

DRAFT Discussion Paper

Transportation Impacts of Potential Marcellus Shale Gas Development

COVER PLACEHOLDER

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i. Executive Summary

The purpose of this document is to provide a preliminary assessment of the nature, scope and intensity of potential transportation impacts of natural gas development in the Marcellus Shale formation for discussion purposes within the Department (NYSDOT), with staff in Governor Cuomo's office, and with the New York State Department of Environmental Conservation (NYSDEC) which is responsible for the promulgation of regulations concerning oil, gas and solutions mining in the State of New York. It is a necessary first step in initiating the dialogue among the many agencies and organizations that will need to prepare for and resolve the problems that may occur, to the greater benefits of the citizens of the State and its economy.

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

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

This Discussion Paper also concludes that the New York State Department of Transportation and local governments currently lack the authority and resources necessary to mitigate such problems. And, that if the State is to prepare for and resolve these problems it is time to establish a frank and open dialogue among the many parties involved.

1. Purpose & Introduction

The purpose of this document is to provide a preliminary assessment of the nature, scope and intensity of potential transportation impacts of natural gas development in the Marcellus Shale for discussion purposes within the Department (NYSDOT), with staff in Governor Cuomo's office, and with the New York State Department of Environmental Conservation (NYSDEC) which is responsible for the promulgation of regulations concerning oil, gas and solutions mining in the State of New York.

The New York State Department of Environmental Conservation's *Draft Supplemental Generic Environmental Impact Statement On The Oil, Gas and Solution Mining Regulatory Program* (DSGEIS) and its predecessor GEIS address the development of oil, gas and solutions wells statewide including both vertical and horizontal drilling methods. It does not focus specifically on the Marcellus Shale Gas Play. However, due to the magnitude of

potential impacts on New York State, the Marcellus Shale is the focus of this Discussion Paper.

The overall purposes of the DSGEIS is to evaluate the impacts of oil, gas and solutions mining, to identify the mitigation actions that might be used to minimize the undesirable impacts of such activities, and then to propose and/or initiate the policy, regulatory, programmatic and other actions deemed to be necessary to implement desirable mitigation. The DSGEIS does not address transportation impacts outside of truck traffic related to site specific drilling and hydro-fracking. It does not address operational impacts on safety or level of service, nor does it address transportation impacts resulting from induced development.

Further, it is critical to identify the possible nature and extent of transportation problems stemming from Marcellus development as, according to the DSGEIS (page 1-3), *"When a final generic environmental impact statement has been filed, no further SEQRA compliance is required if a subsequent proposed action will be carried out in conformance with the conditions and thresholds established for such actions in the generic environmental impact statement/"* Thus, NYSDOT and local governments may be constrained from mitigating future, potentially serious transportation impacts if they are not provided necessary recourse through the finalization of the DSGEIS and its mitigation requirements.

2. Marcellus Overview and Potential Implementation in New York

The Marcellus Shale is a black shale formation extending deep underground from Ohio and West Virginia northeast into Pennsylvania and southern New York. Figure 1 provides a map showing the extent of the Marcellus Shale formation as well as active and inactive gas wells in New York.

The DSGEIS suggests that horizontal drilling and hydraulic fracturing (generally referred to as hydro-fracking in the industry) will be the technologies applied in the Play. Horizontal drilling has been used in New York since the 1980s. A "horizontal well" is first drilled down vertically to a depth above the target gas-bearing rock formation. Special tools are then used to curve the well so that the hole is drilled horizontally within the gas-bearing rock for up to several thousand feet.

Neither the DSGEIS or DEC's website provide significant information in respect to when, where, how much and under what conditions gas development in the Marcellus Shale will occur.

How much drilling might occur?

At the moment there are 58 gas drilling permit requests pending at NYSDEC¹ but from neighboring Pennsylvania's experience we can expect a far greater number of permits to be

¹ Op cit 2

requested once regulatory issues are resolved. In 2004 the Pennsylvania Department of Environmental Protection issued fewer than 100 gas drilling permits in the Play. But, from the beginning of 2005 through the third-quarter of 2010 they issued 5,020 such permits, with the volume increasing each year.² Further, the number of wells in more highly developed shale formations has exceeded 10,000, as is the case for the Barnett Shale Play in Texas. Drilling activity has shown similar growth and in 2010 1,445 gas wells were drilled in the Marcellus formation in Pennsylvania.

New York Estimate: More than 7,000 wells. Peak annual drilling could exceed 1,200 wells. Where

might drilling occur?

Impacts of drilling will occur at both the local and regional levels. Drilling within a municipality will depend on the availability of leases at attractive locations and NYSDEC spacing regulations which currently allow 1 well / 40 acres or 1, multi-well pad per 640 acres. It is likely that multi-well sites / pads will account for the majority of development given their cost savings and greater regulatory efficiencies. Thus, it would also seem likely that several multiple-well pads could be developed in a Town; accessed by multiple routes. And, at least in the short term, concentrated development could occur in multiple communities; as suggested by the pattern of drilling which occurred in the Marcellus in Pennsylvania in 2010 (Figure 2).³

At the other end of the scale, gas development appears to occur over thousands of square miles albeit with significant concentrations in the most productive sub-areas. Therefore, it appears logical that, at least initially, development could occur in New York in Tioga, Chemung and Broome counties—counties which are adjacent to the highly developed deposits in Pennsylvania. It could, however, eventually move on to other areas in the Southern Tier.

Duration and Phasing

The DSGEIS provides estimates of from 30-40 years for the duration of the Play, with most of these estimates provided by the industry. More recent and independent analyses suggest that the estimated productive life of the shale gas wells may be considerably less, and "few will extend beyond 15 years."⁴

The limited information available suggests that development will be modest over the first two or three years. This is because continued expansion of gas development in the Pennsylvania gas play competes for development resources, as well as the need to identify

² PADEP, Bureau of Oil and Gas Management, Weekly Workload Report - 09/20/2010 to 09/24/2010.

³ PADEP, Bureau of Oil and Gas Management, Wells Drilled 2010, January to August
"Lessons from the Barnett Shale suggest caution in other shale plays", Arthur Bergman, 08/10/09

Overlap and Sequencing of activities at wells served by common routes -- Information from the DSGEIS and the industry suggests that drillers have a "string" of well sites to be developed served by local routes. Simply put, they'll build the first pad and then initiate drilling of two wells on the pad, at the same time that they'll initiate construction at a second well site. Eventually they'll be constructing well sites, drilling, fracking, and trucking waste, simultaneously, from a number of gas sites served by the same local road. If the first two wells on each pad prove fruitful, they'll return to drill and frack an additional four wells, resulting in more overlap.

Importantly, the scale of impacts will depend on the number of wells served by a road and are, thus, likely to be larger where multiple wells use common routes simultaneously or in sequence, or both. Thus, it is likely that the largest operational impacts are found not in the area of the gas wells themselves, but downstream, where trucks from multiple wells in a larger area converge on common routes to water supply sites, equipment and material staging areas and the like; or where these convergent volumes combine with medium to high existing volumes on the same route.

Figure 3 shows weekly truck trip estimates for two wells at a single well pad from construction of site access and the well pad through completion of the well based on phasing and truck data provided in the DSGEIS. There are roughly 90 daily truck trips during the peak fracking phase. However, as discussed above, overlapping development at a number of wells could easily result in daily truck volumes of 400 or more; and if water supply activities are compressed into a tighter time frame, truck volumes could exceed 1,000 per day. Further, if roads serve multiple well development areas, they could also expect higher truck volumes over a much longer period than the 6 to 8 months suggested in Figure 3.

With respect to truck traffic it is also important to understand that if development in New York mirrors that seen in other shale gas plays it will occur over 15-30 years. Since horizontal wells will generally require re-fracking, and the literature suggests this may occur from 3 to 5 times or more over the production life of a well, truck traffic will peak and be sustained for those years in which new wells are being developed at the same time that older wells are being refracked.

For discussion purposes this point is illustrated in Figure XX which illustrates a hypothetical development and refracking scenario assuming peak annual well development of 1,440 (like that experienced in Pennsylvania in 2010), full field development in 13 years, a refracking period of 5 years, and 3 fracks per well. In this example truck trip volumes from gas development average approximately 1,100,000 trips per year over a 21 year period with peak year volumes of roughly 1,500,000 trips.

The DSGEIS DID NOT assess the impacts of traffic other than large trucks. So, traffic associated with commuting, provisioning, inspection and other activities at the well sites

is not considered, nor, for that matter, is traffic associated with industry activities away from the well sites.

At the same time it is to be expected that the traffic stemming from such development will far exceed that generated by the development of the gas wells alone. For example, the DSGEIS, page 2-4 notes that cumulative growth associated with gas development is quite significant: "In Pennsylvania, where Marcellus Shale development is underway; Penn State found that the Marcellus gas industry generated \$2.3 billion in total value, added more than 29,000 jobs, and \$240 million in state and local taxes in 2008. With a substantially higher pace of development expected in 2009, economic output will top \$3.8 billion, state and local tax revenues will be more than \$400 million, and total job creation will exceed 48,000/"

Traffic volumes from such cumulative growth will be much greater than from just the activities at the well sites. For illustrative purposes and using the job creation projection of 48,000 new jobs peak hour trip generation from these new jobs might be on the order of 36,000 trips-per-hour plus-or-minus 15 %. This may be from 15-to-30 times the peak hour truck volumes generated by well development activities alone.

3. Transportation Impacts

In order to provide a preliminary assessment of potential transportation impacts resulting from Marcellus Shale gas development, we applied information learned from the Pennsylvania experience to a hypothetical scenario which involves looking at potential impacts from projected wells and well pad sites in Tioga, Broome and Chemung Counties in the context of existing highway and bridge condition, inventory data and operational conditions in these counties. The discussion which follows is based on 3 primary types of information: 1) The potential siting of 160 well pads averaging 4 wells/pad in Tioga, Chemung and Broome counties. The siting of wells was based on a visual inspection of well densities and patterns in the three abutting counties in Pennsylvania (which account for roughly 40% of the Marcellus permits issues in Pennsylvania), proximity to gas pipelines and NYSDEC well spacing regulations which stipulate a spacing of 640 acres per multiple well pad or 40 acres per well. In this case we assume multiple well pads. 2) Bridge and pavement condition data, traffic operations data, and quality of life / context information generated by NYSDOT. And, 3) data and information from PennDOT relating to the traffic impacts of gas well development and the nature and cost of impacts to specifically mitigate the local road impacts.

Given current resource levels and funding, NYSDOT does not have the capacity to plan for mitigation on local roads. This type of analysis is complex and time consuming since it would have to be done in conjunction with the owners and operators of local facilities as these entities have understanding of and access to the scope of local data required to perform this analysis.

a. Physical infrastructure Impacts
i. Bridge and Pavement

The design of modern highway infrastructure is generally based on the loading that the bridge structure or pavement will receive over its expected lifespan. In NYS, conventional pavement design is based on both the amount of traffic volume and the percentage of trucks, which equates to the expected loading. While designed for expected loads, highway infrastructure condition is sensitive to the amount of heavy truck traffic with high axle loads that traverse the facility. For example, *'an old rule-of-thumb is that pavement structural damage done by the passage of a single large truck is equivalent to that done by about 9,000 automobiles'*.⁵

Bridge structures are also sensitive to heavy truck loads. Irrespective of bridge type, either steel or concrete structures, cyclical loads stress the underlying structural material to fatigue. Concrete bridge decks, as the wearing surface for vehicles, are vulnerable to overweight trucks and the cyclical loading of legal weight trucks. Once a crack develops in the concrete from natural wear or overweight loads, the cyclical load of heavy truck traffic causes the crack to grow and cause further deterioration to the deck.

Factors affecting pavements typically include: volume of heavy truck traffic, the thickness of pavement, the width of the travel lanes, the sub-base quality and thickness, and the context of the highway, that is whether it is in a cut or fill. Historically, state highways and bridges have been built to similar standards to accommodate long distance travel. The standardization of construction methods and materials has yielded a highway system that reflects consideration of most of these factors. Local system highways and bridges are generally designed for lower traffic volumes and hence do not reflect state standards or the ability to accommodate heavy truck travel.

The impacts of heavy trucks on bridges will fall most principally on pavement and bridges that are already deficient, or not otherwise built to current standards. Figure 4 shows posted and deficient bridges in Tioga, Chemung and Broome counties. Overall there are 167 State bridges and 147 local bridges that are load posted or otherwise deficient. It is to be expected increased truck volumes stemming from development in the Marcellus will accelerate further deterioration and require the accelerated replacement of state and local pavement and bridges.

Figure 5 depicts State roads with pavement scores of 6 or below. Facilities with pavement scores of 6 warrant consideration of maintenance or reconstruction. As with bridges, increased truck volumes on pavements resulting from development in the Marcellus will accelerate

⁵ <http://dot.state.ak.us/stwddes/desmaterials/assets/pdf/pvmtdesign/ch6.pdf>

further deterioration and accelerate maintenance and/or very expensive and potentially disruptive reconstruction requirements.

For this discussion we are using a planning level assumption that 3 to 5 percent of State bridges will require repair projects added to the capital program each year, as will 5 to 10 percent of local bridges. We're similarly assuming that 3-5 percent of State roads with pavement scores of 6 or lower will require repair projects added to the capital program.

Because local roads are typically built to lower standards than State roads they can expect a sustained significant if not dramatic increase in maintenance and replacement costs from Marcellus Shale development. And, indeed, as demonstrated in Pennsylvania that has occurred and continues to be dramatic. Based on information provided by PennDOT it is possible that somewhere between 200 and 400 miles of local road were improved or reconstructed in 2010 alone. Similar scale impacts are possible in New York.

b. Operational

NYSDOT considers a number of operational variables when determining the need for and type of mitigation to address transportation impacts. These variables include impact on safety (crashes), level-of-service, travel time (delay), conflicts with other travel modes, and impacts to the developed and undeveloped environments.

Evaluating and mitigating the operational impacts of gas development in the Marcellus Shale region presents special problems, however, as large, heavy trucks create unique operational problems. For example, the introduction of large trucks into the traffic stream has a substantially greater impact than a similar volume of smaller vehicles or passenger cars. As the proportion of trucks increases the impacts grow at an even faster rate. Matters are made worse if the road is not already designed to handle heavy trucks.

Short-term impacts may be large but episodic; meaning truck traffic from the development of a string of wells can last for 4-8 months and then disappear, only to reappear 4 to 6 years later when the wells are refracked. Many longer term and regional impacts may occur remotely; that is geographically removed from the "source" of the impact. Streams of trucks from a wide area may converge on a common route such as arterial links to interstates providing access to major waste disposal facilities or large well service companies.

Figure 6 illustrates the problem noted above. It shows Priority Investigation Locations (PILs), areas where there are known accident locations, and high traffic volumes (Vehicle/Capacity ratios of 0.8 or greater). The majority of these are on I-81 and NY Route 17 around Binghamton. These expressways appear to be logical routes for waste trucking from the Marcellus. At some point, an infusion of large numbers of heavy trucks on these highways could create the need for costly capacity and safety improvements. However, the wells themselves, which are the actual sources of the truck traffic, are likely to be widely distributed and remotely located from the problem areas in need of operational mitigation.

An additional consideration in evaluating mitigation requirements for operational impacts relates to the need to consider the impacts of induced development which, as noted earlier, could generate up to 36,000 peak hour trips. Although these trips will be distributed around the Marcellus Region, there is little doubt that communities with major service and staging areas (such as the Town of Horseheads) and housing and commercial venues will see traffic growth whose impacts will necessitate operational improvements. There is, however, no existing regulatory authorization to mitigate the impacts of cumulative development.

Given the wide variety of potential impacts and mitigation costs associated with each type of impact, it is not possible to develop an accurate quantified estimate of mitigation needs. Applying professional judgment comparing the Pennsylvania experience to what could occur in New York, leads us to conclude that Marcellus Region-wide mitigation costs could range from an average of \$6-to-15 million per year. The upper estimate assumes that at least two projects in excess of \$50 million each will be warranted over the 20-30 year life of the Marcellus Shale gas play.

c. Necessary or Desirable Fixes

There are a variety of other conditions that could inhibit truck routing alternatives by gas developers in the Marcellus. As suggested by experience in Pennsylvania there will be cases where improvement of these conditions will enable the selection of "least cost", "smallest impact" or safest routes. Examples of these include the following:

- Sight distance improvements including the removal of trees and vegetation or the relocation of signs
- Realignment of skewed intersections
- Drainage improvements increasing the stability (and lifetime) of roads
- Increased storage for turning traffic at interchanges and intersections
- Necessary elimination of choke points along north/south state routes accessed from Route 17 that travel through the villages of Owego, Waverly and Endicott

The costs of such improvements can range from \$10,000 for minor sight distance improvements, through \$150,000 for minor realignments, up to \$1-million or more for increased storage at interchanges. The responsibility for such fixes can be assigned and charged to individual or multiple gas developers. NYSDOT should explore potential methods to recoup these costs.

d. Quality of Life

Given existing information there is no direct manner of determining the potential quality-of-life impacts resulting from truck traffic caused by gas development in the Marcellus. However, experience with the Finger Lakes Truck Study provides an example of how increased truck volumes can affect local quality of life and result in a demand for mitigation. This example demonstrates how truck traffic can create substantial public and political controversy and generate intense efforts to address the impacts.

In 2008, NYSDOT examined issues of regional concern in the Finger Lakes area resulting from the impact of the Seneca Meadows Landfill expansion near Waterloo. The expansion was expected to generate an additional 185 large truck trips per day. Many of the large trucks utilized a combination of freeways, conventional two lane state highways and local routes in order to minimize travel time, mileage and/or tolls.

The expected increase in large truck volume through the many villages of the Finger Lakes region was perceived to create numerous adverse impacts including increases in accidents, noise pollution, emissions and wear on infrastructure. These impacts would reduce the quality of life in many communities and would also impact tourism and thus have a negative effect on the area's economy.

In order to mitigate the adverse impacts, NYSDOT proposed an elaborate truck routing regulation, involving seven state highways, in order to keep large trucks on the National Highway System and away from the many communities in the Finger Lakes Region.

Due to the controversy surrounding the proposed regulation, the volume of negative feedback received, and the results of an environmental assessment, it was finally determined the regulation should not be implemented. Other measures were undertaken to mitigate the problem. Seneca Meadows Landfill agreed to include language in all new delivery contracts requiring large trucks to minimize the use of secondary highways. Additionally, NYSDOT restricted oversize hauling permits in the Finger Lakes region, increased truck inspections off the interstates in the region, and agreed to make traffic calming improvements in a number of Finger Lakes communities. A Trucking Industry and Community Relations Task Force was also formed to evaluate and monitor the effect of NYSDOT efforts and to make recommendations on actions to reduce truck traffic impacts in the area.

It is probable that truck traffic stemming from Marcellus development will create similar if not greater local concern as the conditions resulting from such development will be much more severe and widely distributed. Local truck volumes may increase by at least 5-times or more than was generated by expansion of the Seneca Landfill. Truck traffic will pass through sensitive areas on a twenty-four hour basis. Gas development will take place over a much larger geographic area and consequently is likely to affect more communities than was experienced in the Finger Lakes Study. And, these conditions will reoccur periodically as refrackings are initiated.

e. Other Considerations

Gas development in the Marcellus Shale will affect a wide array of programs and functions within NYSDOT. These have largely not been explored in developing this *Discussion Draft* but should be considered in future efforts as they will require additional resources and may well need some expansion of their authority. Examples of these include the following.

Hazardous Materials: The fracants used in gas drilling contain a variety of acids and other materials. Given the potential number of trucks that may be carrying hazardous materials it would appear highly desirable to expand training for first responders from both State and Local agencies and organizations.

Enforcement: Given the potentially dramatic increase in the number of large trucks and their distribution around the Marcellus Shale region a significant expansion in truck inspection needs should be anticipated. This will need close coordination with other organizations such as the State Police.

Permitting: There is likely to be a substantial increase in oversize/overweight permitting requests: e.g. one PennDOT region experienced a 100 percent increase in such permitting. Additional permit staff will be required to handle this requirement.

4. Financial Considerations

a. Background

New York's transportation infrastructure is aging, subject to harsh weather conditions, heavily used and in need of modernization. The number of facilities that will require major investment in rehabilitation or replacement is growing at a rate that outpaces current funding. In 2007, NYSDOT undertook a statewide assessment of its 20 year capital needs and determined that \$175 billion (in 2007 dollars) would be needed to fully address all current and expected highway and non-MTA transit needs over this period. To accomplish this would require at least a doubling of NYSDOT's current level of Federal and State funding.

NYSDOT is faced with very difficult funding prospects for the next several years: the current Federal multi-year program bill expired on September 30, 2009 and national fiscal issues may delay Congressional approval of a new bill for several years. Of major concern is the potential insolvency of the Highway Trust Fund which has used gas tax revenues to fund highway and transit improvements since 1956. Similarly, NYS's key highway and bridge transportation fund source, the Dedicated Highway and Bridge Trust Fund (DHBTF) must now rely on substantial transfers from the General Fund. Debt service needs are expected to consume 75% of the DHBTF's revenues in SFY 2012-13. Lastly, the 2005 transportation bond is being phased out with the completion of funded projects.

As the backlog of capital needs increases, more of the state's limited maintenance funding is directed to demand (emergency) maintenance for repairs to keep bridges in service and these

are being programmed at a higher priority than pavement maintenance needs. Despite past investments, New York ranks near the bottom of the 50 states on bridge and pavement conditions. Preservation of the existing infrastructure requires such a large and currently unavailable investment level that little funding can be devoted to projects to expand highway capacity and promote economic development (less than 10% of the current program).

b. Financing Needs to Mitigate the Transportation Impacts of Marcellus Shale Development

The impacts of Marcellus Shale gas development on State transportation financing needs is likely to be profound as illustrated by the rough estimates provided in Table XX. The incremental costs to mitigate Marcellus impacts for the State range from \$90-million to \$156 million per year. The estimate costs for local roads and bridges range from \$121-million to \$222-million per year, some of which may well flow from the State Transportation Budget.

The 20-year aggregate costs are not simply multiples of the annual estimates provided in Table XX, they are likely to be substantially less, for two principle reasons. First, the percentage of roads and bridges accelerating into needed repair will decline over time. And second the mileage of local roads requiring maintenance or reconstruction will decline sharply in out-years as development falls and the need for such treatments during refracking periods is also reduced by the construction of higher quality roads during initial development.

The rationale for these estimates is as follows. For the three target counties we are making a planning level assumption that three to five percent of State bridges will require repair projects added to the capital program each year, as will 5 to 10 percent of local bridges. The replacement cost for such bridges are assumed to be the average replacement cost for the set of state and state of local bridges, respectively. Similarly three to five percent of State roads with pavement scores of 6 or lower will require repair projects added to the capital program. The estimated average maintenance and replacement cost is estimated at \$512,000 per mile. The costs for Operational and Desirable Fixes are based on professional judgment. They also assume the need for such actions will stem from both truck traffic and much higher volumes of traffic resulting from cumulative development.

There are no authoritative sources detailing local road maintenance and replacement costs stemming from Marcellus development. However, verbal reports from industry representatives indicate costs at the following levels: i) \$191-million in road investment by 2 companies in 2010 alone and ii) \$411-million to rebuild local roads over a 3 year period. Such costs will depend primarily on the number of well pads built and wells fracked in any year, thus they will small as drilling commences and large when drilling and fracking peaks.

The estimate for costs of implementing an Excess Maintenance Agreement (EMA) program is based on 2 factors. First, the \$6-million annual cost estimated by PennDOT. And second, the fact that the mileage of local roads likely to be covered by an EMA program may be 2-to-4 times greater than is treated by PennDOT.

5. Transportation Mitigation

a. Local Road Impacts

i. PA's Experience and Approach

PennDOT owns and maintains approximately 25,000 bridges and 40,000 miles of roads. Secondary roads (what NYSDOT considers local roads and does not have maintenance responsibility for) comprise over half of that mileage. Secondary roadways, typically serving rural areas, do not have sufficient strength to withstand the large amount of trucks and other vehicles needed to drill. Understandably, PennDOT reports the rapid deterioration of secondary roads with damage in the range of minor surface issues to completely undermining the roadway base. Additionally, the sudden increase in heavy truck traffic has caused deterioration of several bridge structures.

PennDOT has instituted a formal process to mitigate the deterioration of existing road and bridge conditions due to heavy truck traffic resulting from well drilling activities and to recover all costs associated with the damage being caused. The Agency's approach to achieve the goal of no net deterioration is based on both internal and external actions.

PennDOT protected the secondary roadways from heavy vehicle damage by posting for 10-ton weight limits. The agency has posted approximately 3,500 miles of road miles in the districts located in the Marcellus shale play at a 10 ton limit. (FIGURE map of posted roads) Proposed users hauling on the posted highways must enter into an excess maintenance agreement (EMA). A security instrument (typically a bond), is offered by the user as a guarantee that the highway will maintained during use and any damage is repaired or reconstruction if necessary. At the present time, 2,437 miles of roadway are bonded for \$125 million.

To date there is no direct estimate of the mileage of roads which have been improved, maintained or rebuilt since the inception of the Excess Maintenance effort, but the magnitude of the impacts and requirements are significant, as illustrated by the following:

- According to PennDOT 1,100 miles of bonded roads are estimated to have been damaged, roughly 33% of the posted-road mileage.
- Industry representatives report that 2 companies spent over \$190-million in road maintenance or replacement in the Marcellus in 2010. (Over 20 companies are operating in the Marcellus in Pennsylvania.)

To recover the costs associated with needed improvements, PennDOT is conducting a cost recovery analysis to identify items and fees that can be charged to the industry. Increased permit fees, revisions to the Excess Maintenance Agreement, increased bond amounts and industry credits are all being reviewed. To that end, the PennDOT cost summary for one year stands at \$6.13M with \$4.6 being directly recoverable. (FIGURE TABLE Showing

PennDOT cost breakdown)

PennDOT has also found it necessary to reassign existing agency staff and ask them to handle the additional tasks associated with mitigation. Construction oversight and enforcement of the Excess Maintenance Agreements are additional requirements of the agency staff. Additional staff has been allocated to complete roadway posting, pre-bonding surveys and to monitor and perform road condition surveys. Each posted road is visited every week. At present over 60 full-time staff are assigned exclusively to Marcellus efforts. Yet, the agency reports that "even more staff are needed to effectively handle the required permitting and enhanced tracking and reporting needed to match the Marcellus Shale Industry growth while also ensuring roadway safety and service".

Appendix A contains excerpts from a PennDOT presentation to FHWA providing additional details on its Excess Maintenance Program.

Although built for heavy loads, main traffic routes are still left vulnerable to the increased heavy vehicle traffic as significant increases in truck volume is prematurely deteriorating the roadways and shortening the life cycle of the pavement. Posting main traffic routes is not a desired option for PennDOT as these roadways serve as major travel arteries across the Commonwealth. PennDOT acknowledges that the repairs and cost recovery for this deterioration remains unaddressed.

ii. NYSDOT's Role in Mitigating Local Road Damage

NYSDOT is generally responsible for higher volume highways and bridges that connect municipalities and local governments are generally responsible for lower volume roads that serve their own jurisdiction. Simply put, for local roads, NYSDOT has no role at present beyond providing available data and assistance if requested. The Department lacks both jurisdiction and the resources required to mitigate local roads damaged or destroyed by gas development in the Marcellus Shale region. If NYSDOT is to play a role in mitigation similar to that of PennDOT in Pennsylvania it would appear that that both legislative / policy actions as well as additional resources would be necessary, as shown below. Areas where state legislation and funding increases would be needed are:

- Authorization to apply and enforce local road postings.
- Authorization to enter into local road maintenance agreements with drillers.
- Authorization to bypass State and Federal contracting requirements normally associated with State and private regulatory and/or maintenance requirements.
- Provide \$5-to\$10-million in Excess Maintenance program start-up costs including staffing. Legislative authorization to charge gas developers fees to support and sustain an Excess Maintenance program and to disburse such fees.

Additionally, regardless of whether road maintenance agreements are implemented by municipalities or by NYSDOT, there are significant data needs that would be required to

facilitate an Excess Maintenance effort. The data elements requested by PennDOT are included in Appendix B, Marcellus Shale Maintenance Guidelines. It would be desirable for the NYSDEC to stipulate these and other data elements be provided by applicants for a gas drilling permit before drilling can proceed.

b. State Road Impacts

i. Ability to Mitigate

As with impacts to local roads NYSDOT essentially lacks the capacity to require mitigation for damage to State roads and for the operational and safety impacts that stem from Marcellus development.

First, there is no direct regulatory link between NYSDOT and individual drillers. The vast majority of trucks used by the drillers will require no special permit from the Department. Similarly, the vast majority of gas wells will take their access from local roads and, thus, there will be no tie to the Department's Highway Work Permit requirements.

Second, even for those sites taking access from State roads, peak hour trip generation will fall well below the 100 peak hour trip threshold stimulating the requirement for a traffic impact statement (TIS) and potential mitigation beyond the site limits. Third, there does not appear to be any statutory authority authorizing the Department to require proportional mitigation for the cumulative impacts of cumulative development against a specific economic sub-sector, in this case the gas drilling industry.

And fourthly, the Department lacks the information and resources necessary to evaluate the individual impacts of 1,000 or more wells per year, define the necessary mitigation, establish the proportional contribution to cumulative problems, and assess and justify the proportional "contribution" to the mitigation of such problems.

ii. Potential Mitigation Strategies

It would appear that there are a number of approaches to mitigating the probable and possible transportation impacts to the State system. Each has distinct advantages and drawbacks, each would require some expansion or clarification of NYSDOT's authority, and each would require mandatory data and information from the gas drilling industry that is not currently provided for in NYSDEC's permitting process. The last element can be resolved largely by stipulating that drillers provide the data and more set out in Appendix B; which is largely the same information as would be required to mitigate impacts to local roads.

One option would be to dedicate some share of the gas tax revenues from gas production to mitigate the transportation and other impacts of such development. The

advantages are that it would be clean and simple. The disadvantages are that segregation of transportation from other impacts are politically improbable and, thus, unlikely as would be the establishment and "dedication" of an appropriate revenue share,

A second option might be to levy a "transportation impact fee" for each well drilled in the Marcellus in New York at the time of permitting. The advantages of this option would be that it is "clear and transparent". The disadvantages are that the impacts and their cost cannot be determined with any degree of certainty, that it would require legislative authorization against a specific and powerful industrial subsector, and that existing State programming and procurement requirements would not allow necessary improvements to be implemented when they are needed. This would require streamlined standards and contract mechanisms to deliver projects in a timely and effective manner.

A third option would be to require the establishment of an "industrial association" specifically charged with mitigation of the cumulative impacts of Marcellus Shale development. The benefits of this option would be that it directs mitigation to the industry, that it is not necessarily limited to transportation impacts, and that it would require that they work out their own "proportional shares". The disadvantages are that NYSDOT would still be required to define necessary mitigation, that mitigation would likely be made after the fact, and that the industry would likely oppose such a broad and undefined requirement.

A fourth option might be to require a transportation mitigation surcharge on gas production in the Marcellus. This has the advantages of divorcing mitigation costs from development costs, thus not impeding development, and simplicity in application. It has the disadvantages of inequity in that "producing wells" alone are not responsible for the transportation impacts of Marcellus development, that it would be difficult to establish the surcharge, that mitigation would be made after the fact, and that the industry would likely oppose it.

Finally the Department might do nothing, assuming that future increases in its budget will offset the incremental costs of mitigating the transportation impacts of Marcellus development.

Whatever form of mitigation is decided on It will almost certainly be necessary to align it with the NYS Department of Environmental Conservation's permitting process. In addition, this might provide an opportunity to integrate a transportation impact assessment and mitigation process as a condition of the permit. This in turn would facilitate a variety of activities and conditions necessary for effective mitigation, such as:

- The provision of transportation related data and information - number of trucks, size/weight of trucks, number of trips, proposed routes, proposed schedule {by year, month, day-of-week, and time-ofday).
- A requirement that all large trucks will be permitted to help control and monitor actual truck use/impacts.
- Community outreach in communities likely to be impacted by truck.
- A requirement thst all proposed routes to be pre-surveyed for conditions,
- A requirement for "ongoing" monitoring of road conditions and updating of the associated data, as needed.
- The establishment of trigger points for various mitigation activities
- Assess a "transportation mitigation fee" to address transportation impacts.

c. Alternative Mitigation

The transportation of water, fracking materials and liquid wastes appear to account for well over 90-percent of all truck traffic from a gas well over its productive life. Alternatives that could substantially reduce the use of trucks would similarly reduce their impacts. There may be a variety of such alternatives. These would include innovative methods of fracking such as the use of liquefied natural gas which would eliminate the need for water entirely. They would also include water supply systems which reduce the need for trucking, such as the construction of water weISs serving multiple well pads via a piping system. On site treatment and disposition of wastes is another alternative. According to data from Pennsylvania Cheseapeake Energy has eliminated the trucking of wastes, presumably through on site treatment or disposition. If this practice were extended to other gas development companies operating in the Marcellus in Pennsylvania it would also substantially reduce trucking requirements.

Appendices

PA ppt

PA data

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