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THE LEAGUE OF WOMEN VOTERS of New York State

PUBLIC HEARING ON THE HEALTH IMPACTS OF HYDRAULIC FRACTURING TECHNIQUES
May 26, 2011

Testimony submitted on June 2, 2011 to the
Assembly Standing Committee on Environmental Conservation and
Assembly Standing Committee on Health

The League of Women Voters of New York State (League) submits this written testimony on the possible adverse health effects from the life cycle of extraction of shale gas including, but not limited to, high-volume hydraulic fracturing. The League is a nonpartisan organization devoted to promoting active and informed involvement of individuals in government. It is a grassroots organization that influences public policy through advocacy and education. As such, it has long been a national leader in efforts to protect air, land and water resources. The cornerstone of our position is the "…preservation of the physical, chemical and biological integrity of the ecosystem and maximum protection of public health and the environment."[1]

In New York State, League members developed a 1997 position on watershed protection that calls for the development and implementation of stringent controls to protect the quality of current and potential water supplies. Fracking one gas well requires 3 to 6 million gallons of fresh water, sand and chemicals, some of which are toxic, injected as much as a mile below the surface under very high pressure. Dr. Theo Colburn who has served on the US EPA Science Advisory Board and the Ecosystem Health Committee of the International Joint Commission of the US and Canada, founded the Endocrine Disruption Exchange (TEDX) whose purpose is to compile and disseminate scientific evidence on health and environmental problems caused by low-dose exposure to chemicals that interfere with development and functioning. She has found that 43% of the chemicals she verified as

[1] LWVUS, Impact on Issues, p. 47.

being used in fracking are so-called "endocrine disruptors" which disrupt the body's normal function and have been linked to infertility, ADHD, autism, diabetes and childhood and adult cancers.[2]

According to Poune Saberi, a family physician at University of Pennsylvania, studies have found a 40-fold increased risk of cancer after only "seven days when exposed to the same chemicals that have contaminated drinking water of two families in Pennsylvania from shale gas drilling." Dr. Saberi has also testified that samples EPA collected from water wells of Wyoming residents living around pipelines from drilling sites tested positive for Bisphenol-A, an endocrine disruptor now banned from use in infants' drinking bottles.[3]

Leaks and spills of liquid or solid frack waste can contaminate surface water; lateral or upward migration of chemicals or methane underground could possibly contaminate groundwater. Dr. Anthony Ingraffea, Professor of Engineering at Cornell University whose Ph.D. is in rock fracturing and has worked with industry for years, says anyone denying that this could happen is "not adhering to the laws of physics."[4]

According to a report issued in 2010 by Comptroller Thomas Di Napoli, in 2007 the New York farming industry plays a vital role in the New York economy with total sales in the billions and employment of tens of thousands of workers. New York's farms are primarily family-owned. The report states that farmers play an important role in protecting the state's environment, helping to develop new technologies that minimize water usage, reduce carbon footprints, reduce soil erosion, maintain the productive quality of the land and, most important of all, feed us. New York is the nation's third largest milk producer and fourth largest cheese producer. We are the nation's second largest wine producer and rank third nationwide for grape production. We rank second in the nation for apple production. Forty-five per cent of the state's livestock sales come from the Finger Lakes Region

[2] Sue Smith-Heavenrich, Theo Colburn Addresses Air, Water Issues Related to Gas Drilling, Broader View Weekly (Feb. 20, 2009); What You Need to Know about Natural Gas Production (DVD), the Endocrine Disruption Exchange, P.O. Box 1407, Paonia, CO 81428; www.endocrinedisruption.org

[3] Kristian Boose, Public Comment Philadelphia City Council, Jan. 2011 from Poune Saberi, Family Physician, PROTECTING OUR WATERS (Jan. 27, 2011).

[4] Dr. Anthony R. Ingraffea, "Unconventional Gas Development from Shale Plays: Myths and Realities," West High School, Painted Post, NY, May 19, 2011

and the Southern Tier.[5] New York's certified organic farmers increased in number from 218 in 2002 to 590 in 2008 with a concentration of farmers in the Marcellus Shale region.[6]

Yet, New York's multi-billion dollar agricultural economy faces potential displacement through contamination of our water and soil from unconventional drilling. Last year the Pennsylvania Department of Agriculture was reported to have quarantined dairy cattle believed to have drunk from a frack fluid spill; their milk was no longer considered safe for consumption.[7] In 2009, a tomato farmer in Avella Pennsylvania reported a series of problems with water and soil on his property after drilling started; he found arsenic levels 2,600 what is recommended as well as dangerously high levels of benzene and naphthalene, all used in the fracking process.[8] (Please see brochure entitled "Fracking the Foodshed" attached).

In addition to the possible adverse health impacts of water pollution from the various processes described above, there are very dangerous health consequences from the inevitable air pollution that begins before and continues after the actual drilling and fracking. The first source is diesel exhaust. According to the 2009 NYSDEC dSGEIS (section 6.13.1) up to 8,900 truck trips will be necessary to carry supplies, equipment, chemicals, sand and water to a well pad that has 8 wells. See Attached Appendix A. More diesel exhaust will be emitted by machinery at the well pad and at compressor stations that will operate around the clock as long as gas is being produced. There will be additional emissions from truck traffic when the wells are fracked again.

The danger in working or living nearby or downwind is that diesel exhaust contains particulate materials that can cause asthma, chronic bronchitis and shortness of breath. A 2006 NYS Assembly Task Force report titled "Our Children Shouldn't have to Beg to Breathe" documents the asthma epidemic in New York which at that time had the highest asthma rate in the country.[9]

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[5] Thomas Di Napoli, New York State Comptroller, The Role of Agriculture in the New York State Economy, February 2010

[6] Comments on dSGEIS, Colleen Blacklock, Potential Impacts of Gas Drilling on Agriculture in the Marcellus Shale Region in New York State, Dec. 11, 2008

[7] Mari Margil and Ben Price, Pennsylvania Township Declares Freedom From Fracking, Yes! Magazine, Oct. 27, 2010

[8] Newsinferno, Is Fracking Poisoning Our Food?, August 31, 2010

[9] "Our Children Shouldn't Have to Beg to Breathe: The Asthma Epidemic in New York State and the Practical Steps Government Should Implement Immediately to Tackle this Health Crisis." New York State Assembly Puerto Rican/Hispanic Task Force, April 2006

Diesel exhaust also contains benzene, a chemical that is carcinogenic and is highly correlated with leukemia. Researchers at Ohio State University found diesel exhaust to stimulate growth of new blood vessels, a source of food for tumors.[10]

Another cause of serious health problems is the combination of volatile organic compounds (VOCs) and nitrous oxides. Both come from diesel and natural gas engine exhaust, compressors and flaring of natural gas.[11] When combined in the presence of sunlight, they create ground-level ozone which can cause respiratory or cardiovascular problems.

Finally, we need to consider the problem of how to dispose of the hazardous waste from drilling and fracking. Even though the toxicity and radioactivity associated with drilling waste is well documented, New York State has no coherent plan in place to track the transportation, treatment or disposal of drilling and fracking waste in New York facilities.[12] Drill cuttings and frack fluids that come back to the surface from the Marcellus Shale contain naturally-occurring radioactive materials as well as heavy metals such as chromium, lead and mercury. Since the waste has not been properly categorized as hazardous, however, the drill cuttings (from Pennsylvania) are treated as industrial waste and can go into landfills (as they are now in Allegany, Chemung and Steuben counties). Frack fluids have sometimes been taken to traditional waste treatment facilities, which are not capable of handing the toxicity. Once again, subsequent contamination of air, water and soil can adversely affect the health of people, livestock and crops downwind or downstream.

Thank you for holding the public hearing on the health impacts of fracking on May 26 and allowing submission of written comments afterwards. We trust you will seriously consider them and take steps to pass legislation that will protect the health of people who live, work or travel in New York State.

Sincerely,

Betsey B. Swan

Betsey Swan, President
League of Women Voters of New York State

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[10] Diesel Exhaust is Linked to Cancer Development via New Blood Vessel Growth." 9-2-09. http://researchnews.osu.edu/archive/depexposure.htm

[11] "Oil and Gas Pollution." Oil and Gas Accountability Project, www.ogap.org

[12] Marvin Resnikoff, Ph.D., et al., Radioactivity in Marcellus Shale, May 19, 2010, Radioactive Waste Management Associates, 526 W. 26th Street #517, New York, NY 10001

APPENDIX A

NYSDEC dSGEIS (6.13.1) [truck traffic for a single pad with eight wells]:
"The trucking requirements for rigging and equipment will not be significantly greater than for a single well pad, especially if all wells are drilled consecutively. Water and materials requirements, however, will greatly increase the amount of trucking to a multiwall pad compared to a single well pad. Estimates of truck trips per multi-well pad are as follows (assumes two rig and equipment deliveries and 8 wells):

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

Agriculture and High Volume Slick Water Fracturing Are NOT Compatible

Soil Contamination
Explosions, spills, flares and leaky gas pipes are all shown to have negative effects on agricultural soils. One study shows that gas flaring adversely affects soil fertility; causing the soil to become more acidic and reducing total organic carbon, nitrate, and phosphate content. Another study reports that methane from pipeline leaks changed the oxygen and bacterial composition of the soil, and altered a plant's ability to fix nitrogen, to successfully complete cellulose conversion, and to maintain an adequate hydration level.

Radioactivity
Naturally occurring radioactive materials (NORM) has contributed to widespread contamination of oil and gas production areas. In some cases contamination may be severe. In addition, the Marcellus is very rich in Radium 226. Uranium, radon and other radioactive decay products may be prevalent in the air, in soils and even in drinking water at or near natural gas sites. Taken up by plants, these radioactive elements bioaccumulate in the foodchain, eventually appearing in milk and dairy products.

Heavy Metals
Similarly, heavy metals like strontium, arsenic, barium, cadmium, chromium, lead, and mercury may be found in drilling waste and can be absorbed by plants and incorporated into the food chain. While it is possible to decontaminate soil, it takes a minimum of four years of specific successive plantings to get these metals out.

Soil Erosion and Compaction
Soil erosion from well site construction is not as detrimental as compaction from hundreds of heavy truck trips, but in either case, farmers are finding restoration difficult, if not impossible.

Farmland Fragmentation
Every time a well pad or access road cuts across a farm field, it fragments productive farmland. As parcels become smaller there are fewer contiguous acreage available to operating farms. Eventually farms may become too small to operate profitably. As farms go out of business, the critical mass to economically support related businesses is reduced. Loss of those businesses leaves remaining farms without nearby supply or service providers. As a result other farms will inevitably fail simply from being caught up in the spiral.

Water Usage
The natural gas industry points to agriculture's water usage, but in making a comparison neglects to mention that their use is a consumptive one. Water used in agriculture remains in the hydrologic cycle, while most water used in gas drilling is lost forever.

Ozone Impacts & Decreasing Crop Yields
Gas drilling emissions leasd to increased ground level ozone. Many long-term studies document serious impacts to agricultural productivity due to ground level ozone on. A declining crop yield depends upon the specific crop sensitivity. Grapes are particularly sensitive, as are soybeans, alfalfa, clover and other native New York grazing grasses. Loosing such crops would harm farmers economically and negatively impact food production.

Openings for Invasive Species
When native grasses die out, invasive species move in and can overtake even healthy native plants simply due to their aggressive nature.

Falling Reproductive Rates
At least 40% of the chemicals used for fracking are known endocrine disruptors. Scientific findings indicate adverse effects of endocrine disruptors on reproduction by affecting male fertility and the ability of a female to carry an embryo.

Benzene, a volatile organic compound is easily absorbed through inhalation. Besides causing cancer it is the leading cause of abortions, fetal death and irregular cycles. It is the primary reason for breeding failure. It has been found in the blood and urine of livestock and humans living in close proximity to a natural gas field. If reproduction rates fall, it will have severe consequences on agriculture and food production.

Livestock Poisonings
Livestock often drink surface water from ponds and streams which is easily contaminated in the process of handling fracking fluids at the surface---injecting, withdrawing, collecting, storing and disposing of massive amounts of highly toxic liquids. Small spills can have very big effects on livestock by contaminating their drinking water or the grasses that they eat. Livestock are attracted to the saltiness of these fluids. There are growing documented reports of livestock illness and death from acute toxicity poisoning from exposure to these spills.

And What About Organic Farming?

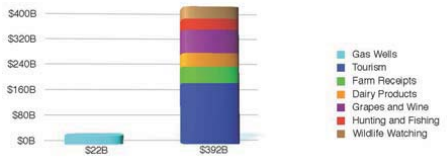
Source: The Map Room

As this map shows via the green dots, organic farms, often smaller in acreage than commodity focused farms, are concentrated over much of New York's Marcellus Shale region. Many organic farmers oppose high volume, slick water fracking and refused to sign leases, but pollution knows no boundaries.

Toxic Compounds Throughout the Foodchain
Bioaccumulation is the process by which compounds accumulate or build up in an organism at a rate faster than they can be broken down by the body's liver. Toxic chemicals and radioactive elements taken up by and accumulated within plants travel throughout the food chain from one living organism to the next, eventually reaching human consumers.

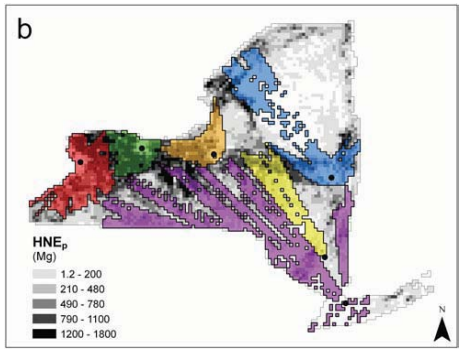
Inadequate Food Safety Inspections
Most food is NOT adequately inspected for chemical residues. Even in cases with known exposure to fracking chemicals, there is no system in place for the testing of affected crops or meat for such toxins. The Government Accountability Office reports that the National Residue Program - responsible for monitoring chemical residues – is missing known heavy metal residues and chemicals present in meat and poultry. The USDA, FDA, and EPA, all responsible in part for the program, may not have complete information on fracking chemicals; therefore, the extent to which potentially harmful fracking chemicals may affect our food are unknown. Some food buyers are already raising concerns about the safety of food produced in close proximity to fracking activity.

Uneconomical Tradeoff
While gas production may provide revenues of $22 billion, other industries - like agriculture - are threatened by the gas industry generate over $400 billion in gross revenues.



Source: Dr. John Schwartz, Ithaca College

Concern For Our Foodshed
A foodshed outlines a particular area from which food is grown, processed, purchased and consumed. Researcher Christian Peters and others at Cornell University mapped potential foodsheds for the largest upstate cities. Map b shows where grass-based agricultural products might travel in a more localized foodshed for the cities of Buffalo (red), Rochester (green), Syracuse (gold), Albany (blue), and Poughkeepsie (yellow). Notice the area in purple which indicates an excess of meat production for the southern tier cities (Alfred, Elmira, Binghamton) sufficient to supply NY City, but which overlies the Marcellus shale.



Source: Mapping Potential Foodsheds in New York State

BETTER SAFE THAN SORRY …

"Ommegang believes that opposing development of hydrofracking is critical to the interests of our community, our people and our business. We are proud of our accomplishment in building a thriving, sustainable and environmentally conscious business in upstate New York. We are deeply concerned at the threat posed by development of drilling in the region and the risk to the purity of the water on which we depend, and which is a key reason we are located here. We are a company that enjoys a national reputation for super-premium quality beers produced in upstate New York and we hope that the state and local regulators attach value to what we do for the region in terms of employment and our representation of upstate New York in restaurants and grocery stores across the nation. We do not want our business' future, our employees' futures and our communities' futures damaged or destroyed by water pollution, or compromised by the industrialization associated with hydrofracking for shale gas."
-- Simon Thorpe, President/CEO of Brewery Ommegang, Cooperstown, New York

"I want to alert you to a less obvious effect that hydrofracking will have on us and on the NYS farms whose products we make a great effort to buy. We are very responsive to the needs of our shoppers. If hydrofracking is allowed to go forward our shoppers are certain to be asking us if the fruits, vegetables, dairy products, eggs and meats from New York State are produced in areas where hydrofracking is taking place. It will not take many inquiries for us to start researching alternatives to NYS products."
-- Joe Holtz, General Manager of Park Slope Food Coop Inc, Brooklyn, New York

"At the Co-op, we work hard to support our Western New York farms. Our business depends on their survival. But if our customers tell us to source clean natural foods from non-hydrofracking regions, we and other grocers will shift our purchasing dollars elsewhere. Hydrofracking may create a few jobs in the energy industry, but it will put at risk our Co-op and all of local partners we do business with."
-- Tim Bartlett, General Manager of Lexington Co-operative Market, Buffalo, New York

A Shrinking Agricultural Base
Pennsylvania agricultural agencies report that 25% of farmers receiving royalty payments discontinued farming, while another 25% converted from dairy farms to grazing operations. Agencies question whether the remaining small dairy farms provide enough of a critical mass to remain viable. If local farmers call it quits, then who will grow our food?

THE TRADE OFF
Government is forcing farmers into a choice many don't want to make. What is needed is an agricultural policy that helps farmers receive a fair price for their products. An energy policy that provides some cash at the expense of the health of the farm families, the safety and marketabiliby of the food they produce, and the profitability of their farms is no substitute for good farm policy. We must do better than to put our water, air and soil, our food supply, the health of individuals and communities and the well-being of future generations at risk.

You can help. Get involved. Find an organization near you at:
www.GasMain.org

Sources quoted can be found at:
https://acrobat.com/#d=nZsSXQ3jSFGOpOf41XyczQ

FRACKING OUR FOODSHED


Photo by Sue Smith-Heavenrich

Is Local Food Production Compatible With Natural Gas Drilling?

Evidence and studies show that agriculture and industrialized natural gas drilling can not co-exist (at least while drilling is in progress, and perhaps beyond) if we want a healthy, sustainable, local food supply.

Our Children Shouldn't Have to Beg to Breathe

The Asthma Epidemic in New York State and the Practical Steps Government Should Implement Immediately to Tackle this Health Crisis

Part of an ongoing series of briefs prepared by the New York State Assembly Puerto Rican/Hispanic Task Force

April 2006

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Introduction

Asthma rates in New York State and the entire nation continue to rise. According to data made available by the Centers for Disease Control, New York has the highest levels of asthma, even though other states have immensely larger populations.

But the problem is much worse in New York than simple statistics reveal. The problem of asthma has reached epidemic proportions in children, especially minority children. Simultaneously, the communities feeling the hardest impact across New York, are low-income communities with a history of environmental decay but with no ability to escape it.

It has long been understood that a true indicator of a civil society is the manner by which it protects its children. At this time and with this disease, New York State is failing miserably.

This policy brief will highlight the current status of this epidemic in communities across New York and provide a few practical solutions that government must take immediately to address this public health crisis.

Other reports have fully documented the rise in asthma rates. This brief is only intended to serve as a tool to focus attention on actions that will immediately help to reduce the level of pollution our children are exposed to, provide them with the medical equipment needed to alleviate chronic symptoms, and remove bureaucratic obstacles that prevent access to medications that will help them breath easier.

"It is appalling that we have not taken the practical steps to address this chronic health problem throughout our state. We have the technology to reduce the level of pollution our children are exposed to and we have the scientific data to prove the harm diesel fuel is causing our communities. It is time for diligent action on this problem."

Assemblyman Peter M. Rivera
Chairman, New York State Assembly Puerto Rican/ Hispanic Task Force

The asthma epidemic has reached an unacceptable point. The devastating impact on minority children and low-income communities across New York can no longer be ignored or tolerated. Especially when lawmakers can implement simple policy changes as the ones outlined in the pages that follow.

While science has not yet provided us with the tool to prevent asthma, we do have other apparatus that can be used to alleviate the symptoms, reduce its environmental triggers, and deliver a higher degree of adequate health care to those suffering with this disease.

Some clear actions demanding immediate implementation are presented here.

The Asthma Epidemic

Asthma affects nearly 15 million Americans, more than 5 percent of the U.S. population with the overwhelming burden of this disease being felt predominantly by children, the poor, and minority communities across the nation. New York is no exception.

"Children are especially at risk from diesel exhaust because exposure to diesel exhaust disrupts the development of lung tissue, robbing kids of full lung capacity and function."

Marissa Rappaport
Consultant to the Natural Resources Defense Council, speaking at a public hearing held at the request of the Assembly Puerto Rican/Hispanic Task Force

One-third of all Hispanics are uninsured and simultaneously our communities are overburdened with high rates of diseases caused by man-made factors that are exacerbated by willful neglect. In the Bronx alone, the rate of asthma for children is now more than 903 cases for every 100,000 people. In Brooklyn, the rate is over 525 cases for every 100,000 people.

According to the Centers for Disease Control, there are over 1.1 million New Yorkers suffering from asthma, more than those of states like California, Florida and Texas, which have larger populations.

Most recently the United States Environmental Protection Agency released information classifying New York as the state with the dirtiest air in the nation. Yet school districts and municipal transportation systems continue to use diesel-burning vehicles that exacerbate the situation.

"I would argue that it's probably the Long Island bus fleet [all public transportation buses] or perhaps the City of Atlanta bus fleet which is run entirely on compressed natural gas that is likely the cleanest bus fleet in the world."

Swati Prakash
Director of Environmental Health for West Harlem Environmental Action, speaking at a public hearing held at the request of the Assembly Puerto Rican/Hispanic Task Force

For example, the Metropolitan Transportation Authority (MTA) operates over 4,500 buses throughout New York City. In 2006, less than 24% of its entire bus fleet runs on clean fuel sources such as hybrid electric and compressed natural gas technologies. The slow process of this transition to clean-burning fuels continues to add to the air pollution that New York has become infamous for.

School districts that operate their own bus fleets are not doing much better. They continue to purchase diesel-burning school buses. These buses have a life-span of ten years. So each purchase is having a long-term detrimental impact on the children they serve and the communities these buses drive through.

With over 50,000 school buses transporting over 2 million school-age children daily throughout the state, it is easy to see how such decisions in aggregate are part of the negligence and neglect that negatively impacts all our lives. This issue is further addressed within this report with a strong and simple solution.

In early spring of 2003, a study by the Harlem Hospital Center found that one of every four children in Harlem has asthma. It is one of the highest rates recorded for a neighborhood in the United States.

It is well understood that excessive school absence disrupts learning and is a strong predictor of premature school dropout. School-aged children with asthma are absent more often compared to their healthy peers without asthma. Yet this growing health problem, which hinders the education of our children, has not become the focus of education or health care policy leaders.

"The health costs to school kids is far too important and if we have to force the bus companies to make these adjustments as a condition of their contracts with the Board of Education, then we will."

Shammeik Barat
Deputy Director of Operations for Senator David A. Patterson speaking at a public hearing held at the request of the Assembly Puerto Rican/Hispanic Task Force

The scope of the health care problem caused by asthma lies not only in the large number of Americans with the disease, but also in the limitations that asthma can impose on the daily lives of children and their families.

Asthma is the leading cause of school absenteeism due to chronic illness and is the second most important respiratory condition that causes home confinement for adults.

Each year, asthma causes more than 18 million days of restricted activity, and millions of visits to physicians' offices and emergency rooms.

A recent study found that children with asthma lose an extra 10 million school days each year. This problem is compounded by an estimated $3 billion in lost productivity for their working parents. In 2005, asthma-related health care cost our nation approximately $18.2 billion.

Recently, the New York State Department of Health has requested that physicians prescribing second generation antihistamines get prior approval before giving these medications to asthma sufferers. These, and other asthma attack reducing medications, are not available unless a physician can convince an anonymous voice on the other side of a telephone that the medication is needed.

Members of the Assembly Puerto Rican/ Hispanic Task Force and New York State Black, Puerto Rican, Hispanic and Asian Legislative Caucus, have fought to prevent the creation of such a policy by the Department of Health.

"Diesel exhaust poses a risk to children's health. Exposure to diesel exhaust can cause lung damage and respiratory problems. Diesel exhaust also exacerbates asthma. Long-term exposure to diesel exhaust is thought to increase the risk of lung cancer."

Ronald Borsellino
Deputy Director of the U.S. Enviromental Protection Agency, speaking at a public hearing held at the request of the Assembly Puerto Rican/Hispanic Task Force

The Task Force and the Caucus have believed that such a policy represents a direct attack on the well-being and dignity of hundreds of thousands of African Americans and Hispanic children across New York State.

"By investigating this matter, you are pursuing a very serious problem that is harming the health of our school children and urgently needs to be addressed."

Stephen J. Boeses
New York State Director for the Healthy Schools Network, Inc., speaking at a pubic hearing held at the request of the Assembly Puerto Rican/ Hispanic Task Force

Trying to reduce health care costs by denying high quality health care to our poor is a proposal that also attacks the core principals of a civil society.

An emergency room visit by an asthmatic child needing urgent treatment costs over $600 per visit. Policies like prior authorization and the clear absence of a strategy to help reduce asthma rates are the real cost burdens to New York in the long and short terms.

A line in the sand must be drawn with regard to this issue. In minority and low-income communities across our state, New Yorkers see such attempts as biased policies that enforce the status quo through neglect and indifference.

But there are practical steps that can be taken to: reduce our children's and community's exposure to dangerous toxic exhausts; increase community involvement in addressing school bus pollution; enhance access to medications that more adequately and safely help New Yorkers reduce their asthma symptoms; and, provide schools with the inexpensive medical equipment needed to help children with acute asthma cope with emergencies in the classroom.

"Diesel engines are one of the largest sources of particulate matter…the fine particulate matter that is found in diesel exhausts causes 15,000 premature deaths annually. Those most susceptible to the effects of this pollutant include the elderly and children."

Ronald Borsellino
Deputy Director of the U.S. Enviromental Protection Agency, speaking at public hearing held at the request of the Assembly Puerto Rican/Hispanic Task Force

How do we explain the ridiculous lack of leadership on solving this problem and bad public health policies to our children?

How do we tell a six year-old child, with an acute asthma attack, triggered by school bus diesel fuel exhaust, that the medication that can make them feel better is only made available to those who can pay for it?

How do we tell our children that, in the wealthiest nation on Earth, they are not important enough to the government that is supposed to protect and help safeguard their interests?

Lawmakers should make no apologies for siding with good medicine over bad public policy and address these questions and this problem with diligent and sincere efforts.

"Suffer the little children" should not be the name given to inaction on this critical public health issue that overwhelmingly burdens poor and minority children in communities across New York.

A Crisis Across New York

As stated previously, the asthma epidemic is not confined to New York City alone. All across New York State, communities are feeling the growing impact as more and more children and adults are being affected by this disease.

The figures provided below show the spread of the problem and should help to forge cooperation by a diverse group of policymakers that are intent on implementing short-term and common sense solutions, while planning for long-term policy initiatives that will help reduce the impact and incidences of asthma.

Asthma Hospitalization Discharge Rates per 100,000 children under 17 years of age as of December 2005 as reported by the New York State Department of Health for suburban and rural counties

County	No. of children	Rate
Suffolk	370,662	195.0
Nassau	323,243	198.0
Orange	98,910	239.0
Sullivan	17,644	191.0
Fulton	12,950	407.0
Oneida	53,796	208.0
Jefferson	27,648	263.0
Cortland	10,982	228.0
Chemung	21,245	260.0
Erie	221,814	179.0
Otsego	13,091	239.0

"Emissions from diesel vehicles pose a serious health threat to every resident of New York City. Particulate, or soot pollution from diesel buses triggers asthma attacks, cancer and even premature death."

Marissa Rappaport
Consultant to the Natural Resources Defense Council, speaking at a public hearing held at the request of the Assembly Puerto Rican/Hispanic Task Force

"Acknowledging data that shows asthma as the most common chronic childhood illness and the number one cause of school absenteeism, it is a clear deduction that New York City's school buses are not facilitating our children's access to education, but implicated in hindering our children's health and educational success."

Shammeik Barat
Deputy Director of Operations for Senator David A. Paterson, speaking at a public hearing held at the request of the Assembly Puerto Rican/Hispanic Task Force

"Our children deserve better. They live in areas that chronically fail to meet EPA's health standards for ozone and/or particulate matter. Their school buses should be vehicles that move children toward education, not contributors to our state's chronic pollution problems."

Marissa Rappaport
Consultant to the Natural Resources Defense Council, speaking at a public hearing held at the request of the Assembly Puerto Rican/ Hispanic Task Force

Asthma Hospitalization Discharge Rates per 100,000 among all population as of August 2004 as reported by the New York State Department of Health

County	No. of children	Rate
Dutchess	69,435	171.0
Orange	98,910	199.1
Putnam	24,878	96.0
Rockland	79,446	132.0
Sullivan	17,644	191.0
Ulster	40,433	126.0
Westchester	231,793	151.0
Total	**562,539**	**163.0**
Bronx	395,520	902.0
Kings	651,965	525.0
New York	270,234	562.0
Queens	502,732	435.0
Richmond	112,954	257.0
Total NYC	**1,933,405**	**568.0**

Asthma Hospitalization Discharge Rates per 100,000 among children under 17 years old as of August 2004 for suburban and rural counties as reported by the New York State Department of Health

County	Total Population	Rate
Suffolk	1,443,299	131.6
Nassau	1,339,301	134.1
Orange	349,480	199.1
Sullivan	74,048	144.1
Fulton	54,896	194.9
Oneida	234,635	186.0
Jefferson	110,212	114.3
Cortland/Otsego	48,639/61,741	115.1
Chemung	90,704	120.2
Erie	946,625	104.0
Otsego	61,741	121.5

Asthma Hospitalization Discharge Rates per 100,000 among all populations as of August 2004 for New York City and surrounding areas as reported by the New York State Department of Health

County	Total Population	Rate
Dutchess	284,270	106.5
Orange	349,480	199.1
Putnam	97,125	73.1
Rockland	289,430	104.6
Sullivan	74,048	144.1
Ulster	178,372	103.0
Westchester	932,748	117.1
Total	**2,205,473**	**124.9**
Bronx	1,343,698	598.0
Kings	2,479,923	343.2
New York	1,549,009	290.6
Queens	2,238,024	215.5
Richmond	451,373	174.4
Total NYC	**8,062,027**	**330.7**

"Aging and dirty school buses not only pose a toxic threat to the children riding inside of them, but to the community residents who are living near school bus parking lots and school bus depots. New York City communities of color are home to a disproportionately large share of these diesel facilities."

Swati Prakash
Director of Environmental Health for the West Harlem Environmental Action, speaking at public hearing held at the request of the Assembly Puerto Rican/Hispanic Task Force

Three Simple Solutions Needed Today

The need for some short-term and long-term solutions that will begin to address the causes of increasing asthma rates and the concentration of pollution-generating facilities in the most impacted communities begins with a genuine desire to address this public health problem.

Itemized below are three practical policy approaches that are both overdue and can be implemented rapidly across New York State. These policy initiatives include:

- The placement of nebulizers in all of the 6,544 public and non-public schools throughout New York State, beginning with the 2,306 school buildings in the communities hardest hit by the asthma epidemic. (Assembly Bill 10504)

"School buses, especially older school buses, emit harmful diesel exhaust. Diesel exhaust not only deteriorates air quality, but also has a negative impact on children's health."

Ronald Borsellino
Deputy Director of the U.S. Enviromental Protection Agency, speaking at public hearing held at the request of the Assembly Puerto Rican/Hispanic Task Force

- The total prohibition of idling by vehicles outside school and child care facilities through enforcement of no idling

rules by school administrators during school arrival and dismissal periods, while simultaneously empowering local communities through involvement in the decisions of when and how to replace aging and polluting diesel-powered school buses. (Assembly Bill 9874)

■ Increasing access to the latest respiratory therapy advances by adding such medicines to the list of drugs already excluded from New York State's prior authorization formulary. Advances in respiratory disease medications provide more effective and safer medicines that should be available to those most in need of such therapies.

Making Nebulizers Available to Acute Asthmatic Children

Almost one in 13 school children suffer from asthma, making it the leading serious chronic illness in children and the leading cause of hospitalizations for children under the age of 15. More than 4.8 million children nationwide suffer from asthma and more than 5,000 Americans die from the illness each year. It is estimated that asthmatic children lose 10 million school days each year.

"Children of color are at especially high risk given their higher rates of asthma prevalence. For example, a recent survey in Central Harlem conducted by Harlem Hospital has found that one in four children in Central Harlem has asthma, which is tree times the national prevalence.

Swati Prakash
Director of Environmental Health for the West Harlem Environmental Action, speaking at public hearing held at the request of the Assembly Puerto Rican/Hispanic Task Force

In the Bronx, there were 10,135 hospital cases of asthma in children younger than 17 reported in 2002, at a rate of more than 854.9 per 100,000. That is in comparison to an average rate of approximately 150 per 100,000 for the rest of the state.

Poor children under the age of 4 are four times more likely to be hospitalized for asthma than children in high-income areas. Asthma is an illness that is far too common among our poorest citizens, especially in children. In New York City, children are almost twice as likely to be hospitalized as children nationwide.

According to the Centers for Disease Control and Prevention (CDC), asthma's impact on health, quality of life, and the economy are substantial. The CDC has also found that the rates of severe asthma continue to disproportionately affect poor and minority populations. For example, African-Americans visit emergency departments, are hospitalized and die due to asthma at rates three times higher than rates for white Americans. Overall, asthma rates in the United States have doubled since 1980.

Health experts and school officials agree that to reduce the high absenteeism of children with chronic asthma who presently must leave school grounds for nebulizer treatments, this equipment must be present in schools and accessible for emergency treatments. These treatments last about 15 minutes but allow students to return to class immediately.

Currently, students requiring nebulizers for emergency treatment of asthma attacks must be sent home or sent to an emergency room.

For thousands of children in areas of our state with high asthma rates, their schooling is being interrupted and the cost on our health care system is substantial. For many of these students their illness will turn their schooling into academic failure because of the high number of school days missed.

The legislature recently approved the placing of defibrillators in all public buildings in New York State to assist anyone having a heart attack. We need to place the same priority on the placement of nebulizers in all schools, starting with those with a large number of asthmatic children.

"Even with these retrofits [to reduce diesel exhaust] school buses will not be as clean as they would be if they are not running on diesel fuels at all. For example, running on compressed natural gas or even electric school buses."

Swati Prakash
Director of Environmental Health for the West Harlem Environmental Action, speaking at public hearing held at the request of the Assembly Puerto Rican/ Hispanic Task Force

A Terrorist Attack and Asthmatic Children

In addition, in the event of a terrorist attack that would require children to stay in school buildings for a prolonged period of time, it is conceivable that children with severe asthma would die because they would have no access to the nebulizers that allow them to continue to breath. At a cost of less than $125.00 per machine and specialized hoses, we can provide substantial public health benefits to tens of thousands of children.

The Total Ban on Vehicle Idling Outside School and Child Care Facilities

The proposed legislation is a simple, pragmatic and no-cost approach to dealing with idling vehicles outside school and child-care grounds**.** It will stop the wasteful and dangerous idling of dozens of school buses in areas congested with young children. This legislation calls for each school district to establish a clean-fuel school bus committee that will recommend ways and timelines for the replacement of aging school buses with clean fuel burning technologies that have been available for many years now.

"Pollution control technologies exist and have been successfully used. Taking action now to clean school buses will lead not only to an immediate improvement in the air quality, it will demonstrate a commitment to children's health."

Ronald Borsellino
Deputy Director of the U.S. Enviromental Protection Agency, speaking at a public hearing held at the request of the Assembly Puerto Rican/ Hispanic Task Force

The specific provisions of this legislation:

1. **Establishes the Children's Clean Air Act**

2. **Amends Section 3623 of the Education Law** to mandate no idling of school buses or other vehicles on, adjacent to or near school grounds of child care facilities.

3. **Creates a Clean Fuel Program Advisory Councils** in every school district in the state. These councils will be composed of nine

members from the school district and are required to produce a public plan for the replacement and discontinued use of diesel fuel burning school buses.

Reducing Exposure to Toxic Fumes from Diesel Fuel Powered Vehicles

The dramatic increases in pediatric asthma cases throughout our state are alarming, and New York has 107 neighborhoods which are considered to be in the top 5% of the most polluted communities in the nation. Simultaneously, these areas have a high concentration of New Yorkers suffering with asthma.

"The solution in this case does not exceed our grasp. We have the means at hand today to minimize children's exposure to harmful diesel fumes from school buses. We applaud the leadership of Assemblyman Peter M. Rivera in bringing the subject of school children's health and the environment to the forefront."

Stephen J. Boeses
New York State Director for the Healthy Schools Network, Inc., speaking at a pubic hearing held at the request of the Assembly Puerto Rican/ Hispanic Task Force

Diesel fuel exhaust has been documented by health experts and the federal government to pose serious health risks, especially to children. From Buffalo to Long Island, this is a real problem with harmful consequences for our children.

Each school day, over two million children board over 50,000 diesel-powered school buses and are exposed to lung-irritating chemicals. For many children this exposure triggers asthma attacks. For others this exposure will lead to respiratory problems.

The proposed legislation is a simple, pragmatic and no-cost approach to dealing with idling vehicles outside school and child-care grounds**.** It will stop the wasteful and dangerous idling of dozens of school buses in areas congested with young children. School officials will be required to enforce the state's no-idling laws. This bill will also ban all non-emergency idling with strict enforcement by local school administrators.

Creating Clean Fuel Program Advisory Councils

In addition, under current practices, school districts and school bus operators continue to replace heavily polluting diesel fuel buses with more of the same**.** This legislation calls for each school district to establish a clean-fuel school bus committee that will recommend ways and timelines for the replacement of aging school buses with clean fuel burning technologies that have been available for many years now.

The growing number of asthmatic children and bad air quality surrounding our schools and child-care facilities can not be ignored anymore.

For years, the State Education Department has failed to move swiftly to force the purchase of clean-fuel school buses when old polluting ones are being replaced. This has further compounded the problem as each new polluting diesel powered school bus purchased will be used for at least 10 years.

Making Asthma Medication Accessible to those Most Impacted by the Asthma Epidemic: Children and the Poor

This proposed legislation will eliminate the use of prior authorization under the preferred drug program for medications used to treat respiratory diseases. This is an important step to help children, the poor and minorities suffering from asthma by allowing them the opportunity to access the best available medicines.

The asthma rates documented throughout this report indicate that this proposed policy change is obvious and will result in a long-term health care cost saving for the state.

This legislation will allow the drugs are used to treat asthma to be covered by Medicaid without going through bureaucratic channels of prior authorization which could lead to the use of less effective drugs.

We can't allow a non-physician bureaucracy to second-guess doctors and ration medicine. By continuing this policy, children suffering from asthma get less effective medication under a plan geared to saving the state money. This is true in the short-term but not in the long-term costs associated with life-time management of this disease.

The current need for prior authorization is bad medicine and bad public policy.

It is believed that such a policy represents a direct attack on the well-being and dignity of hundreds of thousands of African American and Hispanic children across New York State.

Trying to reduce health care costs by denying high quality health care to our poor is a proposal that also attacks the core principals of a civil society.

An emergency room visit by an asthmatic child needing urgent treatment costs over $600 per visit. Policies like prior authorization and the clear absence of a strategy to help reduce asthma rates are the real cost burdens to New York in the long- and short-term.

"Children riding the buses [in a school bus pollution test] were being exposed to more diesel pollution than drivers in vehicles alongside the buses. It was even more shocking to find out that inside the bus children were breathing in levels of toxic, cancer-causing pollution up to 46 times the EPA's cancer risk threshold."

Marissa Rappaport
Consultant to the Natural Resources Defense Council speaking at a public hearing held at the request of the Assembly Puerto Rican/ Hispanic Task Force

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Assemblyman Peter M. Rivera's Press Release *Assemblyman Peter M. Rivera, Health Experts and Clean Air Advocates Call School Buses "Pollution Chambers which Children are Forced to Enter" and Call on Bus Companies to Move Quickly to Reduce Levels of Asthma-Causing Diesel Fuel Pollution in School Buses.* September 4, 2003

"The New York City Board of Education cannot become complacent with accepting an antiquated and hazardous product from their [school bus] vendors. Especially when it comes to providing an essential service to our children."

Shammeik Barat
Deputy Director of Operations for Senator David A. Paterson, speaking at a public hearing held at the request of the Assembly Puerto Rican/ Hispanic Task Force

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New Research Blog Available Here!!

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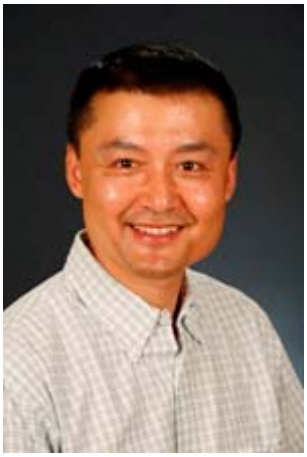
Previous stories pertaining to Professor Sun's research:

"OSU Study Shows Exposure To Bad Air Raises Blood Pressure," 7/28/08.

DIESEL EXHAUST IS LINKED TO CANCER DEVELOPMENT VIA NEW BLOOD VESSEL GROWTH

COLUMBUS, Ohio – Scientists here are the first to demonstrate that the link between diesel fume exposure and cancer lies in the ability of diesel exhaust to induce the growth of new blood vessels that serve as a food supply for solid tumors.

The researchers found that in both healthy and diseased animals, more new blood vessels sprouted in mice exposed to diesel exhaust than did in mice exposed to clean, filtered air. This suggests that previous illness isn't required to make humans susceptible to the damaging effects of the diesel exhaust.



Qinghua Sun

The tiny size of inhaled diesel particles, most less than 0.1 microns in diameter, potentially enables them to penetrate the human circulatory system, organs and tissues, meaning they can do this damage just about anywhere in the body. A micron is one millionth of a meter.

Diesel exhaust exposure levels in the study were designed to mimic the exposure people might experience while living in urban areas and commuting in heavy traffic. The levels were lower than or similar to those typically experienced by workers who use diesel-powered equipment, who tend to work in mines, on bridges and tunnels, along railroads, at loading docks, on farms and in vehicle maintenance garages, according to the U.S. Department of Labor.

"The message from our study is that exposure to diesel exhaust for just a short time period of two months could give even normal tissue the potential to develop a tumor," said Qinghua Sun, senior author of the study and an assistant professor of environmental health sciences at Ohio State University.

“We need to raise public awareness so people give more thought to how they drive and how they live so they can pursue ways to protect themselves and improve their health. And we still have a lot of work to do to improve diesel engines so they generate fewer particles and exhaust that can be released into the ambient air.”

The research appears online and is scheduled for later print publication in the journal *Toxicology Letters*.

The researchers experimented with mice that resembled two conditions that could be present in a human body. In one, the scientists implanted a small platform seeded with normal endothelial cells, the cells that line blood vessels, under the skin of the mice. This was designed to mimic relatively normal conditions in human bodies for cell growth.

In the other, the researchers created an environment that would follow a significant loss of blood flow to a section of a vessel, called ischemia, in the hind limbs of the mice. This generated severe hypoxia, an area with low or no oxygen, a condition that is present in certain diseases.

The exposure to diesel exhaust caused a six-fold increase in new blood vessel formation in the ischemic hind limbs after eight weeks and a four-fold increase in vessel sprouting in the normal hind limbs of the mice in the same amount of time, compared to mice breathing filtered air.

Both types of mice were then exposed to either whole diesel exhaust containing particles at a concentration of about 1 milligram per cubic meter, or to filtered outdoor air, for six hours per day five days a week. The rest of the time they breathed filtered air in their cages. Effects of the exposure were measured after two weeks, five weeks and eight weeks of the exposures.

Though some blood vessel growth and chemical changes could be seen in the mice after two weeks of exposure, “generally, the longer the exposure, the more effects we could see,” said Sun, also an investigator in Ohio State’s Davis Heart and Lung Research Institute. “It’s difficult to translate outcomes from an animal study directly to the human experience, but the bottom line is, the shorter the exposure to diesel exhaust, the better.”

The exposure to diesel exhaust caused a six-fold increase in new blood vessel formation in the ischemic hind limbs after eight weeks and a four-fold increase in vessel sprouting in the normal hind limbs of the mice in the same amount of time, compared to mice breathing filtered air.

The researchers also saw significantly more blood vessel growth in the implanted cells and in rings of tissue taken from the aortas of mice exposed to the exhaust compared to the control mice exposed to clean air. In fact, the researchers found that three types of blood vessel development occurred in these areas after exposure to the diesel exhaust: angiogenesis, the development of new capillaries; arteriogenesis, the maturation or re-started growth of existing vessels; and vasculogenesis, the formation of new blood vessels.

All of these processes are associated with tumor growth, but unprogrammed angiogenesis in particular can wreak havoc in the human body, Sun said.

“Whenever you talk about a solid tumor, angiogenesis is one of the fundamental mechanisms behind its development. Angiogenesis provides the means for tumor cells to grow because they have to have a blood supply. Without a blood supply, solid tumors will not grow,” he said.

“We want our bodies to generate new blood vessels only when we need them. And then stop producing them when we need them to stop.”

Though the researchers have not defined every mechanism behind these processes, they sought to explain at least a few ways in which blood vessels are able to sprout or mature after exposure to diesel exhaust.

They observed that diesel exhaust exposure activated a chemical signal, vascular endothelial growth factor, which has long been associated with new blood vessel development. The exposure also increased levels of a protein, hypoxia-inducible factor 1, that is essential to blood vessel development when oxygen levels are low. At the same time, the presence of the exhaust lowered the activity of an enzyme that has a role in producing substances that can suppress tumor growth.

The scientists also tracked low-grade inflammation in tissues exposed to the exhaust, which is often associated with tumor

development.

Though the tiny size of diesel exhaust particles may contribute to their ability to penetrate all areas of the body, Sun noted that their complex chemical composition, and the way in which those chemicals are released once particles enter the body, also influence how they react with human cells.

Gasoline exhaust particles are larger than diesel fume particles, but it's premature to suggest that they are any less dangerous to humans, Sun said.

"The bigger particles are known to be harmful primarily for upper respiratory tract illnesses. Larger particles also can't travel long distances – they tend to fall to the ground," he said. "Smaller particles hover in the air for a long time and can have long-term impact on humans when inhaled."

Sun and colleagues are now conducting a study testing whether the exhaust particles promote tumor development and metastasis.

This work is supported by Health Effects Institute awards and grants from the National Institutes of Health.

Co-authors on the study are Xiaohua Xu and Ling Zheng of Ohio State's Division of Environmental Health Sciences; Nisharahmed Kherada, Aixia Wang and Sanjay Rajagopalan of the Davis Heart and Lung Research Institute; Xinru Hong of the Department of Obstetrics and Gynecology at Fuzhou General Hospital in Fujian Province, China; Chunli Quan, Morton Lippmann and Lung Chi Chen of the Department of Environmental Medicine at the New York University School of Medicine; and Loren Wold of the Center for Cardiovascular and Pulmonary Research at Nationwide Children's Research Institute.

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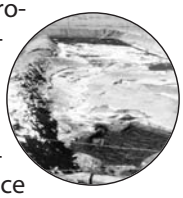
OIL AND GAS POLLUTION

Drilling and Completion. Drilling involves boring down to rock formations that contain oil or natural gas. Fluid or "mud" is circulated down hole to keep the drill bit cool and lubricated, and it returns to the surface carrying rock debris known as "cuttings." During completion, fluids and cuttings within the well bore are removed. Some gas usually exits as these materials come to the surface, and the gas is typically flared. **AIR:** Exhaust fumes from drilling equipment; venting and flaring of natural gas. **SOIL:** Muds and cuttings, which may contain chemical additives, salts, metals and hydrocarbons, are often stored in pits and buried on site. This may sterilize soils. **WATER:** Contaminants in pit sludge may leach out of the soil or overflow the pit and contaminate nearby soils, surface waters and groundwater.

Stimulation. Hydraulic fracturing, a common stimulation technique, involves fracturing the target formation with high-pressure injection of various substances. After fracturing, some of the injected fluids and gas from the formation flow out of the well, and sand remains behind to prop open the fractures. **AIR:** Exhaust fumes from heavy equipment; flaring or venting of gas; wastes stored in pits may contain volatile chemicals that escape into the air. **SOIL:** Many fracturing chemicals are hazardous, and may contaminate soil if spilled on site. **WATER:** Fracturing fluids may be injected into or come in contact with fresh water aquifers. Waste fluids stored in pits may contaminate surface or groundwater if pits leak or overflow.



Produced Water. Typically, during coalbed methane operations water must be removed from the coals before methane will flow to the well. Over time, water production tends to decrease. In conventional natural gas and oil formations, however, water production often increases with time, as the oil and gas are depleted. Produced water is piped or trucked to disposal ponds or underground injection wells; or discharged on land or into surface waters. **AIR:** When stored in open pits volatile hydrocarbons (e.g., benzene) escape into the air. The pumping of shallow water may result in the migration of methane and H_2S to from soil to air. Exhaust is created from water pumps powered by diesel or natural-gas-fired engines. **SOIL:** salts, metals, hydrocarbons or traces of chemical additives in produced water may contaminate soil if spilled on the surface or stored in earthen pits. **WATER:** produced water may contaminate waters through spills, pipelines breaks, leaks from storage ponds, or movement of injected water into a freshwater aquifer.

Separation and Dehydration. During separation, gas is separated from heavier hydrocarbons (e.g., oil and natural gas liquids), and water may also be "knocked out." Dehydrators remove water from the gas stream. Separation and dehydration may occur at well sites, compressor stations, gas processing plants or oil storage sites (i.e., tank batteries). **AIR:** Dehydrators and separators often vent large volumes of methane and volatile organic compounds. Dissolved hydrocarbons in wastewater may escape into the air. **SOIL:** Pits or tanks that store wastewater may leak or overflow and contaminate soil. **WATER:** Wastewater may contain dissolved hydrocarbons, sand and metals that can contaminate surface and groundwater.

Gas Compression. Typically, diesel or natural gas-fired engines provide power to compressors that, in turn, compress the gas. Some compressors are used to pull the gas out of wells, while other compressors push the gas along a pipeline. Field compression may occur at well sites. Centralized compressor facilities are required, however, to move large volumes of gas to and through larger gas transmission pipelines. **AIR:** Engine exhaust; occasional venting of natural gas. **SOIL AND WATER:** Soil and water pollution may occur due to spills or leaks of diesel or other fuel used to power the compressors.

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Natural gas is a clean fuel? THINK AGAIN

CONTAMINANTS AND THEIR SOURCES

BTEX	Benzene, toluene, ethylbenzene and xylenes.	Benzene is a known carcinogen. Toluene may affect the reproductive and central nervous systems; while ethylbenzene and xylenes may have respiratory and neurological effects.	**Venting of natural gas** **Pits** **Produced water** **Dehydration**
CH_4	Methane	Main concern is the explosive nature of this gas.	**Venting of natural gas** **Dehydration**
Diesel fuel	A complex mixture of hydrocarbons.	Both fuel and exhaust contains carcinogenic substances like benzene and PAHs.	**Stimulation fluids** **Oil-based drilling muds** **Engines/heavy equipment**
H_2S	Hydrogen Sulfide	Aggravates respiratory conditions, and affects neurological system, cardiovascular system and can cause central nervous system problems.	**Venting and flaring of natural gas (if present in the oil and gas formations)** **Migration from soils**
Metals	Examples: arsenic, barium, cadmium, chromium, lead, mercury, selenium, zinc and others.	There are different potential health effects associated with each metal. Possible toxic effects include skin problems, hair loss, kidney damage, high blood pressure, increased cancer, neurological damage risk and others.	**Drilling muds** **Stimulation fluids** **Pits** **Produced water** **Venting and flaring** **Diesel exhaust**
NO_x	Nitrogen oxides	React with VOCs to form ground-level ozone and smog, which can trigger respiratory problems. React with other chemicals to form particulate pollution, which can damage lungs and cause respiratory illness, heart conditions and premature death. Reacts with common organic chemicals to form toxics that may cause biological mutations.	**Compressor engines** **Flaring** **Diesel and natural gas engine exhaust**
PAHs	Polycyclic Aromatic Hydrocarbons	Several agencies have classified some PAHs as probable or possible carcinogens. Animal studies show reproductive effects.	**Diesel exhaust** **Flaring** **Pits**
Partic-ulate matter	Small particles suspended in air.	Can be inhaled and cause health effects like respiratory ailments, aggravation of asthma and allergies, painful breathing, shortness of breath, chronic bronchitis and premature death. May combine with other air pollutants to aggravate health problems. Some particulates, such as diesel exhaust are carcinogenic.	**Diesel exhaust** **Pits (dust from)** **Venting and flaring**
SO_2	Sulfur dioxide	Reacts with other chemicals to form particulate pollution, which can damage lungs and cause respiratory illness, heart conditions and premature death.	**Diesel and natural gas engine exhaust** **Flaring**
VOCs	Volatile Organic Compounds, include BTEX formaldehyde and others.	React with NO_x to form ground-level ozone and smog, which can trigger respiratory problems. Can cause health problems such as cancer.	**Venting and flaring of natural gas** **Pits** **Oily wastes** **Diesel and natural gas engine exhaust** **Compressors**

Radioactivity in Marcellus Shale

Report prepared for

Residents for the Preservation of Lowman and Chemung (RFPLC)

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May 19, 2010

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1.0 Qualifications

Marvin Resnikoff is Senior Associate at Radioactive Waste Management Associates and is an international consultant on radioactive waste management issues. He is Principal Manager at Associates and is Project Director for dose reconstruction and risk assessment studies of radioactive waste facilities and transportation of radioactive materials. Dr. Resnikoff has concentrated exclusively on radioactive waste issues since 1974. He has authored or co-authored four books on radioactive waste issues. In June 2000, he was appointed to a Blue Ribbon Panel on Alternatives to Incineration by DOE Secretary Bill Richardson.

He is a 1965 graduate of the University of Michigan with a Doctor of Philosophy in Theoretical Physics, specializing in group theory and particle physics. Dr. Resnikoff is a member of the Health Physics Society.

He has researched and written reports on radioactivity in oil and gas operations for the past 18 years. He has conducted dose reconstruction studies of oil pipe cleaners in Mississippi and Louisiana and is continuing to work on personal injury cases involving former workers and residents at the ITCO and other oil pipe cleaning yards in Louisiana and Texas. He is also presently working on several land contamination cases in Louisiana, Texas and New York involving radiological contaminants. He has conducted radioactive dose reconstruction studies of oil pipe cleaners in Mississippi and Louisiana, and of ranch hands in natural gas operations in Texas.

2.0 Process of Oil and Gas Drilling and Production

Since much of this discussion took place at the Issues Hearing, on April 14, 2010 in Elmira, New York, we will be brief.

2.1 Drilling

A vertical hole is first drilled down to the Marcellus shale formation using a rotary drill. As the drill digs deeper into the earth, additional drilling pipe is added to the wellbore. These pipes, known as a drill string when connected together, are each approximately 30 feet in length and add weight to the drill bit as it drills further through a rock formation. In order for the drill bit to drill deeper into the earth, rock cuttings generated during the drilling process must be moved out of the way and brought to the well surface. Thus, a drilling fluid is circulated through the drill string and used to bring the rock cuttings to the well surface. Drilling fluid can be a liquid or a gas or a combination of the two. Most often drilling fluid is a mud-like liquid consisting of water, clay, and chemical additives, such as scale inhibitors and biocides. Barium is also added for weight, and radium sulfate may form as well. The exact composition of drilling fluid varies from well to well and for different underground rock formations. In the case of vertical drilling to the Marcellus shale formation, pressurized air is used as the drilling fluid: the horizontal leg through Marcellus shale involves a liquid waste or slurry.

Once the vertical hole reaches the Marcellus shale formation, the direction of the drilling is transferred to horizontal drilling through the Marcellus formation. Often, one horizontal well will produce a better oil or gas reservoir than multiple vertical wells, and thus it is beneficial to drill horizontally. Most of the natural gas in the region is found within the Marcellus shale formation; thus, it is more economical and efficient for energy companies to use horizontal wells to tap directly into the stratum. It was stated at the Issues Conference that the spill waste disposed of in Elmira is coming from horizontal drilling at the Fortuna site in Bradford County.

As drilling fluid is circulated through the drill string and back up to the well surface, it mixes with rock cuttings and formation water from the underground formations. Formation water is water that occurs naturally within the pores and fractures of underground rock formations. Depending on the exact geology of a rock formation, formation water may have been present when the rock originally formed. Uranium, a radionuclide

present in the Marcellus shale formation, is not soluble in water, but radium-226, a progeny of uranium, is soluble in water and can become mobilized when formation water is brought to the surface with drilling fluid and drill cuttings. Due to its prolonged existence in an underground formation, formation water can become highly concentrated in radium-226 and other radionuclides.

During horizontal drilling, a liquid drilling fluid is used to circulate drill cuttings to the well surface. Again, this drilling fluid mixes with formation water that may be highly concentrated in radium-226 and other water-soluble radionuclides. Once the gas or oil reservoir is reached and drilling is completed, casing is inserted into the newly-drilled hole and cement is forced into the void space between the walls of the casing and the rock formation. Production tubing, through which oil or gas will flow, is then inserted into the casing.

2.1.1 Drilling Waste Management

There is a variety of drilling waste management methods employed at the drill site that separate liquid and solid wastes before their respective disposal. Two of the most common methods in Pennsylvania involve the use of separation pits and shale shakers.

Separation Pits – Drill cuttings are placed in a plastic-lined, unleveled containment pit where liquid (drilling fluid and formation water) separates from the drill cuttings and falls into one end of the pit. These fluids are pumped into a storage tank and later reused in the well hole or transported to a wastewater treatment plant. The drill cuttings are disposed of at a landfill.

Shale Shakers – Drill cuttings are also dewatered via shale shakers, large sieves used to separate solid drill cuttings from liquid wastes (Figure 1). Drilling fluid and its contained wastes are passed through a vibrating screen on the shale shaker. Liquid wastes pass through the screen and are collected in an underlying basin, whereas the solid drill cuttings are retained above the screen. The shale shaker removes approximately 80% of the total liquid, which is pumped to a storage tank and can be later reused in the well hole or transported to a wastewater treatment plant. The drill cuttings, coated with any remaining liquid waste, eventually fall off the vibrating screen and are collected and disposed of at a landfill. These drill cuttings can also be mixed with sawdust or oak bark chips, creating a woody fiber mass which is transferred to a landfill.

Figure 1. Shale Shaker on an Oil Rig

2.2 Production

Production is the process of extracting oil and gas from an underground hydrocarbon reservoir. Since the casing and the cement prevent access to the hydrocarbon producing zone, the casing and cement must be perforated before oil extraction begins. A special gun is used to set off shaped charges, similar to those

used in armor-piercing shells, and puncture holes in the side of the casing and the cement so that the oil and gas can flow into the well (Figure 2).[1]

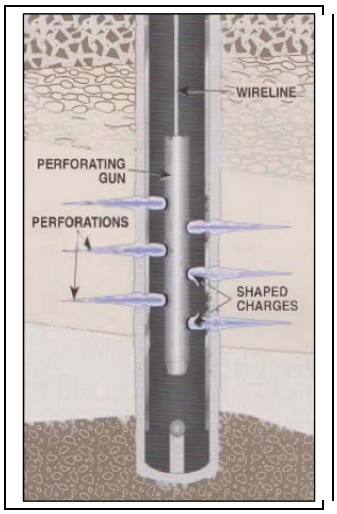

Figure 2. Perforations Created by Charges in a Perforating Gun[2]

As discussed above, formation water exists in the pores and fractures of underground formations, including hydrocarbon reservoirs found in such formations. Therefore, it is extracted from the formation with oil and gas as they are brought to the well surface. When produced water is brought to the surface, it carries with it dissolved solids and other compounds that may be present in the reservoir and rock formation, including Ra-226. Once the reservoir fluids are brought to the well surface, the oil, gas, and produced water are separated from each other. The oil and gas is then directed towards a pipe line, whereas the produced water is stored on site and later disposed of or injected into the underground formation.

3.0 Radionuclide Content of the Marcellus Shale

Radioactivity in the Marcellus shale results from the high content of naturally occurring radioactive uranium and thorium, their decay products including Radium-226, and radioactive potassium elements. The evidence of high radionuclide content is present in geochemical studies and in gamma-ray logs from wells drilled into the Marcellus formation.

In 1981 the United States Geological Survey performed a geochemical study of trace elements and uranium in the Devonian shale of the Appalachian Basin.[3] The Devonian layer refers to sediment formed 350 million years ago from mud in shallow seas. Its full profile consists of a number of strata as seen in Figure 3. Marcellus shale belongs to the Hamilton group of the Middle Devonian formation. Since the layers do not form in a line parallel to the ground surface, the depth at which Marcellus is found can vary from surface outcroppings to as deep as 7,000 feet or more below the ground surface along the Pennsylvania border in the Delaware River valley,[4] and as deep as 9000 feet in Pennsylvania.[5]

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[1] Baker, 2001
[2] Though Figure 2 shows perforation in a vertical leg, it is the horizontal leg in Marcellus shale that is punctured.
[3] Leventhal, 1981
[4] http://www.dec.ny.gov/energy/46288.html
[5] http://geology.com/articles/marcellus-shale.shtml

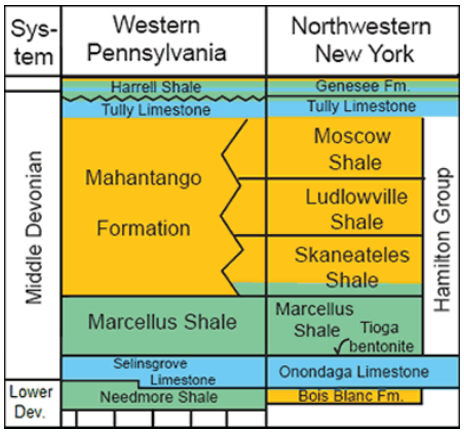

Figure 3. Stratigraphy of the Devonian Shale

The USGS study analyzed seventeen cores from wells in Pennsylvania, New York, Ohio, West Virginia, Kentucky, Tennessee, and Illinois. The researchers collected a variety of geochemical data to be used for resource assessment and identification of possible environmental problems. Rather than direct gamma spectroscopy employed by CoPhysics, uranium was measured in each core with a more appropriate and precise method, delayed-neutron analysis.

Although the cores varied in thickness and in depth, geologists identified the Marcellus stratum in several cores using data on the organic, sulfur, and uranium content of the samples. Table 1 summarizes the results from four cores that tapped into the radioactive Marcellus formation. The depths at which the layer was found as well as the uranium measurements are presented.

Table 1. Uranium Content and Depth of Marcellus Shale in Four Cores

Location of the Core	Depth of Sample (feet)	Uranium Content (ppm)
Allegheny, NY	7342 – 7465	8.9 – 67.7
Tomkins County, NY	1380 – 1420	25 – 53
Livingston County, NY	543 – 576	16.6 – 83.7
Knox County, OH	1027 – 1127	32.5 – 41.1

The four cores were taken from different geographical locations, but the characteristics of the identified Marcellus shale layer, specifically the layer thickness and high uranium content, are consistent. The thickness of the Marcellus shale formation varies between 0 and 250 feet, according to isopach maps. As seen in Figure 4, in Ohio and New York the Marcellus thickness is less than 100 feet, except in southeastern part of New York, where it is slightly greater.

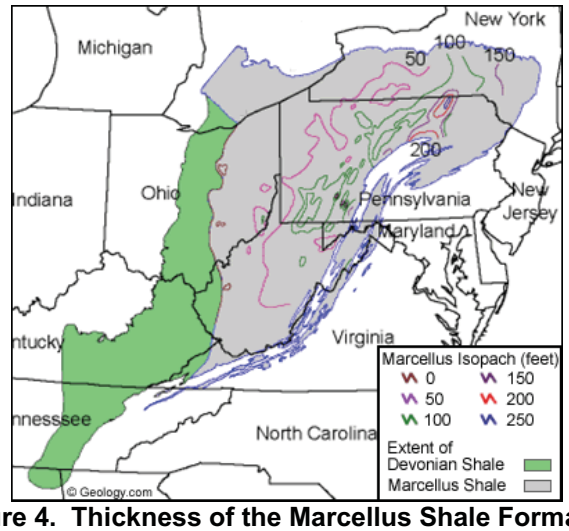

Figure 4. Thickness of the Marcellus Shale Formation

The thickness of the Marcellus layer in the four samples corresponds to the isopach map predictions and is approximately 123, 40, 33, and 100 feet (Table 1). Furthermore, the uranium content in the four samples is extremely high, as expected to be in Marcellus shale, and measures up to 83.7 parts per million (ppm), which is equivalent to 59.4 pCi/gram. Considering that the background uranium content in the four cores is approximately 4 ppm, or 2.8 pCi/gram, the radioactivity in the Marcellus is more than 20 times higher than background. Natural uranium radioactivity of 59.4 pCi/gram is attributed to uranium-234 and uranium-238, each of which contributes about 30 pCi/gram of radioactivity. Since Radium-226 is in secular equilibrium with U-238, it is also on the order of 30 pCi/g. These data show that the radioactivity of the Marcellus formation remains consistently high throughout.

In addition to geochemical studies, gamma ray drill logs also indicate high radioactivity in Marcellus shale. In fact, the Marcellus shale formation is *identified* using a gamma-ray detector that produces a chart of radioactivity (measured in GAPI units[6]) versus depth. Shale rock always displays a spike on such graphs, but compared to other shales the Marcellus shale formation spike is [7]substantially greater. The attached gamma-ray log (Attachment 1) shows a typical spike in radioactivity readings of >400 GAPI units, which is >24 pCi/gram and 25 times higher than background. This is consistent with DEC's findings for the radioactivity of Marcellus shale cuttings.

The gamma readings at the Marcellus shale horizon are uniform. The depth of the Marcellus shale varies, but the thickness of the formations and the uranium spike at all drill holes is remarkably consistent. We are confident that these are the radioactive levels measured in Marcellus shale.

4.0 Concentration of Radionuclides

As mentioned in Section 2 of this report, drilling fluid is used to remove the rock cuttings from horizontal wells in the Marcellus shale formations and to transport the drill cuttings to the well surface. The

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[6] The GAPI unit is defined by a calibration facility at the University of Houston, Texas, where pits with different mixtures of thorium, uranium, and potassium are located. The unit is defined as 1/200th of the deflection measured between the high and low activity zones in the pits. 16.5 GAPI units = 1 pCi/gram

[7] NYSDEC reported in their 2009 Draft Supplemental Generic Environmental Impact Statement (DSGEIS) radioactivities for rock cuttings from two wells in Lebanon and in Bath, NY, where the total radioactivity levels were 25.4+/-4.6 and 29.2+/-4.3pCi/gram respectively, which is consistent with these findings. These radium concentrations are far higher than background concentrations in New York State (Myrik1983),which is 0.85pCi/g.

recovered solid rock cuttings, suspended in a mixture of drilling fluid and formation water with elevated radionuclide content, are placed on shale shakers and dewatered before disposal in the County landfill. However, not all of the liquid waste in which the drill cuttings are suspended will be removed.

There are several steps in the Marcellus shale drilling process that allow radionuclides, particularly Radium-226, to concentrate in liquid waste. First, drilling fluids that include various chemical additives are artificially introduced into the borehole by high pressure injection. Drilling fluids are used during the drilling process to cool and lubricate the drill bit, prevent the well hole from caving in, and circulate drill cuttings to the well surface. Formation water, or natural brine, contained within the pore spaces and fractures of the rock, through which the drill bit progresses, can mix with the drilling fluid and be circulated to the well surface. The formation water can be contained in the rock formations for centuries and can contain extremely high levels of water-soluble radionuclides that are present in the underground formations. In addition to mixing with brine, the drilling fluid may also become contaminated when it comes in contact with radioactive rock. Radium-226 is a highly water-soluble radionuclide and will preferentially dissolve in the drilling fluid under the pressure and temperature conditions below ground. Drilling fluid can be reused many times and radium will progressively concentrate in it after each reuse. Since no sources specify the radioactivity of produced water, we assume that it is the same as brine, which NYSDEC measures at 15,000 pCi/L.[8]

During the Issues Conference NEWNY proposed to exclude from disposal at the Chemung County Landfill wastes containing liquids in excess of 20%. This liquid waste is likely to contain Radium-226 and other water-soluble radionuclides.

4.1 NYSDEC Permit

According to the draft permit, at Condition 31(b), free liquids, sludges, slurries, chemical or industrial wastes that are at least 20% solids can be disposed of at the County landfill. This means that up to 80% of wastes disposed of at the landfill can contain free liquid, sludge, or slurry.

As mentioned in Section 2 of this report, there are currently four possible methods for managing drilling wastes at a Marcellus shale drilling site. The three disposal methods utilized in Pennsylvania, and therefore most likely to be utilized in New York, involve the use of a shale shaker, well pad, or plastic-lined pit to separate solid drill cuttings from drilling fluid, which is highly concentrated with radium-226 and other radionuclides. Since drill cuttings are suspended in liquid drilling fluid upon entering a shale shaker, well pad, or plastic-lined pit, it would be impossible to remove all of the liquid material from the surface area of the cuttings. Drill cuttings particles are roughly the same size as coarse sand and, therefore, provide substantial surface area within a small quantity of particles. As a result, a considerable amount of contaminated drilling fluid will be disposed in the Chemung County landfill with drill cuttings.

5.0 Impacts of Contaminated Waste Disposal

Rock cuttings enhanced in Ra-226 and deposited in the County landfill will pose several problems, which were not considered by NYSDEC.

5.1 Landfill Soil Contamination

Radium-226 has a half-life of 1600 years and, if deposited in the landfill, will remain there essentially forever. Landfill workers that come in contact with the contaminated materials may be exposed. Further, if the landfill is ever inhabited in the future, crops grown in the soil will concentrate radium and be ingested. Ra-226 is a carcinogen and, when ingested or inhaled, concentrates in the bone and can cause leukemia. As we noted in our April 7 memorandum, at page 4, exposures to landfill workers and

[8] NYSDEC, 2010, p. xxx

those who eat fruits or vegetables grown more than 1,000 years in the future over the closed landfill would exceed current health-based dose limits.

Our calculations show that the radiation dose from Marcellus shale drill cuttings, including the direct gamma dose, will exceed regulatory limits. Under the cleanup standards for land contaminated from inactive uranium processing sites, the EPA limits the concentration of radium within the top 6 inches of soil to 5 pCi/gram and to 15 pCi/gram at deeper depths.[9] Therefore, drill cuttings with concentrations of radium above 20 pCi/g (Table 1) would exceed these limits if deposited in a municipal solid waste landfill. Employing the standard Department of Energy software RESRAD, we find that radium concentrations of 20 pCi/g in soil lead to a direct gamma dose and ingestion of contaminated vegetation dose as high as 200 mrem/year. We assumed RESRAD default assumptions for a future resident farmer, including no earth cover in the landfill, a full-time resident, and a garden. Consumption of contaminated fruits and vegetables is the largest component of the dose.

5.2 Radioactive Leachate

Ra-226 is highly water-soluble and will dissolve in water under the temperature and pressure conditions present in the Marcellus shale formation and in water that is introduced into the well during the production process. The concentrations of radium in brine from the formation, or contaminated produced water, were measured by NYSDEC on the order of 15,000 pCi/L. Assuming that the Chemung County landfill accepts 2,000 tons of drill cuttings per week and that up to 20% of this waste is fluid, we estimate that up to 400 tons, or 40,000 liters, of contaminated water may be included in the waste. If we assume that this fluid contains up to 15,000 pCi/L of radium-226, then we calculate that 3.12E+11 picocuries of radium per year may be deposited into the landfill. Other assumptions may be reasonable, and the radium would not be released with leachate immediately, but we believe that NYSDEC has not adequately addressed the issue and has not completed a full analysis of the hazards presented by Chemung County landfill leachate when up to 2,000 tons per week of Marcellus shale cuttings waste is disposed in the landfill.

Several problems exist concerning contaminated liquid in the landfill. First, municipal waste landfills are lined with a layer of clay and plastic and are not designed to contain low level radioactive wastes. The leachate could mobilize radionuclides and distribute them in other locations throughout the landfill or potentially transport the radionuclides to groundwater sources outside the landfill in the event of a breach in the landfill lining. Second, the fluid will mix with leachate collected in the Chemung County landfill. This leachate with residues of radionuclides will be sent to the Elmira wastewater treatment plant, which, like the landfill itself, is also not designed to deal with radioactive waste. Radium-226 has a 1600-year half-life, so this is a long-term problem. Third, from the increasing inventory of radium-226, the landfill will generate progressively increasing volumes of radon gas over time, much of which can be expected to escape uncontrolled. As an inert gas, the landfill gas combustion device cannot control radon. Fourth, trucks transporting cuttings waste to the landfill will carry a substantial volume of liquid with the cuttings and therefore can be expected to leak on occasion. The leaking liquid is particularly radioactive and, over time, can be expected to contaminate local roadways and roadways inside the landfill site.

5.3 Radioactivity Detected by 375P-1000 Detector

Dump trucks transporting Marcellus shale drill cuttings from the drill sites to the Chemung County landfill will be monitored for radioactivity by a 375P-1000 radiation detector, manufactured by Ludlum Measurements Incorporated. These detectors will be placed approximately 6 feet from either side of the vehicles entering the landfill. According to Ludlum Measurements Incorporated, the 375P-1000 radiation detector will sound an alarm when it measures a radioactivity level that produces an exposure rate of 0.95 microCi per hour (μR/hr) above background radiation levels.

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[9] 40 CFR Part 192.12.

We used the program MicroShield version 8.02[10], developed by Grove Software, to determine the minimum radioactivity (in pCi/g) of Marcellus Shale drill cuttings that would result in an exposure rate of 0.95 µR/hr and therefore sound the alarm of the 375P-1000 detector. MicroShield is a program used to estimate dose rates due to a specific external radiation source. The program allows its user to choose from sixteen different source geometries (such as a cylinder, sphere, disk, or rectangle) and up to ten different radiation shield geometries. MicroShield users may also choose custom source and shield materials from the MicroShield database, or design their own source and shield materials with the option of over thirty different constituents. When designing a source or shield material, MicroShield calculates the attenuation and build-up factors of all constituents.

We assume that all Marcellus Shale drill cuttings transported from the drilling sites to the Chemung County landfill will be transported in 15-18 ton dump trucks. We assume that the dump body of each truck body is approximately 12 feet in length, 4 feet in height, and 7 feet in width[11,12]. In addition, we assume each dump body is constructed with two steel side walls with an inner steel wall approximately 0.188 inch thick and the outer wall approximately 0.135 inch thick (10 gauge steel)[13]. Many dump truck bodies are equipped with two side walls so that any dents, scratches, or additional damage caused by the payload to the inner wall of the dump truck body will not appear on the outer surface of the truck.

As inputs to the MicroShield program, we believe the dimensions of the dump body are best represented by a rectangular prism with the same dimensions as specified above. We accounted for the double steel walls of the dump body by incorporating two individual stainless steel shields with thicknesses of 0.188 and 0.135 inch, respectively. We assume the dump body is completely filled with Marcellus Shale drill cuttings. We placed the 375P-1000 radiation detector six feet from the side of the dump body, as this would be the detector's approximate location in reference to all dump trucks entering the Chemung County landfill. The MicroShield program allows its user to manipulate the geometric shape of the radioactive source material, but the radiation dose receptor is always represented as a single point. Since the 375P-1000 radiation detector is not a point but a cylindrical tube with a height of 183 cm and a diameter of 20 cm[14], we assume that the height of the center of the 375P-1000 detector would be located at the same height as the center of the dump truck body and calculate the radiation doses that would be detected at the top, center, and bottom of the detector.

Shale is not a custom source included in the MicroShield database and we therefore designed our own source material to best represent the Marcellus Shale drill cuttings. We assume that the shale is comprised of mostly quartz (SiO_2) calcite ($CaCO_3$) and has a density of 2.35 grams per cubic centimeter (g/cm^3)[15]. Although Marcellus Shale drill cuttings will contain radioactive uranium-238 (U-238) and all of its gamma-emitting progeny, we only calculate the exposure rate caused by radium-226 (Ra-226). Ra-226 is soluble in water and will concentrate in any residual water transported with the drill cuttings into the dump truck body.

The MicroShield program calculates exposure rates, in millirads per hour (mR/hr), which result from the radioactivity of any given source. In order to estimate the radioactivity of Marcellus Shale drill cuttings based on exposure rates, we calculated the radioactivity of Marcellus Shale needed to produce an

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10 Grove Software Incorporated, 2008
11 Valew Truck Bodies, 2009
12 John Deere, 2010
13 Valew Truck Bodies, 2009
14 Ludlum Measurements Inc., 2009
15 University of Melbourne, 2003

exposure rate of 0.95 µR/hr. The relationship between external gamma radiation and exposure rates is linear. Based on the exposure rates of Marcellus Shale drill cuttings with Ra-226 concentrations of 50, 150, 500, and 1,500 pCi/g, we calculated that the Ra-226 concentrations in Marcellus Shale that produced a reading of 0.95 µR/hr are 2,340 pCi/g measured at the top and bottom of the 375P-1000 detector and 2,043 measured at the center of the detector.

As previously discussed, the County landfill will accept 2,000 tons of Marcellus shale drill cuttings with up to 20% of contaminated water. Since the rock cuttings and contained fluid is far less than the estimated sensitivity of the detectors, the radioactive scale cuttings, with up to 20% contaminated water, may not be detected.

6.0 Issues in the CoPhysics Report

The CoPhysics report, commissioned by Fortuna, concludes that the rock cuttings are only 2 to 3 times above background radioactivity levels.[16] However, they make several major mistakes in their methodology.

First, they claim the use of EPA 701.1 measurement protocol in their analysis. The EPA 701.1 protocol is a method used for gamma detection in radioactive materials dissolved in water and is not to be used for measurement of a solid. To measure the radionuclide content in a solid, the material must be dissolved in acid. Ra-226 is then chemically separated detected by measuring emanating radon.

Second, the CoPhysics study does not measure radium directly and instead measures a surrogate. For the detection of thorium-232, CoPhysics measures actinium-228, a decay product with strong gamma emission, which is acceptable since the two radionuclides are in secular equilibrium and since processing does not alter this equilibrium. However, this is not the case for radium, which selectively dissolves in fluid during the drilling process. Thus, use of bismuth-214 as a surrogate for radium-226 in the report is not permissible.

Lastly, it is not clear where the measurements were taken and whether any processing took place before the gamma detector readings. The CoPhysics report does not state whether the rock cuttings were taken from a horizontal or from a vertical bore hole. Under the temperature and pressure conditions that exist in a deep hole, the introduction of liquids into a horizontal well, enhances Ra-226. Since it was stated at the Issues Hearing that the Fortuna site in Bradford County uses horizontal wells, the study should have also analyzed rock cuttings from horizontal wells.

7.0 Conclusions

1. The hazard associated with the disposal of incompletely dewatered Marcellus shale drill cuttings and drilling fluid in a municipal landfill has not been fully evaluated by NYSDEC. The Marcellus shale has elevated radioactive concentrations, approximately 25-30 times above background concentrations. The drilling and dewatering processes enhance the concentration of radium in the drilling fluid. Rock cuttings that hold up to 20% of this fluid are still considered solid waste and will be disposed of in the County landfill. The introduction of this radioactive material into the landfill will give rise to serious problems due to the generation of radon, radiologically contaminated leachate and to potential reuse of the site in the future. NYSDEC regulations regarding the radiation doses from a decommissioned site and the allowable concentrations of radium in soil will be exceeded. In our opinion, these radioactive rock cuttings and associated radioactive drilling fluids belong in a radioactive landfill, such as the Envirocare landfill in Clive,

[16] CoPhysics Corporation, 2010

Utah. Radium-contaminated waste is similar to U mill tailings, which the Utah landfill is designed for.

2. Major uncertainties have not been resolved. The findings of the CoPhysics report conflict with borehole gamma readings and with the independent measurements of the USGS. The CoPhysics report does not explain where the cuttings were found and processed. The measurement methodology, EPA 701.1, and the use of a surrogate Bi-214 to measure Ra-226 are not appropriate for this case.

3. Worker exposure to radioactivity at the working face of a landfill that disposes such waste can be expected to exceed health-base dose limits set by EPA and NRC.

4. The waste at issue can be generated only by means of industrial processes in two gross phases: (a) fluids with chemical additives are forced into subterranean shale formations under high pressure, where they leach out NORM, making the fluids much more radioactive than they were before injection; solid waste is generated from the return waste water only by means of another set of industrial processes, including a shale shaker, centrifuge, and perhaps other mechanisms.

5. The drilling fluids that provide the source for the solid waste are chemically changed by pressurized contact with NORM, concentrating the NORM in the fluids. For example, barium is added to drilling mud pumped into a horizontal wellbore in order to extract radium sulfate from cuttings. This solid may be disposed of with the rock cuttings.

6. Based on RESRAD calculations, the radiation exposures received by a future resident farmer will exceed allowable regulatory limits. The radium concentrations in soil will exceed EPA regulatory limits. NYSDEC has not examined the environmental and health and safety implications of disposing of shale cuttings in a solid waste landfill. In our opinion, the radioactive scale cuttings and fluids are more appropriately deposited in a radioactive landfill designed for this disposal.

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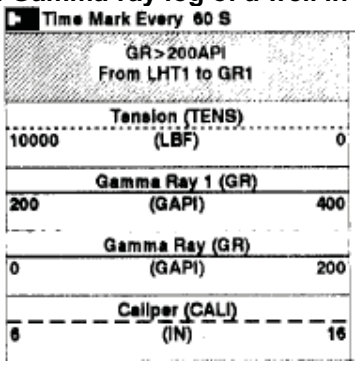
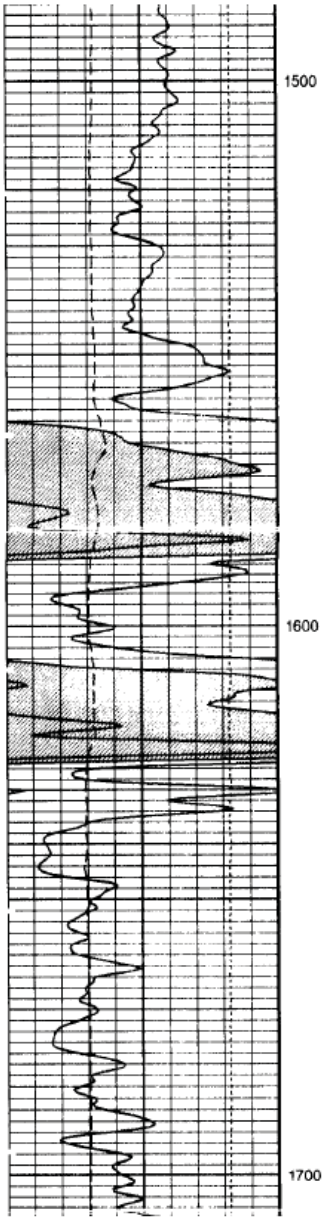
Attachment 1. Gamma-ray log of a well in Shiavone, NY




1500
1600
1700