fueling hoses with check valves to prevent hose drainage after spilling;
- Use of spill and overflow protection devices;
- Use of diversion dikes, berms, curbing, grading or other equivalent measures to minimize or eliminate run-on into tank filling areas;
- Use of curbing or posts around the fuel tank to prevent collisions during vehicle ingress and egress;
- Availability of a manual shutoff valve on the fueling vehicle;
- Inspection and preventive maintenance protocols for the pit walls and liner;
- Procedures for immediately repairing the pit or liner and containing any released liquid until cleanup is complete;
- Location of additive containers and transport, mixing and pumping equipment as follows:
    - within secondary containment;
    - away from high traffic areas;
    - as far as is practical from surface waters;

- not in contact with soil or standing water; and
- product and hazard labels not exposed to weathering.

- Inspection and preventative maintenance protocols for containers, pumping systems and piping systems, including manned monitoring points during additive transfer, mixing and pumping activities;
- Protocols for ensuring that incompatible materials such as acids and bases are not held within the same containment area;
- Maintenance of a running inventory of additive products present and used on-site;
- Use of drip pads or pans where additives and fracturing fluid are transferred from containers to the blending unit, from the blending unit to the pumping equipment and from the pumping equipment to the well;
- Location of tanks within secondary containment, away from high traffic areas and as far as is practical from surface waters; and
- Maintenance of a running inventory of flowback water and production brine recovered, present on site, and removed from the site.

As discussed below, the Department is proposing a method to terminate the application of the SPDES permit upon Partial Site Reclamation in the manner presented in the HVHF GP or otherwise by the Department. With the proposed SPDES permit conditions in place for construction activities and high-volume hydraulic fracturing, as well as permit conditions and/or regulations for gas production, any potential significant adverse impacts from stormwater discharges associated with high-volume hydraulic fracturing would be reduced for most locations.

#### *7.1.2.1 Construction Activities*

In order to facilitate the SPDES permitting process for activities addressed by this Supplement, the Department proposes to utilize the requirements in the SPDES General Permit for Stormwater Discharges from Construction Activities, GP-0-10-001 (Construction General Permit), effective January 29, 2010. A Construction SWPPP, meeting or exceeding the requirements of the Construction General Permit, would be required to be developed as a stand-alone document, but will also constitute part of the Comprehensive SWPPP. The Construction SWPPP would address all phases and elements of the construction activity, including all land

clearing and access road and well pad construction. The Construction SWPPP would be required to be prepared in accordance with good engineering practices and Department's Construction General Permit.

A copy of the Construction SWPPP would be required to be kept on site and available to Department inspectors while SPDES permit coverage is in effect. Particular monitoring, inspections and recordkeeping requirements associated with the construction activity will be initiated upon commencement of construction activities and continue until completion of the construction project.

#### *7.1.2.2 Industrial Activities*

The SPDES permit will require development of a high-volume hydraulic fracturing SWPPP that will be a stand-alone document, but will also constitute part of the Comprehensive SWPPP. The high-volume hydraulic fracturing SWPPP would address potential sources of pollution which may reasonably be expected to affect the quality of stormwater discharges associated with high-volume hydraulic fracturing operations. The Department will require implementation of BMPs that are to be used to reduce the pollutants in stormwater discharges associated with high-volume hydraulic fracturing and to ensure compliance with the terms and conditions of the SPDES permit. Structural, non-structural and other BMPs would have to be considered in the high-volume hydraulic fracturing SWPPP. Structural BMPs include features such as dikes, swales, diversions, drains, traps, silt fences and vegetative buffers. Non-structural BMPs include good housekeeping, sheltering activities to minimize exposure to precipitation to the extent practicable, preventative maintenance, spill prevention and response procedures, routine facility inspections, employee training and use of designated vehicle and equipment storage or maintenance areas with adequate stormwater controls. Particular monitoring, inspections and recordkeeping associated with high-volume hydraulic fracturing would be initiated upon completion of the construction project and continue until coverage under the SPDES permit has been appropriately terminated. Monitoring, inspections and reporting for high-volume hydraulic fracturing will address visual monitoring, dry weather flow inspections, and benchmark monitoring and analysis. Sites active for less than one year would be required to satisfy all annual reporting requirements within the period of activity.

The proposed high-volume hydraulic fracturing SWPPP will apply during all hydraulic fracturing and flowback operations at a well pad and until such time as coverage under the HVHF GP is appropriately terminated. A copy of the high-volume hydraulic fracturing SWPPP must be kept on site and available to Department inspectors while SPDES permit coverage is in effect. SPDES permit coverage may be terminated upon completion of all drilling and hydraulic fracturing operations, fracturing flowback operations and partial site reclamation in a manner specified by the Department. Partial site reclamation has occurred when a Department inspector determines that drilling and fracturing equipment have been removed, the pit or pits used for those operations have been reclaimed, and surface disturbances or surface parking or storage structures not necessary for production activities have been re-graded and seeded, vegetation cover re-established, and post-construction management practices are fully operational. Operators may, however, elect to maintain coverage under the SPDES permit after partial site reclamation if they so choose.

#### *7.1.2.3 Production Activities*

As part of a permit and/or in regulation, the Department proposes to require the owner/operator of the high-volume hydraulic fracturing operation to address potential sources of pollution which may reasonably be expected to affect the quality of stormwater discharges associated with the production phase. The Department will require implementation of BMPs that are to be used to reduce the pollutants in stormwater discharges associated with the production of gas resulting from high-volume hydraulic fracturing and to ensure compliance with the terms and conditions of the appropriate permit and/or regulation. Structural, nonstructural and other BMPs will be incorporated into a permit and/or regulation.

Particular monitoring, inspections and recordkeeping associated with the high-volume hydraulic fracturing will be include in the permit and/or regulation and initiated once coverage under the SPDES permit has been appropriately terminated.

### *7.1.3 Surface Spills and Releases at the Well Pad*

A combination of existing Department engineering controls and management practices, enhanced as necessary to address unique aspects of multi-well pad development and high-volume hydraulic fracturing, would be required in appropriate permits to prevent spills and

mitigate adverse impacts from any that do occur. This would include disclosure to the Department of fracturing fluid constituents, so that the appropriate remediation measures can be taken if a spill occurs. Activities and materials on the well pad of concern with respect to potential surface and groundwater impacts from unmitigated spills and releases include the following:

- Fueling tank and tank refilling activities;
- Drilling fluids;
- Hydraulic fracturing additives and flowback water;
- Production brine;
- Materials and chemical storage;
- Chemical mixing, material handling, loading/unloading areas;
- Bulk chemical/fluid storage tanks;
- Equipment cleaning;
- On-site waste storage or disposal;
- Vehicle and equipment storage/maintenance areas;
- Piping/conveyances;
- Lumber storage and/or processing areas; and
- Cement mixing/concrete products manufacturing.

The proposed spill prevention and mitigation measures advanced herein reflect consideration of the following information reviewed by Department staff:

- The 1992 GEIS and its Findings;
- GWPC, 2009b;
- Alpha, 2009, regarding:

- a survey of regulations related to natural gas development activities in Pennsylvania, Colorado, New Mexico, Wyoming , Texas (including the City of Fort Worth), West Virginia, Louisiana, Ohio and Arkansas;

- materials handling and transport requirements, including USDOT and NYSDOT regulations, the Department's Bulk Storage Programs and EPA reporting requirements; and

- specific recommendations for minimizing potential liquid chemical spills.

- Guidance documents relative to the Department's Petroleum Bulk Storage Program, including:

  - Spill Prevention Operations Technology Series (SPOTS) 10, Secondary Containment Systems for Aboveground Storage Tanks;[437] and

  - Draft Department Program Policy DER-17.[438]

- SWPPP guidance compiled by the Department's Division of Water; The comprehensive Stormwater Pollution Prevent Plan (SWPPP) that would be required by the Department's proposed HVHF GP will include permit requirements for Good Housekeeping Procedures, Spill Reduction Measures and Structural Best Management Practices to minimize or eliminate pollutants in stormwater for all of the activities listed above;

- US Department of the Interior and US Department of Agriculture, 2007; and

- An industry BMP manual provided to the Department.

#### *7.1.3.1 Fueling Tank and Tank Refilling Activities*

The diesel tank fueling storage associated with the larger rigs described in Chapter 5 may be larger than 10,000 gallons in capacity and may be in one location on a multi-well pad for the length of time required to drill all of the wells on the pad. However, the tank would be removed along with the rig during any drilling hiatus between wells or after all the wells have been drilled. There are no long-term or permanent operations at a drill pad which require an on-site fueling tank. Therefore, the tank is considered non-stationary and is exempt from the Department's petroleum bulk storage regulations and tank registration requirements. The following measures are proposed to be required, via permit condition and/or regulation, to

[437] http://www.dec.ny.gov/docs/remediation_hudson_pdf/spots10.pdf.

[438] http://www.dec.ny.gov/docs/remediation_hudson_pdf/der17.pdf.

minimize or prevent spills. For all wells subject to the SGEIS, supplementary permit conditions for high-volume hydraulic fracturing would include the following requirements with respect to fueling tanks and refilling activities:

a. Secondary containment consistent with the objectives of SPOTS 10 for all fueling tanks.

   The secondary containment system could include one or a combination of the following: dikes, liners, pads, holding ponds, curbs, ditches, sumps, receiving tanks or other equipment capable of containing spilled fuel. Soil that is used for secondary containment would be of such character that a spill into the soil will be readily recoverable and would result in a minimal amount of soil contamination and infiltration. Draft Department Program Policy DER-17[439] may be consulted for permeability criteria for dikes and dike construction standards, including capacity of at least 110% of the tank's volume.

   Implementation of secondary containment and permeability criteria is consistent with GWPC's recommendations;

b. Fueling tanks would not be positioned within 500 feet of a perennial or intermittent stream, storm drain, wetland, lake or pond;

c. Fueling tank filling operations would be manned at the fueling truck and at the tank if the tank is not visible to the fueling operator from the truck; and

d. Troughs, drip pads or drip pans would be required beneath the fill port of the fueling tank during filling operations if the fill port is not within the secondary containment.

#### *7.1.3.2 Drilling Fluids*

The 1992 GEIS describes reserve pits excavated at the well which may contain drill cuttings, drilling fluid, formation water, and flowback water from a single well. As stated in the 1992 GEIS:

> Although the existing regulations do mention clay and hardpan as options in pit construction, the Department has consistently required that all earthen temporary drilling pits be lined with sheets of plastic before they can be used. Clay and hardpan are both low in permeability, but they are not watertight. They are also subject to chemical reaction with some drilling and completion fluids. In addition, the time constraints on drilling operations do not allow adequate time for the percolation tests which should be performed to check the permeability of a clay lined pit. Liners for large pits are usually made from several sheets of plastic

[439] http://www.dec.ny.gov/docs/remediation_hudson_pdf/der17.pdf.

> which should be factory seamed. Careful attention to sealing the seams is extremely important in preventing groundwater contamination; [440]*and:*
>
> Pits for fluids used in the drilling, completion, and re-completion of wells should be constructed, maintained and lined to prevent pollution of surface and subsurface waters and to prevent pit fluids from contacting surface soils or ground water zones. Department field inspectors are of the opinion that adequate maintenance after pit liner installation is more critical to halting pollution than the initial pit liner specifications. Damaged liners must be repaired or replaced promptly. Instead of very detailed requirements in the regulations, the regulatory and enforcement emphasis will be on a general performance standard for initial review of liner-type and on proper liner maintenance.
>
> The type and specifications of the liner proposed by the well drilling applicant will require approval by the DEC Regional Minerals Manager. The acceptability of each proposed pit construction and location should be determined during the pre-site inspection. Any pit site or pit orientation found unacceptable to the Department must be changed as directed by the regional site inspector.[441]

Existing regulations require that pit fluids must be removed within 45 days of cessation of drilling operations (includes stimulation), "unless the department approves an extension based on circumstances beyond the operator's control. The department may also approve an extension if the fluid is to be used in subsequent operations according to the submitted plan, and the department has inspected and approved the storage facilities."[442]

Within primary and principal aquifers, existing permit conditions require that if operations are suspended and the site is left unattended, pit fluids must be removed from the site immediately.[443] After the cessation of drilling and/or stimulation operations, pit fluids must be removed within seven days.

Recommended 1992 GEIS specifications, and the ultimate decision to use a site and performance-based standard rather than detailed specifications, were largely based upon the short duration of a pit's use. Pits used for more than one well, as would be the case for high-volume

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[440] NYSDEC 1992, GEIS, p. 9-32.

[441] NYSDEC, 1992, GEIS p. FGEIS48.

[442] 6 NYCRR §554.(1)(c)(3).

[443] Freshwater Aquifer Supplementary Permit Conditions, www.dec.ny.gov/energy/42714.html.

hydraulic fracturing, would be used for a longer period of time. "The containment of fluids within a pit is the most critical element in the prevention of shallow ground water contamination."[444] Specifications more stringent than those proposed in the 1992 GEIS which relate to durability and longer duration of use are appropriate, and are consistent with GWPC's recommendations (Section 5.18.1.2). Additional protection would be provided by the requirement for a SWPPP and by measuring proposed setbacks from the edge of the well pad instead of from the well.

The following measures are proposed to be required to mitigate the potential for releases associated with any on-site reserve pit:

1) The EAF Addendum would require information about the planned location, construction and capacity of the reserve pit. The Department would not approve reserve pits on the filled portion of cut-and-fill sites; and

2) Supplementary permit conditions for multi-well pad high-volume hydraulic fracturing would include the following requirements:

    a. Diversion of surface water and stormwater runoff away from the pit;

    b. Flowback water would be prohibited from being directed to or stored in any on-site pit;

    c. Pit volume limit of 250,000 gallons, or 500,000 gallons for multiple pits on one tract or related tracts of land;

    d. Beveled walls (45 degrees or less) for pits constructed in unconsolidated materials;

    e. Sidewalls and bottoms free of objects capable of puncturing and ripping the liner;

    f. Sufficient slack in liner to accommodate stretching;

    g. Minimum 30-mil liner thickness;

    h. Liners installed and seamed in accordance with the manufacturer's specifications, and constructed, coated, or lined with materials that are chemically compatible with the substance (s) stored and the environment;

[444] GWPC, 2009 April, p. 29.

i. Freeboard monitoring and maintenance of 2 feet of freeboard at all times (except freshwater);

j. Fluids removed and pit inspected by a Department inspector prior to additional use if longer than a 45-day gap in use; and

k. Fluids removed and pit reclaimed within 45 days of completing drilling and stimulation operations at last well on pad.

As discussed in Section 7.1.9, the Department proposes, via permit condition and/or regulation, that, reserve pits would not be utilized for on-site management of drilling fluids and the cuttings entrained with the fluids when the cuttings are required to be disposed of at an off-site facility. Under circumstances which require the off-site disposal of cuttings, both the cuttings and all associated drilling fluids would be required to be managed on-site within a closed-loop tank system.

Chapter 5 discusses the required use of the blow-out prevention (BOP) system and Chapter 6 includes potential impacts that could occur as a result of a component failure of the BOP system or if the system is improperly operated. The Department proposes to require, via permit condition and/or regulation, the following requirements:

1. Individual crew member's responsibilities for blowout control would be posted in the doghouse or other appropriate location and each crew member would be made aware of such responsibilities prior to spud of any well being drilled or when another rig is moved on a previously spudded well and/or prior to the commencement of any rig, snubbing unit or coiled tubing unit performing completion work. During all drilling and/or completion operations when a BOP is installed, tested or in use, the operator or operator's designated representative would be present at the wellsite and such person or personnel would have a current well control certification from an accredited training program that is acceptable to the Department (e.g., International Association of Drilling Contractors). Such certification would be available at the wellsite and provided to the Department upon request;

2. Appropriate pressure control procedures and equipment in proper working order would be employed while conducting drilling and/or completion operations including tripping, logging, running casing into the well, and drilling out solid-core stage plugs. Unless otherwise approved by the Department, a snubbing unit and/or coiled tubing unit with a BOP would be used to enter any well with pressure and/or to drill out one or more solid-core stage plugs; and

3. Pressure testing of the blow-out preventer (BOP) and related equipment for any drilling and/or completion operation would be performed in accordance with the approved BOP use and test plan, and any deviation from the approved plan would be approved by the Department. Testing would be conducted in accordance with American Petroleum Institute (API) Recommended Practice (RP) 53, RP for Blowout Prevention Systems for Drilling Wells, or other procedures approved by the Department.

The aforementioned measures would reduce any significant adverse environmental impacts posed by drilling fluids associated with high-volume hydraulic fracturing.

#### *7.1.3.3 Hydraulic Fracturing Additives*

Chapter 5 describes the USDOT- or UN-approved containers in which hydraulic fracturing additives are delivered and held until they are mixed with water and proppant and pumped into the well, and also describes the length of time that additives are present on the site. Well pad setbacks from water resources described in Section 7.1.11 apply to all locations. Additional protection would be provided by the requirement to measure proposed setbacks from the edge of the well pad instead of from the wellbore. Additional mitigation measures would be implemented as follows to fully mitigate any potential significant adverse impacts from hydraulic fracturing additives:

1) Secondary containment would be required for all fracturing additive containers and additive staging areas. These requirements would be included in supplementary well permit conditions for high-volume hydraulic fracturing.

   Secondary containment measures may include one or a combination of the following; dikes, liners, pads, curbs, sumps, or other structures or equipment capable of containing the substance. Any such secondary containment would be required to be sufficient to contain 110% of the total capacity of the single largest container or tank within a common containment area.

   The Department proposes to require, via permit condition and/or regulation, 1) removal of hydraulic fracturing additives from the site if the site will be unattended and 2) at least two vacuum trucks would be on standby at the wellsite during the pumping of hydraulic fracturing fluid;

2) As described in Part 8.2.1.2, the operator's permit application materials would document its evaluation of alternative additive products that may pose less risk to the environment, including water resources; and

3) Required disclosure to the Department of fracturing fluid additives would ensure that the appropriate steps could be taken if a spill or release did occur. (See Chapter 8 for a discussion of the specific additive information which would be required.)

#### *7.1.3.4 Flowback Water*

The 1992 GEIS addresses use of the on-site reserve pit for flowback water associated with a single well. However, even in the single-well case, potential flowback water volumes associated with high-volume hydraulic fracturing exceed 1992 GEIS descriptions. Estimates provided in Section 5.11.1 are for 216,000 gallons to 2.7 million gallons of flowback water recovered within two to eight weeks of hydraulic fracturing a single well. The volume of flowback water that would require handling and containment on the site is variable and difficult to predict, and data regarding its likely composition are incomplete. Therefore, the Department 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. Even without this requirement, the pit volume limitation proposed above would necessitate that tank storage be available on site. The Department will also continue to encourage exploration of technologies that promote reuse of flowback water when practical. Additional mitigation measures would be implemented as follows:

1) The EAF Addendum would require information about the number, individual and total capacity and location on the well pad of receiving tanks for flowback water;

2) Permit conditions for high-volume hydraulic fracturing would include the following requirements:

    a. Fluids would be removed if there will be a hiatus in site activity longer than 45 days;

    b. Fluids would be removed within 45 days of completing drilling and stimulation operations at last well on pad;

    c. Fluid transfer operations from tanks to tanker trucks would be manned at the truck and at the tank if the tank is not visible to the truck operator from the truck;

    d. Secondary containment for flowback tanks is required; and

    e. At least two vacuum trucks would be on standby at the wellsite during the flowback phase.

#### *7.1.3.5 Primary and Principal Aquifers*

Based on the analysis contained in Section 6.1.3.4, the Department has determined that the activities associated with high-volume hydraulic fracturing pose a risk of causing significant adverse impacts to Primary Aquifers and, therefore, such operations may not be consistent with the long-term protection of Primary Aquifers. The Department finds that standard stormwater control and other mitigation measures may not fully mitigate the risk of potential significant adverse impacts on these water resources from spills or other releases that could occur in connection with high-volume hydraulic fracturing operations.

Therefore, the Department proposes to bar placement of high-volume hydraulic fracturing well pads over Primary Aquifers and an associated 500-foot buffer to provide an adequate margin of safety from the full range of high-volume hydraulic fracturing activities. As defined in TOGS 2.1.3, Primary Aquifers are currently extensively used by major municipalities as a source of drinking water. Contamination of a Primary Aquifer could render a large, concentrated population without drinking water. Replacing a drinking water source of this magnitude would be prohibitive because of exorbitant costs, difficulty in locating alternative water supply sources, and the extensive time needed to implement any alternatives. However, because the mitigation measures that would be imposed through permit conditions and/or regulations may prove effective for preventing uncontained, unmitigated releases that could contaminate Primary Aquifers, this bar will be re-evaluated two years after the commencement of issuance of well permits associated with high-volume hydraulic fracturing operations.

The Department further proposes to require a site-specific SEQRA review for placement of high-volume hydraulic fracturing well pads that are proposed to be located over Principal Aquifers or within a 500-foot buffer, as well as an individualized SPDES stormwater permit. As defined in TOGS 2.1.3 and explained in Chapters 2 and 6, Principal Aquifers are currently not intensively used by major municipalities as a source of drinking water, as compared to Primary Aquifers. However, contamination of a Principal Aquifer could still render a large population without water. Because mitigation measures that would be imposed through permit conditions and/or regulations may prove effective for preventing uncontained, unmitigated releases that could contaminate Principal Aquifers, this proposed requirement will be re-evaluated in two years after the commencement of issuance of well permits for high-volume hydraulic fracturing operations.

It is important to note that although the percentage of land in New York designated as a Primary and Principal Aquifer appears significant, due to the fact that wells can be drilled horizontally, well pads placed outside the boundary of a Primary and Principal Aquifer area may still allow for access to natural gas reserves underlying the significant majority of the area beneath Primary and Principal Aquifers. For example, assuming both a 500-foot buffer from the edge of a Primary and Principal Aquifer and the capacity to drill a 3,500-foot horizontal leg, and also assuming lease rights, surface access rights and lack of other siting restrictions, less than 1% of the area where the Marcellus Shale is deeper than 2,000 feet below ground surface and also beneath Primary or Principal Aquifers would be made at least potentially inaccessible for the extraction of natural gas by high-volume hydraulic fracturing.

*Summary*

The Department committed to evaluate the mitigation measures to determine whether they are sufficient to protect primary and principal aquifers, which are described in Chapters 2 and 6 of this Supplement and in the 1992 GEIS, the Department would implement the following restrictions until at least two years after issuance of the first permit for high-volume hydraulic fracturing:

1) No well pads would be approved within 500 feet of primary aquifers; and

2) A site-specific SEQRA review and determination of significance, and a site-specific SPDES permit, would be required for any proposed well pad within 500 feet of a principal aquifer.

Two years after issuance of the first permit for high-volume hydraulic fracturing, the Department would re-evaluate the need for these restrictions based on experience with high-volume hydraulic fracturing outside of these restricted areas.

### *7.1.4 Potential Ground Water Impacts Associated With Well Drilling and Construction*

Existing construction and cementing practices and permit conditions to ensure the protection and isolation of fresh water would remain in use, and would be enhanced by Permit Conditions for

high-volume hydraulic fracturing. See Appendices 8, 9 and 10. Based on discussion in Chapters 2 and 6 of this Supplement, along with GWPC's regulatory review,[445] the Department proposes to require the following measures associated with well drilling and construction in order to prevent potential groundwater impacts from these activities:

- Baseline water quality testing of private wells within a specified distance of the proposed well;
- Sufficiency of as-built wellbore construction prior to high-volume hydraulic fracturing, including:
    - Adequacy of surface casing to protect fresh water and to isolate potable fresh water supplies from deeper gas-bearing zones;
    - Adequacy of cement in the annular space around the surface casing;
    - Adequacy of cement in the annular space around the intermediate casing;
    - Adequacy of cement on production casing to prevent upward migration of fluids; including gas, during hydraulic fracturing and production conditions;
    - Use of centralizers to ensure that the cement sheath surrounds the casing strings, including the first joint of surface and intermediate casings; and
    - The opportunity for state regulators to witness cementing operations; and
- Prevention of pressure build-up at the surface casing seat and in the annular space between the surface casing and intermediate casing.

The proposed well construction-related requirements advanced herein reflect consideration of the following information and sources:

- The 1992 GEIS and its Findings;
- The Department's existing required casing and cementing practices (Appendix 8);
- The Department's existing supplementary freshwater aquifer permit conditions (Appendix 9);

[445] GWPC, 2009 May.

- Harrison, 1984, with respect to the importance of maintaining the surface-production casing annulus in a non-pressurized condition (a preventative measure which has been implemented as part of the Department's required casing and cementing practices since at least 1985);

- Commissioner's Decision, 1985, regarding well casing cement and the requirement to maintain an open annulus to prevent gas migration into aquifers;

- API, regarding:

    - Specification 5CT, Specifications for Casing and Tubing (April 2002);

    - Recommended Practice (RP) 5A3, RP on Thread Compounds for Casing, Tubing, Line Pipe, and Drill Stem Elements (November 2009);

    - RP 10D-2, RP for Centralizer Placement and Stop Collar Testing (August 2004);

    - Specification 10A, Specifications for Cement and Material for Well Cementing (April 2002 and January 2005 Addendum);

    - Guidance Document, HF1, Hydraulic Fracturing Operations - Well Construction and Integrity Guidelines (October 2009); and

    - RP 65 – Part 2, Isolating Potential Flow Zones During Well Construction (May 2010).

- Pennsylvania Environmental Quality Board, Title 25-Environmental Protection, Chapter 78, Oil and Gas Wells, Pennsylvania Bulletin, Vol. 41, No. 6 (February 5, 2011);

- Ohio Department of Natural Resources, 2008, regarding permit conditions developed to prevent over-pressurized conditions in the surface-production casing annulus;

- GWPC, 2009b, well construction recommendations;

- NYSDOH Recommended Residential Water Quality Testing, Individual Water Supply Wells Fact Sheet #3, relative to recommended water quality testing for all wells and recommended additional parameters to test if gas drilling nearby is the reason for water testing;[446]

- NYSDOH recommendations relative to private water well testing dated July 21, 2009, based on review of fracturing fluid constituents and flowback characteristics;

[446] http://www.health.state.ny.us/environmental/water/drinking/part5/append5b/fs3_water_quality.htm, accessed 9/16/09.

- URS, 2009, water well testing recommendations based on review of fracturing fluid constituents and flowback characteristics;
- Alpha, 2009, regarding:
    - water well testing requirements in other states identified through a survey of regulations in 10 other jurisdictions; and
    - previous drilling in aquifers, watersheds and aquifer recharge areas; and
- ICF, 2009a, regarding:
    - water well testing recommendations; and
    - review of hydraulic fracturing design and subsurface fluid mobility.

#### *7.1.4.1 Private Water Well Testing*

The Department proposes to require, via permit condition, that the operator, at its own expense, sample and test all residential water wells within 1,000 feet of the well pad, subject to the property owner's permission, or within 2,000 feet of the well pad if no wells are available for sampling within 1,000 feet either because there are none of record or because the property owner denies permission. The Department would require that results of each test be provided to the property owner within 30 days of the operator's receipt of laboratory results. The Department would further require that the data be available to the Department and local health department upon request for complaint investigation purposes.

*Schedule*

Testing before drilling is recommended as a mitigation measure related to the potential for groundwater contamination because it provides a baseline for comparison in the event that water contamination is suspected. Testing prior to drilling each well at a multi-well pad provides ongoing monitoring between drilling operations, so the requirement would be attached to every well permit that authorizes high-volume hydraulic fracturing. Testing at established intervals after drilling or hydraulic fracturing operations provides opportunities to detect contamination or confirm its absence. If no contamination is detected a year after the last hydraulic fracturing event on the pad, then further routine monitoring should not be necessary. The Department proposes to require, via permit condition the following ongoing monitoring schedule:

- Initial sampling and analysis prior to site disturbance at the first well on the pad, and prior to drilling commencement at additional wells on multi-well pads;

- Sampling and analysis three months after reaching total measured depth (TMD) at any well on the pad if there is a hiatus of longer than three months between reaching TMD and any other milestone on the well pad that would require sampling and analysis; and

- Sampling and analysis three months, six months and one year after hydraulic fracturing operations at each well on the pad.

For multi-well pads where drilling and hydraulic fracturing activity is continuous, to the extent that water well sampling and analysis according to the above schedule would occur more often than every three months, the Department proposes to simplify the protocol so that sampling and analysis occurs at three month intervals until six months after the last well on the pad is hydraulically fractured, with a final round of sampling and analysis one year after the last well on the pad is hydraulically fractured.

More frequent sampling and analysis, or sampling and analysis beyond one year after last hydraulic fracturing operations, may be warranted in response to complaints as described below or for other reasonable cause.

*Parameters*

The NYSDOH recommends testing for the analytes listed in Table 7.3 to aid with determining whether gas drilling may have had an impact on the quality or quantity of a well. This analysis is not intended to constitute a comprehensive evaluation. In the event that a potential impact is determined, additional investigation (e.g., isotopic analysis of methane to determine source or site-specific chemical analysis) may be necessary.

Table 7.3 - NYSDOH Water Well Testing Recommendations
(Revised July 2011 to reflect more recent recommendations from NYSDOH)

| Parameter | Notes |
|---|---|
| Barium | Barium (barite) is a principal component of many drilling muds. In the event that barite is not used in the drilling mud, a substitution should be made for a component that is present in the drilling mud. |
| Chloride | A measure of chloride anions in water. Chlorides and other salts are naturally occurring and can be found in many different geologic zones, but deep groundwater typically contains high levels of chloride. Flowback water contains high levels of chlorides. Therefore, an increase in chlorides may be an indication that drilling has allowed communication between geologic zones and/or flowback water has contaminated an aquifer. |
| Conductivity | A measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol and sugar do not conduct electrical current very well and therefore have a low conductivity when in water. A change in water quality as a result of drilling is expected to affect the conductivity. |
| Gross alpha/beta | Radioactivity is typically elevated in shale relative to other rock types and the Marcellus Shale is especially enriched. Drilling and production of shale may have the ability to mobilize radioactivity towards the surface where it could either concentrate or infiltrate aquifers. These Gross analyses are screening values for defining when to perform more detailed analyses. |
| Iron | Iron is commonly found in many aquifers and may be mobilized during initial drilling activities. |
| Manganese | Manganese is commonly found in many deep and shallow aquifers and may be mobilized during initial drilling activities. |
| Dissolved methane & ethane | Occurs naturally in many aquifers but may also migrate into aquifers as a product of drilling and production. Additional analysis may be necessary to determine the source and/or percentages of dissolved gasses. |
| pH | A measure of how acidic or basic water is. pH is sensitive to small changes in water chemistry such as those that may result from natural gas drilling. |
| Sodium | Sodium is naturally occurring and commonly found in most water. However, sodium is found in high concentrations in deep shale production brines and gas wells. |
| Total dissolved solids (TDS) | A measure of all dissolved organic and inorganic species in water. TDS is useful as an indicator of aesthetic characteristics of drinking water and as an aggregate indicator of the presence of a broad array of chemical contaminants. An increase in TDS may be indicative of drilling operations having introduced contaminants into the water supply. |
| Static water level | Static water level is the level of the water in the well during normal conditions prior to any pumping. This is a measure of the amount of water in the aquifer. Analysis of changes in static water level should carefully consider the well's construction, maintenance and operational history, recent precipitation and use patterns, the season and the effects of competing wells. |
| Volatile organic compounds (VOCs), specifically BTEX | VOCs encompass a number of compounds that are expected to be used extensively during surface operations and would account for water supplies potentially being affected by spills, leaking pits, or other unforeseen incidents. Additionally, certain VOCs are known to exist in shale and are expected to be a contaminant of concern in the event that flowback waters or production brines migrate into an aquifer. |

*Sampling Protocol*

The Department proposes to require that water samples to be collected by a qualified professional and analyzed utilizing a NYSDOH ELAP approved laboratory,[447] including the use of proper sampling and laboratory protocol, in addition to the use of proper sample containers, preservation methods, holding times, chain of custody, analytical methods, and laboratory QA/QC.

The water samples would be representative of the aquifer being produced by the well. Therefore, the well pump should be allowed to run for at least 5 minutes prior to sample collection. The sample should be collected prior to any in home water treatment that may be present. If this is not feasible, the type of treatment that is present on the well survey should be noted. The samples should be collected in appropriate containers, refrigerated, and transported to the laboratory for analysis.

*Recommended Sampling Procedure for Water Supply Wells*

- Select an indoor, leak-free, cold water faucet from which to collect the sample. If treatment (softener, filter, RO, etc.) exists the sample should be collected from an untreated location or the treatment should be bypassed;
- Remove the faucet's aerator or strainer, if one is present;
- Disinfect the faucet by cleaning and flaming the inside of the faucet;
- Let cold water run for 5 minutes;
- Reduce water flow to a stream of water the size of a pencil or smaller;
- Fill sample bottles per method specifications, making sure not the touch the inside of the bottle or cap; and
- Cap bottles, refrigerate, and transport to the laboratory for analysis.

[447] http://www.wadsworth.org/labcert/elap/elap.html, accessed 9/16/09.

*Complaints*

As noted in the 1992 GEIS:

> The diversity of jurisdictions having authority over local water supplies complicates the response to complaints about water supplies, including those complaints that complainants believe are related to oil and gas activity. Water supply complaints occur statewide and take many forms, including taste and turbidity problems, water quantity problems, contamination by salt, gasoline and other chemicals and problems with natural gas in water wells. All of these problems, including natural gas in water supplies, occur statewide and are not restricted to areas with oil and gas development.[448] *and:*
>
> The initial response to water supply complaints is best handled by the appropriate local health office, which has expertise in dealing with water supply problems.[449]

The Department has MOUs in place with several county health departments in western NY whereby the county health department initially investigates a complaint and then refers it to the Department when a problem has been verified and other potential causes have been ruled out. For complaints that occur more than a year after the last hydraulic fracturing operations on a well pad within the radius where baseline sampling occurred (1,000 feet or 2,000 feet), or for complaints regarding water wells that are more than 2,000 feet away from any well pad, the Department proposes to continue following the aforementioned procedure statewide. Complaints would be referred to the county health department, who would refer them back to the Department for investigation when a problem has been verified and other potential causes have been ruled out. Sampling and analysis to verify and evaluate the problem would be according to protocols that are satisfactory to the county health department, with advice from NYSDOH as necessary.

Complaints that occur during active operations at a well pad within 2,000 feet or the radius where baseline sampling occurred, or within a year of last hydraulic fracturing at such a site, should be jointly investigated by the Department and the county health department. Mineral Resources staff would conduct a site inspection, and if a complaint coincides with any of the following documented potentially polluting non-routine well pad incidents, then the Department

[448] NYSDEC, 1992, GEIS, pp. 15-4 et seq.

[449] NYSDEC, 1992, GEIS, p. 15-5.

would consider the need to require immediate cessation of operations, immediate corrective action and/or revisions to subsequent plans and procedures on the same well pad, in addition to any applicable formal enforcement measures:

- Surface chemical spill;
- Fracturing equipment failure;
- Observed leaks in surface equipment onto the ground, into stormwater runoff or into a surface water body;
- Observed pit liner failure;
- Significant lost circulation or fresh water flow below surface casing;
- The presence of brine, gas or oil zones not anticipated in the pre-drilling prognosis;
- Evidence of a gas-cut cement job;
- Anomalous flow or pressure profile during fracturing operations;
- Any non-routine incident listed in ECL §23-0305(8)(h) (i.e., casing and drill pipe failures, casing cement failures, fishing jobs, fires, seepages, blowouts); or
- Any violation of the ECL, its implementing rules and regulations, or any permit condition, including the requirement that the annulus between the surface casing and the next casing string be maintained in a non-pressurized condition; and

The Department and the county health department would share information. All data on file with the county health department relative to the subject water well, including pre-existing conditions and any available information about the well's history of use and maintenance, would be considered in determining the proper course of action with respect to well pad activities. Sub-section 8.2.3 describes the Department's enforcement authority and the enforcement mechanisms available to the Department.

#### *7.1.4.2 Sufficiency of As-Built Wellbore Construction*

Wellbore construction is addressed by the existing 1992 GEIS. While the same concepts apply to wells used for high-volume hydraulic fracturing, some enhancements are proposed because of the high pressures that will be exerted, the large fluid volumes that will be pumped and potential

concentration of the activity in areas without much subsurface well control. Further, recent Marcellus Shale well drilling and completion experience and associated problems in other states were analyzed and considered.

*Surface Casing*

As defined in regulations, the purpose of surface casing is to protect potable fresh water.[450] For oil and gas regulatory purposes, potable fresh water is defined as water containing less than 250 ppm of sodium chloride or 1,000 ppm of total dissolved solids.[451] As stated in Chapter 2, maximum depth of potable water in an area should be determined based on the best available data. This would include water wells and other oil and gas wells in the area, any available local or regional geologic or hydrogeologic reports, and information from the sources listed in Section 7.1.11.1. When information is not available, a depth of 850 feet to the base of potable groundwater is a commonly-used and practical generalization.

Current casing and cementing practices attached as conditions to all oil and gas permits require that:

- Surface casing shall extend at least 75 feet beyond the deepest fresh water zone encountered or 75 feet into bedrock, whichever is deeper, and deeply enough to allow the blow-out preventer stack to contain any formation pressures that may be encountered before the next casing is run;

- Surface casing shall not extend into zones known to contain measurable quantities of shallow gas, and, in the event such a zone is encountered before the fresh water is cased off, the operator shall notify the Department and take Department-approved actions to protect the fresh water zone(s); and

- Surface casing shall consist of new pipe with a mill test of at least 1,000 psi, or used casing that is pressure tested before drilling ahead after cementing; welded pipe must also be pressure tested.

The Department proposes to require, via permit condition and/or regulation, the submission of a *Pre-Frac Checklist and Certification Form* (pre-frac form) to the Department at least 3 days

[450] 6 NYCRR §550.3(au).

[451] 6 NYCRR §550.3(ai).

prior to commencement of high-volume hydraulic fracturing operations. Regarding the surface casing hole, the pre-frac form would:

a. Attest to well construction having been performed in accordance with the well permit or approved revisions,

b. List the depth and estimated flow rates where fresh water, brine, oil and/or gas were encountered or circulation was lost during drilling operations, and

c. Include information about how any lost circulation zones were addressed.

Hydraulic fracturing would not be authorized to proceed without the above information and certification.

*Surface Casing Cement*

Current casing and cementing practices attached as conditions to all oil and gas permits require:

- Cementing by the pump and plug method and circulation to surface;
- Minimum of 25% excess cement pumped, with appropriate lost circulation materials;
- Testing of the mixing water for pH and temperature prior to mixing;
- Cement slurry preparation to the manufacturer's or contractor's specifications to minimize free water in the cement; and
- No casing disturbance after cementing until the cement achieves a calculated compressive strength of 500 psi (e.g., performance chart).

All of the above requirements would remain in effect, and the Department would require the following additional requirements via permit condition and/or regulation:

1) The pre-frac form would be required as described above;

2) Cement would be required to conform to API Specification 10A, Specifications for Cement and Material for Well Cementing (April 2002 and January 2005 Addendum). Further, the cement slurry would be required to be prepared to minimize its free water content in accordance with the same API specification and it would be required to contain a gas-block additive; and

3) A minimum WOC (wait on cement) time of 8 hours before the casing is disturbed in any way, including installation of a blow-out preventer (BOP). The operator may request a

waiver from the Department from the required WOC time if the operator has bench tested the actual cement batch and blend using mix water from the actual source for the job, and determined that 8 hours is not required to reach a compressive strength of 500 psig.

*Intermediate Casing*

Intermediate casing is run in a well after the surface casing but before production hole is drilled. Fully cemented intermediate casing can be necessary in some wells to prevent possible pressurization of the surface casing seat, and to effectively seal the hole below the surface casing to prevent communication between separate hydrocarbon-bearing strata and between hydrocarbon and water-bearing strata. The primary uses of intermediate casing are to 1) provide a means of controlling formation pressures and fluids below the surface casing, 2) seal off problematic zones prior to drilling the production hole and 3) ensure a casing seat of sufficient fracture strength for well control purposes. The intermediate casing's design and setting depth is typically based on various factors including anticipated or encountered geologic characteristics, wellbore conditions and the anticipated formation pressure at total depth of the well. Factors can also include the setting depth of the surface casing, occurrence of shallow gas or flows in the open hole, mud weights used to drill below intermediate casing, and well-control and safety considerations.

Current casing and cementing practices attached as conditions to all oil and gas well drilling permits state that intermediate casing string(s) and cementing requirements will be reviewed and approved by the Department on an individual well basis. The Department proposes to require, via permit condition and/or regulation, that for high-volume hydraulic fracturing the installation of intermediate casing in all wells covered under the SGEIS would be required. However, the Department may grant an exception to the intermediate casing requirement when technically justified. A request to waive the intermediate casing requirement would need to be made in writing with supporting documentation showing that environmental protection and public safety would not be compromised by omission of the intermediate string. An example of circumstances that may warrant consideration of the omission of the intermediate string and granting of the waiver could include: 1) deep set surface casing, 2) relatively shallow total depth of well and 3) absence of fluid and gas in the section between the surface casing and target interval. Such intermediate casing waiver request may also be supported by the inclusion of information on the subsurface and geologic conditions from offsetting wells, if available.

*Intermediate and Production Casing Cement*

Current casing and cementing practices set requirements for production casing cement and state that intermediate casing cement requirements would be reviewed and approved on an individual well basis. The requirements for production casing cement are as follows:

- Cement must extend at least 500 feet above the casing shoe or tie into the previous casing string, whichever is less;
- If any oil or gas shows are encountered or known to be present in the area, as determined by the Department at the time of permit application, or subsequently encountered during drilling, the production casing cement shall extend at least 100 feet above any such shows;
- Weighted fluid may be used in the annulus to prevent gas migration in specific instances when the weight of the cement column could be a problem;
- Cementing shall be by the pump and plug method for all jobs deeper than 1,500 feet, with a minimum of 25% excess cement unless caliper logs are run, in which case 10% excess will suffice;
- The mixing water shall be tested for pH and temperature prior to mixing; and
- Following cementing and removal of cementing equipment, the operator shall wait until a calculated (e.g., performance chart) compressive strength of 500 psi is achieved before the casing is disturbed in any way.

The above requirements will remain in effect. In addition, the Department proposes to require, via permit condition and/or regulation, the following additional requirements for high-volume hydraulic fracturing:

1) The pre-frac form would be required as described above;
2) The setting depth of the intermediate casing would consider the cementing requirements for the intermediate casing and the production casing as noted below;
3) Intermediate casing would be cemented to the surface and cementing would be by the pump and plug method with a minimum of 25% excess cement unless caliper logs are run, in which case 10% excess would suffice;
4) Production casing cement would be tied into the intermediate casing string with at least 300 feet of cement measured using True Vertical Depth (TVD). If intermediate casing

installation is waived by the Department, the production casing would be cemented to the surface;

5) Cement would conform to API Specification 10A, Specifications for Cement and Material for Well Cementing (April 2002 and January 2005 Addendum). Further, the cement slurry would be prepared to minimize its free water content in accordance with the same API specification and it would contain a gas-block additive;

6) A minimum WOC time of 8 hours before the casing is disturbed in any way, including installation of a blow-out preventer (BOP). The operator may request a waiver from the Department from the required WOC time if the operator has bench tested the actual cement batch and blend using mix water from the actual source for the job, and determined that 8 hours is not required to reach a compressive strength of 500 psig;

7) The operator would run a radial cement bond evaluation log or other evaluation approved by the Department to verify the cement bond on the intermediate casing and the production casing. The quality and effectiveness of the cement job would be evaluated using the above required evaluation in conjunction with appropriate supporting data per Section 6.4 "Other Testing and Information" under the heading of "Well Logging and Other Testing" of API Guidance Document HF1 (First Edition, October 2009). Remedial cementing would be required if the cement bond is not adequate to drill ahead and isolate hydraulic fracturing operations, respectively; and

8) The internal pressure test of the production string, prior to hydraulic fracturing, may not commence for at least 7 days after the primary cementing operations are completed on this casing string to help prevent the formation of a micro-annulus.

*Centralizers*

The use and purpose of centralizers, as recommended by GWPC, is to keep the casing centered in the wellbore so that cement adequately fills the space around it. Current casing and cementing practices attached as conditions to all oil and gas drilling permits require use of centralizers on all casing strings and specify adequate hole diameters and spacing for their use. Centralizers are required every 120 feet on surface casing, but no fewer than two may be run. These requirements will continue to apply to wells drilled for high-volume hydraulic fracturing.

The above requirements will remain in effect. In addition, the Department proposes to require, via permit condition and/or regulation, additional requirements for high-volume hydraulic fracturing:

1) At least two centralizers, one in the middle and top of the first joint of casing, would be installed on the surface and intermediate casing strings, and all bow-spring style

centralizers used on all strings would conform to API Specification 10D for Bow-Spring Casing Centralizers (March 2002).

*Inspections to Witness Casing and Cementing Operations*

Current casing and cementing practices attached as conditions to all oil and gas well drilling permits require notification to the Department prior to any surface casing pressure test when welded connections or used casing is run. In primary and principal aquifer areas, the Department must be notified prior to surface casing cementing operations and cementing cannot commence until a state inspector is present. Supplementary Permit Conditions for high-volume hydraulic fracturing require notification prior to surface, intermediate and production casing cementing for all wells, so that Department staff has the opportunity to witness the operations.

#### *7.1.4.3 Annular Pressure Buildup*

Current casing and cementing practices require that the annular space between the surface casing and the next string be vented at all times to prevent pressure build-up in the annulus. If the annular gas is to be produced, a pressure relieve valve would be installed in an appropriate manner and set at a pressure approved by the Department. Proposed Supplementary Permit Conditions for high-volume hydraulic fracturing state that "under no circumstances should the annulus between the surface casing and the next casing string be shut-in, except during a pressure test."

### *7.1.5 Setback from FAD Watersheds*

Based on the analysis set forth in Section 6.1.5, the Department concludes that high-volume hydraulic fracturing within the NYC and Syracuse watersheds poses the risk of causing significant adverse impacts to these irreplaceable water supplies. The potential economic consequence of such impacts – loss of Filtration Avoidance – are substantial. The Department finds that standard stormwater control and other mitigation measures would not fully mitigate the risk of potential significant adverse impacts on water resources from high-volume hydraulic fracturing. Even with such controls in place, the risk of spills and other unplanned events resulting in the discharge of pollutants associated with high-volume hydraulic fracturing operations, even if relatively remote, would have significant consequences in these unfiltered water supplies. In addition, the increased industrial activity associated with well pad development, road construction and other activities associated with high-volume hydraulic

fracturing is not consistent with the long-term protection of the NYC and Syracuse unfiltered surface drinking water supplies. Accordingly, the Department recommends that regulations be adopted to prohibit high-volume hydraulic fracturing in both the NYC and Skaneateles Lake watersheds, as well as in a 4,000-foot buffer area surrounding these watersheds, to provide an adequate margin of safety from the full range of operations related to high-volume hydraulic fracturing that extend away from the well pad. The Department also is presenting this proposal based on its consistency with the principles of source water protection and the "multi-barrier" approach to systematically assuring drinking water quality. See, e.g., National Research Council Watershed Management for Potable Water Supply: Assessing the NYC Strategy at 97-98 (2000); American Water Works Association, *State Source Water Protection Statement of Principles*, AWWA Mainstream (1997).

### *7.1.6 Hydraulic Fracturing Procedure*

As detailed in this document, potential impacts to ground water from the high-volume hydraulic fracturing procedure itself are, in most cases, not anticipated. To the extent that any impacts may occur, the risks have been reduced by all of the proposed mitigation measures outlined above that the Department proposes to require as permit conditions and/or regulations for high-volume hydraulic fracturing. These include:

- Requirement for private water well testing;
- Pit construction and liner specifications for well pad reserve pits;
- Requirement that covered watertight tanks be used to contain flowback water on site;
- Appropriate secondary containment measures;
- Removal of fluids within specified time frames;
- Requirement that a Department-approved BOP Use and Test Plan be followed during well drilling and/or completion operations;
- Requirement that a snubbing unit and/or coiled tubing unit with a BOP be used to enter any well with pressure and/or to drill out one or more solid-core stage plugs;

- Requirement that appropriate pressure-control procedures and equipment be used, and fracturing equipment that is pressure tested with fresh water, mud or brine ahead of pumping the hydraulic fracturing fluid;

- Requirement for notification to the Department prior to cementing surface, intermediate, and production casing;

- Requirements for cement to surface on the surface and intermediate casing strings and production casing cement tied into the intermediate casing, and a radial cement bond evaluation log or other evaluation approved by the Department on the intermediate and production casing strings;

- Requirement for the submittal of a fracturing treatment plan (as part of the pre-frac form) which includes a profile of the anticipated pressures and water volume for pumping the first stage, a description of the planned treatment interval (i.e., top and bottom of perforations expressed in both True Vertical Depth (TVD) and True Measured Depth (TMD)), the total number of stages and total volume of water for hydraulic fracturing operations;

- Use of the pre-frac form to certify wellbore integrity prior to fracturing;

- Pre-fracturing pressure testing of casing (if a fracturing string is not used) from surface to top of treatment interval;

- Requirement that, prior to spudding the first well on a well pad, a non-routine incident plan is in place to address potential threats to public health and the environment. The plan would include detailed descriptions of notification, reporting, and remedial measures to ensure that any non-routine incident is addressed as quickly and as completely as possible; and

- Disclosure to the Department of fracturing fluid additives so that appropriate remedial actions can be taken in response to any spill or release.

The Department proposes to require as standard permit conditions non-routine incident handling requirements to ensure that any potential environmental or public health issues are identified, reported, and remedied as expeditiously as possible. Non-routine incidents would be identified as soon as possible, and verbal notification to the department would be made within two hours of its discovery or known occurrence. Non-routine incidents may include, but are not limited to: casing, drill pipe or hydraulic fracturing equipment failures; cement failures; fishing jobs; fires; seepages; blowouts; surface chemical spills; observed leaks in surface equipment; observed pit liner failures; surface effects at previously plugged or other wells; observed effects at water wells or at the surface; complaints of water well contamination; anomalous pressure and/or flow

conditions indicated or occurring during hydraulic fracturing operations; or other potentially polluting non-routine incidents or incidents that may affect the health, safety, welfare, or property of any person. If hydraulic fracturing activities are suspended pending the satisfactory completion of non-routine incident reporting and remediation, the operator would be required to receive Department approval prior to recommencing hydraulic fracturing activities in the same well.

To help reduce the risk that abandoned wells do not provide a conduit for contamination of fresh water aquifers, the Department proposes to require that the operator consult the Department's Oil and Gas database as well as property owners and tenants in the proposed spacing unit to determine whether any abandoned wells are present. If (1) the operator has property access rights, (2) the well is accessible, and (3) it is reasonable to believe based on available records and history of drilling in the area that the well's total depth may be as deep or deeper than the target formation for high-volume hydraulic fracturing, then the Department would require the operator to enter and evaluate the well, and properly plug it prior to high-volume hydraulic fracturing if the evaluation shows the well is open to the target formation or is otherwise an immediate threat to the environment. If any abandoned well is under the operator's control as owner or lessee of the pertinent mineral rights, then the operator is required to comply with the Department's existing regulations regarding shut-in or temporary abandonment if good cause exists to leave the well unplugged. This would require a demonstration that the well is in satisfactory condition to not pose a threat to the environment, including during nearby high-volume hydraulic fracturing, and a demonstrated intent to complete and/or produce the well within the time frames provided by existing regulations.

The proposed permit conditions would also include a requirement to monitor flowback rates in addition to daily and total flowback volumes. These flowback data would be required to be documented on the Well Drilling and Completion Report. Though flowback rates (and volumes) will likely vary based on differing well-specific conditions, an analysis of flowback rates may provide an indication of future flowback rates.

As explained in Section 6.1.5.2, the conclusion that harm from fracturing fluid migration up from the horizontal wellbore is not reasonably anticipated is contingent upon the presence of certain

natural conditions, including 1,000 feet of vertical separation between the bottom of a potential aquifer and the top of the target fracture zone. The presence of 1,000 feet of low-permeability rocks between the fracture zone and a drinking water source serves as a natural or inherent mitigation measure that protects against groundwater contamination from hydraulic fracturing. As stated in Section 8.4.1.1, GWPC recommended a higher level of scrutiny and protection for shallow hydraulic fracturing or when the target formation is in close proximity to underground sources of drinking water. Therefore, the Department proposes that site-specific SEQRA review be required for the following projects:

1) Any proposed high-volume hydraulic fracturing where the top of the target fracture zone at any point along any part of the proposed length of the wellbore is shallower than 2,000 feet below the ground surface; and

2) Any proposed high-volume hydraulic fracturing where the top of the target fracture zone at any point along any part of the proposed length of the wellbore is less than 1,000 feet below the base of a known freshwater supply.

Review would focus on local topographic, geologic, and hydrogeologic conditions, along with proposed fracturing procedures to determine the potential for a significant adverse impact to fresh groundwater. The need for a site-specific SEIS would be determined based upon the outcome of the review.

### *7.1.7 Waste Transport*

#### *7.1.7.1 Drilling and Production Waste Tracking Form*

Prior to well permit issuance, the applicant would be required to provide a fluid disposal plan as required by 6 NYCRR § 554.1(c)(1). Waste transport is an integral part of that plan and transportation tracking helps to ensure that fluid wastes are disposed of properly. Because of the number of wells that may be drilled and the current limited disposal options, as well the anticipated volume of flowback water, the paucity of reliable data regarding flowback water and production brine composition from New York operations, and NORM concerns, the Department proposes to require via permit condition and/or regulation that a *Drilling and Production Waste Tracking Form* be completed and maintained by generators, haulers and receivers of all flowback water associated with activities addressed by this Supplement. The record-keeping requirements

and level of detail would be similar to what is presently required for medical waste.[452] The form would be required regardless of whether waste is taken to a treatment facility, disposal well, another well pad, a landfill, or elsewhere. Flowback water transport may be reduced by treatment and reuse on the same pad for hydraulic fracturing. The *Drilling and Production Waste Tracking Form* would also be used to track the transport of production brine from wells covered under the SGEIS.

#### *7.1.7.2 Road Spreading*

*Flowback Water*

As explained in Chapter 5 and presented in Appendix 12, consistent with past practice, the Department began in January 2009 notifying Part 364 haulers applying for, modifying or renewing their Part 364 permit that flowback water may not be spread on roads and must be disposed of at facilities authorized by the Department or transported for use or re-use at other gas or oil wells where acceptable to the Division of Mineral Resources.

*Production Brine*

The notification described above informed Part 364 haulers that any entity applying for a Part 364 permit or permit modification to use production brine for road spreading must submit a petition for a BUD to the Department. However, the data available to date associated with NORM concentrations in Marcellus Shale production brine is insufficient to allow road spreading under a BUD. As more data becomes available, it is anticipated that petitions for such use will be evaluated by the Department.

For production brines that are intended for use on roads, the BUD and Part 364 permit would be issued by the Department prior to the removal of any production brine from the well site. As set forth in the notification, a BUD petition would include analytical results from an ELAP-approved laboratory of a representative sample for the following parameters: NORM, calcium, sodium, chloride, magnesium, TDS, pH, iron, barium, lead, sulfate, oil & grease, benzene, ethylbenzene, toluene, and xylene. Dependent upon the analytical results, the Department may require additional analyses. Evaluations of BUD petitions would include case-by-case

[452] http://www.dec.ny.gov/docs/materials_minerals_pdf/medwste.pdf.

assessments of potential impacts, and would establish limits on volume and frequency of application.

#### *7.1.7.3 Flowback Water Piping*

Flowback water piping and conveyances between well pads and flowback water storage tanks would be described in the fluid disposal plan required by 6 NYCRR §554.1(c)(1) and the proposed GP. The fluid disposal plan would demonstrate that pipelines and conveyances would be constructed of suitable materials, maintained in a leak-free condition, regularly inspected, and operated using all appropriate spill control and stormwater pollution prevention practices.

Upon review of the existing regulatory framework for liquid containment, the Department has determined that the existing regulatory structure established for solid waste management facilities, 6 NYCRR Part 360 (Part 360), is most applicable for the containment, operational, monitoring and closure requirements for centralized flowback water management facilities.[453]

The specific provisions of Subpart 360-6 Liquid Storage would provide the overall requirements for tanks, describing the minimum operational, monitoring and closure requirements. These provisions would cross-reference other applicable provisions of Part 360 which more specifically address system design, materials, quality assurance and certification requirements that likewise would be applicable to the flowback water containment systems discussed in the SGEIS.

#### *7.1.7.4 Use of Tanks Instead of Impoundments for Centralized Flowback Water Storage*

As previously noted, centralized flowback water surface impoundments are not covered under the SGEIS and the Department proposes that such require a site-specific environmental assessment and SEQRA determination of significance. Nevertheless, above ground storage tanks have advantages over surface impoundments. The Department's experience is that landfill owners prefer above ground storage tanks over surface impoundments for storage of landfill leachate. Tanks, while initially more expensive, experience fewer operational issues associated with liner system leakage. In addition, tanks can be easily covered to control odors and air emissions from the liquids being stored. Precipitation loading in a surface impoundment with a

[453] 6 NYCRR Part 360 regulations: http://www.dec.ny.gov/regs/2491.html.

large surface area can, over time, increase the volumes of liquid needing treatment. Lastly, above ground tanks also can be dismantled and reused. The provisions of Section 360-6.3 address the minimum regulatory requirements applicable to above ground storage tanks.

#### *7.1.7.5 Closure Requirements*

The closure requirements for liquid storage facilities under Subpart 360-6 are specified in section 360-6.6 Closure of Liquid Storage Facilities. These provisions detail the specific closure requirements for these containment structures and require any post-operation residues to be properly handled and disposed of as part of the process.

### *7.1.8 SPDES Discharge Permits*

SPDES Discharge Permits - The federal Clean Water Act authorized the development of the *National Pollutant Discharge Elimination System* (NPDES) for implementing the requirements for all discharges to surface waters of the United States. The Department was subsequently charged, pursuant to the ECL, to develop and administer the state's program for meeting the requirements of NPDES. This program, which is authorized by the EPA, is referred to as the *State Pollutant Discharge Elimination System* (SPDES).

Regulation of discharges of pollutants to waters of the state, both surface and groundwaters, is authorized by Article 17 of the ECL. Specific controls on point source discharges are authorized by Article 17, Title 8 of the ECL. New York's SPDES program is more stringent than the federal NPDES program in that the SPDES program also regulates discharges to groundwater. The minimum threshold for applicability of SPDES to groundwater discharges is 1,000 gpd for sanitary wastewater, while discharges which include any industrial wastewater have no minimum threshold. The NYSDOH regulates discharges of less than 1,000 gpd consisting of only sanitary wastewater. The Department is authorized to issue SPDES permits for groundwater discharges for a maximum period of 10 years; permits for discharges to surface waters are issued for a maximum of 5 years.

Administration of the SPDES program is accomplished through the issuance of wastewater discharge permits, including both *individual* permits and *general* permits. Individual SPDES permits are issued to cover a single facility in one location possessing unique discharge

characteristics and other factors. General SPDES permits are issued to cover a category of discharges involving the same or similar types of operations; discharge the same types of pollutants; require the same effluent limitations or operating conditions; require the same or similar monitoring; and do not have a significant impact on the environment, either individually or cumulatively, when carried out in conformance with permit provisions.

The Department is vested with the authority pursuant to state and federal law to enforce the SPDES permit requirements. The primary objective of the SPDES compliance and enforcement program is to protect water quality by ensuring that all point sources of pollution obtain a SPDES permit and comply with all terms and conditions of the permit.

The Department would employ any available compliance mechanisms that may be necessary, including formal enforcement, to attain the goal of SPDES permit compliance.

Flowback water and production brine are considered industrial wastewater. Wastewater is generated by many water users and industries. The SPDES program controls point source discharges to ground waters and surface waters. The Department proposes to require, through the well permitting process, that the permittee demonstrate prior to issuance of the drilling permit that any wastewater treatment facility proposed for disposal flowback water and production brine has the necessary treatment capacity. Furthermore, the Department proposes to continue requiring that once high-volume hydraulic fracturing operations have ceased and the gas well(s) are in the production phase, that the permittee properly collect and dispose of all production fluids generated at the site.

#### *7.1.8.1 Treatment Facilities*

SPDES permits are issued to wastewater dischargers, including treatment facilities such as POTWs operated by municipalities. SPDES permits include specific discharge limitations and monitoring requirements. The effluent limitations are typically the maximum allowable concentrations and/or mass loadings for various physical, chemical, and/or biological parameters to ensure that there are no impacts to the receiving water body.

*POTWs*

A POTW must have an approved pretreatment program, or mini-pretreatment program, developed in accordance with the above requirements in order to accept industrial wastewater from non-domestic sources covered by Pretreatment Standards which are indirectly discharged into or transported by truck or rail or otherwise introduced into POTWs.

The Department's DOW shares pretreatment program oversight (approval authority) responsibility with the EPA. Indirect discharges to POTWs are regulated by 6 NYCRR §750-2.9(b), National Pretreatment Standards, which incorporates by reference the requirements set forth under 40 CFR Part 403, "General Pretreatment Regulations for Existing and New Sources of Pollution." In accordance with DOW's TOGS 1.3.8, 6 NYCRR §750-2.9, 40 CFR Part 403, and 40 CFR 122.42, New York State POTW permittees with industrial pretreatment or mini-pretreatment programs are required to notify the Department of new discharges or substantial changes in the volume or character of pollutants discharged to the permitted POTW. The Department must then determine if the SPDES permit needs to be modified to account for the proposed discharge, change or increase.

Flowback water and production brine from wells permitted pursuant to this Supplement may only be accepted by POTWs or any other wastewater treatment plant with approved pretreatment or mini-pretreatment programs, as noted above, and an approved headworks analysis for this wastewater source in accordance with 40 CFR Part 403 and DOW's TOGS 1.3.8 and as required by the POTW's SPDES permit that includes appropriate monitoring and effluent limits for this wastewater source. The SPDES permit for the POTW would include specific discharge limitations and monitoring requirements, including routine reporting of monitoring results, tracking of these results by the Department, and a well established compliance program to deal with permit violations.

The Department's procedures for POTW acceptance of high-volume hydraulic fracturing wastewater discharges are detailed in Appendix 22 of this Supplement. Discharges that follow these procedures would provide effective mitigation of significant adverse impacts.

*Private Wastewater Treatment Facilities*

Privately owned facilities for the treatment and disposal of industrial wastewater from high-volume hydraulic fracturing operate in other states, including Pennsylvania. Similar facilities that might be constructed in New York would require a SPDES permit. The permittee would apply for SPDES permit coverage for a dedicated treatment facility would include specific discharge limitations and monitoring requirements. The effluent limitations are the maximum allowable concentrations or ranges for various physical, chemical, and/or biological parameters to ensure that there are no impacts to the receiving water body.

Private treatment systems, which are designed, constructed, and approved to treat the parameters specific to high-volume hydraulic fracturing wastewater, including processes as discussed in Section 5.12 (Flowback Water Treatment, Recycling and Reuse), may be more effective than POTWs for the treatment, disposal, and potential reuse of this source of wastewater because they can be designed and optimized to remove the parameters specific to this source of wastewater.

As noted in Chapter 5 of this revised draft SGEIS, onsite treatment of flowback water for purposes of reuse is currently being used in Pennsylvania and other states. The treated water is blended with fresh water at the well, generally, and reused for hydraulic fracturing with the treatment residue hauled off-site. These types of facilities do not require a SPDES permit unless the discharge of wastewater is planned. The use of on-site treatment and reuse facilities reduces the demand for fresh water and provides effective mitigation of potential adverse impacts.

### *7.1.8.2 Disposal Wells*

Because of the 1992 GEIS Finding that brine disposal wells require site-specific SEQRA review, mitigation measures are discussed here for informational purposes only and are not being proposed on a generic basis.

Flowback and disposal strata water quality must be fully characterized prior to permitting and injecting into a disposal well. Additional geotechnical information regarding the disposal strata's ability to accept and retain the injected fluid is also necessary. The permittee would apply for and receive coverage under the EPA UIC program prior to applying for a SPDES permit for discharge using Form NY-2C, available on the Department's website. The

characterization and SPDES permit application process for disposal wells is similar to that for private treatment facilities.

The Department may propose monitoring requirements and/or discharge limits in the SPDES permit in addition to any requirements included in the required EPA UIC permit. These would be determined during the site-specific permitting process required by the Uniform Procedures Act and the 1992 Findings Statement. To be protective of the overlying potable water aquifers, the site-specific permitting process would consider the following topics:

- Distance to drinking water supplies or sources, surface water bodies and wetlands;
- Topography, geology, and hydrogeology;
- The proposed well construction and operation program;
- Water quality analysis of the receiving stratum for TDS, chloride, sulfate and metals;
- Effluent limits for injectate constituents, and potential applicability of 6 NYCRR §703.6 groundwater effluent limits or the groundwater effluent guidance values listed in DOW TOGS 1.1.1; and
- Potential requirement for upgradient and downgradient monitoring wells installed in the deepest identified GA or GSA potable water aquifer.

New York State currently has six permitted underground disposal wells, three of which are used to dispose of brine produced with oil and /or gas. However, these wells are privately owned and currently are approved to inject only their own brine. Use of an existing permitted underground disposal well would require a modification of the existing UIC and SPDES permits for the existing wells to accept flowback.

The Department notes that potential impacts as described in Chapter 6 of this revised draft SGEIS have occurred in other states, and remain a concern. With the above mitigation measures in place, combined with permit monitoring and oversight, significant impacts from waste transport and disposal in connection with high-volume hydraulic fracturing wastewater would be reduced.

### *7.1.9 Solids Disposal*

Cuttings may be managed within a closed-loop tank system or within the lined reserve pit. If cuttings are contained within the reserve pit and a common reserve pit is used for multiple wells on the pad, cuttings may have to be removed several times to maintain the required two feet of freeboard set forth in Section 7.1.3.2. Care must be taken during this operation not to damage the liner.

Cuttings contaminated with oil-based or polymer-based mud could not be buried on site; they would be managed in a closed-loop tank system and removed from the site for disposal in a Part 360 solid waste facility. Supplementary permit conditions pertaining to the management of drill cuttings from high-volume hydraulic fracturing require consultation with the Department's Division of Materials Management for the disposal of any cuttings associated with water-based mud-drilling and any pit liner associated with water-based or brine-based mud-drilling where the water-based or brine-based mud contains chemical additives. Supplemental permit conditions also dictate that any cuttings required to be disposed of off-site, including at a landfill, be managed on-site within a closed-loop tank system rather than a reserve pit.

As the basal portion of the Marcellus has been reported to contain abundant pyrite (an iron sulfide mineral),[454] there exists the potential that cuttings derived from this interval and placed in reserve pits may oxidize and leach, resulting in an acidic discharge to groundwater, commonly referred to as acid rock drainage (ARD). A site-specific ARD-mitigation plan would be required to be prepared and followed by the operator for on-site burial of Marcellus Shale cuttings from horizontal drilling in the Marcellus Shale if the operator elects to bury these cuttings. The ARD-mitigation plan would be designed to neutralize acid drainage through the emplacement of basic carbonate materials (e.g., waste lime or limestone cuttings) prior to on-site burial. The pyritic drill cuttings and the carbonate materials would be mixed thoroughly and compacted prior to reclamation of the pit area. This method was demonstrated to be effective in an ARD-abatement

[454] Engelder and Lash, 2008.

project jointly conducted by Penn DOT and PADEP during construction of U.S. Route 22 near Lewiston PA in 2004.[455]

Alternatively, if the operator elects or is required (for reasons related to drilling fluid composition, as previously discussed) to utilize an off-site disposal facility for disposal of cuttings from horizontal drilling in the Marcellus Shale, then no ARD-mitigation plan is required. In such instances however, supplementary permit conditions require that these cuttings be managed and contained on-site within a closed-loop tank system rather than within a reserve pit, prior to removal for off-site disposal.

Annular disposal of drill cuttings has also been proposed; however, this is not an acceptable practice in New York and is prohibited by the high-volume hydraulic fracturing Supplementary Permit Conditions.

Although not directly related to a water resources impact, consideration also should be given to monitoring and mitigating subsidence by adding fill as any uncontaminated drill cuttings that are buried on site dewater and consolidate.

### *7.1.10 Protecting NYC's Subsurface Water Supply Infrastructure*

The advent, in the late 1990s and early 2000s, of geothermal well drilling – also regulated under ECL 23 if the wells are deeper than 500 feet – led to mutually agreed upon protocols between the Department and the NYCDEP for processing permits to drill in NYC and Delaware, Dutchess, Greene, Orange, Putnam, Rockland, Schoharie, Sullivan, Ulster and Westchester Counties. The Department agreed to notify NYCDEP of any proposed well in the counties outside of NYC, so that NYCDEP could determine if the proposed surface location is within a 1,000-foot wide corridor surrounding a water tunnel or aqueduct. For any well that NYCDEP confirms is outside the corridor, the Department processes the permit application following its normal procedures without any further NYCDEP involvement to address subsurface infrastructure.

For any well within the 1,000-foot corridor, the Department notifies the applicant that the proposed drilling is an unlisted action and may pose a significant threat to a municipal water

[455] Smith et al. 2006.

supply, necessitating a site-specific SEQRA finding. A negative declaration is only filed upon a demonstration to NYCDEP's satisfaction, through proposed drilling and deviation surveying protocols, that it is feasible to drill at the proposed location with confidence that there would be no impact to tunnels or aqueducts. NYCDEP is provided with a copy of each application for a permit to drill, and any permit issued requires notification to NYCDEP prior to drilling commencement.[456]

Prior to reaching the above-described agreement with NYCDEP, Department staff had considered applying the 660-foot protective buffer for underground mining operations that is provided by the oil and gas regulations to NYC's underground water tunnels and aqueducts.[457] However, those regulations require the underground mine operator (or, in this case, the tunnel operator) to provide detailed location information regarding its underground property rights to the Department. NYCDEP has not provided such maps for the subject counties, and the 1,000-foot protective corridor suggested by NYCDEP was agreeable to Department staff because it is more protective and is consistent with the 1992 GEIS criteria for requiring supplemental environmental review for proposed well locations within 1,000 feet of municipal water supply wells.

To mitigate impacts to NYC's subsurface water supply infrastructure, Department staff would continue to follow the above protocol for any proposed ECL 23 well, including any proposed gas well, in the NYC Watershed. Except for the horizontal drilling and hydraulic fracturing that may occur thousands of feet below the depth of any tunnel or aqueduct, the methods and technologies for geothermal wells are the same as for natural gas wells.

### *7.1.11 Setbacks*

Setbacks provide a margin of safety should the operational mitigation measures fail, and are therefore a useful risk management tool. The NYSDOH recognizes separation distances, or setbacks, as a crucial element of protecting water resources against contamination.[458] While the

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[456] Sanford, K.F., 2007.

[457] 6 NYCRR Part 552.4 Regulations: http://www.dec.ny.gov/regs/4465.html

[458] http://www.health.state.ny.us/environmental/water/drinking/part5/append5b/fs1_additional_measures.htm, viewed 8/26/09.

cited reference pertains specifically to drinking water wells, setbacks also mitigate potential impacts to other water resources. As established in the 1992 GEIS with respect to municipal water supply wells, setback distances can be used to help define the level of environmental review and mitigation required for a specific proposed activity.

The proposed setback distances advanced herein reflect consideration of the following information reviewed by Department staff in DMN and DOW:

- The 1992 GEIS and its Findings;
- NYSDOH's required water well separation distances, set forth in Appendix 5-B of the State Sanitary Code.[459] Although sites specifically related to natural gas development and production are not explicitly listed among the potential contaminant sources addressed by Appendix 5-B, NYSDOH staff assisted Department staff in identifying listed sources which are analogous to activities related to high-volume hydraulic fracturing;
- Results and discussion provided by Alpha Environmental Consultants, Inc. (Alpha), to NYSERDA regarding Alpha's survey of regulations related to natural gas development activities in Pennsylvania, Colorado, New Mexico, Wyoming , Texas (including the City of Fort Worth), West Virginia, Louisiana, Ohio and Arkansas;[460]
- Results and discussion provided by Alpha to NYSERDA regarding Alpha's review of the rules and regulations pertaining to protection of water supplies in NYC's Watershed.[461] Again, although natural gas development activities are not specifically addressed, and this SGEIS does not cover high-volume hydraulic fracturing in the NYC or Syracuse watersheds, Alpha identified activities which could be considered analogous to aspects of high-volume hydraulic fracturing, including:
    - Hazardous materials storage;
    - Radioactive waste disposal;
    - Storage of petroleum products;
    - Impervious surfaces;

[459] http://www.health.state.ny.us/environmental/water/drinking/part5/appendix5b.htm#table1, viewed 8/26/09.

[460] Alpha, 2009, Tables 2.1 - 2.10.

[461] Alpha, 2009, p. 94.

    - Stormwater pollution prevention plans;
    - Miscellaneous point sources; and
    - Solid waste disposal;

- Local watershed rules and regulations for various jurisdictions within the Marcellus and Utica Shale fairways. The counties searched included Broome, Chemung, Chenango, Cortland, Delaware, Madison, Otsego, Steuben, Sullivan, Tioga and Tompkins. Local watershed rules and regulations include setbacks from water supplies related to the following activities which are potentially analogous to aspects of high-volume hydraulic fracturing:
    - Chlorides/salt storage;
    - Burial of storage containers containing toxic chemicals or substances;
    - Disposal of radioactive waste by burial in soil; and
    - Direct discharge of polluted liquid to the ground or a water body.

*7.1.11.1 Setbacks from Groundwater Resources*

The following discussion pertains to the lateral distance, measured at the surface, to a water supply or spring from the closest edge of the well pad.

The proposed well and well pad setbacks apply to well permit applications where the target fracturing zone is either at least 2,000 feet deep or 1,000 feet below the underground water supply. These wells would be drilled vertically through the aquifer, so that the location of the aquifer penetration at each well corresponds to the well's location on the ground surface. Well permit applications where the target fracturing zone is less than either 2,000 feet deep or 1,000 feet below a known underground water supply are addressed in Section 7.1.5.

The EAF addendum for high-volume hydraulic fracturing would require evidence of diligent efforts by the well operator to determine the existence of public or private water wells and domestic-supply springs within half a mile (2,640 feet) of any proposed drilling location. The Department proposes that this distance is adequate to ensure the 2,000-foot setback discussed herein threshold for public water supply wells is properly applied. The operator would be required to identify the wells and springs, and provide available information about their depth, completed interval and use. Use information would include whether the well is public or private,

community or non-community and of what type in terms of the facility or establishment it serves if it is not a residential well. Information sources available to the operator include:

- Direct contact with municipal officials;
- Direct communication with property owners and tenants;
- Communication with adjacent lessees;
- EPA's Safe Drinking Water Act Information System database, available at http://oaspub.epa.gov/enviro/sdw_form_v2.create_page?state_abbr=NY; and
- Department's Water Well Information search wizard, available at http://www.dec.ny.gov/cfmx/extapps/WaterWell/index.cfm?view=searchByCounty.

Upon receipt of a well permit application, Department staff would compare the operator's well list to internally available information and notify the operator of any discrepancies or additional wells that are indicated within half a mile of the proposed well pad. The operator would be required to amend its EAF Addendum accordingly.

The EAF Addendum for high-volume hydraulic fracturing would also require well operators to identify any wells listed within the Department's Oil & Gas Database[462] within a) the spacing unit of the proposed well and b) within 1 mile (5,280 feet) of the proposed well location. For each well identified, operators would be required to provide information regarding the distance from the surface location of the existing well to the surface location of the proposed well, as well as information regarding the quantity and type of any freshwater, brine, oil or gas encountered during the drilling of the well, as recorded on the Department's Well Drilling and Completion Report.

This requirement would help to ensure that available information on nearby wells is considered by the operator while designing the proposed wellbore. Additionally, this information can be

[462] The Department's Oil & Gas Database contains information on more than 35,000 oil, gas, storage, solution salt, stratigraphic, and geothermal wells categorized under ECL 23 as Regulated Wells. The Oil & Gas database can be accessed on the Department's website at http://www.dec.ny.gov/cfmx/extapps/GasOil/.

used by Department staff to review any necessary Department well files to ensure that the operator's proposed wellbore design is sufficient to protect ground water resources.

*Public Water Supplies and Primary and Principal Aquifers*

The Department's 1992 GEIS concluded that issuance of a permit to drill less than 1,000 feet from a municipal water supply well is considered "always significant" and requires a site-specific SEIS to analyze groundwater hydrology, potential impacts and propose mitigation measures. The 1992 GEIS also found that any proposed well location between 1,000 and 2,000 feet from a municipal water supply well requires a site-specific assessment and SEQRA determination, and may require a site-specific SEIS. The 1992 GEIS provides the discretion to apply the same process to other public water supply wells.

For multi-well pads and high-volume hydraulic fracturing, the Department proposes that site disturbance associated with such operations be prohibited within 2,000 feet of any public (municipal or otherwise) water supply well, reservoirs, natural lake or man-made impoundments (except engineered impoundments constructed for fresh water storage associated with fracturing operations), and river or stream intake, in order to safeguard against significant adverse impacts due to surface spills and leaks on the well pad that could impact the groundwater supply. As noted, these setbacks would be measured from the closest edge of the well pad. The Department will re-evaluate the necessity of this approach after three years of experience issuing permits in areas outside of the 2,000-foot boundary.

In addition, as stated in sub-section 7.1.3, the Department proposes that for at least two years the surface disturbance associated with high-volume hydraulic fracturing, including well pad and associated road construction and operation, be prohibited within 500 feet of primary aquifers. The Department further proposes that a site-specific SEQRA review be required for high-volume hydraulic fracturing projects at any proposed well pad within or within 500 feet of a Principal Aquifer. As noted, these setbacks would be measured from the closest edge of the well pad. The Department will re-evaluate the necessity of this approach after two years of experience issuing permits in areas outside of these restricted areas.

*Private Water Wells and Domestic Supply Springs*

Chapter 6 describes potential impacts related to high-volume hydraulic fracturing that may require enhanced protections for private water wells and domestic-supply springs. These concerns stem more from handling greater fluid volumes on the surface than from downhole activities. Fluid and chemicals could be present and handled anywhere on the well pad. Setbacks, therefore, would be measured from the edge of the well pad.

As stated above, uncovered pits or open surface impoundments that could contain flowback water are analogous to "chemical storage site(s) not protected from the elements," which are subject to a 300-foot separation distance from water wells under Appendix 5-B of the State Sanitary Code.[463] Flowback water tanks and additive containers could be compared to "chemical storage site(s) protected from the elements," which require a 100-foot setback from water wells.[464] Handling and mixing of hydraulic fracturing additives onsite is comparable to "fertilizer and/or pesticide mixing and/or clean up areas," which require a 150-foot distance from water wells.[465]

The Department proposes that it will not issue well permits for high-volume hydraulic fracturing within 500 feet of a private water well or domestic-supply spring, unless waived by the landowner.

*7.1.11.2 Setbacks from Other Surface Water Resources*

Application of setbacks from surface water resources prevents direct flow of the full, undiluted volume of a spilled contaminant into a surface water body. Some amount of evaporation or soil adsorption would occur in the event of a spill. Existing regulations prohibit the surface location of an oil or gas well within 50 feet of any "public stream, river or other body of water."[466] The 1992 GEIS proposed that this distance be increased to 150 feet and apply to the entire well site instead of just the well itself.

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[463] http://www.health.state.ny.us/environmental/water/drinking/part5/appendix5b.htm#table1, viewed 8/26/09.

[464] http://www.health.state.ny.us/environmental/water/drinking/part5/appendix5b.htm#table1, viewed 8/26/09.

[465] http://www.health.state.ny.us/environmental/water/drinking/part5/appendix5b.htm#table1, viewed 8/26/09.

[466] 6 NYCRR §553.2.

Significant surface spills at well pads which could contaminate surface water bodies, including municipal supplies, are most likely to occur during activities which are closely observed and controlled by personnel at the site. More people are present to monitor operations at the site during high-volume hydraulic fracturing and flowback operations than at any other time period in the life of the well pad. Therefore, any surface spills during these operations are likely to be quickly detected and addressed rather than continue undetected for a lengthy time period. Other factors which reduce the risk of surface water contamination resulting from well pad operations include the following:

- Required stormwater permit coverage, including a SWPPP;
- Supplementary Permit Conditions for High-Volume Hydraulic Fracturing (see Appendix 10), which are proposed to include:
    - Pit construction and liner specifications for well pad reserve pits;
    - Requirement that closed-loop tank systems be used instead of reserve pits for any horizontal drilling in the Marcellus Shale without an ARD- mitigation plan for on-site burial of cuttings and for any drilling requiring cuttings to be disposed of off-site;
    - Requirement that tanks be used to contain flowback water on site;
    - Appropriate secondary containment measures;
    - Use of appropriate pressure-control procedures and equipment, including blow-out prevention equipment that is tested on-site prior to drilling ahead and fracturing equipment that is pressure tested with fresh water, mud or brine ahead of pumping fracturing fluid; and
    - Pre-fracturing pressure testing of casing from surface to top of treatment interval;
- SGEIS setbacks related to potential surface activities measured from the edge of the well pad instead of from the well. Municipal ownership of land surrounding municipal surface water supplies may provide additional protection if the municipal-owned buffer exceeds the setback distance. Other waterfront owners may decline to lease or offer only non-surface entry leases [e.g., Otsego Lake owners around the lake include NYS (Glimmerglass State Park), Clark Foundation, etc.]; and
- The Department's existing requirement for a Freshwater Wetlands Permit in wetland or 100-foot buffer zone.

With respect to surface municipal supplies, the 1992 GEIS found that a 150-foot distance between the wellsite and a surface water supply would provide adequate protection in the event of an accidental spill. Required erosion and sedimentation control plans would address potential impacts to nearby water bodies from ground disturbance. As discussed elsewhere in this document, the Department has since determined that stormwater permit coverage is required for disturbance greater than one acre.

Reservoir setbacks for comparable activities addressed in some local Watershed Rules and Regulations establish various setbacks between 20 and 1,000 feet, but they generally pertain either to actual burial of materials for disposal purposes or direct discharges to the ground or to surface-water bodies. Burial or direct discharges to the ground of fracturing fluid, additive chemicals or flowback water are not proposed and would not be approved. The only on-site burial discussed in Chapter 5 of this document pertains to uncontaminated cuttings and pit-liners associated with air or fresh-water drilling, as allowed under the 1992 GEIS. Direct discharges to surface water bodies are regulated by the Department's SPDES permitting program.

The required setbacks from surface water supplies in other states reviewed by Alpha vary between 100 and 350 feet.[467] Colorado's new Public Water System Protection rule requires a variance for surface activity, including drilling, completion, production and storage, within 300 feet of a surface public water supply.[468]

Many local Watershed Rules and Regulations require smaller setbacks from watercourses, as specifically defined within the watershed, than from reservoirs.

Based on the above information and mitigating factors, the Department proposes that site-specific SEQRA review be required for projects involving any proposed well pad where the closest edge is located within 150 feet of a perennial or intermittent stream, storm drain, lake or pond.

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[467] Alpha, 2009, pp. 41-45.

[468] http://cogcc.state.co.us/RR_Docs_new/rules/300series.pdf, viewed 8/26/09.

## 7.2 Protecting Floodplains

The Department proposes to require, through permit condition and/or regulation, that high-volume hydraulic fracturing not be permitted within 100-year floodplains in order to mitigate significant adverse impacts from such operations if located within 100-year floodplains.

## 7.3 Protecting Freshwater Wetlands

Section 2.3.10 summarizes the State's Freshwater Wetlands regulatory program, which addresses activities within 100 feet of regulated wetlands. In addition, the federal government regulates development activities in wetlands under Section 404 of the Clean Water Act.

The Department found in 1992 that issuance of a well permit when another Department permit is necessary requires a site-specific SEQRA determination relative to the activities or resources addressed by the other permit. In such instances, which include Freshwater Wetlands Permits, the well permit is not issued until the SEQRA process is complete and the other permit is issued.

Mitigation measures for avoiding wetland impacts from well development activities are described in Chapter 8 of the 1992 GEIS, which provides that well permits are issued for locations in wetlands only when alternate locations are not available. Potential mitigation measures are not limited to those discussed in the 1992 GEIS, but may include other alternatives recommended by Fish, Wildlife and Marine Resources staff based on current techniques and practices. Additional measures proposed in this Supplement include the following:

- Requirement that, to the extent practical, fueling tanks not be placed within 500 feet of a wetland (Section 7.1.3.1); and
- Requirement for secondary containment consistent with the Department's SPOTS 10 for any fueling tank, regardless of size (Section 7.1.3.1).

## 7.4 Mitigating Potential Significant Impacts on Ecosystems and Wildlife

Fragmentation of habitat, potential transfer of invasive species, and potential impacts to endangered and threatened species are identified in Chapter 6 as potential significant adverse ecosystem and wildlife impacts specifically related to high-volume hydraulic fracturing that are not addressed by the 1992 GEIS. The following text identifies mitigation measures to address

significant impacts of fragmentation of habitat, potential transfer of invasive species, and endangered and threatened species, as well as the use of certain State-owned land.

### *7.4.1 Protecting Terrestrial Habitats and Wildlife*

Significant adverse impacts to habitats, wildlife, and biodiversity from site disturbance associated with high-volume hydraulic fracturing in the area underlain by the Marcellus Shale in New York will be unavoidable. In particular, the most significant potential wildlife impact associated with high-volume hydraulic fracturing is fragmentation of rare interior forest and grassland habitats and the resulting impacts to the species that depend on those habitats. However, the following specific mitigation measures would prevent some impacts, minimize others, and provide valuable information for better understanding the impacts of habitat fragmentation on New York's wildlife from multi-pad horizontal gas wells.

#### *7.4.1.1 BMPs for Reducing Direct Impacts at Individual Well Sites*

The Department proposes that the BMPs listed below be required mitigation measures to reduce impacts associated with development of individual wellpads and appurtenances located in natural habitats. During the permit review process, site-specific conditions would be considered to determine applicability of each BMP and permit conditions included as appropriate.

- Require multiple wells on single pads wherever possible;
- Design well pads to fit the available landscape and minimize tree removal;[469]
- Require "soft" edges around forest clearings by either maintaining existing shrub areas, planting shrubs, or allowing shrub areas to grow;
- Limit mowing to one cutting per year or less after the construction phase of well pads is completed. Mowing would not occur during the nesting season for grassland birds (April 23 – August 15);
- When well pads are placed in large patches of grassland habitat (greater than 30 acres) located within Grassland Focus Areas (as described in Section 7.4.1.2), construction and drilling activities are prohibited during grassland bird nesting season (April 23 – August 15);

[469] Environmental Law Clinic 2010.

- When well pads are placed in large patches of grassland habitat (greater than 30 acres) located within Grassland Focus Areas, minimize impacts from dust during the grassland bird nesting season (April 23 – August 15) by using dust palliatives and other appropriate measures to reduce dust;

- Require lighting used at wellpads to shine downward during bird migration periods (April 1 – June 1 and August 15 – October 15);

- Limit the total area of disturbed ground, number of well pads, and especially, the linear distance of roads, where practicable;[470]

- Design roads to lessen impacts (including two-track roads and oak mats in low-volume areas[471]) and limit canopy gaps;[472]

- Require roads, water lines, and well pads to follow existing road networks and be located as close as possible to existing road networks to minimize disturbance;

- Gate single-purpose roads to limit human disturbance; and[473]

- Require reclamation of non-productive, plugged, and abandoned wells, well pads, roads and other infrastructure areas. Reclamation would be conducted as soon as practicable and would include interim steps to establish appropriate vegetation during substantial periods of inactivity. Native tree, shrub, and grass species should be used in appropriate habitats.

#### *7.4.1.2 Reducing Indirect and Cumulative Impacts of Habitat Fragmentation*

The best opportunity for reducing indirect and cumulative impacts is to preserve existing blocks of the critically important grassland and interior forest habitats identified in Grassland and Forest Focus Areas (Figure 7.2) by avoiding site disturbance (wellpad construction) in those areas.

Grassland Focus Areas represent those areas within the State that are most important for grassland nesting birds. Forest Focus Areas represent those areas in the State that contain large blocks of forest interior habitats. Development in these areas would be conditioned as outlined below to mitigate impacts on wildlife from habitat fragmentation. The following measures are

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[470] New Mexico Dept Game & Fish, 2007.

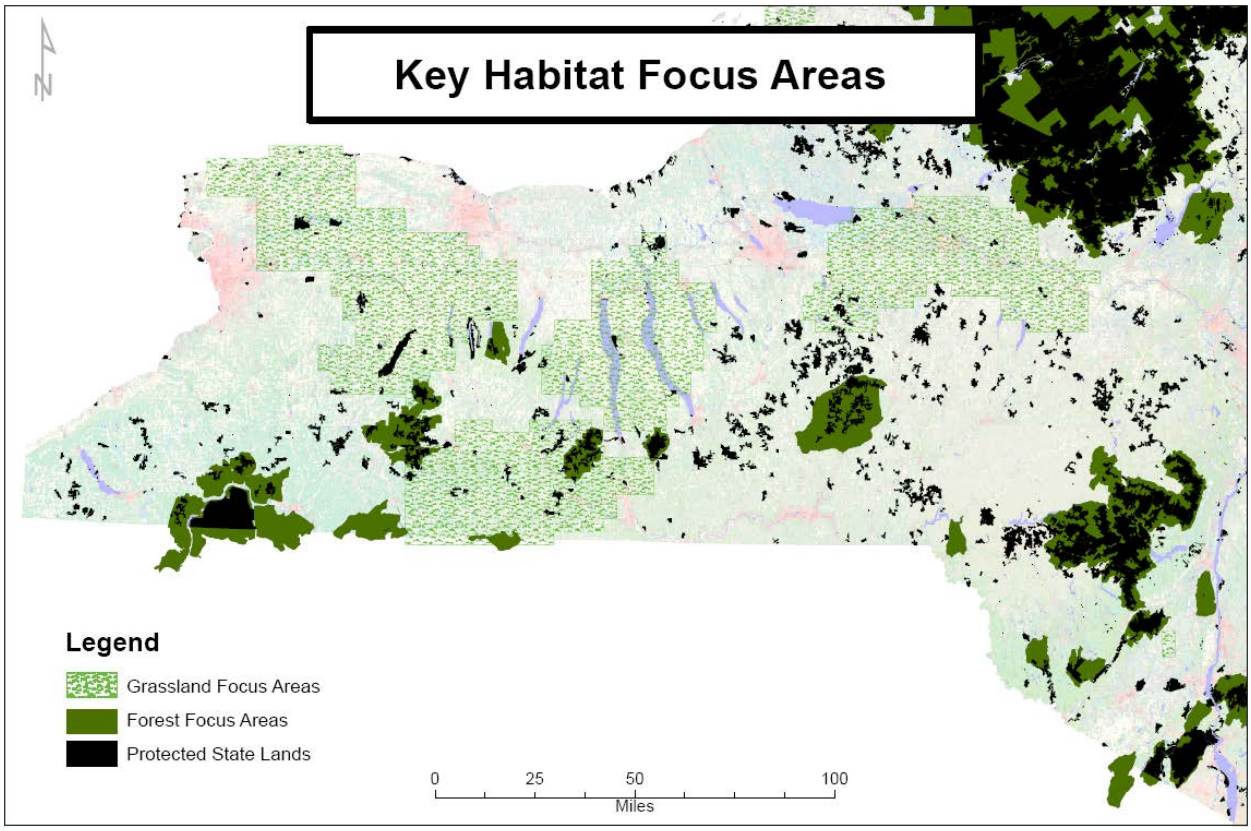
[471] Weller et al., 2002.

[472] NYSDEC, Strategic Plan for State Forest Management, 2010.

[473] New Mexico Dept Game & Fish, 2007.

considered necessary to mitigate the cumulative impacts of habitat fragmentation for these critically important habitat types while not strictly prohibiting development.

Figure 7.2 - Key Habitat Areas for Protecting Grassland and Interior Forest Habitats
(Updated August 2011)




*Grassland Focus Areas*

Grassland Focus Areas depicted in Figure 7.2 were determined by a group of grassland bird experts, including Department staff with input from outside experts representing federal agencies and academia.[474] The focus areas were derived from Breeding Bird Atlas (BBA) data from 2002-2004;[475] they were further modified by expert knowledge, and then followed up with a 2-year field verification study before being finalized. They represent areas of New York State that contain the most important grassland habitat mosaics.

[474] See Morgan and Burger 2008.

[475] McGowan and Corwin 2008 or visit DEC's website (http://www/dec/ny.gov/animals/7312.html).

The 2006 BBA provided the core dataset for delineating Grassland Focus Areas. All atlas blocks with a high richness of breeding grassland birds, as well as contiguous blocks also supporting grassland species, were included in the focus areas. The target for the focus areas was to "capture" or include at least 50% of the BBA blocks where each of the grassland species was found to be breeding across the state. The focus areas were able to reach that target for all but the most widespread species. Although the BBA does not provide estimates of abundance or densities, one of the criteria for inclusion in a focus area was contiguity with adjacent blocks containing grassland birds; analyses indicate that such blocks contain significantly higher abundances of the target species than isolated blocks.

Extensive field surveys were conducted in 2005 and 2006 throughout the focus areas. These surveys collected distribution and abundance data to confirm that the analysis of the breeding-bird data reflected actual conditions in the field (Table 7.4). A total of 487 different habitat patches were surveyed statewide. In some cases, focus area boundaries were adjusted based on field survey data. The overall process resulted in the identification of 8 focus areas that support New York's grassland breeding birds, 4 of which occur in the area underlain by the Marcellus Shale.

Table 7.4 - Principal Species Found in the Four Grassland Focus Areas within the area underlain by the Marcellus Shale in New York (New July 2011)

| Grassland Focus Area | Species |
|---|---|
| Western Area | Upland sandpiper, vesper sparrow, horned leak, savannah sparrow, short-eared owl* |
| Southern Area | Northern Harrier, grasshopper sparrow, Eastern meadowlark, savannah sparrow |
| Middle Northern Area | Vesper sparrow, grasshopper sparrow, horned lark, savannah sparrow, short-eared owl* |
| Eastern Area | Northern harrier, short-eared owl* |
| *Wintering only | |

*Specific Mitigation Measures to Reduce Impacts to Grasslands*

In order to mitigate impacts from fragmentation of grassland habitats, the Department proposes to require, through the permit process and/or by regulation, that surface disturbance associated with high-volume hydraulic fracturing activities in contiguous grassland habitat patches of 30 acres or more within Grassland Focus Areas would be based on the findings of a site-specific

ecological assessment and implementation of mitigation measures identified as part of such ecological assessment, in addition to the BMPs required for all disturbances in grassland areas that are identified in Section 7.4.1.1. This ecological assessment would include pre-disturbance biological studies and an evaluation of potential impacts on grassland birds from the project. Pre-disturbance studies would be required to be conducted by qualified biologists and would be required to include a compilation of historical information on grassland bird use of the area and a minimum of one year of field surveys at the site to determine the current extent, if any, of grassland bird use of the site. Should the Department decide to issue a permit after reviewing the ecological assessment, the applicant would be required to implement supplemental mitigation measures by locating the site disturbance as close to the edge of the grassland patch as feasible and proposing additional mitigation measures (e.g., conservation easements, habitat enhancement). In addition, enhanced monitoring of grassland birds during the construction phase of the project and for a minimum period of two years following active high-volume hydraulic fracturing activities (i.e., following well completion) would be required.

**Explanation for 30 Acre Threshold**: Many of New York's rarest bird species that rely on grasslands are affected by the size of a grassland patch. Several species of conservation concern rely on larger-sized grassland patches and show strong correlation to a minimum patch size if they are to be present and to successfully breed. Minimum patch sizes will vary by species, and by surrounding land uses, but a minimum patch size of 30-100 acres is warranted to protect a wide assemblage of grassland-dependent species.[476] Although a larger patch size is necessary for raptor species, a minimum 30 acres of grassland is needed to provide enough suitable habitat for a diversity of grassland species. Grasslands less than 30 acres in size are of less importance since they do not provide habitat for many of the rarer grassland bird species.[477] The Grassland Focus Areas cover about 22% of the area underlain by the Marcellus Shale. However, the actual impacts on Marcellus development would affect less area for two reasons. First, only those portions of the Grassland Focus Areas meeting the minimum patch size requirement would be subject to the aforementioned additional restrictions on surface disturbance. Second, even in

[476] USFWS n.d., Sample and Mossman 1997, Mitchell et al. 2000.

[477] USFWS n.d., Sample and Mossman 1997, Mitchell et al. 2000.

areas where surface disturbance should be avoided, gas deposits could be accessed horizontally from adjacent areas where the restriction does not apply.

*Forest Focus Areas*

Forest Focus Areas depicted in Figure 7.2 were based on Forest Matrix Blocks developed by The Nature Conservancy (TNC).[478] TNC's goal in developing Forest Matrix Blocks was to estimate viability and resilience of forests and determine those areas where forest structure, biological processes, and biological composition are most intact. Resilient forest ecosystems can absorb, buffer, and recover from the full range of natural disturbances. TNC used three characteristics in developing their Forest Matrix Blocks: size, condition, and landscape context. Size was based on the key factors of the area necessary to absorb natural disturbance and species area requirements (see Figure 7.3).

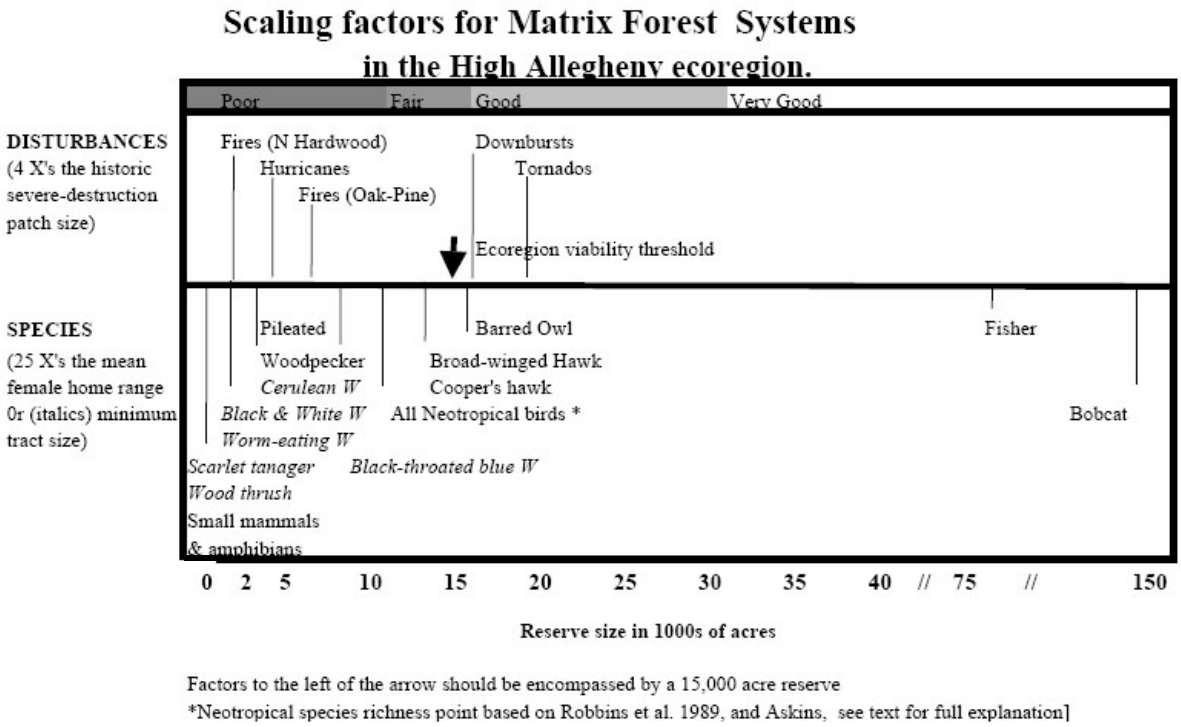
- **Natural disturbances and minimum dynamic area:** Eastern forests are subject to hurricanes, tornadoes, fires, ice storms, downbursts, and outbreaks of insects or disease. While most of these disturbances are small and recovery is fast, damage from larger catastrophic events may last for decades. Resilient forest ecosystems can absorb, buffer, and recover from the full range of natural disturbances. The effects of catastrophic events are typically spread across a landscape in an uneven way. Patches of severe damage are embedded in larger areas of moderate or light disturbance. Using historical records, vegetation studies, air photo analysis, and expert interviews, TNC scientists determined the size and extent of patches of severe damage for each disturbance type expected over one century. Historic patterns in the Northeast suggest that an area of approximately four times the size of the largest severe damage patch is necessary for a particular matrix block to remain adequately resilient.

    - **Breeding territories and area sensitive species:** Forest ecosystems must also be big enough to support characteristic interior species, including birds, mammals, herptiles, and insects. Many species establish and defend territories during breeding season, from which they obtain resources to raise their young. Twenty-five times the average size of a territory, together with information on other minimum area restrictions for that species, may be used as an estimate of the space needed for a small population. This reflects a rule of thumb developed for zoo populations on the number of breeding individuals required to conserve genetic diversity over generations (Figure 7.3);[479]

[478] TNC, 2003.

[479] TNC, 2003.

Figure 7.3 - Scaling Factors for Matrix Forest Systems in the High Allegheny Ecoregion[480] (New July 2011)




- Condition was based on the key factors of structural legacies, fragmenting features, and biotic composition. TNC's criteria for viable forest condition were: low road density with few or no bisecting roads; large regions of core interior habitat with no obvious fragmenting feature; evidence of the presence of forest breeding species; regions of old growth forest; mixed age forests with large amounts of structure or forests with no agricultural history; no obvious loss of native dominants; mid-sized or wide-ranging carnivores; composition not dominated by weedy or exotic species; no disproportional amount of damage by pathogens; and minimal spraying or salvage cutting by current owners. Matrix blocks are bounded by fragmenting features such as roads, railroads, major utility lines, and major shorelines. The bounding block features were chosen due to their ecological impact on biodiversity in terms of fragmentation, dispersion, edge-effects, and invasive species; and

- Landscape context was based on the key factors of edge-effect buffers, wide-ranging species, gradients, and structural retention. In evaluating landscape context, TNC evaluated and recorded information on the surrounding landscape context for all matrix communities. TNC generally considered areas embedded in much larger areas of forest

[480] From TNC, 2004.

> to be more viable than those embedded in a sea of residential development and agriculture. However, no area was rejected solely on the basis of its landscape context because the matrix forests in many of the poorer landscape contexts currently serve as critical habitat for forest interior species and may be the best example of the forest ecosystem type. Thus, this criterion was used to reject or accept some examples that were initially of questionable size and condition.

TNC applied the territory size and disturbance factors to all of the ecoregions in the Northeast, and tailored minimum size thresholds for matrix blocks to each ecoregion's forested extent, ecology, and natural disturbance history. The area underlain by the Marcellus Shale in New York is located in the High Allegheny Plateau (HAL) ecoregion (minimum block size of 15,000 acres), and contains 26 forest matrix blocks ranging in size from 17,000 acres to 176,000 acres, totaling 1.3 million acres. These matrix blocks are comprised of several dominant forest community types, including Northern hardwoods, maple-birch-beech forest, oak hickory forest and Allegheny oak forests.[481]

*Specific Mitigation Measures to Reduce Impacts to Forests*

In order to mitigate impacts from fragmentation of forest interior habitats, the Department proposes to require, through the permit process and/or by regulation, that surface disturbance associated with high-volume hydraulic fracturing activities in contiguous forest patches of 150 acres or more within Forest Focus Areas would be based on the findings of a site-specific ecological assessment and implementation of mitigation measures identified as part of such ecological assessment, in addition to the BMPs required for all disturbances in forested areas that are identified in Section 7.4.1.1. The ecological assessment would include pre-disturbance biological studies and an evaluation of potential impacts on forest interior birds from the project. Pre-disturbance studies would be required to be conducted by qualified biologists and would be required to include a compilation of historical information on forest interior bird use of the area and a minimum of one year of field surveys at the site to determine the current extent, if any, of forest interior bird use of the site. Should the Department decide to issue a permit after reviewing the ecological assessment, the applicant would be required to implement supplemental mitigation measures by locating the site disturbance as close to the edge of the forest patch as feasible and proposing additional mitigation measures (e.g., conservation easements, habitat

[481] TNC, 2002.

enhancement). In addition, enhanced monitoring of forest interior birds during the construction phase of the project and for a minimum period of two years following the end of high-volume hydraulic fracturing activities (i.e., following date of well completion) would be required.

**Explanation for 150-Acre Threshold:** Fragmentation of large forest blocks can negatively affect breeding birds that require interior forest habitat for successful reproduction. Fragmentation due to human development of forest openings and structures that are relatively permanent will fragment habitats, create more edge, and reduce breeding success. Human-induced openings can influence breeding bird productivity several hundred feet from the edge of the forest through increased predation and increased nest parasitism. There is a wide diversity of bird species that rely on forest interior habitats to breed. As such, patch size requirements can vary widely by species, and can be influenced by surrounding land cover as well as the amount of forest cover on the landscape. Previous research on forest interior birds suggests that the minimum forest patch size needed to support forest breeding species ranges between 100 and 500 acres.[482] A 100-acre patch size is the minimum that would probably support a relatively diverse assemblage of forest breeding birds. Additional research indicates that the negative impacts along a forest edge extend between 200-500 feet into the forest.[483] If we assume a 100-acre forest patch with a 300-foot forested buffer, the minimum patch size for forest interior birds is approximately 150 acres of contiguous forest. Patches less than 150 acres are not of optimum value to forest interior birds. The Forest Focus Areas outside the Catskill Forest Preserve cover about 6% of the area underlain by the Marcellus Shale. However, the actual impacts on Marcellus development would affect less area for two reasons. First, only those portions of the Forest Focus Areas meeting the minimum patch size requirement would be subject to the aforementioned restrictions on surface disturbance. Second, even in areas where surface disturbance should be avoided, gas deposits could be accessed horizontally from adjacent areas. Given the horizontal reach of the wells, only about 2% of the subsurface areas would not be accessible.

[482] Roberts and Norment 1999, Hoover et al. 1995, Robbins 1979.

[483] Rosenburg et al. 1999, Robinson et al. 1995.

#### *7.4.1.3 Monitoring Changes in Habitat*

The following mitigation measures are necessary to better understand and evaluate the impacts of habitat fragmentation on New York's wildlife from multi-pad horizontal gas wells and would be required as permit conditions for any applications seeking site disturbance in 150-acre portions of Forest Focus Areas and 30-acre portions of Grassland Focus Areas:

- Conduct pre-development surveys of plants and animals to establish baseline reference data for future comparison;[484]
- Monitor the effects of disturbance as active development proceeds and for a minimum of two years following well completion. Practice adaptive management as previously unknown effects are documented; and[485]
- Conduct test plot studies to develop more effective revegetation practices. Variables might include slope, aspect, soil preparation, soil amendments, irrigation, and seed mix composition.[486]

With the aforementioned measures in place, the significant adverse impacts on habitat from high-volume hydraulic fracturing would be partially addressed.

### *7.4.2 Invasive Species*

Chapter 26 of the Laws of New York, 2008, amended the ECL to create the New York Invasive Species Council[487,488] and define the Department's authority regarding control of invasive species in New York. The Council, co-lead by the Department and the Department of Agriculture and Markets (DAM), comprises the Department of Transportation (DOT), the Office of Parks, Recreation and Historic Preservation (OPRHP), the State Education Department (SED), the Department of State (DOS), the Thruway Authority, the New York State Canal Corporation, and the Adirondack Park Agency (APA).

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[484] New Mexico Dept Game & Fish, 2007.

[485] New Mexico Dept Game & Fish, 2007.

[486] New Mexico Dept Game & Fish, 2007.

[487] ECL § 9-1707.

[488] The New York Invasive Species Council supplanted the Invasive Species Task Force that was established in 2003 to explore the invasive species issue and provide recommendations to the Governor and Legislature by November 2005. The task force's findings and recommendations are summarized in the "Final Report of the New York State Invasive Species Task Force," which is available at http://www.dec.ny.gov/docs/wildlife_pdf/istfreport1105.pdf.

The role of the Council includes identifying actions to prevent the introduction of invasive species, detect and respond rapidly to control populations of invasive species, monitor invasive species populations, provide for the restoration of native species and habitats that have been invaded, and promote public education on invasive species.[489]

Additionally, a comprehensive management plan is being developed which will address all taxa of invasive species in New York, with an emphasis on prevention, early detection and rapid response, and opportunities for control and restoration to prevent future damage. In accordance with ECL §9-1705(5)(c), the plan will incorporate the approved New York State Aquatic Nuisance Species Management Plan, the Lake Champlain Basin Aquatic Nuisance Species Management Plan, and the Adirondack Park Aquatic Nuisance Species Management Plan.

The Council also prepared a report that described a regulatory system for non-native species[490] and included a four-tier system for preventing the importation and/or release of non-native animal and plant species. The system contains proposed lists of prohibited, regulated and unregulated species, and a procedure for the review of any non-native species that is not on the aforementioned lists before the use, distribution or release of such non-native species.

ECL §9-1709(2)(d) authorizes the Department to prohibit and actively eliminate invasive species at project sites regulated by the State. This responsibility falls within the purview of the Department's Division of Fish, Wildlife and Marine Resources.

#### *7.4.2.1 Terrestrial*

In order to mitigate the potential transfer of terrestrial invasive species from project locations associated with high-volume hydraulic fracturing, including well pads, access roads, and engineered impoundments for fresh water, the Department proposes that well operators be required to conduct all activities in accordance with the best management practices below. This would be reflected by a permit condition (see Appendix 10) requiring the preparation and

[489] ECL §9-1705(5)(b).

[490] Final report – A regulatory system for non-native species. New York Invasive Species Council. 10 June 2010. http://www.dec.ny.gov/docs/lands_forests_pdf/invasive062910.pdf.

implementation of an invasive species mitigation plan that would be included on all well permits where high-volume hydraulic fracturing is proposed.

*Survey for the Presence of Invasive Species*

Invasive species control is two-fold in that it involves both limiting the spread of existing invasive species and limiting the introduction of new invasive species. In order to accomplish these objectives, it is necessary to identify the types of invasive species which are present at a project site as well as map the locations and extent of any established population.

Therefore, the Department proposes to require that well operators submit, with the EAF Addendum for a single well or the first well proposed on a multi-well pad, a comprehensive survey of the entire project site, documenting the presence and identity of any invasive plant species. The survey should be conducted by an environmental consultant familiar with the invasive species in New York. This survey would establish a baseline measure of percent aerial coverage and, at a minimum, would be required to include the plant species identified on the Interim List of Invasive Plant Species in New York State.[491] A map (1:24,000) showing all occurrences of invasive species within the project site would also be required to be included with the survey as part of the EAF Addendum.

Field notes, photographs and GPS handheld equipment should be utilized in documenting any occurrences of invasive species and all such occurrences would be required to be clearly identified in the field with signs, flagging, and/or stakes prior to any ground disturbance. If the invasive species survey submitted with the EAF Addendum shows the presence of specific invasive species, consultation with the Department may be required prior to any ground disturbance.

*Preventing the Spread of Invasive Species*

- Prior to any ground disturbance, any invasive plant species encountered at the site should be stripped and removed. Cut plant materials, including roots and rhizomes, should be placed in heavy duty, 3-mil or thicker, black, contractor-quality plastic cleanup bags. The bags should then be securely tied and transported from the site to a proper disposal

[491] This list appears in Tables 6.3 and 6.4.

facility in a truck with a topper or cap, in order to prevent the spread or loss of the plant material during transport;

- Cut invasive plant species materials should not be disposed of into native cover areas;

- Machinery and equipment, including hand tools, used in invasive species affected areas would be required to be pressure-washed and cleaned with water (no soaps or chemicals) prior to leaving the invasive species affected area to prevent the spread of seeds, roots or other viable plant parts. This includes all machinery, equipment and tools used in the stripping, removal, and disposal of invasive plant species;

- Equipment or machinery should not be washed in any waterbody or wetland, and run-off resulting from washing operations should not be allowed to directly enter any water bodies or wetlands. Appropriate erosion control measures would be required be employed;

- Loose plant and soil material that has been removed from clothing, boots and equipment, or generated from cleaning operations would either be a) rendered incapable of any growth or reproduction or b) appropriately disposed of off-site. If disposed of off-site, the plant and soil material would be required to be transported in a secure manner;

*Preventing New Invasive Species Introductions*

- All machinery and equipment to be used in the construction of the proposed project location, including but not limited to trucks, tractors, excavators, and any hand tools, would be required to be washed with high pressure hoses and hot water prior to delivery to the project site to insure that they are free of invasive species;

- All fill and/or construction material (e.g. gravel, crushed stone, top soil, etc.) from offsite locations should be inspected for invasive species and should only be utilized if no invasive species are found growing in or adjacent to the fill/material source; and

- Only certified weed-free straw should be utilized for erosion control.

*Restoration and Preservation of Native Vegetation*

- Native vegetation should be reestablished and weed-free mulch should be used on bare surfaces to minimize weed germination;

- Only native (non-invasive) seeds or plant material should be used for re-vegetation during site reclamation. An appropriate native seed mixture should be selected based on pre-disturbance surveys;

- All seed should be from local sources to the extent possible and should be applied at the recommended rates to ensure adequate vegetative cover to prevent the colonization of invasive species;

- As part of site reclamation, re-vegetation should occur as quickly as possible at each project site;

- Any top soil brought to the site for reclamation activities should be obtained from a source known to be free of invasive species; and

- The site should be monitored for new occurrences of invasive plant species following partial reclamation. If new occurrences are observed, they should be treated with appropriate physical or chemical controls.

*General*

- Implementation of the above practices would be required to be in accordance with a site-specific and species-specific invasive species mitigation plan that includes seasonally appropriate specific physical and chemical control methods (e.g., digging to remove all roots, cutting to the ground, applying herbicides to specific plant parts such as stems or foliage, etc.). The invasive species mitigation plan would be required to be available to the Department upon request and available on-site for a Department inspector's review at any time that related activities are occurring;

- The well operator should assign an environmental monitor to check that all trucks, machinery and equipment have been washed prior to entry and exit of the project site and that there is no dirt or plant material clinging to the wheels, tracks, or undercarriage of the vehicles or equipment; and

- Any new invasive species occurrences found at the project location should be removed and disposed of appropriately.

#### *7.4.2.2 Aquatic*[492]

It is beneficial to the operators to implement water conservation and recycling practices because of the potential difficulties obtaining the large volumes of water needed for hydraulic fracturing. Most or all operators will recycle or reuse flowback water to reduce the need for fresh water.

It is possible that some unused fresh water may remain in a surface impoundment after drilling and hydraulic fracturing is completed. This is likely in circumstances where operators build large centralized surface impoundments to hold water for all drilling and hydraulic fracturing operations within a several mile radius. Unused water may be transported by truck or pipeline and discharged into tanks or surface impoundments for use at another drilling location. It also is possible that unused water could be transported and discharged at its point of origin with proper

[492] Alpha, 2009, p. 3-6 *et seq*., and supplemented by DEC.

approval. Either of these options avoids the transfer of invasive species into a new habitat or watershed. Precautions would be required to be implemented, especially when water is stored in surface impoundments, to preclude the transfer of invasive species into new habitats or watersheds.

Unused fresh water also could be transported to a wastewater treatment facility for processing, although this is considered unlikely given the anticipated demand for water in the drilling and hydraulic fracturing process. As detailed in Section 7.1.8.1, flowback water cannot be taken to a publicly owned treatment works without the Department's approval. Standard treatment processes at waste water treatment plants, such as dissolved air flotation, have been shown to successfully remove biological particles and sediments that might harbor invasive species; however, the safest method to avoid transfer of invasive species is to not transfer water from one water body to another.

Regulatory protections exist to reduce the potential for the transfer of aquatic invasive species. Regulations and policies of SRBC and DRBC both address the transfer, reuse and discharge of water and SRBC requires appropriate treatment to prevent the spread of aquatic invasive species. Table 7.5 is a matrix of SRBC and DRBC regulations pertaining to transfer of invasive species. The regulations are identified that specifically address the transport of invasive or nuisance aquatic species. Other regulations in Table 7.5 do not specifically relate to invasive species, but the required actions and policies nonetheless may have the effect of reducing or eliminating their transport.

The SRBC's policy is to discourage the diversion or transfer of water from the basin with the objective of conserving and protecting water resources. Additionally, the SRBC specifically requires that "any unused (surplus) water shall not be discharged back to the waters of the basin without appropriate controls and treatment to prevent the spread of aquatic nuisance species."

## TABLE 7.5
## Summary of Regulations Pertaining to Transfer of Invasive Species

| Agency | Document | Article | Regulation Summary |
|---|---|---|---|
| SRBC | Federal Register, Vol 73, No. 247, Rules and Regulations | 18 CFR Part 806.22,f,8 | All flowback and produced fluids, including brines, must be treated and disposed of in accordance with applicable state and federal law. |
| SRBC | Regulation of Projects | 18 CFR Part 806.24,b,3,c | For diversions into the SRB, must provide: (1) the source, amount, and location of the diverted water,and (2) the water quality classification, if any, of the SRBC discharge stream and the discharge location(s). (3) All applicable withdrawal or discharge permits or approvals must have been applied for or received, and must prove that the diversion will not result in water quality degradation that may be injurious to any existing or potential ground or surface water use. |
| SRBC | Regulation of Projects | 18 CFR Part 801.3,b | The SRBC will require evidence that proposed interbasin transfers of water will not jeopardize, impair or limit the efficient development and management of the SRBC's water resources, or any aspects of these resources for in-basin use, or have a significant unfavorable impact on the resources of the basin and the receiving waters of the Chesapeake Bay. |
| SRBC | Regulation of Projects | 18 CFR Part 801.3,c,1 | Allocations, diversions, or withdrawals of water must be based on (1) the rights of landholders in any watershed to use the stream water in reasonable amounts and to have the stream flow not unreasonably diminished in quality or quantity by upstream use or diversion of water; and (2) on the maintenance of the historic seasional variations of the flows into Chesapeake Bay. |
| SRBC | Regulation of Projects | 18 CFR Part 806.23,2 | The SRBC may deny or limit an approval if a withdrawal may cause significant adverse impacts to SRB water, including: lowering of groundwater or stream flow levels; rendering competing supplies unreliable; affecting other water uses; causing water quality degradation that may be injurious to any existing or potential water use; affecting any living resources or their habitat; causing permanent loss of aquifer storage capacity; or affecting low flow of perennial or intermittent streams. |
| SRBC | Federal Register, Vol 73, No. 247, Rules and Regulations | 18 CFR Part 806.22,f,6 | Flowback fluids or produced brines used for hydrofracturing must be separately accounted for, but will not be included in the daily use volume or be subject to the mitigation requirements of § 806.22 [b]. |
| SRBC | Standard Docket Conditions Contained In Gas Well **Consumptive Water Use** | * Item 10. | Unused water shall not be discharged back to the SRB waters without appropriate controls and treatment to prevent the spread of aquatic nuisance species. |
| SRBC | Regulation of Projects | 18 CFR Part 806.25,b, 4 | Industrial water users must evaluate and utilize applicable recirculation and reuse practices. |
| SRBC | Standard Docket Conditions Contained In Gas Well **Surface Water** Dockets | Item 4. (Not contained in all approvals) | Within ninety (90) days of this approval, the project sponsor shall submit a plan of study and a schedule for completion to conduct a survey and evaluate the potential impacts on the rare and protected freshwater mussels located in the Susquehanna River within the area of the withdrawal. |
| SRBC | Standard Docket Conditions Contained In Gas Well **Surface Water** Dockets | Item 5. (Not contained in all approvals) | This approval does not become effective until the SRBC is satisfied that the withdrawal has no adverse impacts to the rare and protected freshwater mussel species of concern. |
| SRBC | Standard Docket Conditions Contained In Gas Well **Surface Water** Dockets | * Item 10. | Must report the method of water transport (tanker truck or pipeline) and show that all water withdrawn from surface water sources is transported, stored, injected into a well, or discharged with appropriate controls and treatment to prevent the spread of aquatic nuisance species. |
| DRBC | Water Code 18 CFR Part 410 | 2.20.2 | The underground water-bearing formations of the DRB, their waters, storage capacity, recharge areas, and ability to convey water shall be preserved and protected. |
| DRBC | Water Code 18 CFR Part 410 | 2.20.3 | Projects that withdraw underground waters must reasonably safeguard the present and future public interest in the affected water resources. |
| DRBC | Water Code 18 CFR Part 410 | 2.20.4 | Withdrawals from DRB ground water are limited to the maximum draft of all withdrawals from a ground water basin, aquifer, or aquifer system that can be sustained without rendering supplies unreliable, causing long-term progressive lowering of ground water levels, water quality degradation, permanent loss of storage capacity, or substantial impact on low flows of perennial streams, unless the DRBC decides a withdrawal is in the public interest. In confined coastal plain aquifers, the DRBC may apply aquifer management levels, if any, established by a signatory state in determining compliance with criteria relating to "longterm progressive lowering of ground water levels." |
| DRBC | Water Code 18 CFR Part 410 | 2.20.5 | The principal natural recharge areas of the DRB shall be protected from unreasonable interference. No recharge sources (ground or surface water) shall be polluted based on water quality standards promulgated by the DRBC or any of the signatory parties. |
| DRBC | Water Code 18 CFR Part 410 | 2.20.6 | The DRB ground water resources shall be used, conserved, developed, managed, and controlled for the needs of present and future generations, so interference, impairment, penetration, or artificial recharge shall be subject to review and evaluation under the Compact. |
| DRBC | Water Code 18 CFR Part 410 | 2.10.1 | The DRBC may acquire, operate and control projects and facilities for the storage and release of waters, for the regulation of flows and DRB surface and ground water supplies, for the protection of public health, stream quality control, economic development, improvement of fisheries, recreation, pollution dilution and abatement, the prevention of undue salinity and other purposes. No signatory party may permit any augmentation of flow to be diminished by the diversion of any DRB water during any period in which waters are being released from storage by the DRBC for the purpose of augmenting such flow, except in cases where such diversion is authorized by this compact, or by the DRBC pursuant to, or by the order of a court of competent jurisdiction. |

| Agency | Document | Article | Regulation Summary |
|---|---|---|---|
| DRBC | Water Code 18 CFR Part 410 | 2.30.2 | The waters of the DRB are limited in quantity and to drought. The exportation of DRB water is discouraged. The DRB waters have limited assimilative capacity to accept substances without significant impacts. Wastewater import that would significantly reduce the assimilative capacity of the receiving DRB stream is discouraged and should be reserved for users within the DRB. |
| DRBC | Water Code 18 CFR Part 410 | 2.30.3 | Consideration of the importation or exportation of water will be conducted pursuant to this policy and include assessments of the water resource and economic impacts of the project and of all alternatives to any water exportation or wastewater importation project. |
| DRBC | Water Code 18 CFR Part 410 | 2.30.4 | The DRBC has jurisdiction over exportations and importations of water (Section 3.8 of the Compact, and inclusion within the Comprehensive Plan) as specified in the Administrative Manual - Rules of Practice and Procedure. The applicant shall address those of the items listed below as directed by the DRBC: A. efforts to develop or use and conserve outside resources; B. water resource, economic, and social impacts of each alternative, including the "no project" alternative; D. amount, timing and duration of the proposed transfer and its relationship to DRB hydrologic conditions, and impact on instream uses and downstream waste assimilation capacity; E. benefits to the DRB as a result of the proposed transfer; F. volume of the transfer and its relationship to other specified actions or Resolutions by the DRBC; G. the relationship of the transfer volume to all other diversions; H. other significant benefits or impairments to the DRB as a result of the proposed transfer. |
| DRBC | Water Code 18 CFR Part 410 | 2.30.6 | The DRBC gives no credit toward meeting wastewater treatment requirements for wastewater imported into the Delaware Basin. Wasteload allocations assigned to dischargers will not include loadings attributable to wastewater importation. |
| DRBC | Water Code 18 CFR Part 410 | 2.200.1 | DRB water quality will be maintained in a safe and satisfactory condition for...wildlife, fish and other aquatic life. |
| DRBC | Water Code 18 CFR Part 410 | 2.350.2 | The DRBC will preserve and protect wetlands by: A. minimizing adverse alterations in the quantity and quality of the underlying soils and natural flow of waters that nourish wetlands; B. safeguarding against adverse draining, dredging or filling practices, liquid or solid waste management practices, and siltation; C. preventing the excessive addition of pesticides, salts or toxic materials arising from non-point source wastes; and D. preventing destructive construction activities. |
| DRBC | Water Code 18 CFR Part 410 | 2.400.2 | The drought of record, which occurred in the period 1961-1967, shall be the basis for planning and development of facilities and programs for control of salinity in the Delaware Estuary. |
| DRBC | Water Code 18 CFR Part 410 | 3.10.3,A,1 | The DRBC maintains the quality of interstate waters, where existing quality is better than the established stream quality objectives, unless such change is justifiable as a result of necessary economic or social development or to improve significantly another body of water. The DRBC will require the highest degree of waste treatment practicable. No change will be considered which would be injurious to any designated present or future use. |
| DRBC | Water Code 18 CFR Part 410 | 3.10.3,A,2,b | There will be no measurable change in water quality except towards natural conditions in water that has high scenic, recreational, ecological, and/or water supply values. Waters with exceptional values may be classified as either **Outstanding Basin Waters (OBW) or Significant Resource Waters (SRW)**. OBW shall be maintained at their existing water quality. 2) SRW must not be degraded below existing water quality, although localized degradation of water quality may be allowed for initial dilution if the DRBC, after consultation with the state NPDES permitting agency, finds that the public interest warrants these changes, unless a mixing zone is allowed and then to the exten of the mixing zone designated as set forth in this section. If degradation of water quality is allowed for initial dilution purposes, the DRBC, will designate mixing zones for each point source and require the highest possible point source treatment levels necessary to limit the size and extent of the mixing zones. The dimensions of the mixing zone will be based upon an evaluation of (a) site specific conditions, including channel characteristics; (b) the cost and feasibility of treatment technologies; and (c) the design of the dis |
| DRBC | Water Code 18 CFR Part 410 | 3.10.3,A,2,c | 1) Direct discharges of wastewater to **Special Protection Waters (SPW)** are discouraged. New wastewater treatment facilities and substantial alterations to existing facilities that discharge directly to SPW may be approved after the applicant has evaluated all nondischarge/ load reduction alternatives and is unable to implement these alternatives because of technical and/or financial infeasibility. 2) New wastewater treatment facilities and substantial alterations to existing facilities within the drainage area of SPW may be approved after the applicant fully evaluated all natural treatment alternatives and is unable to implement them because of technical and/or financial infeasibility. **For both 1) and 2)** above, the applicant will consider alternatives to all loadings – both existing and proposed – in excess of actual loadings at the time of SPW designation. 3) New wastewater treatment facilities and substantial alterations to existing facilities discharging directly to SRW may be approved only following a determination that the project is in the public interest as that term is defined in Section 3.10.3.A.2.a.5 4) The general number, location and size of future wastewater treatment facilities discharging to OBW (if ar |
| DRBC | Water Code 18 CFR Part 410 | 3.10.3,A,2,d | Addresses emergency systems (standby power facilities, alarms, emergency management plans) for wastewater treatment facilities discharging to SPW. Emergency management plans shall include an emergency notification procedure covering all affected downstream users. The minimum level of wastewater treatment for new wastewate treatment facilities and substantial alterations to existing wastewater treatment facilities that discharge directly to OBW or SRW will be **Best Demonstrable Technology (BDT)** (See rule for chemical analyses results that define BDT.) BDT may be superseded by applicable federal, state or DRBC criteria that are more stringent. BDT for disinfection - ultraviolet light disinfection or an equivalent disinfection process that results in no harm to aquatic life, does not produce toxic chemical residuals, and results in effective bacterial and viral destruction. DRBC may approve effluent trading on a voluntary basis between point sources within the same watershed or between the same Interstate or Boundary Control Points to achieve no measurable change to existing water quality. Regulation discusses facilities within drainage areas of SPW and discharges to OBW and SRW and lists water quality control points and the analyses parameters. |
| DRBC | Water Code 18 CFR Part 410 | 3.10.3,A,2,e | 1) Projects subject to review under Section 3.8 of the Compact that are located in the drainage area of SPW must submit for approval a Non-Point Source Pollution Control Plan that controls the new or increased non-point source loads generated within the portion of the project's service area which is also located within the drainage area of SPW The plan will state which BMPs must be used to control the non-point source loads. RULE DISCUSSES trade-off plans in detail. It discusses: projects located above major |

| Agency | Document | Article | Regulation Summary |
|---|---|---|---|
| | | | surface water impoundments; projects located in municipalities that have adopted and are actively implementing non-point source/stormwater control ordinances, projects located in watersheds where the applicable state environmental agency, county government, and local municipalities are participating in the development of a watershed plan. 2) Approval of a new or expanded water withdrawal and/or wastewater discharge project will be subject to the condition that any new connection to the project system only serve an area(s) regulated by a non-point source pollution control plan which has been approved by the DRBC. 3) Future plans for SPWs non-point source control regulations |
| DRBC | Water Code 18 CFR Part 410 | 3.10.3B | DRB waters will not contain substances attributable to municipal, industrial, or other discharges in concentrations or amounts sufficient to preclude the protection of specified water uses. a. The waters shall be substantially free from unsightly or malodorous nuisances due to floating solids, sludge deposits, debris, oil, scum, substances in concentrations or combinations which are toxic or harmful to human, animal, plant, or aquatic life, or that produce color, taste, odor of the water, or taint fish or shellfish flesh. b. The concentration of total dissolved solids, except intermittent streams, shall not exceed 133 percent of background. In no case shall concentrations of substances exceed those values given for rejection of water supplies in the United States Public Health Service Drinking Water Standards. |
| DRBC | Water Code 18 CFR Part 410 | 3.10.3C | The DRBC designates numerical stream quality objectives for the protection of aquatic life for the Delaware River Estuary (Zones 2 through 5) which correspond to the designated uses of each zone. Aquatic life objectives for the protection from both acute and chronic effects are herein established on a pollutant-specific basis. (See RULE) |
| DRBC | Water Code 18 CFR Part 410 | 3.10.3D | The DRBC designates numerical stream quality objectives for the protection of human health for the Delaware River Estuary (Zones 2 through 5) which correspond to the designated uses of each zone. Stream quality objectives for protection from both carcinogenic and systemic effects are herein established on a pollutant-specific basis. (See RULE) |
| DRBC | Water Code 18 CFR Part 410 | 3.10.4,A | All wastes shall receive a minimum of secondary treatment, regardless of the stated stream quality objective. |
| DRBC | Water Code 18 CFR Part 410 | 3.10.4,B | Wastes (exclusive of stormwater bypass) containing human excreta or disease producing organisms shall be effectively disinfected before being discharged into surface bodies of water as needed to meet applicable DRBC or State water quality standards. |
| DRBC | Water Code 18 CFR Part 410 | 3.10.4,C | Effluents shall not create a menace to public health or safety at the point of discharge. |
| DRBC | Water Code 18 CFR Part 410 | 3.10.4,D | Lists discharge contaminant limits. |
| DRBC | Water Code 18 CFR Part 410 | 3.10.4,E | Where necessary to meet the stream quality objectives, the waste assimilative capacity of the receiving waters shall be allocated in accordance with the doctrine of equitable apportionment. |
| DRBC | Water Code 18 CFR Part 410 | 3.10.4,F | 1. Discharges to intermittent streams may be permitted by the DRBC only if the applicant can demonstrate that there is no reasonable economical alternative, the project is environmentally acceptable, and would not violate the stream quality objectives set forth in Section 3.10.3B.1.a. 2. Discharges to intermittent streams shall be adequately treated to protect stream uses, public health and ground water quality, and prevent nuisance conditions. |
| DRBC | Water Code 18 CFR Part 410 | 3.10.5,E | The DRBC will consider requests to modify the stream quality objectives for toxic pollutants based upon site-specific factors. Such requests shall provide a demonstration of the site-specific differences in the physical, chemical or biological characteristics of the area in question, through the submission of substantial scientific data and analysis. The demonstration shall also include the proposed alternate stream quality objectives. The methodology and form of the demonstration shall be approved by the DRBC. |
| NYSDEC | 6 NYCRR Part 608 | 608.9 | (a) Water quality certifications required by Section 401 of the Federal Water Pollution Control Act, Title 33 United States Code 1341(see subdivision (c)of this Section). Any applicant for a federal license or permit to conduct any activity, including but not limited to the construction or operation of facilities that may result in any discharge into navigable waters as defined in Section 502 of the Federal Water Pollution Control Act (33 USC 1362), must apply for and obtain a water quality certification from the department.The applicant must demonstrate compliance with Sections 301-303, 306 and 307 of the Federal Water Pollution Control Act (See RULE.) |

* Connotes the indicated regulation pertains directly to invasive or nuisance species. All other regulations reference practices, methods, and actions that are not specifically targeted at reducing or eliminating the transport of invasive species, but nonetheless may indirectly address the issue.

The DRBC controls both exportation and importation of water from the Delaware River Basin. The DRBC's Rules of Practice and Procedure state that a project sponsor (e.g., operator) may not discharge to surface waters of the basin or otherwise undertake the project (gas well) until the sponsor has applied for, and received, approval from the commission. Flow-back water cannot be taken to a publicly owned treatment works within the Delaware River Basin without the approval of the DRBC. DRBC also prohibits discharge to the waters of the basin without prior approval. These actions and policies effectively control the use, withdrawal, discharge, and transfer to water from and into the basin and reduce the potential for transfer of invasive aquatic species.

The measures and protocols adopted by the SRBC and DRBC help to address the potential for transfer of invasive species associated with water use for high-volume hydraulic fracturing. These protocols, however, are not explicit nor do they apply to the entire area subject to natural gas activities covered by this SGEIS. Thus, in addition to the requirements of SRBC and DRBC, the Department recommends that the following best management practices be instituted and incorporated into the required invasive species mitigation plan to reduce the risk of transferring invasive species from both the exportation and importation of fresh water. These best management practices target two specific pathways for the transfer of invasive species, namely the vehicles and equipment used to transfer the fresh water and the fresh water being moved between sites and/or discharged.

Best Management Practices for vehicles and equipment:

1. Inspect all vehicles and equipment including trucks, trailers, pumps, hoses, screens, gates, etc. prior to deployment to new site;

2. Drain all hoses and equipment at collection site after use;

3. Clean all mud, vegetation, organisms and debris and dispose on site if the contaminants originated at site; dispose in 3 mil trash bags and dispose in trash if contaminants were transported from another site;

4. When withdrawing water from waters at multiple surface water locations on a single water body, begin at furthest upstream collection point;

5. Before moving to another water body, decontaminate equipment that has come in contact with surface water using appropriate protocols outlined below:

    - Pressure wash with 140º F water at contact point for 3 minutes or disinfect with 200 ppm (0.5 oz/gallon) chlorine for 10 minute contact time; keep disinfection solution from entering surface waters; and

    - Dry (regardless of treatment);

6. Well operators should provide truck and equipment drivers and operators with clear instructions, inspection checklists identifying areas on the vehicles or equipment most likely to harbor invasive species, and specifications and protocols for cleaning and disinfection; and

7. Document all inspections, cleaning and disinfection activities in a log that would be required to be maintained by the well operator and made available to the Department upon request. At a minimum this log would be required to include:

    - Dates and times of all inspection and cleaning/disinfection activities;

    - Identification of the vehicles and equipment inspected and cleaned/disinfected; and

    - Information regarding the method of cleaning/disinfection.

Best Management Practices for fresh water:

1. Transport unused fresh water via truck or pipeline to other drilling locations where it can be discharged into tanks or for subsequent use; and

2. If fresh water cannot be used at another drilling location, dispose of unused fresh water over land (not in surface water or in manner that drains directly to surface water), preferably in same drainage area as collected, and using appropriate erosion control measures.

### *7.4.3 Protecting Endangered and Threatened Species*

Prospective project sites should be screened against the Department's Natural Heritage Database to determine if endangered or threatened species are known to occur within the vicinity. The best method for reducing impacts to these species is to avoid siting projects in locations and habitats known to be utilized by endangered and threatened wildlife.

Whenever possible, impacts to endangered and threatened animal species should be avoided. The process for accomplishing this is laid out below:

- As part of the EAF, the project proponent should do at least one of the following to screen the project site for potential endangered and threatened animal species:
- Request a screening from the New York Natural Heritage Program;
- Self-screen utilizing the Nature Explorer and Environmental Resource Mapper web tools on the Department's website; or
- Conduct site-specific surveys to determine if endangered and threatened animal species are present at the project site;
- If any endangered and threatened animal species are found to occur in the vicinity of the project site, the project proponent should consult with the Regional Department Natural Resources Office;
- Regional Department staff can work with project proponent to identify how species may be affected;
- Project proponent changes the location of the proposed project or otherwise modifies the project to avoid any potential "take" of a protected species identified by Department staff; and
- If the "take" of an endangered and threatened species is deemed to be unavoidable, the project proponent would be required to apply for an Incidental Take Permit.

The specific procedure for applying for the Incidental Take Permit is set forth in the Department's regulations at 6 NYCRR Part 182 and is summarized below:

- The applicant develops an endangered or threatened species mitigation plan;
- The applicant develops an implementation agreement that affirms how the mitigation plan will be accomplished;
- The Department reviews the mitigation plan and implementation agreement to determine if it meets applicable regulatory criteria; and
- If the Department approves the mitigation plan and implementation agreement and all other regulatory criteria are met, then an Incidental Take Permit can be issued, subject to the requisite SEQRA review.

The Department finds that with the implementation of the above measures, impacts on protected endangered and threatened species would be reduced.

### *7.4.4 Protecting State-Owned Land*

As discussed in Section 6.4.4, the following issues are of significant concern as they relate to State-owned forests, wildlife management areas and parklands, and the potential impacts upon them (See also Sections 6.4.1 and 7.4.1):

- Forest fragmentation: Because of their size and long-term ownership, the specified state-owned public lands are integral to providing continuous interior forest habitat conditions and are protected from industrial development. The road systems needed to conduct drilling and fracturing operations represent significant potential impacts to this important habitat type;

- Grassland fragmentation: Because of their size and long-term ownership, the specified state-owned lands are integral to providing grassland habitat conditions and are protected from industrial development. The road systems needed to conduct drilling and fracturing operations represent significant potential impacts to this important habitat type;

- Public recreation: The level of truck traffic associated with horizontal drilling and high volume hydraulic fracturing, the presence of drilling rigs and compressor complexes, and the need to light well pads during drilling and fracturing operations would be likely to create significant impacts on public recreation opportunities during the construction, drilling and fracturing phases of development; and

- Wildlife impacts: Increased light and noise levels would be likely to have significant impacts on local wildlife populations, including impacts on breeding, feeding and migration. The activities creating these impacts could take place for up to three years at any one site, depending on how many wells are drilled from a particular well pad. The local wildlife populations could take years or even decades to recover.

As an example for one natural gas reservoir that could be developed by high-volume hydraulic fracturing, State Forests, Wildlife Management Areas and State Parks comprise less than 6% of the area underlain by the Marcellus Shale in New York State. (As stated in Chapter2, drilling will not occur on Forest Preserve lands because the State Constitution prevents their being leased or sold.) Acknowledging that there will likely be physical, technological, ownership and leasing impediments to reaching all areas under State-owned forests, wildlife management areas and parklands, it is still likely that less than 3% of the Marcellus Shale formation would be rendered

unavailable by prohibiting horizontal drilling and high-volume hydraulic fracturing surface disturbance on these lands.

In order to ensure that the State fulfills the purposes for which State Forests and State Wildlife Management Areas were created, no surface disturbance associated with horizontal drilling and high-volume hydraulic fracturing would be permitted on State Forests or Wildlife Management Areas. This prohibition does not include accessing subsurface resources located within these areas from adjacent private lands. With the surface disturbance restriction in place, the Department concludes that impacts to the specified state-owned lands from high-volume hydraulic fracturing would be reduced. Current OPRHP policy would impose a similar restriction on State Parks.

## 7.5 Mitigating Air Quality Impacts

This section identifies mitigation measures which are necessary, or may be necessary, to achieve compliance with Federal and State air quality standards, State air quality guidelines and State and Federal regulations. A detailed discussion of the Department's air quality impact assessment and analysis of applicable State and Federal regulatory requirements and regional air quality considerations which give rise to these mitigation measures is presented in Section 6.5. This section focuses on the following four points. First, the section identifies pollution control measures required to ensure compliance with ambient air quality standards for criteria air pollutants and State ambient air thresholds for toxic pollutants. This information is discussed in detail in Section 6.5.2 and, therefore, is included here in summary form. Second, this section includes a more detailed discussion of pollution control techniques required pursuant to State and Federal regulations for specific pollutants, such as $NO_x$, where emissions would be affected by the type of equipment and fuel to be used. The Department will address the different approaches, including various operational scenarios and equipment which can be used to achieve compliance. Third, this section summarizes the total suite of mitigation measures for well pad operations. Fourth, this section outlines an approach to mitigate formaldehyde emissions from the compressor station.

### *7.5.1 Mitigation Measures Resulting from Regulatory Analysis (Internal Combustion Engines and Glycol Dehydrators)*

This section outlines the potential mitigation measures which would be best suited for given types of engine and fuel combinations to control $NO_x$; the use of ULSF fuel in diesel engines to control sulfur oxide emissions; and mitigation measures for glycol dehydrators. Section 7.5.2 identifies SCR as the $NO_x$ control measure recommended for diesel engines as a result of the review of manufacturer's information and current use based on the detailed dispersion modeling assessment in Section 6.5.2. In addition, based on the modeling analysis, particulate traps are deemed the control technology of choice for certain tier diesel engines. Section 7.5.3 outlines all mitigation measures deemed necessary to assure compliance with Federal and State air quality standards. State air quality guidelines and Federal and State regulations are detailed in Section 6.5.

#### *7.5.1.1 Control Measures for Nitrogen Oxides - $NO_x$*

*Control Techniques for Natural Gas Engines*

Three generic control techniques have been developed for reciprocating engines: 1) parametric controls (timing and operating at a leaner air-to-fuel ratio); 2) combustion modifications such as advanced engine design for new sources or major modification to existing sources (clean-burn cylinder head designs and pre-stratified charge combustion for rich-burn engines); and 3) post-combustion catalytic controls installed on the engine exhaust system. Post-combustion catalytic technologies include SCR for lean-burn engines, NSCR for rich-burn engines, and CO oxidation catalysts for lean-burn engines. For example, the off-site compressors will be required to use an oxidation catalyst.

*Control Techniques for 4-Cycle Rich-Burn Engines*

*Nonselective Catalytic Reduction (NSCR)* - This technique uses the residual hydrocarbons and CO in the rich-burn engine exhaust as a reducing agent for $NO_x$. In NSCR, hydrocarbons and CO are oxidized by $O_2$ and $NO_x$. The excess hydrocarbons, CO and $NO_x$ pass over a catalyst (usually a noble metal such as platinum, rhodium, or palladium) that oxidizes the excess hydrocarbons and CO to $H_2O$ and $CO_2$, while reducing $NO_x$ to $N_2$. $NO_x$ reduction efficiencies are usually greater than 90 %, while CO reduction efficiencies are approximately 90 %.

The NSCR technique is effectively limited to engines with normal exhaust oxygen levels of 4 % or less. This includes 4-stroke rich-burn, naturally aspirated engines and some 4-stroke rich-burn, turbocharged engines. Engines operating with NSCR require tight air-to-fuel control to maintain high reduction effectiveness without high hydrocarbon emissions. To achieve effective $NO_x$ reduction performance, the engine may need to be run with a richer fuel adjustment than normal. This exhaust excess oxygen level would probably be closer to 1 %. Lean-burn engines could not be retrofitted with NSCR control because of the reduced exhaust temperatures.

*Pre-Stratified Charge* - Pre-stratified charge combustion is a retrofit system that is limited to 4-stroke carbureted natural gas engines. In this system, controlled amounts of air are introduced into the intake manifold in a specified sequence and quantity to create a fuel-rich and fuel-lean zone. This stratification provides both a fuel-rich ignition zone and rapid flame cooling in the fuel-lean zone, resulting in reduced formation of $NO_x$. A pre-stratified charge kit generally contains new intake manifolds, air hoses, filters, control valves, and a control system.

*Control Techniques for Lean-Burn Reciprocating Engines*

*Selective Catalytic Reduction* (SCR) - SCR is a post-combustion technology that has been shown to effectively reduce $NO_x$ in exhaust from lean-burn engines. An SCR system consists of an ammonia storage, feed, and injection system, and a catalyst and catalyst housing. SCR systems selectively reduce $NO_x$ emissions by injecting ammonia (either in the form of liquid anhydrous ammonia or aqueous ammonium hydroxide) into the exhaust gas stream upstream of the catalyst. $NO_x$, $NH_3$, and $O_2$ react on the surface of the catalyst to form $N_2$ and $H_2O$. For the SCR system to operate properly, the exhaust gas would be within a particular temperature range (typically between 450° F and 850° F). The temperature range is dictated by the catalyst (typically made from noble metals, base metal oxides such as vanadium and titanium, and zeolite-based material). Exhaust gas temperatures greater than the upper limit (850º F) will pass the $NO_x$ and ammonia unreacted through the catalyst. Ammonia emissions, called $NH_3$ slip, are a key consideration when specifying a SCR system. SCR is most suitable for lean-burn engines operated at constant loads, and can achieve efficiencies as high as 90 %. For engines which typically operate at variable loads, such as engines on gas transmission pipelines, an SCR system may not function effectively, causing either periods of ammonia slip or insufficient ammonia to gain the reductions needed.

*Catalytic Oxidation* - Catalytic oxidation is a post-combustion technology that has been applied, in limited cases, to oxidize CO in engine exhaust, typically from lean-burn engines. As previously mentioned, lean-burn technologies may cause increased CO emissions. The application of catalytic oxidation has been shown to effectively reduce CO emissions from lean-burn engines. In a catalytic oxidation system, CO passes over a catalyst, usually a noble metal, which oxidizes the CO to $CO_2$ at efficiencies of approximately 70 % for two-stroke lean-burn engines and 90 % for 4-stroke lean-burn engines.

*Control Techniques for Diesel and Dual-Fuel Engines*

The most common $NO_x$ control technique for diesel and dual-fuel engines focuses on modifying the combustion process. However, post-combustion techniques, such as SCR and NSCR, are currently also available. Controls for CO have been partly adapted from mobile sources.

Combustion modifications include injection timing retard (ITR), pre-ignition chamber combustion (PCC), air-to-fuel ratio adjustments, and de-rating. Injection of fuel into the cylinder of a CI engine initiates the combustion process. Retarding the timing of the diesel fuel injection causes the combustion process to occur later in the power stroke when the piston is in the downward motion and combustion chamber volume is increasing. Increasing the volume lowers the combustion temperature and pressure, thereby lowering $NO_x$ formation. ITR reduces $NO_x$ from all diesel engines; however, the effectiveness is specific to each engine model. The amount of $NO_x$ reduction with ITR diminishes with increasing levels of retard.

Improved swirl patterns promote thorough air and fuel mixing and may include a pre-combustion chamber (PCC). A PCC is an antechamber that ignites a fuel-rich mixture that propagates to the main combustion chamber. The high exit velocity from the PCC results in improved mixing and complete combustion of the lean air/fuel mixture, which lowers combustion temperature, thereby reducing $NO_x$ emissions. The air-to-fuel ratio for each cylinder can be adjusted by controlling the amount of fuel that enters each cylinder. At air-to-fuel ratios less than stoichiometric (fuel-rich), combustion occurs under conditions of insufficient oxygen which causes $NO_x$ to decrease because of lower oxygen and lower temperatures. Derating involves restricting the engine operation to lower than normal levels of power production for the given application. Derating reduces cylinder pressures and temperatures, thereby lowering $NO_x$ formation rates.

SCR is an add-on $NO_x$ control placed in the exhaust stream following the engine and involves injecting ammonia ($NH_3$) into the flue gas. The $NH_3$ reacts with $NO_x$ in the presence of a catalyst to form water and nitrogen. The effectiveness of SCR depends on fuel quality and engine duty cycle (load fluctuations). Contaminants in the fuel may poison or mask the catalyst surface causing a reduction or termination in catalyst activity. Load fluctuations can cause variations in exhaust temperature and $NO_x$ concentration which can create problems with the effectiveness of the SCR system.

NSCR is often referred to as a three-way conversion catalyst system because the catalyst reactor simultaneously reduces $NO_x$, CO, and HC and the system involves placing a catalyst in the exhaust stream of the engine. The reaction requires that the $O_2$ levels be kept low and that the engine be operated at fuel-rich air-to-fuel ratios.

#### *7.5.1.2 Control Measures for Sulfur Oxides - $SO_x$*

Sulfur oxide emissions are a function of only the sulfur content in the fuel rather than any combustion variables. During the combustion process, essentially all the sulfur in the fuel is oxidized to $SO_2$. The oxidation of $SO_2$ creates sulfur trioxide ($SO_3$), which reacts with water to create sulfuric acid ($H_2SO_4$), a contributor to acid precipitation. Sulfuric acid reacts with basic substances to create sulfates, which are fine particulates that contribute to PM-10 and visibility reduction. Sulfur oxide emissions also contribute to corrosion of the engine parts.

Past communications with representatives of natural gas producer Chesapeake Energy indicated contractors that provide approximately 80% of the diesel rigs to the industry are using ultra low sulfur fuel (ULSF, 15ppm) because of the reduced availability of the alternative low sulfur fuel. Industry has identified the use of ULSF for all engines as a mitigation measure in their Information Report in response to Department requests.

The final EPA regulation at 40 CFR Part 63 Subpart ZZZZ (Engine MACT rule) described in Appendix 17 will mandate the use of ultra low sulfur fuel (ULSF). Accordingly, ULSF is being required for all engines to be used in New York Marcellus Shale activities.

#### *7.5.1.3 Natural Gas Production Facilities Subject to NESHAP 40 CFR Part 63, Subpart HH (Glycol Dehydrators)*

40 CFR Part 63, Subpart HH imposes specific control requirements on TEG dehydrator units. Area source TEG dehydration units with natural gas throughput and benzene emission rates above the cutoff levels described in Section 6.5.1.2, must be connected, through a closed vent system, to one or more emission control devices. The control devices must: 1) reduce HAP emissions by 95 % or more (generally by a condenser with a flash tank); or 2) reduce HAP emissions to an outlet concentration of 20 ppm by volume (ppmv) or less (for combustion devices); or 3) reduce benzene emissions to a level less than 1.0 Tpy. As an alternative to complying with these control requirements, pollution prevention measures, such as process modifications or combinations of process modifications and one or more control devices that reduce the amount of HAP generated, are allowed provided that they achieve the same required emission reductions.

Area source TEG dehydration units with natural gas throughput and benzene emission rates above the cutoff levels described in Section 6.5.1.2, must reduce emissions by lowering the glycol circulation rate to less than or equal to an optimum rate. The optimum rate is determined by the following equation:

$$LOPT = 1.15*3.0 \frac{\text{gal TEG}}{\text{lb } H_2O} * \frac{\{F*(I - O)\}}{\{24\text{hr/day}\}}$$

Where:
LOPT = Optimal circulation rate, gal/hr.
F = Gas flowrate (MMSCF/D).
I = Inlet water content (lb/MMscf).
O = Outlet water content (lb/MMscf).

The constant 3.0 gal TEG/lb $H_2O$ is the industry accepted rule of thumb for a TEG-to-water ratio. The constant 1.15 is an adjustment factor included for a margin of safety.

All glycol dehydrator units used at the well pad will be required to assure compliance with the 1 Tpy benzene emission limit using the above equation and necessary data and, in the event of wet gas, apply a condenser to assure such compliance.

### *7.5.2 Mitigation Measures Resulting from Air Quality Impact Assessment and Regional Ozone Precursor Emissions*

The modeling analysis conducted and described in Section 6.5.2 concluded that most of the air quality standards and ambient thresholds will be met under the operations scenarios described by industry, including certain self-imposed restrictions on these operations. For example, industry has committed to: 1) limiting the number of wells to be drilled and completed per pad and per year to a maximum of four; 2) not operate drilling and hydraulic fracturing engines simultaneously at a single well pad; and 3) limit the amount of gas to be vented and flared per well. Even with these restrictions, however, certain air quality standards and ambient thresholds are projected to be exceeded for certain pollutants and, therefore, further mitigation measures are necessary. Section 6.5.2 details the specific pollutants of concern and the associated additional mitigation measures necessary to achieve standards compliance. For the mitigation measures necessary for the drilling and hydraulic fracturing engines, the review process and analysis conducted to support the specific control techniques recommended by the Department is also detailed.

In summary, the Department has determined that the modeling results support the following conclusions for the necessary mitigations which would be necessary for ambient standards compliance:

1) In order to meet the annual benzene ambient guideline concentration (AGC) due to the glycol dehydrator emission, the stack height needs to be a minimum of 30 feet even with the benzene emission limit of 1 Tpy;

2) The gas venting has to use a minimum stack height of 30 feet if “sour” gas is encountered in order to meet the 1-hour standard for $H_2S$;

3) The off-site compressor must have a minimum stack height of 25 feet, in addition to the oxidation catalyst required by regulation, in order to meet the formaldehyde annual threshold; and

4) Certain EPA “Tier” drilling and hydraulic fracturing engines will not be allowed for use in New York Marcellus activities, while others must be equipped with particulate traps and SCR controls.

Section 6.5.2.6 details measures required for specific tiers of engines. With respect to these specific measures for engines, industry is allowed to provide alternative measures which can

demonstrate the equivalent emission reductions and standards compliance. In addition to these measures, based on the modeling results, additional controls to reduce $NO_x$ emissions might be necessary in the future to address the Ozone NAAQS SIP requirements. The full set of control measures resulting from the regulatory and modeling assessments are provided in Section 6.5.5 and are repeated in the next section for convenience.

### *7.5.3 Summary of Mitigation Measures to Protect Air Quality*

#### *7.5.3.1 Well Pad Activity Mitigation Measures*

The necessary control measures resulting from the air quality assessments will be imposed on the well pad activities through the well permitting process, as described in Section 6.5.5. Based on industry's self-imposed limitations on operations and Department's determination of conditions necessary to reduce or mitigate adverse air quality impacts from the well drilling, completion and production operations, the following restrictions must be imposed in the well permitting process:

- The diesel fuel used in drilling and hydraulic fracturing engines will be limited to ULSF with a maximum sulfur content of 15 ppm;
- Drilling and fracturing engines will not be operated simultaneously at the single well pad;
- The maximum number of wells to be drilled and completed annually or during any consecutive 12-month period at a single pad will be limited to four;
- The emissions of benzene at any glycol dehydrator to be used at the well pad will be limited to one ton/year as determined by calculations with the GRI-GlyCalc program. If wet gas is encountered, the dehydrator will have a minimum stack height of 30 feet (9.1m) and will be equipped with a control devise to limit the benzene emissions to one ton/year;
- Condensate tanks used at the well pad shall be equipped with vapor recovery systems to minimize fugitive VOC emissions;
- During the flowback phase, the venting of gas from each well pad will be limited to a maximum of 5 MMscf during any consecutive 12-month period. If "sour" gas is encountered with detected hydrogen sulfide emissions, the height at which the gas will be vented will be a minimum of 30 feet (9.1m);
- During the flowback phase, flaring of gas at each well pad will be limited to a maximum of 120 MMscf during any consecutive 12-month period;
- Wellhead compressors will be equipped with NSCR controls;

- No uncertified (i.e., EPA Tier 0) drilling or hydraulic fracturing engines will be used for any activity at the well sites;

- The drilling engines and drilling air compressors will be limited to EPA Tier 2 or newer equipment. If Tier 1 drilling equipment is to be used, these will be equipped with both particulate traps (CRDPF) and SCR controls. During operations, this equipment will be positioned as close to the center of the well pad as practicable. If industry deviates from the control requirements or proposes alternate mitigation and/or control measures to demonstrate ambient standard compliance, site specific information will be provided to the Department for review and concurrence; and

- The completion equipment engines will be limited to EPA Tier 2 or newer equipment. Particulate traps will be required for all Tier 2 engines. SCR control will be required on all completion equipment engines regardless of the emission Tier. During operations, this equipment will be positioned as close to the center of the well pad as practicable. If industry deviates from this requirement or proposes mitigation and/or alternate control measures to demonstrate ambient standard compliance, site specific information will be provided to the Department for review and concurrence.

The EAF Addendum will require information regarding stack heights. If stack heights shorter than those specified in Table 7.6 are proposed, then information must be attached to the EAF Addendum which demonstrates that other control measures will effectively prevent exceedances for the listed pollutants.

Table 7.6 - Required Well Pad Stack Heights to Prevent Exceedances

| Equipment | Pollutant | Stack Height |
|---|---|---|
| Flowback vent | $H_2S$ | 30 feet<br>NOTE: not required if previous drilling at the same pad has demonstrated that $H_2S$ is not present |
| Glycol dehydrator | Benzene | 30 feet<br>NOTE: Subpart HH compliance as described in Section 7.5.1.3 is also required. |

### *7.5.3.2 Mitigation Measures for Off-Site Gas Compressors*

As concluded in Sections 6.5.1.8 and 6.5.5, any off-site compressor "stations" will require a case by case air permit review pursuant to the Department's air permitting regulations. Thus, all necessary control measures, such as the stack height necessary to avoid exceedances of the annual formaldehyde, will be determined for each compressor during the application review

process. From the regulatory requirements described in Section 6.5.1, an oxidation catalyst will be required to reduce the emissions of CO, VOCs and formaldehyde in all instances.

## 7.6 Mitigating GHG Emissions

Potential GHG emissions are discussed in Section 6.6 for the siting, drilling and completion of 1) single vertical well, 2) single horizontal well, 3) four-well pad (i.e., four horizontal wells at the same site), and respective first-year and post first-year emissions of carbon dioxide ($CO_2$) and methane ($CH_4$) as both short tons and as carbon dioxide equivalents ($CO_2e$) expressed in short tons for expected exploration and development of the Marcellus Shale and other low-permeability gas reservoirs using high volume hydraulic fracturing. The real benefit of the emission estimates comes not with quantifying possible emissions but from the identification and characterization of likely major sources of $CO_2$ and $CH_4$ during the anticipated operations. Identification and understanding of the key contributors of GHGs allows mitigation measures and future efforts to be efficiently focused. The following sections discuss possible mitigation measures for limiting GHGs, with particular emphasis on $CH_4$ because of its Global Warming Potential (GWP).

### *7.6.1 General*

EPA's Natural Gas STAR Program is a flexible, voluntary partnership that encourages oil and natural gas companies – both domestically and abroad – to adopt cost-effective technologies and practices that improve operational efficiency and reduce emissions of $CH_4$, a potent greenhouse gas and clean energy source.[493] Natural Gas STAR partners can implement a number of voluntary activities to reduce GHG emissions from both exploration and production activities. The Department strongly encourages active participation in the program. Therefore, an example of a measure that could be included in a greenhouse gas emissions impacts mitigation plan includes:

- Proof of participation in the EPA's Natural Gas STAR Program to reduce methane emissions (see Appendices 24 and 25).[494]

[493] http://www.epa.gov/gasstar/.

[494] http://www.epa.gov/gasstar/join/index.html.

### *7.6.2 Site Selection*

Site selection directly impacts the number of rig and equipment mobilizations needed to develop a well pad or area. Well operators can limit the generation of $CO_2$ by limiting vehicle miles traveled (VMT) and fuel consumption. Examples of measures that could be included in a greenhouse gas emissions impacts mitigation plan include:

- Drilling as many wells as possible on a pad with one rig move;
- Spacing wells for efficient recovery of natural gas;
- Hydraulic fracturing as many wells as possible on a pad with one equipment move; and
- Planning for efficient rig and fracturing equipment moves from one pad to another.

### *7.6.3 Transportation*

Transportation related to sourcing of equipment and materials, including disposal, was identified as a potential contributor of $CO_2$ emissions. Well operators can limit the generation of $CO_2$ by limiting VMT and fuel consumption. Examples of measures that could be included in a greenhouse gas emissions impacts mitigation plan include:

- Sourcing personnel and equipment from locations within the State or region to minimize the travel distance;
- Using materials that are extracted and/or manufactured within the State or region to minimize the shipping distance;
- Recycling fluids at in-state facilities;
- Disposal or processing wastes at in-state facilities including disposal wells; and
- Using efficient transportation engines.

### *7.6.4 Well Design and Drilling*

Well operators can limit GHG emissions during well drilling operations by effectively designing drilling programs. Examples of measures that could be included in a greenhouse gas emissions impacts mitigation plan include:

- Extending each lateral wellbore as far as technically and legally possible to reduce the total number of wells required within a spacing unit;

- Spacing the lateral wellbores for efficient recovery of natural gas;
- Re-using drilling fluids;
- Drilling overbalanced to limit/prevent venting and/or flaring of CH4;
- Using materials with recycled content (e.g., well casing, drilling fluids);
- Using efficient rig engines;
- Using efficient air compressor engines for drilling;
- Using efficient exterior lighting;
- Ensuring all flow connections are tight and sealed;
- Flaring methane instead of venting; and
- Performing leak detection surveys and taking corrective actions.

### *7.6.5 Well Completion*

Well completion activities primarily contribute to GHG emissions from the internal combustion engines required for hydraulic fracturing and flaring operations during the flowback period. Examples of measures that could be included in a greenhouse gas emissions impacts mitigation plan include:

- Re-using flowback water;
- Using materials with recycled content (e.g., hydraulic fracturing fluids);
- Using efficient hydraulic fracturing pump engines;
- Using efficient exterior lighting;
- Limiting flaring during the flowback phase by using REC equipment (see Appendix 25);
- If allowed by the PSC, constructing gathering lines so that the first well on a pad can initially be flowed into a sales line;
- Ensuring all flow connections are tight and sealed;
- Flaring methane instead of venting; and

- Performing leak detection surveys and taking corrective actions.

Two years after the completion date of the first well drilled and completed under the SGEIS, the Department would analyze the actual usage of RECs in New York, and examine existing conditions relative to industry's development of the Marcellus Shale and other low-permeability gas reservoirs, and PSC's position on the timing of pipeline installation as discussed in Chapter 8. At the same time, the Department would evaluate a possible additional REC requirement under certain circumstances through a new supplementary permit condition for high-volume hydraulic fracturing.

### *7.6.6 Well Production*

As mentioned above, compared to any of the aforementioned operational phases, the ongoing production phase of any given well is the most significant period and contributor of GHGs, especially $CH_4$. Natural gas compressors which run virtually around-the-clock, produce both $CO_2$ and $CH_4$ emissions. Equipment required to process produced natural gas, specifically the glycol dehydrators (i.e., vents & pumps) and pneumatic devices, generate $CH_4$ emissions during normal production operations. Examples of measures that could be included in a greenhouse gas emissions impacts mitigation plan include:

- Implementing EPA's Natural Gas STAR BMPs including below;[495]
- Reducing Methane Emissions From Pneumatic Devices in the Natural Gas Industry;[496]
- Reducing Methane Emissions from compressor rod packing systems;[497]
- Reducing emissions when taking compressors off-line;[498]
- Replacing Glycol Dehydrators with Desiccant Dehydrators;[499]

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[495] http://www.epa.gov/gasstar/tools/recommended.html.

[496] http://www.epa.gov/gasstar/documents/ll_pneumatics.pdf.

[497] http://www.epa.gov/gasstar/documents/ll_rodpack.pdf.

[498] http://www.epa.gov/gasstar/documents/ll_compressorsoffline.pdf.

[499] http://www.epa.gov/gasstar/documents/ll_desde.pdf.

- Replacing gas-assisted glycol pumps with electric pumps;[500]
- Optimizing glycol circulation and installing flash tank separators in glycol dehydrators;[501]
- Using efficient compressor engines;
- Using efficient line heaters;
- Using efficient glycol dehydrators;
- Re-using production brines;
- Ensuring all flow connections are tight and sealed;
- Performing leak detection surveys and taking corrective actions;
- Using efficient exterior lighting; and
- Using solar-powered telemetry devices.

### *7.6.7 Leak and Detection Repair Program*

Because the production phase is the greatest contributor of GHGs and in an effort to mitigate VOC and methane leaks during this phase, the Department proposes to require, via permit condition and/or regulation, a Leak Detection and Repair Program would include as part of the operator's greenhouse gas emissions impacts mitigation plan which is required for any well subject to permit issuance under the SGEIS. In accordance with the corresponding plan developed by the operator to meet the Leak Detection and Repair Program's below minimum requirements, an annual report for the calendar year would be completed by March 31 of each following year. Each annual report would be retained by the site owner for a minimum period of 5 years and would be made available to the Department upon request. The report would include the inspection results of the inspections and repairs completed and an explanation for any repairs that were not completed. The report would be accompanied by the certification of a company official that all repairs completed were in accordance with company policies and the requisite plan, and include a schedule for completion of repairs for any remaining leaks identified in the

[500] http://www.epa.gov/gasstar/documents/ll_glycol_pumps3.pdf.

[501] http://www.epa.gov/gasstar/documents/ll_flashtanks3.pdf.

report. In addition, based on the leak history of a site, the report would include an evaluation and determination of the adequacy of the existing inspection procedures and schedule or a plan to modify existing procedures and/or increase the number of inspections in the current and future years. The Leak Detection and Repair Program may be modified at the operator's discretion provided it continues to meet the minimum requirements of the SGEIS.

The Leak Detection and Repair Program within the greenhouse gas emissions impacts mitigation plan would contain the following minimum requirements.

- There would be an ongoing site inspection for readily detected leaks by sight and sound whenever company personnel or other personnel under the direction of the company are on site. Anytime a leak is detected by sight or sound, an attempt at repair should be made. If the leak is associated with mandated worker safety concerns, it should be so noted in follow-up reports;

- Within 30 days of a well being placed into production and at least annually thereafter, all wellhead and production equipment, surface lines and metering devices at each well and/or well pad including and from the wellhead leading up to the onsite separator's outlet would be inspected for VOC, methane and other gaseous or liquid leaks. Leak detection would be conducted by visible and audible inspection and through the use of at least one of the following: 1) electronic instrument such as a forward looking infrared camera, 2) toxic vapor analyzer, 3) organic vapor analyzer, or 4) other instrument approved by the department;

- All components noted above that are possible sources of leaks would be included in the inspection and repair program. These components include but are not limited to: line heaters, separators, dehydrators, meters, instruments, pressure relief valves, vents, connectors, flanges, open-ended lines, pumps and valves from and including the wellhead up to the onsite separator's outlet;

- For each detected leak, if practical and safe an initial attempt at repair would be made at the time of the inspection, however, any leak that is not able to be repaired during the inspection may be repaired at any time up to 15 days from the date of detection provided it does not pose a threat to on-site personnel or public safety. All leaking components which cannot be repaired at detection would be identified for such repair by tagging. All repaired components would be re-inspected within 15 days from the date of the initial repair and/or re-repair to confirm, using one of the approved leak detection instruments, the adequacy of the repair and to check for leaks. The department may extend the period allowed for the repair(s) based on site-specific circumstances or it may require early well or well pad shutdown to make the repair(s) or other appropriate action based on the number and severity of tagged leaks awaiting repair; and

- Site inspection records would be maintained for a minimum period of 5 years. These records would include the date and location of the inspection, identification of each leaking component, the date of the initial attempt at repair, the date(s) and result(s) of any re-inspection and the date of the successful repair if different from initial attempt.

### *7.6.8 Mitigating GHG Emissions Impacts - Conclusion*

Well operators can reduce their GHG emissions through active participation in the EPA's Natural Gas STAR Program, leak detection and repair, and through effective planning and implementation of necessary activities. The Department proposes to require, as a permit condition for high-volume hydraulic fracturing that the operator construct and operate the site in accordance with a greenhouse gas emissions impacts mitigation plan that may incorporate the above practices and considers, to the extent practicable, any applicable Department policy documents. However, the impacts mitigation plan would, at a minimum, include:

- A list of GHG-related BMPs planned for implementation at the permitted well site;
- A Leak Detection and Repair Program consistent with the SGEIS;
- Required use and a description of EPA's Natural Gas STAR Best Management Practices for any equipment (e.g., low bleed gas-driven pneumatic valves and pumps) located from the wellhead to the onsite separator's outlet (Department's regulatory authority cutoff as described in Chapter 8);
- A description of planned use of reduced emissions completions, if any, including an estimate of the amount of methane that would be recovered instead of flared by the use of such; and
- A statement that upon request the operator would provide the Department with a copy of its report(s) for New York State as required under the EPA's GHG reporting rule discussed in Chapter 8. The operator would provide such to the Department upon request at any time during the period up to and including five years after the well is permanently plugged and abandoned under a Department permit. If the well is located on a multi-well pad, records would be maintained and made available during the period up to and including five years after the last well on the pad is permanently plugged and abandoned under a Department permit.

Further, partners in EPA's Natural Gas STAR Program should include proof of their participation and starting date. The operator's greenhouse gas emissions impacts mitigation plan would be available to the Department upon request.

The Department proposes to require, via permit condition, the following additional requirements:

- Gas vented through the flare stack would be ignited whenever possible. The stack would be equipped with a self-ignition device; and
- A reduced emissions completion, with minimal flaring (if any), would be performed whenever a sales line is available during completion at any individual well or the multi-well pad.

## 7.7 Mitigating NORM Impacts

### *7.7.1 State and Federal Responses to Oil and Gas NORM*[502]

Discovery of elevated concentrations of NORM levels in other areas outside of New York in the 1980s led to a series of state and private investigations of the issue. State responses to the potential of elevated oil and gas NORM range from no action (barring self-reported problems) to decisions for further study, to implementation of new formal regulations and guidance documents. NORM is not subject to direct federal regulation (except its transport) under either the AEA or LLRWPA, and exploration and production (E&P) wastes are specifically exempt from regulation under Subtitles D and C of RCRA (LA Office of Conservation, 2009); however, NORM is regulated indirectly at the federal level through potential environmental impacts to drinking water (SDWA) and cleanup of abandoned hazardous waste sites (CERCLA and NCP).

### *7.7.2 Regulation of NORM in New York State*

In New York State, the handling of radioactive material and waste is regulated. Requirements for radioactive materials licensing, excluding medical and educational uses in New York City and entities under exclusive federal jurisdiction, are in the State Sanitary Code, Chapter 1, Part 16 (10 NYCRR 16) and Industrial Code Rule 38 (12 NYCRR 38). The NYSDOH is the licensing agency, and it enforces both Part 16 and Code Rule 38. Requirements for environmental discharges, waste shipment and disposal, or environmental cleanup are regulated by the Department under its 6 NYCRR Part 380 series of regulations. Additionally, the Department's solid waste disposal regulations, Part 360, precludes disposal of wastes regulated under Part 380 in a Part 360 solid waste landfill.

[502] Alpha, 2009, p. 2-44 et seq.

Disposal of flowback waster or brine through a POTW is addressed in section 7.1.8.1.

The overall licensing requirement for radioactive material, §16.100 of the State Sanitary code states, in part, that "no person shall transfer, receive, possess or use any radioactive material except pursuant to a specific or general license issued under this Part." Exemptions to the overall requirement are listed in Part 16, Appendix 16-A. In summary, any person is exempt from the requirements to the extent that such person transfers, receives, possesses or uses products or materials containing radioactive material in concentrations and quantities not in excess of those listed in the accompanying tables. Where multiple radionuclides are present, the sum of the ratios shall not exceed unity (one).

The discharge of licensed radioactive material and processed and concentrated NORM (such as waste filters, sludges, or backwash from the treatment of flowback water or production brine) into the environment is regulated by the Department. NORM contained in flowback water or production brine may be subject to applicable SPDES permit conditions.

Analytical results from initial sampling of production brine from vertical gas production wells in the Marcellus formation have been reviewed and suggest that the potential for NORM scale buildup in pipes and equipment may require licensing of a facility. The results also indicate that production brine may be subject to discharge limitations to ensure compliance with Part 380.

Existing data from drilling in the Marcellus Formation in other States, and from within New York for wells that were not hydraulically fractured, shows significant variability in NORM content. This variability appears to occur both between wells in different portions of the formation and at a given well over time. This makes it important that samples from wells in different locations within New York State are used to assess the extent of this variability. During the initial Marcellus development efforts, sampling and analysis would be undertaken in order to assess this variability. These data would be used to determine whether additional mitigation is necessary to adequately protect workers, the general public, and environment of the State of New York.

In order to determine which gas production facilities may be subject to the licensing and environmental discharge requirements, radiological surveys and measurements are necessary

including radiation exposure rate measurements of areas of potential NORM contamination, accessible piping, tanks or other equipment that could contain NORM pipe scale buildup. Facilities that possess NORM wastes or piping, tanks or other equipment with elevated radiation levels may need a radioactive materials license. Further, any discharge of effluents into the environment would need to be tested for NORM concentrations in order to ensure compliance with regulatory requirements.

The Department proposes to require, via permit condition and/or regulation, that radiation surveys be conducted at specified time intervals for Marcellus wells developed by high-volume hydraulic fracturing completion methods on all accessible well piping, tanks, or other equipment that could contain NORM scale buildup. The surveys would be required to be conducted for as long as the facility remains in active use. Once taken out of use no increases in dose rate are to be expected. Therefore, surveys may stop until either the site again becomes active or equipment is planned to be removed from the site. If equipment is to be removed, radiation surveys would be performed to ensure appropriate disposal of the pipes and equipment. All surveys would be conducted in accordance with NYSDOH protocols. The NYSDOH's Radiation Survey Guidelines and a sample Radioactive Materials Handling License are presented in Appendix 27.

The Department finds that existing regulations, in conjunction with the proposed requirements for radiation surveys, would reduce any potential significant impacts from NORM.

## 7.8 Socioeconomic Mitigation Measures[503]

High-volume hydraulic fracturing operations would have many positive socioeconomic results in the local areas where development is expected to occur. These operations would likely result in a substantial increase in economic activity in the affected areas, as well as a substantial increase in tax revenues to the state and localities. However, as described in previous sections, this increased economic activity would also have the potential to result in adverse impacts in regions with high drilling activity, particularly acute in the short term, including localized impacts on the housing market caused by the in-migration of construction and production workforces and an

[503] Section 7.8, in its entirety, was provided by Ecology and Environment Engineering, P.C., August 2011 and was adapted by the Department.

increase in demand for certain state and local government services, resulting in increased government expenditures.

As discussed in Section 6.8, 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. Impacts that were potentially significant under the average development scenario were not as significant under the low development scenario. Similarly, impacts on population, housing, and community services are more significant when concentrated in smaller geographic areas than when incurred across broader geographic areas or statewide. The rate and concentration of development also affects the significance of impacts on visual resources, the ambient noise environment, and transportation networks.

The rate and concentration of development is related to many factors that cannot necessarily be controlled, such as the price of natural gas, input costs, the price of other energy sources, changes in technology, and the general economic conditions of state and nation, which will all affect the overall rate of development, as well as the uncertainty in the development potential of the Marcellus and Utica Shales.

Through its permitting process, the Department will monitor the pace and concentration of development throughout the state to mitigate adverse impacts at the local and regional levels. The Department will consult with local jurisdictions, as well as applicants, to reconcile the timing of development with the needs of the communities. Where appropriate the Department would impose specific construction windows within well construction permits in order to ensure that drilling activity and its cumulative adverse socioeconomic effects are not unduly concentrated in a specific geographic area.

Another way to mitigate the potential adverse impacts associated with in-migration to the region would be to actively encourage the hiring of local labor. Because natural gas exploration, drilling, and production activities typically require specialized skills, a jobs training program or apprentice program should be developed through the SUNY system (e.g., community colleges and agricultural and technical colleges) to increase the number of local residents with the requisite job skills for the natural gas industry, thereby reducing the number of workers that

would need to be hired from outside the region. Such a program would also have the benefit of reducing unemployment in these regions. A jobs training program would not eliminate the need for in-migration of skilled labor, but the program could partially offset the in-migration of workers and thus partially offset the potential housing impact from such in-migration.

## 7.9 Visual Mitigation Measures[504]

As noted, in most cases high-volume hydraulic fracturing operations would not result in significant adverse impacts on visual resources as set forth in NYSDEC DEP-00-2, "Assessing and Mitigating Visual Impacts" (NYSDEC 2000). The most significant visual impacts would result from construction of the well pad and well, and those impacts would be of short duration. Nevertheless, this section describes generic measures to address temporary adverse impacts of well site construction, development, production, and reclamation on visual resources. These measures could be undertaken in cases where well construction takes place near visually sensitive areas identified within the area underlain by the Marcellus and Utica Shales in New York State. Measures to mitigate impacts on visual resources would be generally similar, regardless of the type of visual resource or its location, and despite the need for compliance with rules, regulations, and permits promulgated by other federal, state, and/or local (town, county or regional) agencies.

The development of measures to reduce impacts on visual resources or visually sensitive areas would follow the procedures identified in NYSDEC DEP-00-2, "Assessing and Mitigating Visual Impacts" (NYSDEC 2000). These measures can generally be divided into: design and siting measures that could be incorporated during the construction, development, and production phases; maintenance measures that could be incorporated into the development and production phases; and decommissioning measures that could be incorporated into the reclamation phase. Offsetting mitigation, as opposed to avoidance and direct mitigation measures, would typically be used only as a last resort for the resolution of significant impacts on visual resources or visually sensitive areas, as determined by Department staff. These measures are discussed in greater detail in the following subsections.

[504] Section 7.9, in its entirety, was provided by Ecology and Environment Engineering, P.C., August 2011 and was adapted by the Department.

Generally, mitigation measures would be developed in consultation between Department staff and well operators and would be site-specific, or project-specific where multiple sites are a part of the project design. Depending on the location of the well pad and the resource potentially impacted, it may also be necessary to consult with additional state and federal regulatory agencies to develop measures to mitigate visual impacts on specific types of visual resources or visually sensitive areas, including but not limited to the New York State Historic Preservation Officer for NRHP-listed or -eligible historic properties; consultation with the National Park Service for National Historic Landmarks (NHLs) and National Natural Landmarks (NNLs); consultation with the U.S. Fish and Wildlife Service for National Wildlife Management Areas; consultation with the NYSDOT for state-designated Scenic Byways, etc.; and consultation with local (town, county, or regional) agencies for locally designated visual resources or visually sensitive areas that were identified on the EAF.

### *7.9.1 Design and Siting Measures*

Design and siting measures, as described in NYSDEC DEP-00-2, would typically consist of screening, relocation, camouflage or disguise, maintaining low facility profiles, downsizing the scale of a project, using alternative technologies, using non-reflective materials, and controlling off-site migration of lighting (NYSDEC 2000). These various design and siting techniques are summarized below.

- **Screening**. Screening uses natural or man-made objects to conceal other objects from view; these objects may be constructed of any material that is opaque.

- **Relocation**. Relocation consists of moving facilities or equipment within a site to take advantage of the mitigating effects of topography and/or vegetation.

- **Camouflage or disguise**. Camouflage or disguise consists of using forms, colors, materials, and patterns to minimize or mitigate visual impacts.

- **Low profiles**. The use of low profiles consists of reducing the height of on-site objects to minimize their visibility from surrounding viewsheds.

- **Downsizing**. Downsizing consists of reducing the number, areas, or density of objects on a site to minimize their visibility from surrounding viewsheds.

- **Alternative technologies**. The use of alternative technologies consists of substituting one technology for another to reduce impacts.

- **Non-reflective materials**. The use of non-reflective, materials consists of using materials that do not shine or reflect light into surrounding viewsheds.

- **Lighting**. Lighting should be the minimum necessary for safe working conditions and for public safety, and should be sited to minimize off-site light migration, glare, and 'sky glow' light pollution.

Design and siting measures are the simplest and most effective methods for avoiding, minimizing, or mitigating direct and indirect impacts on visual resources or visually sensitive areas. For example, the state has determined that surface drilling would be prohibited on state-owned land, including reforestation areas and wildlife management areas, which would include many of the types of visual resources or visually sensitive areas discussed in Section 2.3. Implementing this siting measure would result in the exclusion from surface drilling of many resources and areas that may be designated or used, in part or in whole, for their scenic qualities, thereby decreasing the potential for direct visual impacts of surface drilling on such resources or areas. The implementation of design and siting measures would also minimize indirect impacts on visual resources or visually-sensitive areas that are outside of, but in close proximity to, areas where drilling is proposed.

Additional use of design and siting measures to avoid, reduce, or mitigate visual impacts would typically be implemented during the construction, development, and production phases of a well site. These measures could be used individually or in combination as determined appropriate and feasible by Department staff and well operators.

For example, the use of multi-well pads for horizontal drilling and hydraulic fracturing is a design and siting measure that incorporates both relocation and downsizing techniques by installing more than one well in one location. The benefit of the multi-well pad is that it decreases the overall number of pads in the surrounding landscapes, which would result in the decreased potential for impacts on visual resources or visually sensitive areas during the construction, development, production, and reclamation phases.

The use of horizontal drilling and high-volume hydraulic fracturing is a design and siting measure that incorporates the use of alternative technology to extract natural gas from the prospective Marcellus and Utica Shale region. The benefit of horizontal drilling and high-

volume hydraulic fracturing is that it provides flexibility in pad location, such that well pads can be sited to avoid or minimize the potential for temporary, short-term, and long-term impacts on visual resources or visually sensitive areas during the construction, development, production, and reclamation phases (NTC 2011). Such considerations should be reflected in Department consideration of well pad applications.

The potential benefit of using camouflage or disguise as a design measure to minimize impacts on visual resources or visually sensitive areas is shown in Photo 7.1 below. This photo shows fracturing activities on a well site, a phase when well sites are almost entirely filled with on-site equipment, which represents new landscape features and results in an area that appears visually prominent in views from nearby vantage points. Although the fracturing phase of development is considered temporary and periodic (as described in Table 6.53), it would be possible to minimize visual impacts during fracturing activities that might occur in the spring, summer, or fall by requiring on-site water storage tanks (the red tanks in Photo 7.1) to be a green color to mimic surrounding conditions. This would reduce the prominence of the tanks in the surrounding landscape during seasons when visual resources or visually sensitive areas are typically visible to the greatest numbers of the viewing public.

The 2010 visual impact assessment (Upadhyay and Bu 2010) evaluated the effectiveness of implementing certain design and siting techniques as measures to mitigate visual impacts. Using aerial photograph interpretation, the authors suggested that reducing the size of the well pad (downsizing) after drilling (the development phase) was complete could result in reduced site-specific visual impacts from surrounding vantage points and that reducing the density of multiple well pads in an area could result in reduced visual impacts within a larger area or region (e.g., within a county). Their study further suggested that the following design and siting measures would avoid or minimize visual impacts from surrounding vantage points: relocating well sites to avoid ridgelines or other areas where aboveground equipment and facilities breaks the skyline; and minimizing off-site light migration by using night lighting only when necessary and using the minimum amount of nighttime lighting necessary, directing lighting downward instead of horizontally, and using light fixtures that control light to minimize glare, light trespass (off-site light migration), and light pollution (sky glow) (Upadhyay and Bu 2010).

Photo 7.1 - View of a well site during the fracturing phase of development, with maximum presence of on-site equipment. (New August 2011)

A tourism study (Rumbach 2011) prepared for the Southern Tier Central (STC) Regional Planning and Development Board suggests that visual impacts from horizontal drilling and hydraulic fracturing could be most effectively addressed during the siting and design phases by ensuring that well pads are designed and located in ways that minimize potential impacts on visual resources or visually sensitive areas to the extent practicable. The study also encourages the inclusion of visual impact mitigation conditions, developed in accordance with NYSDEC DEP-00-2, in permits when visual resources may be impacted. The study also recommends the development of a best practices manual for Department staff and the industry, which would provide information on what is expected by the Department in terms of well siting and visual mitigation, and the identification of instances where visual mitigation may be necessary. Additional recommendations included encouraging local agencies (towns, counties, and regions) to identify areas of high visual sensitivity, which may require additional visual mitigation, and to develop a feedback mechanism in the project review process to confirm the success of measures

to avoid, minimize, or mitigate visual impacts, based on the analysis of results for prior projects (Rumbach 2011).

### *7.9.2 Maintenance Activities*

The maintenance activities described in NYSDEC DEP-00-2 should be implemented to prevent project facilities from becoming "eyesores." Such measures would typically consist of appropriate mowing or other measures to control undesirable vegetation growth; erosion control measures to prevent migration of dust and/or water runoff from a site; measures to control the off-site migration of refuse; and measures to maintain facilities in good repair and as organized and clean as possible according to the type of project (NYSDEC 2000).

Maintenance activities to avoid, reduce, or mitigate visual impacts would typically be implemented during the development and production phases for well sites. Facilities should be maintained in good repair and as organized and clean as possible.

Upadhyay and Bu's visual impact assessment evaluated the effectiveness of site restoration to minimize visual impacts on surrounding landscapes. Their definition of site restoration as a mitigation measure, defined as restoring drilling pads to their original condition after drilling and hydraulic fracturing activities (i.e., the development phase) are completed, is similar in concept to the NYSDEC DEP-00-2 definition of maintenance activities as a mitigation measure. Their conclusion was that site restoration following drilling and hydraulic fracturing activities was an effective way to reduce adverse visual impacts of producing well sites within the existing landscape. With appropriate site restoration, well sites in the production phase, when activity is minimal and there are only a few relatively unobtrusive aboveground structures on site, are not prominent features within the surrounding landscape (Upadhyay and Bu 2010).

### *7.9.3 Decommissioning*

The decommissioning activities described in NYSDEC DEP-00-2 should be implemented when the useful life of the project facilities is over; these activities would typically occur during the

reclamation phase for well sites.[505] Such activities would typically consist of, at a minimum, the removal of aboveground structures at well sites. Additional decommissioning activities that may also be required include: the total removal of all facility components at a well site (aboveground and underground) and restoration of a well site to an acceptable condition, usually with attendant vegetation and possibly including recontouring to reestablish the original topographic contours; the partial removal of facility components, such as the removal or other elimination of structures or features that produce visual impacts (such as the restoration of water impoundment sites to original conditions); and the implementation of actions to maintain an abandoned facility and site in acceptable condition to prevent the well site from developing into an eyesore, or prevent site and structural deterioration (NYSDEC 2000).

The tourism study prepared for the STC (Rumbach 2011) discusses additional measures that could be implemented during the reclamation phase to mitigate visual impacts. These measures, which would be applied to all well pads, include the application of specific procedures identified in the 1992 GEIS for topsoil conservation and redistribution in agricultural districts. These procedures include stripping off and stockpiling topsoil during construction; protecting stockpiled topsoil from erosion and contamination; cutting well casings to a safe buffer depth of 4 feet below the ground surface; preparing areas before topsoil redistribution if compaction has occurred on-site; and redistributing the topsoil over the disturbed area of the former well pads during reclamation (Rumbach 2011).

### *7.9.4 Offsetting Mitigation*

The offsetting mitigation described in NYSDEC DEP-00-2 should be implemented when the impacts of well sites on visual resources or visually sensitive areas are significant and when such impacts cannot be avoided by locating the well pad in an alternate location. Per guidance in NYSDEC DEP-00-2, offsetting mitigation would consist of the correction of an existing aesthetic problem identified within the viewshed of a proposed well project. Thus, a decline in the landscape quality that would result from development of a proposed well site could, at least partially, be 'offset' by the correction. An example of offsetting mitigation might be the removal

[505] Although substantial equipment and activity would be present at well sites during the construction and development phases, such equipment and activities are temporary. Once construction and well development is completed, some activities would cease and some equipment would be removed, and these are not considered to be decommissioning activities.

of an existing abandoned structure that is in disrepair (i.e., an 'eyesore') to offset impacts from the development of a well site within visual proximity to the same sensitive visual resource (NYSDEC 2000). Offsetting mitigation should be employed only when significant improvements in visually sensitive locations can be expected at a reasonable cost (NYSDEC 2000).

## 7.10 Noise Mitigation Measures[506]

Noise is best mitigated by increasing distance between the source and the receiver; the greater the distance the lower the noise 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.

### *7.10.1 Pad Siting Equipment, Layout and Operation*

Many of the potential negative impacts of gas development depend on the location chosen for the well pad and the techniques used in constructing the access road and well site. Before a drilling permit can be issued, Department 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, Department staff will rely on Policy Guidance Document DEP-00-1, "Assessing and Mitigating Noise Impacts."

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. As described above and in more detail in Subsection 5.1.4.2, current regulations allow for a single well pad per 40-acre spacing unit, one multi-well pad per 640-acre spacing unit, or various other combinations. This provides the potential for one multi-well pad to recover the resource in the same area that could contain up to 16 single well pads.

[506] Section 7.10, in its entirety, was provided by Ecology and Environment Engineering, P.C., August 2011 and was adapted by the Department.

With proper pad location and design, the adverse noise impacts could be significantly reduced. A multi-well pad provides a platform to extract gas over a wider area than the area exploited by a single vertical well. This provides an opportunity to locate the multi-well pad away from a noise receptor and in a location where there is intervening topography and vegetation, which can reduce the noise level at the receptor location to a level below that which might result from several single-well pads in close proximity to the receptor location.

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 fracturing water is also possible by reusing water for multiple fracturing jobs. In certain instances, it also may be economically viable to transport water via pipeline to a multi-well pad.

### *7.10.2 Access Road and Traffic Noise*

As noted, high-volume hydraulic fracturing results in a greater number of heavy truck trips to the well pad compared to conventional drilling. Given the extensive trucking and associated noise involved with water transportation for high-volume hydraulic fracturing, attention should be given to the location of access road(s). Where appropriate, roads should be located as far as practicable from occupied structures and places of assembly. This would serve to protect noise receptors from noise impacts associated with trucking and road construction that could conflict with their property use.

Traffic noise mitigation measures may include modification of speed limits and restricting or prohibiting truck traffic on certain roads. Restricting truck use on a given roadway would reduce noise levels at nearby receptors, since trucks are louder than cars. However, displacing truck traffic from one roadway to another would shift noise impacts from one area to another. While reducing speeds may reduce noise levels, a reduction of at least 10 mph is needed to achieve a noticeable difference in noise level.

### *7.10.3 Well Drilling and Hydraulic Fracturing*

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.

Once the location and layout of a drilling site have been established and prior to the execution of the drilling project, noise modeling should be required using commercially available noise modeling software for any site located within 1,000 feet of a noise receptor. The software should be capable of simulating the three-dimensional outdoor propagation of sound from each noise source and account for sound wave divergence, atmospheric and ground sound absorption, and sound attenuation due to interceding barriers and topography. The effect of topography on noise propagation would be an important factor in the areas where drilling to access the Marcellus and Utica Shales would likely occur. The results of the modeling should be used by the applicant to evaluate noise levels that would be experienced at the nearest noise receptors and to develop mitigation measures for use in controlling noise levels generated during drilling and hydraulic fracturing of the well(s).

Examples of noise mitigation techniques that can be implemented as site-specific permit conditions include the following, as practicable:

- Requiring the measurement of ambient noise levels prior to beginning operations;
- Specifying daytime and nighttime noise level limits as a permit condition and periodic monitoring thereof;
- Placing tanks, trailers, topsoil stockpiles, or hay bales between the noise sources and receptors;
- Using noise-reduction equipment such as hospital-grade mufflers, exhaust manifolds, or other high-grade baffling;
- Limiting drill pipe cleaning (“hammering”) to certain hours;
- Running of casing during certain hours to minimize noise from elevator operation;

- Placing air relief lines and installing baffles or mufflers on lines;
- Limiting cementing operations to certain hours (i.e., perform noisier activities, when practicable, after 7 A.M. and before 7 P.M.);
- Using higher or larger-diameter stacks for flare testing operations;
- Placing redundant permanent ignition devices at the terminus of the flow line to minimize noise events of flare re-ignition;
- Providing advance notification of the drilling schedule to nearby receptors;
- Placing conditions on air rotary drilling discharge pipe noise, including:
    - Orienting high-pressure discharge pipes away from noise receptors;
    - Having the air connection blowdown manifolded into the flow line. This would provide the air with a larger-diameter aperture at the discharge point;
    - Having a 2-inch connection air blowdown line connected to a larger-diameter line near the discharge point or manifolded into multiple 2-inch discharges;
    - Shrouding the discharge point by sliding open-ended pieces of larger-diameter pipe over them; or
    - Rerouting piping so that unusually large compressed air releases (such as connection blowdown on air drilling) would be routed into the larger-diameter pit flow line to muffle the noise of any release;
- Using rubber hammer covers on the sledges when clearing drill pipe;
- Laying down pipe during daylight hours;
- Scheduling drilling operations to avoid simultaneous effects of multiple rigs on common receptors;
- Limiting hydraulic fracturing operations to a single well at a time;
- Employing electric pumps; and

- Installing temporary sound barriers (see Photo 7.2, Photo 7.3, and Photo 7.4) of appropriate heights, based on noise modeling, around the edge of the drilling location between a noise generating source and any sensitive surroundings. Sound control barriers should be tested by a third-party accredited laboratory to rate Sound Transmission Coefficient (STC) values for comparison to the lower-frequency drilling noise signature.

Many of these mitigation techniques have been successfully applied at wells drilled in New York

Photo 7.2 - Sound Barrier. Source: Ground Water Protection Council, Oklahoma City, OK and ALL Consulting, Tulsa OK, 2009 (New August 2011)

Source: Penn State Cooperative Extension

Photo 7.3 - Sound Barrier Installation (New August 2011)

Photo 7.4 - Sound Barrier Installation (New August 2011)

### *7.10.4 Conclusion*

As discussed in the 1992 GEIS (NYSDEC 1992), temporary, short-term noise impacts may vary, based on the presence of topographic barriers (e.g., hills) or vegetative barriers (e.g., hills, trees, tall grass, shrubs). Drilling and hydraulic fracturing 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 the operation of trucks, backhoes, tractors, and cement mixers. During hydraulic fracturing, the primary source of noise is the multiple fracturing fluid pumps operating simultaneously. In most instances, the closest receptor is the residence of the owner of the property where the well is located, and the owner will have agreed to the disturbance by entering into a voluntary lease agreement with the well operator. However, this may not always be the case, due to compulsory integration and other circumstances. Noise impacts can be reduced, when necessary, at nearby receptors (regardless of lease status) by a combination of setbacks, site layout to take advantage of existing topography, implementation of noise barriers, and special permit conditions.

The 1992 GEIS (NYSDEC 1992) indicated that there were unavoidable adverse noise impacts for those living in 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 types of noise impacts associated with horizontal drilling with high-volume hydraulic fracturing have been found to be similar to those for vertical drilling, these findings are also applicable to horizontal drilling and high-volume hydraulic fracturing. The extended time period for horizontal drilling with high-volume hydraulic fracturing, while still temporary, makes the control of noise impacts essential. Since noise control is most effectively addressed during 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 need. The Department's guidance document DEP-00-01, "Assessing and Mitigating Noise Impacts," should be utilized along with a site plan and noise modeling (when the well pad is to be located within 1,000 feet of occupied structures or places of assembly) for this purpose. In addition, the applicant is encouraged to review any applicable local land use policy documents with the understanding that NYSDEC retains authority to regulate gas development (NTC 2011).

Supplementary permit conditions for high-volume hydraulic fracturing would include the following requirements to mitigate potential noise impacts:

- Unless otherwise required by private lease agreement, the access road must be located as far as practicable from occupied structures, places of assembly, and occupied but unleased property; and
- The well operator must operate the site in accordance with a noise impacts mitigation plan consistent with the SGEIS.

The operator's noise impacts mitigation plan shall be provided to the Department along with the permit application. Additional site-specific noise mitigation measures will be added to individual permits if a well pad is located within 1,000 feet of occupied structures or places of assembly.

## 7.11 Transportation Mitigation Measures[507]

The transportation of water, hydraulic fracturing materials, and liquid wastes appears to account for well over 90% of all heavy truck traffic from a gas well over its productive life. Mitigating measures can help prevent, reduce or compensate for the potentially significant adverse impacts resulting from the increased transportation and road use related to vehicular traffic necessary for horizontal drilling and high-volume hydraulic fracturing. These are summarized by potential impact category as described in Section 6.11.

### *7.11.1 Mitigating Damage to Local Road Systems*

As discussed in Section 6.11, the majority of impacts on roads would occur on local roads near the wells. The following measures would address impacts of increased transportation, particularly by heavy trucks, on local road systems.

#### *7.11.1.1 Development of Transportation Plans, Baseline Surveys, and Traffic Studies*

The Department would require, as part of any permit application, that the applicant submit a transportation plan. The transportation plan would identify the number of anticipated truck trips to be generated by the proposed activity; the times of day when trucks are proposed to be

[507] Section 7.11, in its entirety, was provided by Ecology and Environment Engineering, P.C., August 2011 and was adapted by the Department.

operating; the proposed routes for such truck trips; the locations of, and access to and from, appropriate parking/staging areas; and the ability of the roadways located on such routes to accommodate such truck traffic. The transportation plan would also identify whether the operator has entered into a road use agreement or agreements with local governments and the condition of roads and bridges that are expected to be used by trucks directly and indirectly associated with the drilling operation. No permit should be issued until the Department and the NYSDOT are satisfied that the Transportation Plan is adequate to ensure that the traffic associated with the activity can be conducted safely and would reduce the impacts from truck traffic on local road systems to the maximum extent feasible.

It is important that the Transportation Plan evaluate pre-impact conditions so that any potential damages to roads and infrastructure can be fairly assessed. Establishing an accurate assessment of current conditions by conducting a baseline survey can be beneficial to both the local municipality and the operator; such baseline surveys should include information for local, state and interstate roads. State and interstate highways are surveyed annually and state secondary roads are surveyed every two years (NYSDOT 2010). However, local municipalities may not have the funds, equipment, or staff to survey local roads on a regular basis. Therefore, it would be the responsibility of the operator to conduct a baseline survey of local roads in accordance with methods described in the NYS traffic survey methods manual (NYSDOT 2010).

The results of a baseline survey of local road conditions should be combined with an assessment of the existing heavy truck traffic on the local roads and the relative amount of project-related traffic to develop a road condition study. This road condition study would be used to assess the proportion of the cost of road repairs that would be the responsibility of the operator. For example, if the road condition study concludes that the well operator would double the existing heavy truck traffic, and the road condition study indicates that a deterioration of pavement condition during the heavy traffic period of the project would occur, then the operator would be required to have an agreement in place to pay for the work required to repair or prevent the road deterioration.

*7.11.1.2 Municipal Control over Local Road Systems*

Under NYS highway vehicle traffic laws, local municipalities retain control over their roads, and as such, can implement measures to prevent or minimize transportation impacts. For example, NYS Vehicle and Traffic Law § 1640(a)(5) provides that, "The legislative body of any city or village, with respect to highways … in such city or village … may by local law, ordinance, order, rule or regulation … exclude trucks, commercial vehicles, tractors, tractor-trailer combinations, [and] tractor-semitrailer combinations from highways specified by such legislative body." Part 10 of this same section allows legislative bodies of a city or village to "establish a system of truck routes upon which all trucks, tractors and tractor-trailer combinations, having a gross weight in excess of ten thousand pounds are permitted to travel and operate and excluding such vehicles and combinations from all highways except those which constitute such truck route system." Part 20 of this same section allows for the establishment of weight, height, length, and width criteria, for which vehicles in excess of such standards may be excluded from highways or the setting of limits on hours of operation of such vehicles on particular city or village highways or segments of such highways. Essentially, NYS Vehicle and Traffic Law §1640(a) (5), (10), and (20) allow local governments to establish regulations pertaining to the use of city or town highways by trucks, tractor trailers, etc., and to exclude such vehicles from use of city or town highways as may be delineated by the local legislative body.

In addition to city and village ordinances or rules that may govern the use of highways within a city or village, NYS Vehicle and Traffic Law § 1650(4)(a) provides that "the county superintendent of highways of a county with respect to county roads in such county, may by order, rule or regulation: … exclude trucks, commercial vehicles, tractors, etc. in excess of designated weight, length, height and width from county highways, or set limits of hours of operation for such vehicles." This is essentially the same legislative authority given to cities and villages in Vehicle and Traffic Law §1640, except this pertains to counties. The same is true of Vehicle and Traffic Law § 1660(a) (10), (11), (17), and (28), which allow for the same exclusion of trucks, tractors, tractor-trailers, etc., as provided in the previous Articles, except that this section pertains to the authority of a town's legislative body. In addition, Town Law § 130 (7) allows for a town board, after a public hearing, to enact, amend, or repeal ordinances, rules, and

regulations pertaining to the use of streets, highways, sidewalks, and public places by pedestrians, motor and other vehicles, and restrict parking of all vehicles therein.

As noted above, municipalities would be notified of applications that indicate that high-volume hydraulic fracturing is planned. In addition, municipalities should monitor the Department's Web site for additional information regarding gas development in their areas. In light of their substantial authority over access to local roads, local governments (county, town, and village) would likely be proactive in exercising their authority under NYS highway vehicle traffic laws. This would include requiring a local road use agreement (discussed below), taking into account the required road condition study, which would provide the basis for potentially assessing fees for maintenance and improvements to local roads.

*7.11.1.3 Road Use Agreements*

As stated above in Section 7.11.1.2, local governments have the authority to enter into road use agreements with well operators, which identify where an operator may or may not drive trucks, weight limits, times of day, etc. Therefore, the owner or operator should attempt to obtain a road use agreement with the appropriate local municipality; if such an agreement cannot be reached, the reason(s) for not obtaining one must be documented in the Transportation Plan. The owner or operator would also have to demonstrate that, despite the absence of such agreement, the traffic associated with the activity can be conducted safely and that the owner or operator would reduce the impacts from truck traffic on local road systems to the maximum extent feasible.

The road use agreement would be the primary mechanism by which local governments can hold well operators accountable for damages and repairs to roads, bridges, and drainage structures that may be impacted by their excess use. When utilized appropriately, this mechanism has proven effective with wind developers in New York State.

Measures that should be part of a road use agreement or trucking plan, as appropriate, include:

- Route selection to maximize efficient driving and public safety, pursuant to city or town laws or ordinances as may have been enacted under Vehicle and Traffic Law §1640(a)(10);

- Avoidance of peak traffic hours, school bus hours, community events, and overnight quiet periods, as established by Vehicle and Traffic Law §1640(a)(20);

- Coordination with local emergency management agencies and highway departments;

- Upgrades and improvements to roads that will be traveled frequently for water transport to and from many different well sites, as may be reimbursable pursuant to ECL §23-0303(3);

- Advance public notice of any necessary detours or road/lane closures;

- Adequate off-road parking and delivery areas at the site to avoid lane/road blockage; and

- Use of rail or temporary pipelines where feasible to move water to and from well sites.

Supplementary permit conditions for high-volume hydraulic fracturing would re-emphasize that issuance of a well permit does not provide relief from any local requirements authorized by or enacted pursuant to the Vehicle and Traffic Law. Such permit conditions would also require the following:

1. Prior to site disturbance, the operator shall submit to the Department and provide a copy to the NYSDOT of any road use agreement between the operator and local municipality; and

2. The operator shall file a transportation plan, which shall be incorporated by reference into the permit; the plan will be developed by a NYS-licensed Professional Engineer in consultation with the Department and will verify the existing condition and adequacy of roads, culverts, and bridges to be used locally.

When there is no agreement, the applicant should nevertheless be guided by Environmental Conservation Law (ECL) § 23-0303(2), which provides that "this article shall supersede all local laws or ordinances relating to the regulation of the oil, gas and solution mining industries; but shall not supersede local government jurisdiction over local roads or the rights of local governments under the real property tax law." This gives local municipalities the authority to designate and enforce vehicle and traffic laws pertaining to the use of local roads by motor vehicles, including trucks engaged in activities connected to gas drilling.

#### *7.11.1.4 Reimbursement for Costs Associated with Local Road Work*

Under Highway Law § 136 (2), "a county superintendent shall establish regulations governing the issuance of highway work permits, including the fees to be charged therefor, a system of deposits of money or bonds guaranteeing the performance of the work and requirements of insurance to protect the interests of the county during performance of the work pursuant to a highway work permit." It is through this legislation that a county is able to financially mitigate impacts on roads and highways caused by roadwork associated with well development, but this law would not provide for payments for damages to roads from excess use.

### *7.11.2 Mitigating Incremental Damage to the State System of Roads*

Truck traffic on the interstate highway system and other regional roads would also suffer wear and tear due to the added traffic associated with horizontal drilling and high-volume hydraulic fracturing. Given the potentially dramatic increase in the number of large trucks and their distribution in the high-volume hydraulic fracturing region, a significant expansion in truck inspection requirements would be expected. This would require close coordination with other organizations, including local municipalities and the State Police. There is likely to be a substantial increase in oversize/overweight permitting requests, which may require additional permit staff at NYSDOT to handle these requests.

In addition, the installation of associated infrastructure, such as gas and water pipeline expansions and extensions, would require highway work permits, resulting in additional management, oversight, and inspection services by NYSDOT staff. Local municipalities would also likely see a sharp increase in their transportation-related staffing needs and budgets. These additional needs would include staff to carry out or oversee road condition surveys, traffic counts (or studies), local road and detour postings, execution of Road Use or Excess Maintenance agreements, and other activities. Personnel and resources would be necessary to monitor road conditions, manage and enforce agreements, and provide regulatory and emergency services.

State permit regulations could be developed that assess mitigation fees as a permit condition to defray some of these new costs. Other state revenue sources and mechanisms for collecting fees to address damages and wear to the state system of roads would include contributions to the

Highway and Bridge Conservation Fund, the collection of heavy vehicle registration fees, tolls and other highway use taxes, petroleum business taxes, and motor fuel taxes.

However, the revenue that is currently collected to compensate the state for damages to the state system of roads is deemed by NYSDOT to be insufficient for addressing required roadway maintenance. Thus, the added burden of the potential adverse impacts on the state system of roads associated with the proposed development of natural gas reserves using high-volume hydraulic fracturing may pose an additional financial burden on the state, which would be considered an adverse impact that may not be fully mitigated.

### *7.11.3 Mitigating Operational and Safety Impacts on Road Systems*

Where appropriate, site-specific mitigation of safety impacts would be applied to each applicant's permit. These would include, but are not limited to, the following:

- Limiting truck weight, axle loading, and weight during seasons when roads are most sensitive to damage from trucking (e.g., during periods of frost heaving and high runoff);
- Requiring the operator to pay for the addition of traffic control devices or trained traffic control agents at peak times at identified problem intersections or road segments;
- Providing industry-specific training to first responders to prepare for potential accidents;
- Road use agreements limiting heavy truck traffic to off-hour periods, to the extent feasible, to minimize congestion;
- Providing a safety and operational review of the proposed routes, which may include commitments to providing changes to geometry, signage, and signaling to mitigate safety risks or operational delays; and
- Avoiding hours and routes used by school buses.

Due to the generic nature of this analysis and the unknown road segments where these heavy- and light-duty trucks would travel, it is not possible at this time to identify specific operational and safety impacts, nor is it possible to identify operational or safety mitigation strategies for specific locations.

As noted in Section 7.8 (Socioeconomic Mitigation Measures), through its permitting process, the Department will monitor the pace and concentration of development throughout the state to

mitigate adverse impacts at the local and regional levels. The Department will consult with local jurisdictions, as well as applicants, to reconcile the timing of development with the needs of the communities. Where appropriate the Department would impose specific construction windows within well construction permits in order to ensure that drilling activity and its cumulative adverse socioeconomic effects are not unduly concentrated in a specific geographic area. Those measures, designed to mitigate socioeconomic impacts and impacts on community character, can also be employed to minimize operational and safety impacts where such impacts are identified.

### *7.11.4 Other Transportation Mitigation Measures*

High-volume hydraulic fracturing is a relatively new and evolving technology, and the industry is exploring a variety of alternatives that could substantially reduce the need for and impacts of heavy trucks. Potential future alternatives include innovative methods of hydraulic fracturing such as the use of natural gas gels, which might entirely eliminate the need for trucking water to well sites; and innovative water supply systems such as the construction of water wells serving multiple well pads via a piping system, which would reduce the need for trucking water to well sites. On-site treatment and disposition of wastes is another potential alternative that could reduce the need for trucking. For example, Chesapeake Energy has eliminated the trucking of wastes from well sites through on-site treatment and disposition in the Marcellus Shale area in Pennsylvania. If this practice were extended to other gas development companies operating in other areas with gas-producing shales, such as the Marcellus and Utica Shales in New York, it would result in similar substantial reductions in the need for trucking.

### *7.11.5 Mitigating Impacts from the Transportation of Hazardous Materials*

Preliminary data has been provided to the Department outlining the typical components of the fracturing fluids to be used in the state. The operator will provide specific information on the types and quantities of hazardous materials expected to be transported through the jurisdictions that they will be operating in and brought on site as part of the permitting process.

Specific information on the transportation of these materials is presented in Section 5.5. In summary, all fracturing fluids and additives are transported in “DOT-approved” trucks or containers. The federal Hazardous Material Transportation Act (HMTA) and Hazardous Materials Transportation Uniform Safety Act (HMTUSA) are the basis for federal hazardous

materials transportation law and give regulatory authority to the Secretary of the USDOT to enforce the regulations. These extensive regulations address the potential concerns involved in transporting hazardous fracturing additives, including loading, unloading, shipping, and packaging. These regulations are enforced by the USDOT agencies and, when followed and enforced, can mitigate risks.

The NYSDOT requires all registrants of commercial motor vehicles to obtain a USDOT number and has adopted many USDOT regulations that apply to interstate highway transportation. There are minor exceptions to these federal regulations; however, the exemptions do not directly relate to the objectives of this review. New York State regulations include motor vehicle carriers that operate solely on an intrastate basis. These carriers must comply with 17 NYCRR Part 820 (as described in Section 8.1.2.2) in addition to the applicable requirements and regulations of the Vehicle and Traffic Law and the NYS Department of Motor Vehicles. This includes regulations requiring carriers to obtain authorization to transport hazardous materials from the USDOT or NYSDOT Commissioner.

Municipalities may require trucks transporting hazardous materials to travel on designated routes, in accordance with a road use agreement; however, this would not eliminate entirely the potential for an accidental release. Depending on its size and location, a spill could have a significant adverse impact on the local community. First responders and emergency personnel would need to be aware of hazardous materials being transported in their jurisdiction and also be properly trained in case of an emergency involving these materials. Permit conditions may require the operator to provide first responder emergency response training specific to the hazardous materials to be used in the drilling process if a review of existing resources indicates such a need, and transportation plans may provide that sensitive locations be avoided for trucks carrying hazardous materials.

### *7.11.6 Mitigating Impacts on Rail and Air Travel*

The potential impacts on the rail industry would be positive. Growth in haulage, and consequently in revenues and employment, would likely occur. However, as evidenced in Pennsylvania, infrastructure would need to be improved (e.g., tracks extended, rail yards expanded, new sidings/offloading facilities provided at appropriate locations, etc.). The potential

adverse impacts of increased traffic on the existing rail facilities could be mitigated by the construction of new facilities. The majority of financing for improvements is provided by the rail companies or through partnerships and investment partnerships with major users. At the same time, there can be a significant demand for public investment as well. The variety of financing and investment instruments can be drawn from Pennsylvania's experience, for example SEDA-COG Joint Railway Authority, which financed roughly $16 million of projects in six counties through a combination of USDOT grants ($10 million), a $3.8 million PennDOT grant, and a $2.2 million public-private partnership.

## 7.12 Community Character Mitigation Measures[508]

Local and regional planning documents are important in defining a community's character and are the principal way of managing change within a community. These plans are used to guide development and provide direction for land development regulations (e.g., zoning, noise control, and subdivision ordinances) and designation of special districts for economic development, historic preservation, and other reasons.

As discussed in Chapter 3, the Department would require the applicant to prepare an EAF Addendum for gathering and compiling the information needed to evaluate high-volume hydraulic fracturing projects (≥300,000 gallons) in the context of this SGEIS and its Findings Statement, and to identify the required site-specific mitigation measures.

The EAF Addendum would be required as follows:

- With the application to drill the first well on a pad constructed for high-volume hydraulic fracturing, regardless of whether the well is vertical or horizontal;
- With the applications to drill subsequent wells for high-volume hydraulic fracturing on the pad if any of the information changes; and
- Prior to high-volume re-fracturing of an existing well.

[508] Section 7.12, in its entirety, was provided by Ecology and Environment Engineering, P.C., August 2011 and was adapted by the Department.

The EAF Addendum would require the applicant to identify whether the location of the well pad, or any other activity under the jurisdiction of the Department, conflicts with local land use laws, regulations, plans, or policies. The applicant would also be required to identify whether the well pad is located in an area where the affected community has adopted a comprehensive plan or other local land use plan and whether the proposed action is inconsistent with such plan(s).

Where the project sponsor indicates that the location of the well pad, or any other activity under the jurisdiction of the Department, is either consistent with local land use laws, regulations, plans, or policies, or is not covered by such local land use laws, regulations, plans, or policies, no further review of local land use laws and policies would be required.

In cases where a project sponsor indicates that all or part of their proposed application is inconsistent with local land use laws, regulations, plans, or policies, or where the potentially impacted local government advises the Department that it believes the application is inconsistent with such laws, regulations, plans, or policies, the Department intends to request additional information in the permit application to determine whether this inconsistency raises significant adverse environmental impacts that have not been addressed in the SGEIS.

The Department notes, that recently the New York Court of Appeals in *Matter of Wallach v. Town of Dryden et al.*, 23 N.Y.3d 728 (2014), found that ECL Section 23-0303(2) does not preempt communities with adopted zoning laws from entirely prohibiting the use of land for high-volume hydraulic fracturing. In that decision, the Court noted that: "Manifestly, Dryden and Middlefield engaged in a reasonable exercise of their zoning authority … when they adopted local laws clarifying that oil and gas extraction and production were not permissible uses in any zoning districts. The Towns both studied the issue and acted within their home rule powers in determining that gas drilling would permanently alter and adversely affect the deliberately cultivated, small-town character of their communities."

In addition, a supplemental site-specific review is required when an applicant proposes to construct a well pad on a farm within an Agricultural District when the proposed disturbance is larger than 2.5 acres. In such cases, the Department would consult with the DAM to develop

additional permit conditions, best management practice requirements, and reclamation guidelines to be followed.

Examples of the proposed Agricultural District requirements include but are not limited to the following:

- Decompaction and deep ripping of disturbed areas prior to topsoil replacement;
- Removal of construction debris from the site;
- No mixing of cuttings with topsoil;
- Removal of spent drilling muds from active agricultural fields;
- Location of well pads/access roads along field edges and in nonagricultural areas (where practicable);
- Removal of excess subsoil and rock from the site; and
- Fencing of the site when drilling is located in active pasture areas to prevent livestock access.

Implementation of these measures would lead to successful reestablishment of agricultural lands when well pads are no longer productive.

The socioeconomic, visual, noise, and transportation impacts discussed in Sections 6.8, 6.9, 6.10, and 6.11, respectively, also impact community character. To the extent that these impacts are mitigated as discussed in Sections 7.8 (Socioeconomic), 7.9 (Visual), 7.10 (Noise), and 7.11 (Transportation), impacts on community character would also be reduced to the extent that the impacts are related to community character.

## 7.13 Emergency Response Plan

There is always a risk that despite all precautions, non-routine incidents may occur during oil and gas exploration and development activities. An Emergency Response Plan (ERP) describes how the operator of the site will respond in emergency situations which may occur at the site. The procedures outlined in the ERP are intended to provide for the protection of lives, property, and natural resources through appropriate advance planning and the use of company and community

assets. The Department proposes to require supplementary permit conditions for high-volume hydraulic fracturing that would include a requirement that the operator provide the Department with an ERP consistent with the SGEIS at least 3 days prior to well spud. The ERP would also indicate that the operator or operator's designated representative will be on site during drilling and/or completion operations including hydraulic fracturing, and such person or personnel would have a current well control certification from an accredited training program that is acceptable to the Department.

The ERP, at a minimum, would also include the following elements:

- Identity of a knowledgeable and qualified individual with the authority to respond to emergency situations and implement the ERP;
- Site name, type, location (include copy of 7 ½ minute USGS map), and operator information;
- Emergency notification and reporting (including a list of emergency contact numbers for the area in which the well site is located; and appropriate Regional Minerals' Office), equipment, key personnel, first responders, hospitals, and evacuation plan;
- Identification and evaluation of potential release, fire and explosion hazards;
- Description of release, fire, and explosion prevention procedures and equipment;
- Implementation plans for shut down, containment and disposal;
- Site training, exercises, drills, and meeting logs; and
- Security measures, including signage, lighting, fencing and supervision.