Legislative Budget and Finance Committee

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PA's Program for Beneficial Use of Biosolids (Sewage Sludge) by Land Application

Conducted Pursuant to HR 2016-60

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Table of Contents

Summary and Recommendations

House Resolution 60 of 2016 calls on the Legislative Budget and Finance Committee (LBFC) to review the Commonwealth's program for the beneficial use of sewage sludge by land application, including the methods currently used for biosolids use and disposal, the costs involved with these methods, and alternatives to the current use and disposal methods. The resolution also calls for us to review the methods the Department of Environmental Protection uses to administer and enforce the program.

Note on terminology: While the terms *biosolids* and *sewage sludge* are sometimes used interchangeably, the term "sewage sludge" is typically used to refer to the solids that settle out in the wastewater treatment process, while the term "biosolids" is used to refer to the finished, treated, and processed product that can legally be applied to land. This report follows that convention.

We found:

Pennsylvania sends more of its biosolids to landfills than most states. Almost half (about 46 percent) of Pennsylvania biosolids are sent to landfills, with land application—typically on agricultural land—accounting for about 38 percent, and incineration about 15 percent. Nationally, about 60 percent of biosolids are land applied, 20 percent landfilled, and 20 percent incinerated.

No biosolids management method is risk-free. While the U.S. Environmental Protection Agency and others have concluded that the risk of land application of biosolids, if done properly, is minimal, some risk may still exist. For example, a 2002 report conducted by the National Academy of Sciences[1] found that additional scientific work is needed "to reduce persistent uncertainty about the potential for adverse human health effects from exposure to biosolids." In response to this report, the EPA has undertaken additional studies to ensure that the chemical and pathogen standards it developed in 1993 are supported by current scientific data and risk-assessment methods. Several of these studies are still on-going. EPA is also required to collect and analyze data at least every two years for the purpose of identifying new pollutants that may need to be regulated. Risks and negative environmental impacts also exist if biosolids are landfilled (landfilling is land intensive and creates the risk of rainfall runoff and possible leaching) or incinerated (releases carbon dioxide and possibly other volatile pollutants into the atmosphere).

Pennsylvania biosolids are classified as either EQ (Exceptional Quality) or non-EQ. EQ biosolids must meet strict pollution requirements; be treated to have

[1] *Biosolids Applied to Land: Advancing Standards and Practices*, 2002.

very low pathogen levels, typically through the application of high heat; and have reduced levels of compounds that attract vectors (e.g., insects and rodents). EQ biosolids may be bagged and sold to residential property owners with no restrictions on how the product can be used. Non-EQ biosolids, which comprise over 80 percent of the land-applied biosolids in Pennsylvania, have less strident pollution limits; are treated to reduce pathogens but at levels significantly higher that allowed for EQ biosolids; and have less stringent vector reduction requirements. Non-EQ biosolids are typically supplied to farmers at no cost, but are subject to multiple siting and use restrictions. Farmers can only apply biosolids up to the agronomic rate for nitrogen of the crop being grown.

Land application of biosolids is the least expensive use/disposal method. While costs can vary widely depending on factors such as the volume of material handled at the treatment facility, the distance between a treatment facility and landfill, and landfill tipping fees, a 2007 report conducted for the Center for Rural Pennsylvania found that, for large facilities, land application costs an average of $145 per dry ton versus $260 per dry ton for landfill and $290 per dry ton for incineration. The cost difference is less for small facilities, $252 per dry ton for land application verses $280 per dry ton to landfill. Also, landfill costs vary greatly across the state, with significantly higher tipping fees in the eastern part of Pennsylvania.

The Executive Director of the Mid-Atlantic Biosolids Association estimated that, transportation costs being equal, it typically costs large facilities about $45 more per wet ton to landfill biosolids than it does to apply them to land. This too, however, can vary across the state.

Based on the information in the Center for Rural Pennsylvania report, total costs for disposing and land application of biosolids generated in Pennsylvania amounted to approximately $70 million in 2007 ($37 million for landfilling, $19 million for land application, and $13 million for incineration).

Biosolids reduce fertilizer costs to farmers. Biosolids contain nitrogen, phosphorus, and various micronutrients that are beneficial to plant growth. The organic matter in biosolids also reduces surface runoff, reduces erosion, and improves the water- and nutrient-holding capacity of the soil. Additionally, some farmers receive a modest cash payment to offset the cost for spreading non-EQ biosolids. Biosolids have also been used in abandoned mine reclamation efforts in Dauphin, Centre, Clearfield, and Schuylkill Counties.

The use of biosolids is protected under the Right to Farm Act. The health effects of applying biosolids on farm fields (cited as burning eyes, sore throats, coughing, headaches, and nausea) was a central issue in Gilbert v. Synagro. The complainants also cited odors so bad they could not leave their homes on many occasions. In December 2015, the Supreme Court reaffirmed the ruling of the lower

court that the use of biosolids as fertilizer is a "normal agricultural practice" and is, therefore, protected under Pennsylvania's Right to Farm Act.

Public concern over offensive odors has been cited as the biggest threat to the beneficial use of biosolids. The odor emanating from biosolids can vary from barely noticeable to highly objectionable, depending on the characteristics of the raw material and how the material is processed and handled. Steps treatment plants can take to reduce odors include adding iron and/or lime and ensuring the material has fully completed the aerobic or anaerobic digestion process. Avoiding land application when wind, humidity, and precipitation conditions are unfavorable and avoiding spreading near residential and commercial properties if the material is unusually odiferous are also steps that can be taken to avoid odor complaints. Negative health effects from breathing biosolids emissions have also been cited, but the EPA reports that the cause of such health complaints is poorly understood and requires additional research.

DEP's regulation of the land application of biosolids focuses primarily on nitrogen concerns. If biosolids are applied at a higher amount than a plant's agronomic rate, excess nitrogen or phosphorus can move into surface water or groundwater. DEP, therefore, includes in its general permit an application rate under which the biosolids may be used. The application rate is based on the nitrogen needs of the crop receiving the biosolids. DEP has also expressed concern that biosolids are being applied at rates that exceed plant phosphorus requirements. If DEP begins to place greater emphasis on excess phosphorous, and depending on how it interprets its regulations, it could significantly reduce the amount of biosolids allowed to be applied on farm land.

DEP only conducts periodic inspections of biosolids land application sites. DEP's regulations state that DEP "intends" to conduct an administrative inspection of both biosolids generating facilities and the farms that spread biosolids "at least once a year." DEP guidelines further state that land application sites should be inspected "periodically" when the site is actively receiving biosolids. We reviewed DEP records for 12 facilities and 36 application sites (6 sampled from each DEP region) for the three-year period 2014-2016. None of the 12 facilities had a DEP inspection pertaining to its biosolids operations (one had an inspection, but it was not related to its biosolids permit). Of the 36 application sites we reviewed, an "intended" administrative file review was conducted on only 30 percent of sites and a routine/complete inspection (not a requirement) was conducted at 9 percent of the sites.

Pennsylvania's regulations regarding the beneficial use of biosolids appears to be generally in line with the requirements in other states. All states must, at a minimum, comply with federal regulations when generating and applying biosolids. States may, however, enact stricter standards at their discretion. We reviewed requirements in several other states with regard to setbacks from water

sources, setbacks from occupied dwellings, and requirements for notification to nearby landholders. It was difficult to make apples-to-apples comparisons because states use different criteria (e.g., setbacks from occupied dwellings vs. setbacks from property boundaries). Pennsylvania's requirements were less strict in some instances and stricter in others. Overall, however, Pennsylvania's regulatory requirements regarding the land application of biosolids appeared to be roughly comparable to the regulations in the comparison states.

Many new technologies are being developed to improve how biosolids are processed and to create alternative beneficial uses. Many of these efforts focus on maximizing the energy (primarily methane) stored in sewage sludge to generate heat for the production of steam or electricity. Several Pennsylvania sewage treatment plants already burn the methane produced by anaerobic digesters to provide heat and create electricity for on-site use. Other efforts focus on reducing the amount of energy required in the aeration and drying steps.

One of these new technologies is the OmniProcessor, which can use fecal sludge to generate drinkable water, electricity, and a pathogen-free ash. The OmniProcessor has been successfully demonstrated at a test facility in Seattle and at a larger facility in Dakar, Senegal, but there are no full-scale facilities in the United States. A Maine company is seeking to obtain DEP and PUC approval to import dry sewage sludge, in the form of pellets, into Pennsylvania to be used as an innovative alternative fuel at coal-powered power plants. Dried biosolids can also be used as fuel in the kilns used for cement making.

Recommendation

DEP should modify its General Operating Permit requirements to require biosolids generators to develop odor management plans. Offensive odors are the primary cause of public opposition to the land application of biosolids. If treated and spread using modern technology and sound management practices, biosolids odors can be minimized. We recommend DEP amend its requirements for a General Operating Permit to require, as a component of the Biosolids Quality Enhancement Plan (BQEP), that generators of biosolids establish and implement an odor management plan.[2] The plan should incorporate appropriate best practices, taking facility size into consideration, with regard to both the treatment process and how the biosolids are stored and applied at receiving sites. If DEP inspectors are made aware of a valid odor complaint, they could then take appropriate enforcement actions if the odor management plan is not being properly implemented.

[2] Under the current program, odor management is a factor to be considered in the development of the BQEP but, unlike for Concentrated Animal Operations and Concentrated Animal Feeding Operations, a written odor management plan is not required.

I. Introduction

In June 2015, the Pennsylvania House of Representatives passed House Resolution 60 calling on the Legislative Budget and Finance Committee to review the Commonwealth's program for the beneficial use of sewage sludge by land application.

Study Objectives

The resolution lists five study objectives to be included in the report:

(1) The methods currently used for biosolids use and disposal in this Commonwealth.

(2) The costs involved with current methods of biosolids use and disposal.

(3) The methods used to administer and enforce the program established under 25 Pa. Code Ch. 271 Subch. J by the Department of Environmental Protection.

(4) All appropriate alternatives to current use and disposal methods employed in this Commonwealth and in other states, particularly in regard to their economic feasibility and effects on the environment and on public health in comparison to current use and disposal methods.

(5) Any alternative beneficial use, including but not limited to, electric power generation and abandoned mine reclamation, and any obstacles that may hinder the expansion of any alternative beneficial use of biosolids.

Methodology

Much of the information contained in this report came from various published reports and articles, including, *Biosolids Disposal in Pennsylvania* (The Center for Rural Pennsylvania, 2007); *Guidelines for Application of Sewage Biosolids to Agricultural Lands in the Northeastern U.S.* (Rutgers University, 2007); *Land Application of Sewage Sludges: An Appraisal of the U.S. Regulations* (Cornell University, 1999); and *Water: Biosolids Management and Enforcement* (Office of Inspector General, 2000). We also reviewed several documents published by the U.S. Environmental Protection Agency and the Pennsylvania Department of Environmental Protection as well as testimony delivered before the House Committee on Environmental Resources and Energy.

Organizations and individuals contacted and offering input into the study include the Pennsylvania Department of Environmental Protection; Pennsylvania Department of Agriculture; Material Matters; Synagro, Inc.; Pennsylvania Municipal Authorities Association, Sludge Free UMBT, Inc.; Murray McBride, Ph.D.; Herschel

A. Elliot, Ph.D.; Mid-Atlantic Biosolids Association; Pennsylvania Farm Bureau; Pennsylvania Grange; the Pennsylvania Water Environment Association and the Pennsylvania Septage Management Association.

The report addresses the issue of whether the land application of biosolids, particularly on agricultural fields, is safe for the public health and the environment. The U.S. EPA, U.S. Department of Agriculture, and many others have concluded the practice of land application on agricultural fields, when done according to regulations, is safe and appropriate. Other qualified experts, however, disagree, or at least raise warnings. We do not have the scientific expertise to assess the merits of these competing claims. Instead, the report provides information on the key points of both sides. We also note that the EPA has taken the concerns expressed seriously enough to have launched a significant effort to assess many of these concerns. A status report on the progress of EPA's efforts can be found in Appendix B.

The report does not address the use or disposal of residential septage, where regulatory requirements are less stringent than those for sewage sludge.

Acknowledgements

We thank staff of the Pennsylvania Department of Environmental Protection as well as representatives from all the aforementioned agencies and groups for the cooperation and assistance provided during this study.

Important Note

This report was developed by Legislative Budget and Finance Committee staff. The release of this report should not be construed as an indication that the Committee or its individual members necessarily concur with the report's findings and recommendations.

Any questions or comments regarding the contents of this report should be directed to Philip R. Durgin, Executive Director, Legislative Budget and Finance Committee, P.O. Box 8737, Harrisburg, Pennsylvania 17105-8737.

II. Findings

The terms biosolids and sewage sludge are sometimes used interchangeably.[1] Although there is no regulatory distinction between sewage sludge and biosolids at either the federal or state level, for the purposes of this report, we use the term "sewage sludge" to refer to the solids that settle out in the wastewater treatment process and the term "biosolids" to refer to the finished, treated, and processed product that can legally be applied to land.[2] Thus, when properly treated and processed, sewage sludge becomes biosolids.

Biosolids are created through the treatment of domestic wastewater generated from sewage treatment facilities. The treatment of biosolids often begins before the wastewater reaches the sewage treatment plant. In many wastewater treatment systems, federal regulations require that industrial facilities pre-treat their wastewater to remove hazardous contaminants before it is sent to a wastewater treatment plant.[3] Wastewater treatment facilities monitor incoming wastewater streams to ensure their compatibility with the treatment plant process.

Once the wastewater reaches the plant, the sewage goes through several physical, chemical, and biological processes that clean the wastewater and remove the solids. The wastewater treatment processes include steps to help sanitize wastewater solids to control pathogens, such as certain bacteria, viruses, parasites, and other organisms capable of transporting disease.

Once treated, biosolids can be land applied to farm fields and other sites such as mine reclamation areas, sent to a landfill, or incinerated.[4] All 50 states allow the land application of biosolids, although the extent of land application varies widely among states.

A. The Methods Currently Used for Biosolids Use and Disposal in This Commonwealth[5]

Approximately 300,000 tons (dry-weight) of municipal sewage sludge are produced each year in Pennsylvania. Three viable options currently exist for disposal

[1] Because of the difficulty of revising federal law and regulatory language, U.S. EPA has never officially adopted the term "biosolids." It is, nevertheless, widely used in agency documents and on the EPA website.
[2] If we quote a regulation or report that uses the term "sludge" rather than biosolids, we maintain the original wording.
[3] The regulations do not require all hazardous contaminants be removed. The EPA bases its standards on the greatest pollution reductions economically achievable for each industry.
[4] In Pennsylvania, biosolids taken to landfills must meet Class B pathogen standards, but do not need to meet metal contents standards.
[5] Much of the Pennsylvania-specific data used in this section of the report is from *Biosolids Disposal in Pennsylvania*, Herschel A. Elliott, Ph.D., Robin C. Brandt, Ph.D., and James S. Shortle, Ph.D, sponsored by a grant from the Center for Rural Pennsylvania, November 2007.

or use of this material: land application on farm, forest, or mine land; landfill placement; and incineration. In 2007, it was estimated that, in Pennsylvania, about 38 percent of biosolids were applied to land, about 46 percent of biosolids were sent to a landfill, and 15 percent were incinerated. These percentages vary across the state, with land application occurring more frequently in the southeastern and southcentral regions of the state, and landfill disposal occurring more frequently in the more rural areas of the state.

Table 1

Dry Tons of Biosolids by Facility Size and Disposal Method

	Annual Biosolids Management Quantities (dry tons)
Landfill	
Small	19,700
Medium	45,000
Large	76,300
Total	141,000
Land Application	
Small	8,200
Medium	20,900
Large	87,600
Total	116,700
Incineration	
Small	-
Medium	1,000
Large	45,000
Total	46,000
TOTAL	303,700
Landfill	46.4 percent
Land Application	38.4 percent
Incineration	15.2 percent

Source: *Biosolids Disposal in Pennsylvania*, November 2007.

An undetermined amount of Pennsylvania-generated biosolids are shipped out of state, and a significant, but also undetermined, amount of biosolids are transported into Pennsylvania from neighboring states.

Compared to national averages, Pennsylvania, based on 2007 data, has a relatively high percentage of biosolids taken to landfills.

Nationally:

- 60 percent of all biosolids is beneficially used as a fertilizer on farm land following treatment,
- 20 percent is incinerated,
- 17 percent ends up buried in a landfill, and
- 3 percent is used as mine reclamation cover.

Land application. Before sewage sludge can be applied to land, it must be treated to stabilize the organic material and reduce pathogens. The U.S. Environmental Protection Agency (EPA) divides biosolids that can be land applied into two groups based on the level of pathogens: Class A and Class B. Biosolids that meet standards for very low pathogen content, typically as the result of composting or the application of high heat (400 degrees for 30 minutes), are Class A. All EQ biosolids must meet Class A pathogen reduction standards. When applied to a farm field, Class A biosolids are subject to certain buffer requirements, but not to crop harvesting restrictions.[6]

Class B biosolids are also treated, normally through either digestion (aerobic or anaerobic) or by adding lime, but may still contain detectible levels of pathogens. For this reason, various buffer requirements, public access, and crop harvesting restrictions apply to lands where Class B biosolids are applied. In 2007, most—about 87 percent—of the biosolids used for land application were Class B biosolids.

Due to harvesting restrictions (e.g., food crops with harvested parts that touch the sewage sludge/soil mixture and that are totally above the land surface may not be harvested for 14 months after application of sewage sludge, and food crops with harvested parts below the land surface may not be harvested for 20 months), Class B biosolids are almost exclusively used for feed and forage crops or crops such as wheat and barley, where the harvested parts do not touch the surface of the soil. Such harvest restrictions do not apply to Class A biosolids, and they may be bagged and sold as fertilizer for home gardens. The specific regulatory criteria used to classify biosolids are discussed in Section C.

The greatest advantage of biosolids to farmers is a reduction in fertilizer costs, as biosolids contain significant amounts of nitrogen, phosphorus, and organic matter that can benefit crop production. Biosolids typically have about 4 percent

[6] Although not explicitly defined in the Part 503 rule, Exceptional Quality (EQ) biosolids refer to biosolids that meet low-pollutant and Class A pathogen reduction limits and that have a reduced level of compounds that attract insects and animals (vectors). Exceptional Quality biosolids can be used on the farms without a site permit. Biosolids sold or given away in a bag or container or applied to home lawns and gardens must meet the Exceptional Quality standard.

nitrogen, in a form that is released slowly over time. Biosolids also contain phosphorus and many micronutrients that can be beneficial to crop growth. The organic matter in biosolids reduces surface runoff, reduces erosion, and improves the water- and nutrient-holding capacity of the soil. The addition of organic matter is particularly helpful in areas where soils are naturally low in organic matter.

In addition to its value as a fertilizer and soil conditioner, Class B biosolids can also be an income stream for farmers, as they may receive a modest payment as reimbursement for the cost of spreading Class B biosolids. Farmers typically must pay for Class A biosolids.

Once a municipal treatment plant decides to land apply its biosolids, it typically proceeds with a competitive bidding process for a distributor.[7]

In addition to farming uses, biosolids are also applied to land to provide:

- Organic matter and nutrients to sod and nursery operations.
- Soil conditioner for construction of golf courses, parks, and athletic fields.
- Landfill cover.
- Land reclamation.
- Mine reclamation.
- Forest fertilization.
- Erosion control.
- Improvement to rangeland soil.
- Horticulture.
- Slope stabilization.

Safety of land application of biosolids. The current EPA regulations regarding biosolids, which the Pennsylvania Department of Environmental Protection has largely adopted (see Section C below), became effective in 1993. The regulations, known as the Part 503 Rule, were promulgated after nearly 10 years of research, some of which was based on work done in the 1970s. More recent research has identified many new chemical compounds that have been found in biosolids but that were not considered when the 1993 regulations were being developed. Concerns over the possible long-term effects of these chemicals, and over some of the assumptions and criteria used when developing the 1993 regulations, have been at the center of debate regarding the safety of the land application of biosolids, particularly biosolids that are applied on agricultural lands.

[7] Synagro Technologies, Inc,, a major distributing of biosolids in Pennsylvania, informed us it is their policy to not reimburse farmers for spreading biosolids.

For example, a 2002 report conducted by the National Research Council (NRC) of the National Academy of Sciences found that, while there has been no documented scientific evidence that the Part 503 Rule has failed to protect public health, additional scientific work is needed "to reduce persistent uncertainty about the potential for adverse human health effects from exposure to biosolids."[8] In particular, the report found:

- The technical basis of the 1993 chemical standards for biosolids to be outdated.
- The reliability of EPA's prescribed treatment techniques should be better documented using current pathogen detection technology, and more research on environmental persistence and dose-response relationships is needed to verify that current management controls for pathogens are adequate to maintain minimal exposure concentrations over an extended period of time.
- No substantial reassessment has been done to determine whether the chemical or pathogen standards promulgated in 1993 are supported by current scientific data and risk-assessment methods.
- EPA needs to study more rigorously the exposure and health risks, or the lack thereof, in worker and community populations exposed to biosolids.

The report concluded that, to assure the public and to protect public health, there is a critical need to update the scientific basis of the rule to (1) ensure that the chemical and pathogen standards are supported by current scientific data and risk-assessment methods, (2) demonstrate effective enforcement of the Part 503 rule, and (3) validate the effectiveness of biosolids-management practices.

EPA responded to the NRC report with a 14-Project Action Plan, as well as its own review of existing sewage sludge regulations. The Action Plan has four main objectives:

- Determine potential risks of select pollutants.
- Measure pollutants of interest.
- Characterize potential volatile chemicals and bioaerosols from land application sites.
- Understand effectiveness of water/sludge treatment and risk management practices.

Appendix B contains EPA's assessment of the status of these 14 projects as of December 2016.

[8] *Biosolids Applied to Land: Advancing Standards and Practices*, National Academy of Sciences, 2002.

EPA is also required to collect and analyze data at least every two years for the purpose of identifying new pollutants that may need to be regulated.[9] As part of this process, EPA has identified 15 chemicals for which it will conduct a more refined risk assessment and risk characterization process.[10] The results of the assessment are to serve as a basis for determining whether to propose amendments to the sewage sludge regulations for any of these chemicals.[11] For example, the EPA is currently conducting research on the potential effects of endocrine-disrupting chemicals in biosolids, with the goal of providing safer ways to apply biosolids and ways to reduce the concentrations of endocrine-disrupting chemicals in biosolids. EPA has also noted that, on a longer term basis, it plans to continue evaluating the 135 chemicals found in samples taken as part of the Targeted National Sewage Sludge Survey (TNSSS).

In Virginia, a legislatively created Expert Panel conducted an 18-month study of the land application of biosolids in Virginia and also found "no evidence or literature verifying a causal link between biosolids and illness, recognizing current gaps in the science and knowledge on this issue." [12] The panel did, however, recommend additional research be done to identify any potential relationships between human, livestock, and wildlife health and exposure to biosolids. The panel also made a series of other recommendations regarding ways Virginia's biosolids program could be improved to address concerns regarding odors, improved communications among all parties involved in the generation and use of biosolids, incident reporting, and other concerns. Virginia's biosolids program is discussed further in Section C.

As recently as 2015, Dr. M.B. McBride, a professor in Cornell University's Department of Crop and Soil Science, expressed his belief that it is inadvisable to use sewage sludge on farms, citing the following reasons:[13]

- Toxic organic pollutants (dioxins, brominated fire retardants, etc.) may transfer and bioaccumulate in animal fat and milk of livestock.
- Crops can take up some toxic metals and certain synthetic chemicals.
- Most chemicals in present day sludges have not been tested for toxicity or impacts on soils, animals or humans.
- Contamination of wells and surface waters, especially by pathogens and pharmaceuticals, is possible.

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[9] Information on the EPA's most recent biennial review is included as Appendix C.

[10] acetone, anthracene, barium, beryllium, carbon disulfide, 4-chloroaniline, diazinon, fluoranthene, manganese, methyl ethyl ketone, nitrate, nitrite, phenol, pyrene and silver.

[11] Pennsylvania would be required to automatically adopt any such changes into state regulation.

[12] *HJR 694 Biosolids Expert Panel Final Report*, December 22, 2008.

[13] Taken from *Concerns with Application of Sewage Sludge Products on Farmlands*, M.B. McBride, Department of Crop and Soil Sciences, Cornell University, (undated). See also *Case for Caution Revisited: Health and Environmental Impacts of Application of Sewage Sludges to Agricultural Land,* Ellen Z. Harrison, retired Director, and Murray McBride, Director, Cornell Waste Management Institute, Cornell University, Ithaca, NY., March 2009.

- Importing nitrogen and phosphorus usually results in nutrient excess on livestock farms, and therefore is an environmental liability, not a benefit.

Similarly, Dr. Caroline Snyder, a retired Professor of Science, Technology, and Society at Rochester Institute of Technology, has written and testified about the potential hazards of the land application of biosolids on agricultural land (see Exhibit 1). Dr. Snyder has also testified about her concerns regarding the Domestic Sewage Exclusion. This federal regulation allows certain chemical process waste, which would otherwise be considered a hazardous waste, to be mixed with untreated sanitary waste and sent to a water treatment facility for processing. Any such mix, however, would still be subject to the pretreatment standards under the Clean Water Act.

Several citizens and citizen groups contacted us to express concerns regarding offensive odors and health and environmental impacts. Reported health impacts included lung and respiratory problems, heart ailments, skin rashes, and MRSA (an antibiotic-resistant staph infection). Reported environmental impacts included biosolids runoff onto local roads and streams; the over-application of phosphorous; the pollution of farm lands, particularly from chemicals and pharmaceuticals that have not yet been studied by the EPA; businesses and industries that allow toxic metals and chemicals to enter into sewage systems in violation of state and federal regulations; and toxic chemicals entering into the food chain and drinking water supplies. Concerns were also expressed over the depressed property values that can result from owning property in near proximity to farms that spread biosolids. The recommendations of one such citizens group are presented in Appendix D.

The health effects of applying biosolids on farm fields (complaints of burning eyes, sore throats, coughing, headaches, and nausea) was a central issue in a recent, and widely followed, Pennsylvania Supreme Court case, Gilbert v. Synagro (131 A.3d 1 (Pa. 2015). The complainants also cited extremely offensive odors as emanating from the biosolids, with odors so bad they could not leave their homes on many occasions. In December 2015, the Supreme Court ruled in favor of Synagro, a biosolids distributor, and reaffirmed the ruling of the local court that the use of biosolids as fertilizer is a "normal agricultural practice" and is therefore protected under Pennsylvania's Right to Farm Act (3 P.S. §§951-957).[14, 15]

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[14] The purpose of the Right to Farm act is "to reduce the loss to the Commonwealth of its agricultural resources by limiting the circumstances under which agricultural operations may be the subject matter of nuisance suits and ordinances." The act also provides that "Every municipality that defines or prohibits a public nuisance shall exclude from the definition of such nuisance any agricultural operation conducted in accordance with normal agricultural operations so long as the agricultural operation does not have a direct adverse effect on the public health and safety."

[15] One judge, while concurring in the decision, noted that additional steps could have been taken to reduce odors. He wrote: "Thus, I would not rule out the possibility that an evidentiary record in a future dispute could support the concept that the use of certain identified odor-control practices is necessary for a particular application of biosolids to qualify as "normal" and, thus, to fall within Section 954(a)'s protective scope."

Exhibit 1

Ten Government-Industry Myths About Biosolids

Caroline Snyder Ph.D.

MYTH NO. 1: For more than 2000 years industrial waste and sewage sludge have been land-applied as soil amendments. (Source: EPA[i])

FACT: The myriad hazardous industrial chemical wastes found concentrated in modern treated sewage sludges (biosolids), including pesticides, pharmaceuticals, plasticizers, flame retardants and growth hormones to mention a few, did not even exist until recent decades.

MYTH NO. 2: Biosolids are nutrient-rich organic fertilizers. (Source: EPA[ii])

FACT: It's highly deceptive to call mixtures of many thousands of industrial chemical pollutants "nutrient-rich" simply because several of the pollutants are nitrogen and phosphorus compounds found in commercial fertilizers. Biosolids produced from sewage sludges generated in industrial urban centers are undoubtedly the most pollutant-rich materials on Earth. When applied to land, industrial pollutants in biosolids reenter aquatic systems and are magnified up the food chain.[iii]

MYTH NO. 3: Over 99% of biosolids is composed of water, organic matter, sand, silt, and common natural elements. (Source: NEBRA[iv])

FACT: It's also deceptive to call mixtures of many thousands of industrial chemical pollutants "natural," especially when EPA and the biosolids industry are targeting consumers who use the words "natural" and “organic” to mean free of synthetic chemical contaminants.

MYTH NO. 4: Biosolids are essentially pathogen free. (Source: State of California[v])

FACT: Many if not most pathogenic (disease-causing) bacteria and viruses can survive treatment processes used to produce biosolids (Class A and Class B); and many dangerous pathogens, such as *Salmonella* and *Staphylococcus*, can re-grow to high levels in biosolids, which is mostly comprised of human feces.[vi] New research indicates that sewage sludge treatment facilities are actually breeding grounds for antibiotic-resistant pathogens.[vii]

MYTH NO. 5: Infectious prions will not survive wastewater treatment and therefore are not present in land-applied biosolids. (Source: U. Arizona[viii])

FACT: The latest research shows that prions survive wastewater treatment processes.[ix]

MYTH NO. 6: Biosolids are not sources of pathogens or toxicants. Sludge syndrome is a somatic disease triggered by biosolids odors and by fears raised in the community and through the media. (Source: Mid-Atlantic Biosolids Association[x])

FACT: Odors from biosolids are a warning that the material is emitting disease- causing pathogens and biological toxins, *e.g.*, endotoxins. Peer-reviewed scientific studies have demonstrated that resulting health effects are not imagined but real.[xi]

MYTH NO. 7: Allegations of health problems linked to biosolids exposure are urban myths. (Source: NEBRA[xii])

Exhibit 1 (Continued)

FACT: Many hundreds of sludge-exposed rural neighbors have reported chronic respiratory, skin and gastrointestinal conditions consistent with exposures to the types of chemical and biological contaminants found in biosolids. The relationship between land application of biosolids and such adverse health effects has been documented in valid scientific studies, including the peer-reviewed scientific literature.[xiii]

MYTH NO. 8: Treatment breaks down most organic chemical pollutants. (Source: NEBRA[xiv])

FACT: EPA's 2009 Targeted National Sewage Sludge Survey of 74 sewage treatment plants in 38 states, which sampled 145 industrial chemical pollutants, found them in every sample.[xv] Their concentration ranges often topped ppm-levels and higher, exceeding concentrations considered safe in drinking water by orders of magnitude. Moreover, the breakdown products from organic chemical pollutants are often more harmful than the parent compounds.[xvi]

MYTH NO. 9: Biosolids contaminants are tightly bound to soil and do not become bioavailable. According to Rufus Chaney, "You can put enough heavy metals in the soil to kill the crop but that crop is still safe for human consumption." (Source: USDA[xvii])

FACT: EPA and the USDA buried studies demonstrating heavy metals in biosolids exceeding current levels permitted by EPA caused liver and kidney damage in farm animals grazing on fields treated with biosolids.[xviii] After EPA promulgated the current sludge rule in 1992, it worked with the Water Environment Federation to establish the "National Biosolids Public Acceptance Campaign." EPA's Office of Inspector General investigated EPA's efforts to silence Dr. David Lewis, one of its top scientists who documented adverse health effects, and concluded that EPA could not assure the public that land application of biosolids is safe.[xix]

MYTH NO. 10: U.S. sludge regulations that govern the land application of biosolids (40 CFR Part 503) are completely protective, based on science and valid risk assessment models. (Source: NEBRA[xx])

FACT: A 1999 Cornell Waste Management Institute paper concluded that the 503s do not protect human health, agriculture, or the environment.[xxi] The 503s regulate only nine metals plus inorganic nutrients (N, P). Even though industry can legally discharge any amount of hazardous waste into sewage treatment plants, the rules are based on chemical-by-chemical risk assessment which ignores the effects of mixtures and interactions. The 2002 NRC biosolids panel recognized this and concluded that "*is not possible to conduct a risk assessment for biosolids at this time (or perhaps ever) that will lead to risk-management strategies that will provide adequate health protection without some form of ongoing monitoring and surveillance . . . the degree of uncertainty requires some form of active health and environmental tracking.*[xxii]

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[i] R.K. Bastian. "Interpreting Science in the Real World for Sustainable Land Application 2005," *JEQ 34,1:174*.
[ii] EPA Fact Sheet. http://water.epa.gov/polwaste/wastewater/treatment/biosolids/
[iii] Hale, R.C., M.J. LaGuardia, E.P. Harvey, M.O. Gaylor, T.M. Mainor, and W.H. Duff. "Persistent pollutants in land applied sludges." *Nature* 412:140-141.
[iv] NEBRA, *Response to Toxic Action Center's Toxic Sludge in Our Communities*. March 3, 2003.
[v] CalRecycle. http://www.calrecycle.ca.gov/organics/biosolids/
[vi] Gattie, DK and DL Lewis. 2004. "A high-level disinfection standard for land-applied sewage sludge (biosolids)." *Environ. Health Perspect*. 112:126-31.
[vii] Gibbs, RA et al. 1997. "Re-growth of fecal coliforms and salmonellae in stored biosolids and soil amended with biosolids." *Water Science and Technology* 35 (11-12).

Exhibit 1 (Continued)

[viii] Miles S.L; Takizawa, C.P. Gerba, and I.L. Pepper. 2011. Survival of Infectious Prions in Class B Biosolids. *J.Env..Sci. & Hlth*. 46: 364-370.
[ix] Kaplan N. Prions' Great Escape. http://www.nature.com/news/2008/080701/full/news.2008.926.html
[x] Toffey, W.E. Biosolids Odorant Emissions as a Cause of Somatic Disease. Presentation to the 2007 North East Bisolids & Residuals Conference & Exhibit. Philadelphia Water Department. December 4, 2007.
[xi] Shusterman, D. 1992. Critical review; the health significance of environmental odor pollution. *Arch.Environ.Health* 47:76-87.
[xii] NEBRA March 3, 2003 op.cit p. 10.
[xiii] Lewis, D. L. et al. 2002. Interactions of pathogens and irritant chemicals in land-applied sewage sludges (biosolids) BMC 2:11. http://www.biomedcentral.com/1471-2458/2/11; Lewis, DL, Gattie DK. 2002. Pathogen risks from applying sewage sludge to land *Environ. Sci. Technol*. 36:286A-293A; Ghosh, J. 2005. Bioaerosols Generated From Biosolids Applied Farm Fields In Wood County, Ohio. Master of Science Thesis, Graduate College of Bowling Green State University. Abstract by Robert K Vincent, Advisor. www.ohiolink.edu/etd/send-pdf.cgi/Ghosh%20Jaydeep.pdf?bgsu1131322484; Khuder, S. *et al*. *Arch. Environ. Occup. Health* 2007; 62, 5–11.
[xiv] NEBRA. March 3, op.cit. p. 22.
[xv] U.S. EPA. Biosolids: Targeted National Sewage Sludge Survey Report - Overview, January 2009, EPA 822-R-08-014. http://water.epa.gov/scitech/wastetech/biosolids/tnsss-overview.cfm; See also Jennifer G. Sepulvado, Andrea C. Blaine, Lakhwinder S. Hundal, and Christopher P. Higgins. Occurrence and Fate of Perfluorochemicals in Soil Following the Land Application of Municipal Biosolids. *Environ. Sci. Technol*., Publication Date (Web): March 29, 2011 (Article) DOI: 10.1021/es103903d
[xvi] DL Lewis, W Garrison, KE Wommack, A Whittemore, P Steudler, J Melillo. Influence of environmental changes on degradation of chiral pollutants in soils. *Nature* 1999; 401:898-901; Paris DF, Lewis DL. Chemical and microbial degradation of ten selected pesticides in aquatic systems. *Residue reviews* 1973; 45:95-124.
[xvii] MD Abernethy, "To sludge or not to sludge?: At summit, scientists discuss risks," Interview with R Chaney, USDA. Green Consumer Headlines, Times-News, May 2, 2010. http://www.managemylife.com/mmh/articles/curated/278108
[xviii] U.S. EPA Report: EPA-600/S1-81-026, 232 p. (Apr. 1981). "Sewage Sludge – Viral and Pathogenic Agents in Soil-Plant-Animal Systems." G.T. Edds and J.M. Davidson, Institute of Food and Agricultural Systems, University of Florida. An EPA Project Summary is available at http://nepis.epa.gov/ by searching 600S181026 or key words in the title of the report.
[xix] U.S. EPA Office of Inspector General Status Report - Land Application of Biosolids, 2002-S-000004, Mar. 28, 2002. www.epa.gov/oig/reports/2002/BIOSOLIDS_FINAL_REPORT.pdf
[xx] NEBRA, "Is biosolids recycling safe? How do we know?" http://www.nebiosolids.org/index.php?page=faqs
[xxi] Harrison, E.Z. McBride M.B. and Bouldin D.R. Land application of sewage sludges: an appraisal of the US regulations. Int.J.Environment and Pollution, Vol.11, No.1. 1-36. Retrieved at http:cwmi.css.cornell.edu/PDFS/LandApp.pdf. See also Case for Caution Revisited 2008 (revised 2009) retrieved at http:cwmi.css.cornell.edu/case.pdf. http://cwmi.css.cornell.edu/PDFS/LandApp.pdf. The 503 sludge rule can be found athttp://water.epa.gov/scitech/wastetech/biosolids/upload/fr2-19-93.pdf
[xxii] National Academy of Sciences, National Research Council. Biosolids Applied to Land: Advancing Standards and Practices, National Academy Press, Jul. 2, 2002. www.nap.edu/books/0309084865/html

Most recently, in 2016 the California Superior Court, in striking down a voter initiative that banned the land application of biosolids to farmland in Kern County, stated that "the overwhelming weight of the evidence is that there is no basis in fact for any determination that land application of biosolids poses any risk to Kern County residents….There is no evidence of risk to human health."

We also reviewed a report by the National Fire Protection Association that summarized the 23 OSHA investigations of deaths at wastewater treatment plants, sewers, or sewage treatment facilities from 2001-2010.[16] The deaths were caused by a wide variety of factors (truck accidents, trench collapses, falling down steps or into pit tanks), but none were attributed to inhaling windborne pathogens.

This study would appear to support a 1997 manual by the Cornell University School of Industrial and Labor Relations which noted:

> Workers engaged in sewer maintenance and wastewater treatment are exposed to a wide variety of routinely found disease-producing microorganisms, but, in spite of this exposure literature searches have revealed little evidence of occupational health problems associated with wastewater pathogens. Most studies show that risk of infection from exposure to wastewater or sludge is minimal.[17]

Landfill

A Center for Rural Pennsylvania (CRP) report found that almost half (about 46 percent) of Pennsylvania's biosolids are disposed at landfills.[18] According to state regulations, biosolids taken to municipal solid waste landfills must meet Class A or Class B pathogen standards, but do not need to meet metal contents standards.

From a management and materials handling perspective, landfilling of biosolids is perhaps the simplest solution. From an economic standpoint, landfilling, particularly in western Pennsylvania, presently compares favorably with other options. This is likely to change, however, as landfill space becomes more limited and tipping fees (waste-dumping costs) increase. From an environmental standpoint, landfilling prevents the release of any sludge-borne pollutants or pathogens by concentrating the sludge into a single location. If the landfill is properly constructed and maintained, environmental risks from these pollutants escaping are minimal.

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[16] Worker Casualties involving Wasterwater, Sewers or Sewage Treatment Plants and Fire Incidents at Water or Sanitation Utilities, Marty Ahrens, National Fire Protection Association, June 2012.
[17] *Health Hazard Manual: Wastewater Treatment Plant and Sewer Workers,* Nellie J. Brown, Cornell University, December 1, 1997.
[18] *Biosolids Disposal in Pennsylvania*, Herschel A. Elliott, Ph.D., Robin C. Brandt, Ph.D., and James S. Shortle, Ph.D., funded by The Center for Rural Pennsylvania, November 2007.

Biosolids landfilling options include disposal in a monofill (a landfill that accepts only wastewater treatment plant biosolids) or in a co-disposal landfill (a landfill that combines biosolids with municipal waste solids). The ratio of solid waste to biosolids it typically 9:1, and biosolids are sometimes mixed with soil and used to cover the refuse at the end of the working day, as intermediate cover between landfill cells, or to promote vegetative growth in the final cover material when a section of the landfill is being closed.

EPA has cited high concentrations of metals or other toxins in the biosolids or odorous material that may create a public nuisance if managed through other options as two common scenarios that lead to landfill disposal rather than beneficial reuse. Additionally, land application requires storage or other alternative management options during periods of unsuitable weather or cropping restrictions, tighter odor control measures, and public outreach efforts; all issues that can typically be avoided with landfills.

The CRP report noted that low tipping fees, especially in western Pennsylvania, have encouraged municipalities to use landfills to dispose of biosolids. However, the Pennsylvania section of the American Society for Civil Engineers reported in 2010 that Pennsylvania's 46 active landfills (including six construction and demolition waste landfills) collectively had a remaining average capacity life of 16 years as of January 2009. They also noted that few new permits are being granted for new landfill sites, due in part to changes made to the state approval process.

Negative environmental impacts associated with landfilling of biosolids include leaching that may transport nitrate, metals, and/or pathogens to groundwater if the landfill site has not been properly selected or if the liner has been damaged. Rainfall runoff from an active landfill may carry contaminates to nearby surface waters. Landfilled biosolids will also decompose under anaerobic conditions and generate methane, a greenhouse gas. This gas is often captured and either flared off or used for electricity generation or direct use (e.g., in driers or kilns).[19] Landfilling biosolids is also contrary to the EPA's national beneficial reuse policy and has been banned in New Jersey as a poor use of land.

Incineration

Biosolids can also be incinerated, which greatly reduces the volume of the material to be disposed of, completely destroys pathogens, decomposes most organic chemicals, and can recover a small amount of heat value. The residual ash is a stable, relatively inert, inorganic material that has just 10 to 20 percent of the original biosolid's volume.

[19] As of July 2016, there were 652 operational landfill methane energy projects in the U.S., including 40 in Pennsylvania. (www.eesi.org/papers/view/fact-sheet-landfill-methane)

Most trace metals in the sewage sludge become concentrated in the ash. This material most commonly is landfilled, although it potentially could be used as a component in construction materials such a cement, bricks, or asphalt paving.

Incineration, however, releases carbon dioxide (a greenhouse gas) and possibly other volatile pollutants (cadmium, mercury, lead, dioxins) into the atmosphere. Incinerator operation requires sophisticated systems to remove fine particulate matter (fly ash) and volatile pollutants from stack gasses. This makes incineration one of the more expensive options for biosolids disposal. Also, as with landfilling, the potential benefits from organic matter and plant nutrients are lost.

A relatively small percentage of biosolids are incinerated; about 15 percent in Pennsylvania and about 20 percent nationally. Pennsylvania currently has facilities that can burn biosolids in Erie, Westmoreland, Montgomery, Delaware, and Luzerne Counties.[20] Advanced technologies, such as regenerative and recuperative thermal oxidizers (discussed below) may increase the feasibility of incineration as a means of disposal. However, given the high capital cost of constructing new incinerators and the associated air pollution control equipment, the number of biosolids incinerators is not likely to grow significantly in the near future.

B. The Costs Involved With Current Methods of Biosolids Use and Disposal

Biosolids processing and disposal is a major portion of a wastewater utility's costs, amounting to approximately 20 percent to 30 percent of total operating cost.

Land Application and Landfill Disposal Costs

The 2007 Center for Rural Pennsylvania report developed cost estimates for both beneficial use (land application) and landfill disposal of biosolids by size of facility. These estimates are shown in Table 2.

[20] In 2012, Allentown entered into a contract to construct a waste-to-energy incinerator that would have blended waste with sewage sludge to convert the mixture into a fuel, but the contract was canceled in 2014. The city cited financing difficulties, although the company that would have built the plant disputed that as the reason.

Table 2

Average Cost Per Dry Ton by Facility Size

	Land Application	Landfill
Small Facilities (<1 MGD)		
# Observation	24	58
Average cost per dry ton[a]	$252.00	$280.35
Medium Facilities (1 to 5 MGD)		
# Observation	13	39
Average cost per dry ton[a]	$201.65	$256.08
Large Facilities (>5 MGD)		
# Observation	14	19
Average cost per dry ton[a]	$145.16	$260.32

MGD – Million gallons per day.
[a] Includes estimated cost to transport materials.

Source: *Biosolids Disposal in Pennsylvania*, November 2007.

Based on this table, costs for landfilling are generally between 10-40 percent higher than land application, with lower differentials to be expected at small facilities.[21] Unlike most states, Pennsylvania requires biosolids that are landfilled to meet the same pathogen reduction requirements as biosolids that are land-applied, so processing costs are similar whether landfilled or land-applied.

The CRP report notes that biosolids management costs have two major components: the actual dollar costs associated with capital and operating expenses and the more subjective "costs" that deal with the value of resource recycling and the cost of environmental risks. Table 2 only addresses the former costs.

Using information in the CRP report, we calculated total costs for disposing and land application of biosolids generated in Pennsylvania amounted to approximately $70 million in 2007 ($37 million for landfilling, $19 million for land application, and $13 million for incineration).

The cost of landfilling biosolids is quite variable across the state, with the cost for landfill disposal being significantly higher in the eastern part of Pennsylvania due, at least in part, to the closing of large landfills in New York and New Jersey.[22] Green Power, Inc. estimated tipping fees in 2014 varied from $103 to $63.25 per ton, with the average fee being $75.96.[23]

[21] In 1999, EPA estimated that monofilling (landfilling to a dedicated biosolids fill) is about 20 percent more expensive than land application.
[22] Due in part to odor complaints, the PA DEP also ordered the closing of a Pennsylvania landfill on the border of Pennsylvania and New Jersey, which accepted sewage sludge, by 2017.
[23] The national average was $49.78.

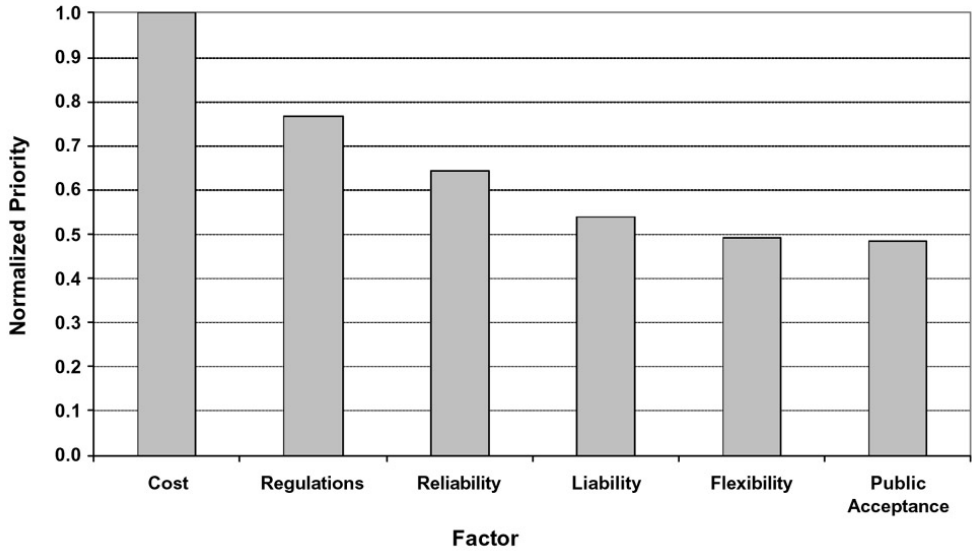
The Executive Director of the Mid-Atlantic Biosolids Association estimated that it costs about $15 per wet ton to "tip" biosolids at a farm versus about $60 per wet ton to "tip" at a landfill. Assuming transportation costs to be equal, this results in added costs of about $45 to landfill a wet ton of biosolids. Transportation costs are estimated to be typically in the range of $30-$50 per wet ton, so total costs for land application could be expected to be in the range of $45-$65 per wet ton, compared to $90-$110 per wet ton to landfill.

Incineration. The cost for incineration was derived largely from figures provided by the EPA and other reliable sources. Because of the high capital costs and sophisticated operational requirements, incineration was almost exclusively confined to large treatment facilities (over 5 million gallons per day). According to the EPA, the operation and maintenance costs for multiple hearth facilities with air pollution control equipment to meet the Part 503 Rule requirements are approximately $244 per dry ton of biosolids. Other studies have found costs of incineration to be $220 to $360 per dry ton. The CRP report used $290 per dry ton as its cost estimate for incineration in 2007.

Factors Other Than Costs. While costs may be the primary factor a treatment facility uses when determining how to deal with biosolids, it is not the only factor. Exhibit 2 shows the results of a 2007 survey of wastewater treatment facilities with regard to the relative importance of six factors (cost, flexibility, reliability, public acceptance, regulatory requirements, and liability concerns) in their decision as to whether to land apply, landfill, or incinerate its biosolids.

Exhibit 2

Relative Priority of Factors Affecting Selection of Biosolids Management at PA Wastewater Treatment Plants



Source: *Biosolids Disposal in Pennsylvania*, November 2007.

As the table shows, costs and regulations were the two most important factors, with public acceptance being the least important factor. Also, many municipalities that are committed to recycling consider landfill disposal of biosolids a waste of valuable nutrients and soil amendments that could benefit farms.

C. The Methods Used to Administer and Enforce the Program Established Under 25 Pa. Code Ch. 271 Subch. J by the Department of Environmental Protection

The U.S. Environmental Protection Agency, at 40 CFR Part 503, federally regulates biosolids disposal options. Biosolids that are to be land applied must meet or exceed these EPA regulations and quality standards. The Part 503 rule governing the use and disposal of biosolids contains limits for metals in biosolids, pathogen reduction standards, and site and crop harvesting restrictions. The rule also contains monitoring, record keeping, and reporting requirements for land-applied biosolids, as well as requirements for biosolids that are surface disposed or incinerated.

States must, at a minimum, meet these federal standards, but they may impose stricter standards for their particular state.

Pennsylvania's Subchapter J Regulations

Land application of sewage sludge in Pennsylvania was first regulated in 1977 under 25 Pa. Code Ch. 75. Regulation was done at that time on a site-specific basis and the assessment of a site's suitability. Sewage sludge application rates were based on research conducted at various northeastern U.S. universities, as well as on mine reclamation research conducted at Penn State. In 1994, Pennsylvania established interim guidelines that largely adopted the technical aspects of Part 503 but that included several additional requirements not found in Part 503. For example:

- DEP requires permits (see 271.902a).
- DEP requires EQ biosolids to be non-liquid (see 271.911(b))
- DEP requires notifications (DEP, County, Adjacent landowners) for Class B Biosolids (see 271.913)
- DEP requires training (see 271.915(J)).
- DEP requires testing for PCBs (see 271.914)
- The buffers to homes, well, sinkholes, and streams, maximum slopes, soil depth to seasonal high water table, soil pH, and conservation and manure plan requirements in 271.915 are more restrictive than in federal regulations (see 503.14.)

General Permits

State regulations adopted after Part 503 changed the regulatory focus of biosolids from being site-specific to assessing the quality of the biosolids to be applied, along with the regulatory requirements for applying it to land. In particular, Pennsylvania's regulations established a general permitting system instead of individual permits for application sites. A general permit can be issued to a treatment plant that generates sewage sludge or to residential septage haulers who land apply it.

Three general permit categories are established based on the quality of biosolids sought to be land applied. The three categories of permits are:

- PAG-07 – for the highest quality biosolids (Exceptional Quality, or EQ), with few use regulatory restrictions.
- PAG-08 – for biosolids that do not meet the same quality level as the EQ biosolids, and, therefore, have more use restrictions on them.
- PAG-09 – for residential septage, which is simply removed from septic tanks and screened and treated with lime. This has similar restrictions on its use as does PAG-08.

As reflected in the different permits, two categories of biosolids (the Pennsylvania regulations use the term sewage sludge) are recognized. First, exceptional quality (EQ) means it has lower pollutant concentration limits than shown in Table 3 (left column), meets or exceeds the Class A pathogen reduction standards, and meets one of the first eight vector attraction reduction standards listed in Table 3.

Non-EQ sludge need only be below the ceiling concentrations for the pollutants listed in Table 3 (right column), meet one of the Class B or Class A pathogen reduction standards, and meet one of the 10 vector reduction standards. As listed later, unlike EQ biosolids, non-EQ biosolids have multiple regulatory restrictions for land application.

The process for obtaining a general permit requires a requesting party to file a Notice of Intent (NOI) with DEP for coverage under one of the three general permits, accompanied by payment of a $500 fee. An NOI form provided by DEP must be used and submitted to the appropriate regional DEP office with jurisdiction over the treatment plant or facility that produces the biosolids to be used. The Notice of Intent must then be approved by DEP.

An approved permittee is responsible for locating sites that meet the specific site criteria outlined in the Subchapter J regulations and their approved permit. These include insuring that the farm conservation plan or erosion and sedimentation control plan is implemented, soil pH is maintained at about 6.0, the isolation distances are being maintained, and that the access, harvest, and grazing restrictions are being met. County conservation district staff may accompany DEP on

these site visits to review the farmer's conservation or erosion and sediment control plan.

Notice must also be given to adjacent landowners, DEP, and to the appropriate county conservation districts 30 days prior to the initial application of biosolids to the land. This notification also includes posting signs around the proposed land application site. Upon receipt of this notice, DEP is to review the site within 30 days for its suitability. The preparer of biosolids is responsible for ensuring the applicable regulatory requirements for biosolids are met prior to its land application.

Pollutant Concentration

Maximum concentrations of the ten regulated pollutants are set forth in Table 3. The left column of the table sets forth the concentration limits that must be met for biosolids to qualify as EQ for land application. The restrictions listed on the right side of the table are the concentration limits to be met for non-EQ biosolids.[24]

Table 3

Ceiling Concentrations

Exceptional Quality Biosolids	Pollutant	Non-exceptional Quality Biosolids
Monthly Average Concentrations (Milligrams per Kilogram)[a]		
41	Arsenic	75
39	Cadmium	85
1,500	Copper	4,300
300	Lead	840
17	Mercury	57
75	Molybdenum	75
420	Nickel	420
100	Selenium	100
2,800	Zinc	7,500
4	PCBs	8.6

[a] Dry weight basis

Source: Penn State Extension, *Land Application of Sewage Sludge in Pennsylvania – A Plain English Tour of the Regulations.*

These limits are instantaneous values, meaning all biosolids samples analyzed must meet the established limits. Pennsylvania's ceiling concentrations are identical to the federal limits except for PCBs, which the federal regulations do not address.

[24] In 2009, EPA conducted a national survey of wastewater treatment plants, selecting 80 representative facilities. Three of the nine regulated metals had at least one sample where the observed concentration exceeded the respective land application ceiling concentration. Using statistical techniques, EPA determined that less than three percent of the POTWs in the survey's target population might be expected to exceed the land application standards for any of these three metals. The maximum observed concentration for the other six regulated pollutants regulated by EPS (EPA does not regulate PCBs) were well below their respective land application regulatory limits.

The total amount of a pollutant that may be added to an application site is also limited. Each time biosolids is land applied to a site, pollutants in each application must be added to the total from previous applications, resulting in a cumulative loading rate. EQ biosolids are not subject to cumulative loading rates. Pennsylvania's cumulative pollutant loading rates (see Table 4) are identical to the federal limits.

Table 4

Cumulative Pollutant Loading Rates

Pollutant	Cumulative Pollutant Loading Rate (Kilograms per Hectare)	English Units (Pounds per Acre)
Arsenic	41	36
Cadmium	39	34
Copper	1,500	1,320
Lead	300	264
Mercury	17	15
Nickel	420	370
Selenium	100	88
Zinc	2,800	2,464

Source: 25 Pa Code §271.914(b)(2).

Pathogen and Vector Reduction

Pathogen reduction is the extent to which biosolids are treated to reduce disease-causing organisms. There are two levels of pathogen reduction. Class A biosolids have a high level of pathogen reduction; Class B biosolids still have a considerable, but lesser, level of pathogen reduction. Biosolids must meet pathogen reduction requirements at the time it is land applied, sold, or given away.

Pennsylvania regulations specify various methods by which Class A pathogen reduction can be obtained (e.g., heat treatment, pH and temperature, composting, and irradiation). In addition, fecal coliform bacteria density must be less than 1,000 per gram of total solids or salmonella bacterial must be less than 3 per 4 grams of dry solids.

Class B pathogen reduction can be met by either monitoring the fecal coliform density (the geometric mean of seven samples is required to be less than 2,000,000 per gram of dry solids) or through a designated Process to Significantly Reduce Pathogens (PSRP). Typical PSRPs used in Pennsylvania are anaerobic digestion and lime stabilization.

Vector attraction are characteristics of biosolids that attract rodents, flies, mosquitoes, and the like. The regulatory goal is to decrease disease vectors in contact with biosolids to reduce the risk of disease transmission. EQ biosolids must meet one of the first eight vector attraction reduction standards listed in Exhibit 3, whereas non-EQ biosolids can meet any of the 10 vector reduction standards. Pennsylvania regulations describe the 10 VAR standards as shown in Exhibit 3.

Exhibit 3

Vector Attraction Reduction Options

Option	EQ	Non-EQ
The mass of volatile solids in the sewage sludge shall be reduced by a minimum of 38%.	X	X
When the 38% volatile solids reduction requirement in paragraph (b)(1) cannot be met for an anaerobically digested sewage sludge, vector attraction reduction can be demonstrated by digesting a portion of the previously digested sewage sludge anaerobically in the laboratory in a bench-scale unit for 40 additional days at a temperature between 86° and 98°F (or 30° and 37°C). When at the end of the 40 days, the volatile solids in the sewage sludge at the beginning of that period is reduced by less than 17%, vector attraction reduction is achieved.	X	X
When the 38% volatile solids reduction requirement in paragraph (1) cannot be met for an aerobically digested sewage sludge, vector attraction reduction can be demonstrated by digesting a portion of the previously digested sewage sludge that has a percent solids of 2% or less aerobically in the laboratory in a bench-scale unit for 30 additional days at 68°F (or 20°C). When at the end of the 30 days, the volatile solids in the sewage sludge at the beginning of that period is reduced by less than 15%, vector attraction reduction is achieved.	X	X
The SOUR for sewage sludge treated in an aerobic process shall be equal to or less than 1.5 milligrams of oxygen per hour per gram of total solids (dry weight basis) at a temperature of 68°F (or 20°C).	X	X
Sewage sludge shall be treated in an aerobic process for 14 days or longer. During that time, the temperature of the sewage sludge shall be higher than 104°F (or 40°C) and the average temperature of the sewage sludge shall be higher than 113°F (or 45°C).	X	X
The pH of sewage sludge shall be raised to 12 or higher by alkali addition and, without the addition of more alkali, shall remain at 12 or higher for 2 hours and then at 11.5 or higher for an additional 22 hours.	X	X
The percent solids of sewage sludge that does not contain unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 75% based on the moisture content and total solids prior to mixing with other materials.	X	X
The percent solids of sewage sludge that contains unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 90% based on the moisture content and total solids prior to mixing with other materials.	X	X
Sewage sludge shall be injected below the surface of the land. No significant amount of the sewage sludge may be present on the land surface within 1 hour after the sewage sludge is injected. When the sewage sludge that is injected below the surface of the land is Class A with respect to pathogens, the sewage sludge shall be injected below the land surface within 8 hours after being discharged from the pathogen treatment process.		X
Sewage sludge applied to the land surface shall be incorporated into the soil within 6 hours after application to the land. When sewage sludge that is incorporated into the soil is Class A with respect to pathogens, the sewage sludge shall be applied within 8 hours after being discharged from the pathogen treatment process.		X

Source: 25 Pa Code §271.933(b).

Monitoring and Application Rate

Monitoring. The frequency of monitoring depends on the amount of biosolids a treatment plant land applies or distributes for land application, not on the total amount it generates. At a minimum, monitoring is to be as follows:

Exhibit 4

Frequency of Monitoring—Land Application

Amount of biosolids (Tons/or metric tons per 365 day period)	Frequency
Greater than zero but less than 319 (290)	Once per year
Equal to or greater than 319 (290) but less than 1,650 (1,500)	Once per quarter (4 times per year)
Equal to or greater than 1,650 (1,500) but less than 16,500 (15,000)	Once per 60 days (6 times per year)
Equal to or greater than 16,500 (15,000)	Once per month (12 times per year)

Source: 25 Pa Code §271.917.

Monitoring is conducted by the permitted facility, not the DEP. DEP is to be notified immediately if the permittee becomes aware of non-compliance with any biosolids quality standard relating to pathogen reduction, vector attraction, or pollutant concentration. After two years of monitoring at these frequencies, DEP may reduce the required frequency, but may not be less than once per year.

Application Rates. While biosolids contain several nutrients essential for plant growth, the main nutrient of concern in calculating an appropriate application rate per the requirements of the Subchapter J regulations is nitrogen. Application rates, therefore, are based on the nitrogen need of the crops receiving the biosolids for both EQ and non-EQ biosolids. The purpose for this is that maintaining an application rate then keeps excess nitrogen from migrating into groundwater.[25]

With application rates based solely on nitrogen loadings, there can often be an oversupply of phosphorus to the soil. Growing concerns regarding the impacts of phosphorus-rich biosolids on land applications have emerged. A representative of DEP explained to us that no formal regulatory changes were currently planned regarding incorporating phosphorous into the calculation of the application rates of biosolids and that, therefore, biosolids will continue to be applied at the agronomic rate according to the requirements of §271.915(f) and as defined in §271.907 (i.e., based on nitrogen loading). The DEP representative did say, however, DEP is

[25] Reclamation sites may be allowed to apply additional amounts of biosolids where there is more of a need for nitrogen and organic matter.

considering administratively adding phosphorous management to the biosolids regulatory process, using the Penn State Phosphorous-Index,[26] when DEP reauthorizes current general permits.

A change in phosphorous management could particularly affect livestock farmers who are applying manure as well as biosolids. If the application rates are restricted, they will be obliged to give priority to manure application in order to manage and dispose of it. They may not be able then to accept biosolids in addition, due to the possibility of increased phosphorous levels.

The Pennsylvania Department of Agriculture has also expressed concerns regarding the phosphorous in biosolids as follows:

> Given the challenges Pennsylvania will face in meeting phosphorous reduction goals of the Chesapeake Bay TMDL, and given the fact that much of the reductions in phosphorous must come from agricultural lands, we believe it would be appropriate to evaluate whether it is appropriate to continue to allow the application of bio-solids for agronomic purposes to be based on nitrogen needs of the crop, or if Pennsylvania should require these application rates to consider phosphorous and its potential loss to the environment.

Site Requirements

There are specific site requirements for locations receiving non-EQ biosolids.[27] General site requirements are as follows:

- Cumulative pollutant loading must be determined for each of the elements listed in Table 4. Any prior sewage sludge applications made to the site must be included in the determination. Once the cumulative loading limit is reached for any of the pertinent elements, no further sewage sludge applications may be made to that site.
- Sewage sludge may only be applied at reclamation sites if the reclamation activity is approved or permitted by DEP.
- Written consent of the landowner must be obtained before sewage sludge is applied to the land.

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[26] According to Penn State's website, The P Index is a field evaluation tool that was developed to identify areas that have a high risk of the loss of phosphorous to bodies of surface water. The P Index combines indicators of P source and of P transport. The P source indicators used in the Pennsylvania P Index are the Mehlich 3 soil test P; fertilizer application rates and methods; and manure application rates, methods, and P source coefficients (PSC). The transport indicators used are erosion, runoff potential, subsurface drainage, distance to a body of water, and evaluation of management practices that impact how P is potentially lost from a field. To use the P Index, one must develop a nitrogen-based nutrient management plan for a crop management unit and then evaluate this plan using the worksheets developed for the P Index.

[27] There are no site restrictions for EQ biosolids.

- At least seven days before sewage sludge is applied, the occupant of the land must be provided with written instructions that describe the acceptable uses and limitations of the sewage sludge.
- At least 30 days prior to the first application of sewage sludge at a site, written notification that includes a brief description of the operation, site restrictions, and name and permit number of the sewage sludge applicator must be provided to: (1) adjacent landowners, (2) the County Conservation District, and (3) the DEP regional office. This notification also includes posting signs around the proposed land application site.
- Before any sewage sludge is applied to a site, a representative soil sample must be obtained. At a minimum, the sample must be analyzed for pH and for the constituents listed in Table 3.
- The generator of the sewage sludge must supply written notification of the sewage sludge's total nitrogen content (on a dry weight basis).

Management practices at sites receiving land application are also restricted by regulation. These are summarized below:

- Sewage sludge may not be applied to land if it is likely to adversely affect a threatened or endangered species or its designated habitat.
- Sewage sludge may not be applied to land that is frozen, snow covered, or flooded.
- Sewage sludge may not be applied to agricultural land that is: within 100 feet of a perennial stream, within 100 feet of the edge of a sinkhole, within 300 feet of an occupied dwelling unless the current owner provides a written waiver, without an implemented erosion and sedimentation control plan or a farm conservation plan, within 300 feet of a water source unless the current owner provides a written waiver, within 100 feet of an exceptional value wetland, and within 11 inches of the seasonal high water table, nor within 3.3 feet of the regional groundwater table.
- Sewage sludge may not be applied to agricultural land with slopes greater than 25 percent or to reclamation land with slopes greater than 35 percent.
- Sewage sludge may not be applied to soil with a pH of less than 6, unless the sewage sludge material will increase the soil pH to 6 or greater within six months following application.
- Sewage sludge may not be applied at rates greater than the agronomic rate (based on the nitrogen requirement of the crop to be grown).
- Sewage sludge may not be applied at a farm where resident animals produce sufficient manure to meet the farm's nitrogen needs, unless a management plan that allows for off-farm uses of the manure is implemented.

- When land applying sewage sludge, the applicator must display the permit number on the side and rear of each vehicle used.
- Sewage sludge used for land reclamation must be incorporated within 24 hours of application.

Additional site restrictions focus on reducing the risk of pathogen transmission to either humans or animals and apply only to Class B biosolids. These include:

- Food crops with harvested parts that touch the sewage sludge–soil mixture and that are totally above the land surface may not be harvested for 14 months after application of sewage sludge.
- Food crops with harvested parts below the land surface may not be harvested for 20 months if the sewage sludge was on the soil surface for at least four months prior to incorporation, or for 38 months if the sewage sludge was incorporated within four months of application.
- Food, feed, and fiber crops may not be harvested for 30 days after application of sewage sludge.
- Animals may not be allowed to graze on land for 30 days after sewage sludge is applied.
- Turf grown on land where sewage sludge has been applied may not be harvested for one year after application of the sewage sludge if the turf will be placed on land with a high potential for public exposure or on a lawn.
- Public access to land where sewage sludge has been applied must be restricted for one year if the site has a high potential for public exposure, and for 30 days if the site has a low potential for public exposure.

Recordkeeping and Inspections

Proper records must be maintained showing that the biosolids being applied meet the quality criteria outlined in the permits and that the site management criteria were met during application. These records must be kept for at least five years (some need to be kept indefinitely), as set forth in the permit and whether the information concerns biosolids quality or the application site. DEP also receives this data yearly, which is available for public review. Regulations provide also that:

> A person operating under a land application of sewage sludge permit shall allow authorized representatives of the Commonwealth, without advance notice or a search warrant, upon presentation of appropriate credentials, and without delay, to have access to areas in which the activities covered by the land application of sewage sludge permit will be,

> are being or have been conducted to ensure compliance with The Clean Streams Law, the act, regulations promulgated under The Clean Streams Law or under the act, and a permit issued under this subchapter. Samples may be taken of solid, semisolid, liquid or contained gaseous material for analysis.

While Subchapter J regulations do not require regular inspections of facilities that produce biosolids for agricultural use or the farms that use biosolids, the regulations state that DEP "intends" to conduct inspections of such facilities and farms "at least once per year." (see §271.421(c)(7))

We reviewed inspection information recorded on Pennsylvania's Environment Facility Application Compliance Tracking System (eFACTS). We examined eFACTS information for 36 active biosolids application sites. This involved randomly choosing two sites in three different counties in each of DEP's six regions. We reviewed the inspections listed on eFACTS for years 2014-2016 for each of the 36 biosolids sites. The different types of inspections recorded were the following:

- Administrative file review
- Complaint inspection
- Compliance evaluation
- Routine complete (partial) inspection
- Follow up inspections
- Violations (just their existence, not what they were)

The 2006 DEP guideline document ("Guidelines for Identifying, Tracking and Resolving violations for the Land Application of Biosolids," February 11, 2006) provided insight into the different types of DEP inspections. An "administrative file review" is described as a review of the recordkeeping and reporting forms for a site, which is to be done annually. Both generating facilities as well as application sites are to have what are called "routine/complete inspections", which "should" happen once a year for generating facilities and, for sites actively applying biosolids, is to occur either within 30 days after receiving a Notification of First Land Application 30-Day Notice, periodically when aware a site is actively receiving biosolids, or to investigate a complaint. Regarding application sites, a "routine/complete inspection" is where an inspector reviews the site and reports to determine compliance with management practices and site restrictions contained in Subchapter J. It is unclear from the guideline document what a "compliance evaluation" is and how it differs from other inspections. The same is true of the "complaint inspection," although we operated under the assumption this is an inspection triggered by a complaint.

Our review of 36 application sites showed only one violation over three years. This must be viewed, however, in light of the fact that an annual administrative file review was conducted on only approximately 30 percent of the sampled application sites, and routine/complete inspections (while not regularly required) were conducted on only 9.3 percent of applications. Moreover, we viewed all 65 "complaint inspections" on eFACTS for the Clean Water program for the period April 2011 through March 2017. None of the 26 complaint inspections where a violation was found pertained to the land application of biosolids.

We also reviewed the eFACTS reports regarding 12 facilities in four different DEP regions permitted for generating biosolids and found that no regular facility-level inspections were reported. One facility with permits under multiple programs did report regular inspections, but the information on eFACTS was inconclusive as to which program the inspections pertained.

Exhibit 5

Inspection Records for Sampled Sites (2014-2016)

Region	Adm. File Rev	Complaint Inspec.	Compliance Eval.	Routine/Complete Inspec.	Follow-up Inspec.	Violations
South Central						
Site 1	2016-2014	-	-	-	-	-
Site 2	2016-2014	2014	-	-	-	-
Site 3	2016-2014	-	-	-	-	-
Site 4	2016-2014	-	-	-	-	-
Site 5	2016-2014	-	-	-	-	-
Site 6	2016-2014	-	-	-	-	-
Southwest						
Site 1	-	-	-	-	-	-
Site 2	2014	-	-	2014(2x)	-	-
Site 3	-	-	-	-	-	-
Site 4	2014	-	-	2014	-	-
Site 5	2014	-	-	-	-	-
Site 6	2014	-	-	-	-	-
Northwest						
Site 1	-	-	2015	2014	-	-
Site 2	-	-	2015	2014	-	-
Site 3	-	-	2016 2015	2014	-	-
Site 4	2013	-	-	-	-	-
Site 5	-	-	2016 2015	2014	-	-
Site 6	-	-	2016	2014	-	-
Northcentral						
Site 1	2014	-	-	2014	-	-
Site 2	2014	-	-	-	-	yes
Site 3	-	-	-	-	-	-
Site 4	2014 2014		-	-	-	-
Site 5	2014	-	-	-	-	-
Site 6	-	-	-	-	-	-
Northeast						
Site 1	-	-	2016	-	-	-
Site 2	-	-	-	-	-	-
Site 3	2014 2014	-	-	2014 (was only a partial)	-	-
Site 4	2014 2014	-	-	-	-	-
Site 5	-	-	-	-	-	-
Site 6	-	-	-	-	-	-
Southeast						
Site 1	-	-	-	-	-	-
Site 2	2014	-	-	-	-	-
Site 3	2015 2014	-	-	-	-	-
Site 4	2014	-	-	2016 (was only a partial)	-	-
Site 5	-	-	-	-	-	-
Site 6	-	-	-	-	-	-
% of potential	29.6	0.9	7.4	9.3	0.0	0.9

Source: Compiled by LB&FC staff through review of eFACTS database.

Other States

We reviewed for comparison purposes the regulatory requirements of states contiguous to and nearby Pennsylvania, as well as federal EPA Section 503 regulations regarding several site restriction requirements. These included the issues of setback requirements from a water source, setback requirements from an occupied dwelling, and notice requirements for adjacent landowners. The results of this comparison are set forth in Exhibit 6 at the end of this section.

As Exhibit 6 shows, although states do not use consistent criteria, Pennsylvania's regulations regarding the land application of biosolids generally appear to be in line with those of the other states we reviewed.

In 2003, the Virginia General Assembly amended the Code of Virginia to give local governments more oversight over biosolids recycling within their jurisdictions (Section 62.1-44.19:3 of the Code of Virginia). State regulations were then approved authorizing each county to pass a local ordinance and enabling it to assign an individual to monitor the application of biosolids within its boundaries. Under such a state-approved ordinance, a local monitor is permitted to test and monitor the land application of biosolids to ensure compliance with all applicable laws and regulations. Monitors may also order the abatement of any violation of state regulations. Localities that have local ordinances cannot enforce more restrictive conditions on the land application of biosolids than already exist in the state program. Approximately 24 of Virginia's 95 counties have such biosolids ordinances.

State law also allows the Virginia Department of Environmental Quality (DEQ) to collect $7.50 per dry ton of land-applied biosolids, to be paid by the generator of the biosolids and be deposited into the Sludge Management Fund. These funds, which amounted to $1.36 million in FY 2015, were used to support 15 biosolids permit program staff at the DEQ and covered 91 percent of the direct costs associated with the biosolids program. A small portion of the fees ($54,867) were used to reimburse localities for their monitoring efforts.

The Virginia DEQ employs biosolids specialists at its seven regional offices located throughout Virginia who are responsible for monitoring and enforcing biosolids regulations. The specialists evaluate sites before, during, and after application of biosolids. There is a particular emphasis on being present as many times as possible when biosolids spreading is actually occurring. These field experts are equipped with specialized tools to determine compliance with location of application. An inspection report is prepared for each visit to a land application site. The inspection report documents numerous aspects of the activity and conditions observed. The biosolids specialists are also available to answer questions from the public.

Localities are empowered by state law with the ability to employ an individual that monitors the use of biosolids to ensure state and federal requirements are met, just like a Virginia Department of Environmental Quality biosolids specialist. The local monitor can also require that any activity that is in violation of the regulations be stopped. DEQ can reimburse the locality for costs incurred in implementing a local monitoring program, provided the local monitor has met training requirements and prescribed procedures are followed.

The Issue of Odor

The odor emanating from biosolids can vary from barely noticeable to highly objectionable, depending on the characteristics of the raw material and how the material is processed and handled. The objectionable smells that come from biosolids are generally the result of a combination of different odorous sulfur compounds and ammonia, with descriptions of their odors ranging from rotten cabbage (dimethyl disulfide) to rotten eggs (hydrogen sulfide).

Unlike for Concentrated Animal Operations (CAOs) or Concentrated Animal Feeding Operations (CAFOs), which are required to have written, site-specific Odor Management Plans, Pennsylvania's DEP regulations do not specifically address the biosolids odor issue.[28] Odor management is, however, a factor that is to be considered in the development of the Biosolids Quality Enhancement Plan, a required plan for facilities that land-apply non-EQ biosolids. DEP may require as part of the Biosolids Quality Enhancement Plan that the generator adopt practices that include soil incorporation, storage restrictions, and more stringent VAR practices. DEP may also revoke the facility's General Permit if the facility is unable to mitigate the nuisance odor situation.

DEP's Protective Action Guide (PAG)-08 also includes language that would allow DEP to take action against a permit holder if DEP validates that the odors from a particular biosolids source are causing a "persistent public nuisance." While DEP has not used this provision to initiate official enforcement action, DEP has used this language to persuade facilities to make corrections. For example, one large facility was causing odor problems with the biosolids they generated and land applied, which DEP documented over several years at different application sites. The "persistent public nuisance" language in the permit was a significant factor that led this facility to choose to stop land applying and begin the process of upgrading their biosolids treatment.

Steps treatment plants can take to reduce odors include adding iron and/or lime and ensuring the material has fully completed the aerobic or anaerobic digestion process. Avoiding land application when wind, humidity, and precipitation conditions are unfavorable and avoiding spreading near residential and commercial

[28] The CAO/CAFO odor regulations apply to the facilities; they do not address the land application of manure.

properties if material is unusually odiferous are also low-cost steps that can be taken to avoid odor complaints.

In 2000, the U.S. EPA published a fact sheet on odor control in biosolids management.[29] The EPA noted that, regardless of any possible health effects, water quality professionals have a responsibility to mitigate nuisance odors and that such odors can threaten the success of the beneficial use of biosolids. While the elimination of all odor may not be a realistic goal, effective management practices can be taken to minimize odors, both at the biosolids producing facilities and at the land application sites. Methods to minimize odors at land application sites are shown in Exhibit 7. A decision tree, developed by the Water Environment Research Foundation, on steps facilities can take to reduce biosolids odors is presented in Exhibit 8.

EPA also recommends that the biosolids producers should accept responsibility for odor control at land application sites, and their terms of agreement with biosolids distributors should include management practices to minimize odors. In addition, the generator and contractor should have an odor response plan in place to provide guidance and policy on documenting and responding to odor complaints, and the land applier should have the ability and responsibility to divert biosolids from a site that is experiencing odor problems.

EPA notes that the most cost-effective approach to odor control is in the operation and maintenance practices at the processing facility, noting that a comprehensive odor audit is the best assurance that capital and operating dollars are spent wisely. Given the wide variety of facilities and odor management steps that could be taken, it was not feasible for us to estimate the costs that might be incurred to bring odors to an acceptable level at those facilities or sites where odors are an issue.

We also reviewed for comparison requirements of contiguous states (and the EPA) regarding the issue of odor, as shown in Exhibit 6.

[29] *Biosolids and Residuals Management Fact Sheet: Odor Control in Biosolids Management*, EPA, September 2000.

Exhibit 6

Requirements of Contiguous States and the EPA Regarding Odor

State	Set Back From Water Source	Set Back From Occupied Dwelling	Notice to Adjacent Landholder	Standards for Odor
Delaware	150-foot buffer must be maintained between the edge of the wetted field area and all property boundaries and the shoulder of internal and external public roads; A 100-foot buffer is required between the wetted edge of spray fields and the edge of any perennial lake or stream. A 50-foot buffer is required between spray fields and the edge of any channelized, intermittent watercourse. If wastewater irrigation causes an intermittent watercourse to become perennial, the 100-foot buffer requirement will apply.		Upon Department acceptance of the Project Development Report, the applicant must apply for a Department Sludge Utilization permit. Upon receipt of a completed application for this permit, the Department will advertise receipt of the application and conduct any hearings in accordance with 7 Del.C. Ch. 60. The cost of the advertisement is to be borne by the applicant.	
Maryland	100 feet	200 feet		
New Jersey	200 feet or less from surface waters; within 1,500 feet of a public community water supply well; within 300 feet of a public non-community or non-public water supply well.		Notification must be provided (prior to submission of a Letter of Land Application Management Approval [LLAMA] request to the Department) to all landowners and occupants adjacent to or abutting a proposed residual land application site. This requirement may be satisfied through public notice in a newspaper of local circulation. The Department also requires that a copy of all LLAMA applications be forwarded to the clerk of the municipality in which land application is proposed. The Department will not issue a LLAMA unless all the required public notices have been provided.	All applicants for a NJPDES permit for land application are required to demonstrate the characteristics of the marketable residual product to be produced with regards to the potential to create odors. The Department requires information that new residual products will meet marketable residual product standards and that the product will not exhibit nuisance characteristics.
New York	200 feet of potable water well; 200 feet of surface water and state-regulated wetland (waste not directly injected); 100 feet of surface water and state regulated wetland (waste directly injected)	50 feet of property line; Within 500 feet of residence, place of business, or public contact area	Written permission from the landowners must be obtained for all lands where land application will occur. A multi-party certificate indicating who will be responsible for each applicable operational requirement must be completed and followed.	In all cases, the solid waste that is land applied must be incorporated into the soil within 24 hours after application, unless concerns regarding odor and surface runoff can be mitigated by other means, and such means are approved by the department.

Exhibit 6 (Continued)

State	Set Back From Water Source	Set Back From Occupied Dwelling	Notice to Adjacent Landholder	Standards for Odor
Pennsylvania	100 feet of a perennial stream; 300 feet of water source	300 feet	(1) A person who prepares sewage sludge that is land applied at a location and a person who land applies residential septage at a location for agricultural, forest or land reclamation purposes shall send or otherwise provide written notification to the adjacent landowner, the county conservation district and the Department at least 30 days prior to the first application of the sewage sludge at that location. The notification shall: (i) Include a brief description of the operation, any site restrictions, the name of the person land applying the sewage sludge and the applicable permit number. (ii) Be sent by personal delivery or first class mail and, for an adjacent landowner, shall also be given by posting at the property line in a manner sufficient to notify the adjacent landowner of the items in subparagraph (i). (iii) For the county conservation district and the Department, include the location of the fields on a United States Geological Survey map and on a Natural Resources Conservation Service Soils Map. (iv) For the Department, be sent to the Department's regional office that has jurisdiction for the location where the sewage sludge will be applied.	Nuisance issues and concerns from neighbors may arise when biosolids are applied. Farmers may have to deal with complaints about odors and increased truck traffic, as well as concerns about pollutants and pathogens in the biosolids. Farmers must be sure that biosolids applicators are sensitive to these issues and carefully manage the operation to minimize problems.
West Virginia	50 feet of any surface water collection point; 200 feet of a drinking water supply well	200 feet of an occupied dwelling; within 100 feet of an adjacent property owner's property line		Sewage sludge processing facilities must be designed and operated to control vectors and odors. Off-site odor monitoring is required quarterly.
Federal	10 meters (approx. 33 feet)		The person who applies bulk sewage sludge to the land shall provide the owner or lease holder of the land on which the bulk sewage sludge is applied notice and necessary information to comply with the requirements in this subpart.	

Source: Compiled by LB&FC staff.

Exhibit 7

Methods to Reduce Odors at Land Application Sites

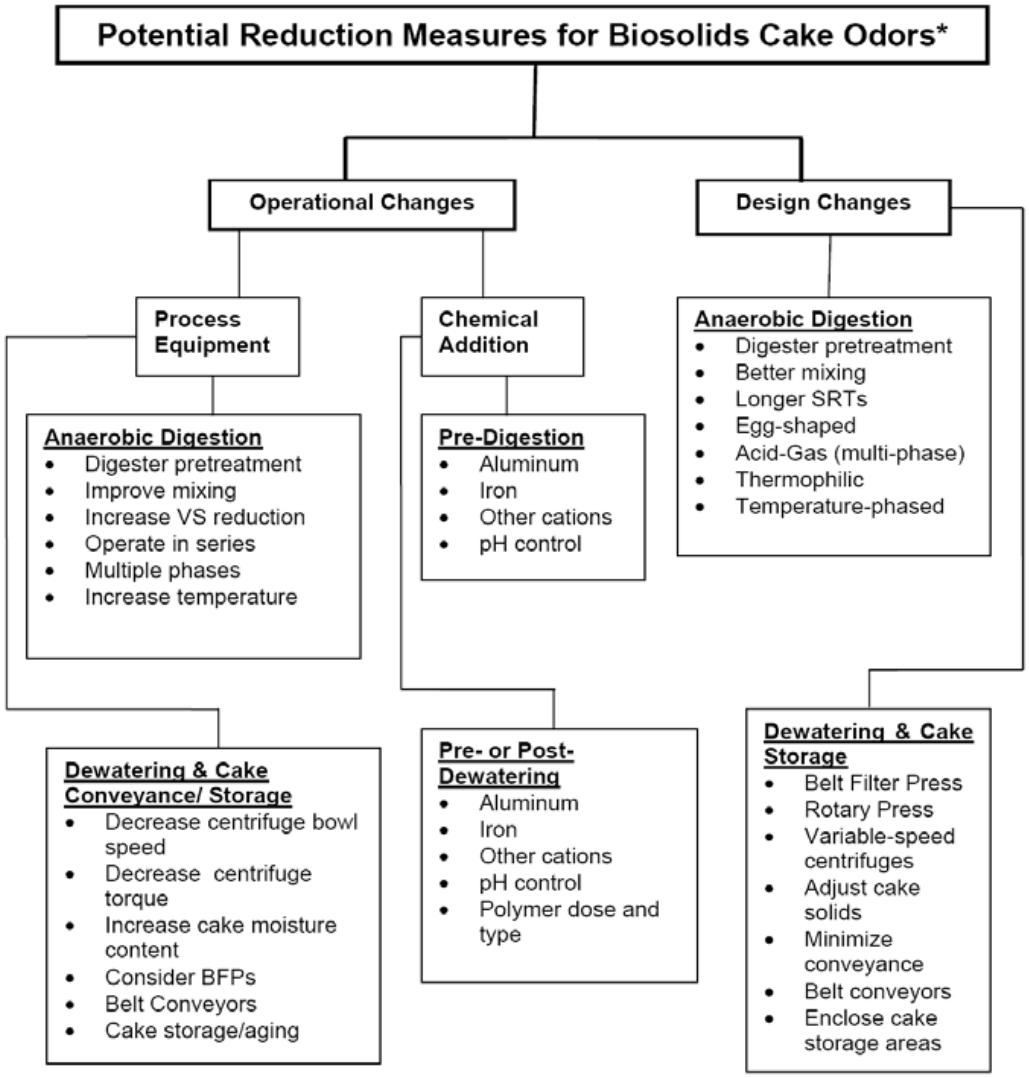
Methods to reduce odors at land application sites include:

- Properly stabilize, condition and manage biosolids at the treatment works to minimize odors from the final product.
- Selection remote sites and fields away from neighbors (USEPS & USDA, 2000).
- Apply well stabilized materials.
- Clean tanks, trucks and equipment daily.
- Whenever possible, subsurface inject or incorporate biosolids into the soil (WEF 1997).
- Minimize the length of time biosolids are stored (USEPA & USDA 2000).
- Reduce visibility and maximize the distance of the storage area from occupied dwellings (USEPA & USDA 2000).
- Avoid land application when wind conditions favor transport of odors to residential areas (USEPA & USDA, 2000).
- Plan field storage of biosolids based on the stability, quantity, and length of time biosolids are stored in addition to the location of the site with respect to nearness of neighbors and the meteorological conditions (USEPA & USDA).
- Avoid land application when nearby residential areas are planning outdoor activities or around holidays such as Memorial Day, Independence Day, and Labor Day (WEF 1997).
- Develop an odor control plan and train all staff to identify and mitigate odors.
- Have alternate management including land-filling for particular malodorous batches of biosolids.

Source: *Biosolids and Residuals Management Fact Sheet Odor Control in Biosolids Management*, EPA, 2000.

Exhibit 8

Schematic Diagram of Biosolids Odors Reduction Roadmap



***Note**: None of these options should be considered independently of the others, and odor reductions in one area may impact treatment processes and odors in other areas. Therefore, an integrated and customized approach is required for each WWTP.

Source: *WERF Biosolids Odors Reduction Roadmap User's Guide*, Water Environment Research Foundation Collaboration. 2010.

D. All Appropriate Alternatives to Current Use and Disposal Methods Employed in This Commonwealth and in Other States, Particularly in Regard to Their Economic Feasibility and Effects on the Environment and on Public Health in Comparison to Current Use and Disposal Methods

In 2006, EPA published a 135-page report entitled *Emerging Technologies for Biosolids Management*. The report breaks down these technologies into three categories: Embryonic (developmental), Innovative (tested at full scale), and Established (in wide use). Exhibit 9 summarizes the various technologies covered in the report and provides information on their various potential benefits as compared to established technologies.

Promising Innovative Technologies. Although we found no fundamentally new alternatives to current use (land application) and disposal (landfill and incineration) methods, much is being done to make the current use and disposal methods more efficient and to take better advantage of the potential positive attributes of biosolids. For example:

- *Integrated systems with experimental activities to improve efficiency.* In 2011, a group of scientists and treatment plant operators reported on new developments in anaerobic digestion, such as disintegration, microaerobic conditions, and thermal hydrolysis, that have been shown to effectively improve the biogas production of anaerobic digestion. New procedures to change sludge flow characteristics have also been shown to improve the dewatering/drying steps. A third step, gasification, can also be included and is capable of producing ceramsite, which is a material that can be used as a construction material, and adsorbent, a material that can be used as a soil conditioner.
- *Thermal oxidization.* Regenerative and recuperative thermal oxidizers are an improvement over traditional multiple hearth incinerators in that they recapture much of the heat that would otherwise be released into the atmosphere. These systems work by breaking down volatile organic compounds (VOCs) and other pollutants into carbon dioxide and water, which is then released into the atmosphere. Improved efficiency by using a heat exchanger to recover thermal energy is important because these systems operate at about 1500 degrees F. Thermal oxidation systems can reduce sludge to a much smaller quantity of ash (as low as 7 percent by weight) and can generate useful heat for the production of steam or electricity. The Green Bay Metropolitan Sewage District in Wisconsin plans to use the thermal oxidation system to incinerate and dispose of its sewage sludge beginning in early 2017.

- *Thermal hydrolysis.* Thermal hydrolysis involves pretreating the solids prior to digestion. Biosolids are first treated with pressurized steam that destroys pathogens. The material is then fed to a tank operating at near atmospheric pressure. The drop in pressure causes the cells to burst, increasing the availability of food and proteins to the microbes in the digester. The methane harvested from the digester can then be used to generate much of the heat and power needed for the plant. The process also helps cut down odor problems during the treatment of organic materials.

  In 2015, the Blue Plains AWTP, located in Washington, D.C., replaced lime stabilization with a thermal hydrolysis system, making it the largest thermal hydrolysis facility in the world as of 2016. The thermal hydrolysis process allows the Blue Plains plant to produce Class A biosolids and generates about 10 megawatts of electricity that has allowed the plant to reduce its electricity consumption by a third.
- *More efficient aeration.* Aeration accounts for about half of the energy costs in the typical wastewater plant. By changing the operating conditions in the plant to favor organisms that grow in low levels of oxygen, it is possible to greatly reduce the amount of oxygen necessary in the aeration step, thus saving energy costs.
- *Five utilities have expressed interest in piloting controlled-flow cavitation technology for sludge treatment* from a company called Arisdyne. The technology, developed by Arisdyne, pushes liquid at higher pressures through a smaller orifice to increase velocity and reduce static pressure. When the vapor bubbles that are created collapse, it generates shear forces that break down cells. This decreases the amount of sludge produced and can increase the amount of biogas by up to 25 percent.
- *Schwing Bioset.* The Schwing Bioset process achieves Class A biosolids through the addition of quicklime and sulfamic acid, rather than external heat. This system has proven successful, and Casella Organics is installing a full-scale system in New York.
- *OmniProcessor.* The OmniProcessor was designed with funding by the Bill and Melinda Gates Foundation to produce drinkable water, electricity, and a pathogen-free ash suitable for use as a fertilizer or in construction materials. A prototype has been built and is running near Seattle, Washington, and the foundation hopes to bring the OmniProcessor to India, Africa, and other developing parts of the world. The foundation estimates that each roughly $1.5 million plant can process sewage for a community of 100,000 people.

  Although originally designed for use in developing countries where good sewage systems do not exist and where potable water is scarce, the OmniProcessor can also be integrated into Western-style sewage treatment systems. When co-located at a wastewater or sewage treatment plant, the

processor would consume the digested or undigested sludge that is separated during treatment.

Several research teams are currently developing various types of Omni-Processors with funding from the foundation using technologies such as combustion, supercritical water oxidation, and pyrolysis. The treatment process first involves boiling the sewage sludge, during which water vapor is boiled off and recovered. A dry sludge is left behind which is then combusted as fuel to heat a boiler. This boiler produces steam and the heat necessary for the boiling process. The steam is then used to generate electrical energy. Some of this electrical energy is used for the final water reverse osmosis purification stages to produce safe drinking water and to power ancillary pumps, fans, and motors.

- *Solar drying to fuel and fertilizer product.* The Parkson Thermo-System uses the sun as its main power source to generate 95 percent of the energy required for drying sludge. The system produces Class A product and has been used for treatment plants as large as 80 million gallon per day. (By way of comparison, the City of Reading's treatment plant is 28.5 MGD, and Philadelphia's three treatment plants have a total capacity of 522 MGD.)

Exhibit 9

Summary of Biosolids Technologies

Technology and Advancement(s)	Potential Benefit* as Compared to Established Technologies					
	Low Capital Cost	Low Annual Costs	Reduces Solids or Thickens	Produces Class A Biosolids	Reduces Odor	Beneficial Use (Non Agriculture)
Chapter 2 Conditioning						
Established						
Chemical Conditioning						
Heat Conditioning						
Innovative						
Cell Destruction						
Chemical (Microsludge™)		●	●			
Ultrasonic		●	●			
Embryonic						
Cell Destruction Biological (BIODIET®)		●	●			
Electrocoagulation			●			
Enzyme Conditioning			●			
Chapter 3 Thickening						
Established						
Centrifuge						
Flotation Thickening						
Gravity Belt Thickening						
Gravity Thickening						
Rotary Drum Thickening						
Innovative						
Flotation Thickening – Anoxic Gas	●	●	●		●	
Membrane Thickening	●	●	●			
Recuperative Thickening	●	●	●			
Embryonic						
Metal Screen Thickening	●		●			

Exhibit 9 (Continued)

Technology and Advancement(s)	Potential Benefit* as Compared to Established Technologies					
	Low Capital Cost	Low Annual Costs	Reduces Solids or Thickens	Produces Class A Biosolids	Reduces Odor	Beneficial Use (Non Agriculture)
Chapter 4 Stabilization						
Established						
Aerobic Digestion						
Autothermal Thermophilic Aerobic Digestion (ATAD)						
Alkaline Stabilization						
Advanced Alkaline Stabilization						
Anaerobic Digestion						
Dual Digestion						
Two-Stage Mesophilic						
Composting						
Pasteurization						
Solidifcation						
Synox						
Innovative						
Aerobic Digestion						
Aerobic/Anoxic	●	●	●			
Anaerobic Digestion						
Anaerobic Baffled Reactor (ABR)	●	●	●			
Columbia Biosolids Flow-Through – Thermophilic Treatment (CBFT3)	●	●	●	●		
High Rate Plug Flow (Bio Terminator 24/85)	●	●	●			
Temperature Phased Anaerobic Digestion (TPAND)	●	●	●	●		
Thermal Hydrolysis (CAMBI Process)	●	●	●	●		
Thermophilic Fermentation (ThermoTech™)	●	●	●	●		
Three-Phase Anaerobic Digestion			●	●		
Two-Phase-Acid/Gas Anaerobic Digestion	●	●	●	●		
Vermicomposting	●	●		●		
Embryonic						
Aerobic Digestion						
Simultaneous Digestion and Metal Leaching			●			

Exhibit 9 (Continued)

Technology and Advancement(s)	Potential Benefit* as Compared to Established Technologies					
	Low Capital Cost	Low Annual Costs	Reduces Solids or Thickens	Produces Class A Biosolids	Reduces Odor	Beneficial Use (Non Agriculture)
Anaerobic Digestion						
Ozone Treatment				●		
Ferrate Addition				●	●	
Disinfection						
Irradiation				●	●	
Neutralizer®				●	●	
Chapter 5 Dewatering						
Established						
Belt Filter Press						
Centrifuge						
Chamber Press						
Drying Beds						
Auger-Assisted						
Natural Freeze-Thaw						
Vacuum-Assisted						
Vacuum Filters						
Innovative						
Drying Beds						
Quick Dry Filter Beds	●	●	●			
Electrodewatering	●	●	●			
Metal Screen Filtration						
Inclined Screw Press	●	●	●			
Textile Media Filtration						
Bucher Hydraulic Press	●	●	●			
DAB™ System	●	●	●			
Geotube® Container	●	●	●			
Embryonic						
Electro Dewatering						
Electroacoustic	●	●	●			
Electroosmotic	●	●	●			

Exhibit 9 (Continued)

Technology and Advancement(s)	Potential Benefit* as Compared to Established Technologies					
	Low Capital Cost	Low Annual Costs	Reduces Solids or Thickens	Produces Class A Biosolids	Reduces Odor	Beneficial Use (Non Agriculture)
Membrane Filtration	●	●	●			
Membrane Filter Press						
Textile Media Filtration						
Simon Moos	●	●	●			
Tubular Filter Press	●	●	●			
Thermal Conditioning and Dewatering						
Mechanical Freeze-Thaw			●			
Chapter 6 Thermal Conversion						
Established						
Combustion						
Fluidized-Bed Furnace						
Multiple-Hearth Furnace						
Oxidation						
Wet Air Oxidation						
Innovative						
Combustion						
Reheat and Oxidize (RHOX)		●	●		●	
Oxidation						
Supercritical Water Oxidation			●	●		
Vitrifcation						
Minergy			●			●
Embryonic						
Combustion						
Molten Salt Incineration			●		●	
Oxygen Enhanced Incineration			●		●	
Fuel Production						
Gasifcation						●
Sludge-to-Oil						●
SlurryCarb™	●	●	●			●

Exhibit 9 (Continued)

Technology and Advancement(s)	Potential Benefit* as Compared to Established Technologies					
	Low Capital Cost	Low Annual Costs	Reduces Solids or Thickens	Produces Class A Biosolids	Reduces Odor	Beneficial Use (Non Agriculture)
Oxidation						
Deep-Shaft Wet Air Oxidation (VERTAD™)		•	•	•		
Plasma Assisted Sludge Oxidation	•		•			
Vitrifcation						
Melting Furnace			•			•
Chapter 7 Drying						
Established						
Direct Drying						
Flash Drying						
Indirect Drying						
Innovative						
Belt Drying	•		•	•		•
Direct Microwave Drying	•		•	•		•
Flash Drying	•		•	•		•
Fluidized Bed Drying	•		•	•		•
Embryonic						
Chemical Drying	•		•	•	•	•
Multiple Effect Drying						
Carver-Greenfeld (Not a viable technology)						
Chapter 8 Other Processes						
Innovative						
Cannibal Process	•	•	•			
Lystek	•	•		•		
Injection into Cement Kiln	•	•	•		•	•

* Potential Benefits require confirmation on a case-by-case basis. May enhance existing facilities, replace existing facilities, or offer an alternative choice for new facilities. For existing facilities, analysis of invested costs to date must be considered.

Source: *Emerging Technologies for Biosolids Management*, Office of Wastewater Management U.S. Environmental Protection Agency, Washington, D.C. EPA 832-R-06-005. September 2006.

E. Any Alternative Beneficial Use, Including But Not Limited to, Electric Power Generation and Abandoned Mine Reclamation, and Any Obstacles That May Hinder the Expansion of Any Alternative Beneficial Use of Biosolids

Several Pennsylvania sewage treatment plants already burn the methane produced by anaerobic digesters to provide heat and create electricity for on-site use. These include the Advanced Wastewater Treatment Facility in Harrisburg, which produces methane which is then used to produce electricity as well as heat the building at the plant, and a 5.6 MW Biogas Cogeneration Facility, located at the Northeast Water Pollution Control Plant in Philadelphia, that began commercial operations on November 2014. The biogas is produced from the sewage treatment process and is turned into electricity.

Another example is a new (completed in 2014) wastewater-to-treatment plant in Milton (Northumberland County) which uses an anaerobic treatment process to convert wastewater into biogas, which is then used to generate electricity. The plant generates enough electricity for all its own need and is to able to sell the excess electricity (about 50 percent of the electricity generated) to the PJM power grid. The plant also produces pelletized biosolids as another revenue stream.

In addition to burning methane to turn turbines to produce electricity, several innovative technologies are being researched and tested, including:

- ***Bactobots.*** Bactobots are genetically-enhanced, highly-metabolic bacteria that digest pollutants in wastewater and turn them into electricity through the use of an electrogenic bioreactor platform. The Bactobots also expel gases and chemicals that can also be used to generate electricity. Bactobots cut costs by cleaning water while generating energy for use in other parts of the treatment process. The Metropolitan Sewer District of Greater Cincinnati recently began a pilot project to determine if the bactobots are meeting required pollutant removal goals and generating the anticipated level of electricity.
- ***Microbial fuel cells.*** Dr. Bruce Logan, at the Pennsylvania State University, is a lead researcher in the biological generation of electricity in wastewater treatment facilities through microbial fuel cells. A microbial fuel cell allows for the direct conversion of organic matter to electricity using bacteria that are already present in wastewater. The bacteria remove electrons from the organic matter through oxidation and, when deprived of oxygen, will transfer the electrons to an electrode, a process which can then be used to create an electric current flow.
- ***Hydrogen fuel cells.*** Researchers from DOE's Lawrence Livermore National Laboratory (LLNL) and Florida-based Chemergy Inc. plan to

demonstrate an innovative bioenergy technology that converts wastewater treatment plant byproducts into hydrogen gas which is then fed into fuel cells to generate electricity. Fuel cells can generate electricity without combustion. A $1.75 million project will demonstrate an integrated system on a limited industrial scale at the Delta Diablo Sanitation District facility in Antioch, California.

- ***Advanced Fluidized Composting (AFC).*** AFC involves three steps: treating the sludge through a thermopohilic biological reactor to biodegrade the sludge organics and destroy pathogens, solids separation to remove water, and a chemical treatment to destroy the molecular compounds that are resistant to biological degradation. In essence, the process is a biological/ chemical version of incineration. For large treatment plants, the process can also be configured to incorporate an anaerobic process to convert the organics in the sludge to methane for biomass-to-energy cogeneration. The process reportedly can reduce the amount of residual sludge by 70 percent from typical anaerobic digesters.
- ***Phosphorous recovery.*** Phosphorous is a valuable mineral essential to plant growth. Although Pennsylvania has an excess of phosphorous, which leads to water pollution, many areas of the United States and in foreign countries are phosphorous deficient, and stocks of high grade phosphate rock are becoming scarce. Recovering phosphorous from sewage sludge and shipping it as fertilizer to phosphorous deficient regions, if it could be done economically, could be an alternative beneficial use. Several processes exist to recover phosphorous from sewage sludge. One such process, patented by ASH DEC Umwelt AG (Austria), involves incinerating raw sewage sludge. The ash is then mixed with additives and compacted into pellets that are then fed into a thermal reactor at temperatures of over 1800 degrees F. At these temperatures, up to 99 percent of key unwanted metals (mercury, cadmium, lead, zinc, and copper) will react with the additives and evaporate. The resultant phosphorus-rich ash can then be mixed with other nutrients, such as nitrogen and potassium, to produce an agricultural fertilizer. ASH DEC notes that this technology is very high-tech and highly energy intensive. Therefore, while it may be a good technology in highly industrialized countries where laws prohibit the use of treated sewage sludge in agriculture, there are other methodologies that allow for a much simpler and less energy intensive nutrient recovery.

  A municipal-owned company in Denmark is using another process to recover phosphorous and nitrogen from wastewater by adding magnesium salt. This process refines the phosphorus, and allows heavy metals and other environmentally unfriendly substances to be discarded. The remaining granulate contains phosphorus, nitrogen, and magnesium and is well-suited for use as a fertilizer. The plant in Denmark, built in 2013,

produces about 50 kilograms of phosphorous daily, and a second plant is being constructed.

- ***As an alternative fuel for coal-burning power plants.*** A Maine company is seeking to obtain DEP approval to import dry sewage sludge, in the form of pellets, into Pennsylvania to be used as a fuel at coal-powered power plants. Pennsylvania is an attractive market for such a product because we have alternative fuel standards that require utilities to get an increasing amount of their electricity from alternative and renewable sources. The PUC has yet to rule, however, as to whether biosolids would qualify as an alternative fuel.
- ***As an alternative fuel in cement kilns.*** Cement is manufactured by heating lime, silica, alumina, iron, and other materials at high temperatures. The resulting substance is a marble-like ball called clinker that is ground, mixed with limestone and gypsum, and used to create concrete. Pennsylvania has nine cement plans across the state producing about 3.9 metric tons of cement annually.

  Various companies around the world are currently using dried biosolids as a fuel, or one of several fuels, used in the cement making process. The Holcim Cement works at Siggnethal, is one of several based in Switzerland that uses biosolids as a part of their fuel source. The ratio of energy sources for the kiln energy requirements are now approximately oil, 35 percent; coal, 35 percent; biosolids, 10 percent; animal meal, 5 percent; car tires, 5 percent; and organic solvent waste, etc., 10 percent.

  The Cement Sustainability Initiative (CSI) from the World Business Council of Sustainable Development (WBCSD) has highlighted the Heidelberg Cement-CRC joint venture plant in Guangzhou in the south of China as a role model for the cement industry. The plant utilizes waste heat from the kiln process to dry the sludge from 80 percent moisture down to 40 percent.

  The organic part of the biosolids is used as a fuel replacement for the coal, whereas the mineral part of the sludge (on dry basis, about 40 percent) is replacing virgin raw materials. The silica, calcium, and aluminum components are used as part of the raw material mix of a clinker process. There is no residual waste left. The Chinese authorities and the cement works are jointly developing further extension of this successful approach.
- ***Abandoned Mine Reclamation.*** Using biosolids in abandoned mine reclamation is considered a beneficial use through land application. Biosolids have advantages over conventional fertilizer at mine reclamation sites because biosolids contain organic matter that can be incorporated into the rocky culm to help regenerate a soil layer. Because mine sites typically have little or no topsoil, the initial biosolids application rate at mine sites is generally higher than the agronomic rate used at agricultural sites.

Applying biosolids in this manner is currently occurring in Centre, Clearfield, and Schuylkill Counties. The biosolids used in Centre and Clearfield Counties originate, for the most part, in New York and New Jersey, whereas the biosolids used in Schuylkill County originate in Pennsylvania. Biosolids from Harrisburg are also being used to reclaim a mine site in Dauphin County now owned by the Pennsylvania Game Commission and from the City of Allentown to restore zinc-contaminated land in Palmerton (Carbon County).

At land reclamation sites, an approved Storm Runoff Erosion and Sedimentation Control Plan must be implemented to minimize impacts to surface water. Concern over these practices, however, has led to a proposed bill to ban the use of biosolids near water supplies under a land reclamation permit.

Material Matters, a biosolids consulting firm, has noted that a major obstacle to the land application of biosolids for abandoned mine reclamation is the inability to identify the owner of the property.

The CRP report recommends that state regulations should allow biosolids application rates to exceed 60 dry tons per acre when being used for reclamation of drastically disturbed sites, such as at abandoned mines or brownfield sites. The paper notes that application rates in excess of 60 dry tons per acre are permitted in other states, and that the short-term loss of nitrate to groundwater is more than offset by the positive effects of rebuilding soils, rapid establishment of vegetation, and returning the site to productive land uses. The authors also recommend DCNR revise its policy against using biosolids to re-vegetate burn areas. The authors further recommend the Commonwealth adopt policies to encourage the use of biosolids on state contracted projects where appropriate, such as establishing and maintaining vegetation in state roadside and median strip plantings.

While using biosolids to reclaim former mining sites has been controversial, a paper prepared in the late 1990s that reviewed the "lessons learned" from the use of biosolids for reclamation of mine lands in Pennsylvania found that the field experience with biosolids "continues to demonstrate clear environmental benefits and negligible adverse effects."[30] The paper notes that, even after two decades, remediated sites showed vigorous ground cover, signs of active animal populations, minimal surface erosion, and clear-flowing streams.

[30] *Two Decades of Mine Reclamation: Lessons Learned from One of the Nation's Largest Biosolids Beneficial Use Programs*, William E. Toffey, Philadelphia Water Department; Charles R. Miller, Wheelabrator Water Technologies; and L. Douglas Saylor, PA Department of Environmental Protection. Undated.

III. Appendices

APPENDIX A

PRIOR PRINTER'S NO. 327 PRINTER'S NO. 2682

THE GENERAL ASSEMBLY OF PENNSYLVANIA

HOUSE RESOLUTION

No. 60 Session of 2015

INTRODUCED BY EMRICK, MILLARD, SANKEY, MURT, ROSS, BENNINGHOFF, MAJOR, MUSTIO, KORTZ, D. PARKER, GOODMAN, MAHER AND HANNA, FEBRUARY 4, 2015

AS REPORTED FROM COMMITTEE ON ENVIRONMENTAL RESOURCES AND ENERGY, HOUSE OF REPRESENTATIVES, AS AMENDED, DECEMBER 18, 2015

A RESOLUTION

Directing the Legislative Budget and Finance Committee to review the Commonwealth's program for beneficial use of sewage sludge by land application.

WHEREAS, In 1997, the Commonwealth established regulations for the beneficial use of sewage sludge, more commonly referred to as biosolids, by land application; and

WHEREAS, The regulations are published under 25 Pa. Code Ch. 271 Subch. J (relating to beneficial use of sewage sludge by land application); and

WHEREAS, Subchapter J establishes standards for general and individual land application of sewage sludge permits for the beneficial use of sewage sludge by land application; and

WHEREAS, The standards consist of general requirements, pollutant limits, management practices and operational standards; and

WHEREAS, Subchapter J also includes pathogen and alternative vector attraction reduction requirements; and

WHEREAS, The standards in Subchapter J include reporting requirements and the frequency of monitoring and recordkeeping requirements when biosolids are applied to the land for beneficial use; and

Appendix A (Continued)

WHEREAS, A comprehensive review of the Commonwealth's program for the beneficial use of biosolids by land application has not been conducted since the study on land application of sewage sludge in Pennsylvania in 1997; therefore be it

RESOLVED, That the Legislative Budget and Finance Committee undertake a comprehensive review of the beneficial use of biosolids by land application and prepare a report of its findings which shall, at a minimum, identify all of the following:

(1) The methods currently used for biosolids use and disposal in this Commonwealth.

(2) The costs involved with current methods of biosolids use and disposal.

(3) The methods used to administer and enforce the program established under 25 Pa. Code Ch. 271 Subch. J by the Department of Environmental Protection.

(4) All appropriate alternatives to current use and disposal methods employed in this Commonwealth and in other states, particularly in regard to their economic feasibility and effects on the environment and on public health in comparison to current use and disposal ~~methods;~~ METHODS.

(5) ANY ALTERNATIVE BENEFICIAL USE, INCLUDING BUT NOT LIMITED TO, ELECTRIC POWER GENERATION AND ABANDONED MINE RECLAMATION, AND ANY OBSTACLES THAT MAY HINDER THE EXPANSION OF ANY ALTERNATIVE BENEFICIAL USE OF BIOSOLIDS;

and be it further

RESOLVED, That the Legislative Budget and Finance Committee make a report of its findings and recommendations to the House of Representatives within one year of adoption of this resolution.

APPENDIX B

Biosolids Projects Update Status of 68 FR 75531 projects December 2016			
Project No.	**Project Title**	**Status**	**Comments**
1	Biennial Review (BR) Under CWA Section 405(d)(2)(C)	**Ongoing**	Under the Clean Water Act, EPA is required to collect and analyze available data not less than every two years for the purpose of identifying new pollutants that may need to be regulated. EPA continues to evaluate published data and conduct exposure and hazard evaluations for pollutants when sufficient data are available. The most recent evaluations (i.e., 2005, 2007, 2009, and 2011 Biennial Reviews) identified pollutants for which some data were available (http://www.epa.gov/biosolids/biennial-review). However, the available data were not sufficient at the time to allow the Agency to conduct exposure and hazard assessments or determine what, if any, regulatory action may be needed. EPA will continue to review new peer-reviewed literature and assess availability of relevant data to determine whether additional pollutants should be considered for regulation. Because data are often incomplete and resources to manage chemical releases are finite, EPA is exploring various methods and screening tools that could serve to reduce the number of chemical-pathway combinations OW evaluates in higher-tier assessments, thus saving time and cost of full assessments for all chemical-pathway combinations.
2	Compliance Assistance and Enforcement Actions	**Ongoing**	EPA and states continue to actively address biosolids violations and require proper land-application of biosolids to prevent risk to human health or the environment. The public can now report possible environmental violations or crimes through EPA's Office of Enforcement and Compliance Assurance website (http://www.epa.gov/biosolids/part-503-compliance-and-annual-reporting-guidance). EPA's Office of Enforcement and Compliance Assurance (OECA) shifted some resources devoted to traditional biosolids enforcement to higher priority enforcement areas and devoted two FTEs to maintain a minimal national presence in biosolids enforcement work. These two FTE are located in a Biosolids Center of Excellence (BCOE), housed in Region 7, which will maintain EPA's biosolids enforcement expertise. Although these FTE will be in EPA Region 7, they are expected to be the national staff leads for all EPA biosolids enforcement activities across the country, coordinating with the other Regions and headquarters as appropriate. EPA, on September 24, 2015, signed the final National Pollutant Discharge Elimination System (NPDES) Electronic Reporting Rule for publication in the Federal Register. This rule will replace most paper-based Clean Water Act (CWA) NPDES permitting and compliance monitoring reporting requirements with electronic reporting. The new rule covers biosolids reporting under 40 CFR Part 503 (the EPA biosolids regulations), requiring electronic submittal of Biosolids Annual Reports for land application, surface disposal, and incineration.
3	Methods Development, Optimization, and Validation for Microbial Pollutants in Sewage Sludge [includes multiple components with different status]		

Appendix B (Continued)

Project No.	Project Title	Status	Comments
3a	Optimization of the Methods for Detecting, Enumerating, and Determining the Viability of Helminth / Ascaris Ova in Sewage Sludge	**Completed**	A Standard Operating Procedure for a helminth ova method that can provide results in as little as a few days for detecting viable helminth ova in sewage sludge is being reviewed and finalized. The method is essentially complete and awaiting multi-lab validation and promulgation to 40 CFR 136, but no schedule or funding is proposed at this time. In the meantime, EPA encourages the helminth ova method available in Appendix I in https://www.epa.gov/biosolids/control-pathogens-and-vector-attraction-sewage-sludge
3b	Improved Methods for Detecting Viruses in Sewage Sludge	**Completed**	A report was published in September 2007 titled *Preliminary Comparative Study of Methods to Extract Virus from Raw and Processed Sewage Sludges* , EPA/600/R-07/118. Two simple virus extraction techniques were compared to an EPA standard method for the isolation of human enteric viruses from raw sewage sludge and class A biosolids. The techniques were used to detect both indigenous and seeded virus from a wastewater treatment plant that distributes class A material produced by a heat drying process. The method is essentially complete and awaiting multi-lab validation and promulgation to 40 CFR 136, but no schedule or funding is proposed at this time. In the meantime, EPA encourages the viral method available in Appendix H in https://www.epa.gov/biosolids/control-pathogens-and-vector-attraction-sewage-sludge
3c	Development and Validation of Analytical Methods for Fecal Coliform in Sewage Sludge	**Completed**	EPA reports EPA-821-R-06-012 (Method 1680) and EPA-821-R-06-013 (Method 1681) were published in September 2005 establishing new and improved methods for detecting and quantifying fecal coliform in sewage sludge: https://www.epa.gov/biosolids/epa-analytical-methods-biological-pollutants-wastewater-and-sewage-sludge
3d	Development and Validation of Analytical Methods for Salmonella in Sewage Sludge	**Completed**	An EPA report EPA-821-R-06-14 (Method 1682) was published in September 2005 establishing a new and improved method for detecting and quantifying *Salmonella* in sewage sludge: https://www.epa.gov/biosolids/epa-analytical-methods-biological-pollutants-wastewater-and-sewage-sludge
3e	Microbial organisms	**Completed**	EPA conducted a new biosolids holding time study to determine appropriate holding times for fecal coliform and *Salmonella* in biosolids samples. An EPA report (EPA-821-R-07-003) was published and results have been incorporated into analytical methods: https://www.epa.gov/biosolids/epa-analytical-methods-biological-pollutants-wastewater-and-sewage-sludge

Appendix B (Continued)

Project No.	Project Title	Status	Comments
4	Field Studies of Application of Treated Sewage Sludge	**Completed**	In 2005, a collaborative USDA and EPA field-scale evaluation of biosolids application in North Carolina was conducted to assess releases of pollutants (chemicals and microorganisms) to air and soil. Several different sampling and analysis methods were used to assess and optimize the sampling techniques. The final report was posted June 2012: https://www.epa.gov/biosolids/multimedia-sampling-during-application-biosolids- land-test-site
5	Targeted National Sewage Sludge Survey	**Survey Completed. Risk Characterization of TNSSS Analytes with Sufficient Data is Underway**	EPA completed the Targeted National Sewage Sludge Survey (TNSSS) report and posted documents to EPA's Biosolids Web Site in January 2009. Reports are available at http://www.epa.gov/biosolids/sewage-sludge-surveys. Data from the survey will help determine exposure to target pollutants in biosolids and whether target pollutants may need to be evaluated for possible regulation pursuant to 40 CFR 503. Assessment and risk characterization of the 145 pollutants detected and quantified in the survey, where sufficient data exist, is ongoing. A draft-final risk characterization document for Phase I TNSSS pollutants (i.e., barium, beryillium, manganese, molybdenum, silver, 4-Chloroaniline, fluoranthene, pyrene, nitrate, and nitrite) has undergone peer review and follow-up activities are underway at this time. EPA is also evaluating, on a longer term, the other 135 TNSSS pollutants.
6	Participate in Incident Tracking Workshop	**Completed**	EPA attended a Water Environment Research Foundation (WERF) sponsored incident-tracking workshop in 2005. WERF-led follow-up activities from the workshop included developing research that could provide information about the occurrence of reported symptoms near sites where soil amendments, including biosolids, are applied to land. A WERF report *Epidemiologic Surveillance and Investigation of Illness Reported by Neighbors of Biosolids Land Application Sites* includes a protocol designed to be used by local, state, and federal health and environmental officials. WERF pilot tested and refined the protocol and issued a final report in 2012 titled *A Protocol for the Surveillance and Investigation of the Concerns Reported by Neighbors of Land Application (Biosolids and Other Soil Amendments;* 08-HHE-5PP-P): http://www.werf.org/_ad/SearchResults.aspx?q=protocol%20for%20surveillance through at least 2010, and WERF plans to issue a final report thereafter.
7	Conduct Exposure Measurement Workshop	**Completed**	An exposure measurements workshop was held in Cincinnati in March 2006. Attendees of the workshop proposed a list of research projects aimed at addressing exposure following land-applied biosolids. An EPA report was issued September 2007 (EPA/600/R-07/055) that includes presentations by attendees and suggested priority research needs.https://www.epa.gov/biosolids/proceedings-biosolids-exposure-measurement- workshop

Appendix B (Continued)

Project No.	Project Title	Status	Comments
8	Assess the Quality and Utility of Data, Tools and Methodologies to Conduct Microbial Risk Assessments on Pathogens	**Completed**	EPA released the final report, *Problem Formulation for Human Health Risk Assessments of Pathogens in Land-Applied Biosolids* in March 2011: https://www.epa.gov/node/85691/revisions/188809/view
9	Support Pathogen Equivalency Committee (PEC)	**Upgrade of the PEC website is Completed. Evaluation of Equivalency Applications are Ongoing**	The PEC developed a more formal approach for evaluating equivalent treatments to current required treatments. The new approach, with its QA requirements, is posted on the Science Advisory Board's webpage. EPA improved the PEC website (https://www.epa.gov/biosolids/pathogen-equivalency-committee) so applicants can submit requests online using a consistent format that should help expedite reviews. Evaluation criteria are being modified to provide a better understanding of the proposed disinfection process' capabilities. Numerous technologies are in different stages of receiving a recommendation from the PEC of Processes to Further Reduce Pathogens equivalency. With recent and pending retirements of PEC participants, the Agency is evaluating options for managing the PEC moving forward.
10	Development and Application of Analytical Methods for Detecting Pharmaceutical and Personal Care Products in Sewage Sludge	**Completed**	EPA published a document titled "Research Towards Developing Methods for Selected Pharmaceutical and Personal Care Products (PPCPs) Adapted for Biosolids", EPA/600/X-06/017, September 2006. EPA also developed analytical methods for over 100 pharmaceutical and personal care products for biosolids, water, soil, and sediment. These analytical methods were made publicly available in December 2007 and were used in EPA's Targeted National Sewage Sludge Survey and other applications. Method 1694 for Pharmaceuticals and Personal Care Products in Water, Soil, Sediment, and Biosolids are available on the Clean Water Act Analytical Methods website: https://www.epa.gov/cwa- methods/other-clean-water-act-test-methods-chemical
11	Publish the Proceedings of USEPA-USDA Workshop on Emerging Infectious Disease Agents and Issues Associated with Animal Manures, Biosolids, and Other Similar By-Products	**Completed**	A special issue of Compost Science, *Contemporary Perspectives on Infectious Disease Agents in Sewage Sludge and Manure*, was printed and distributed at the Water Environment Federation's Specialty Conference on Biosolids, April 17-21, 2005 in Nashville, TN.

Appendix B (Continued)

Project No.	Project Title	Status	Comments
12	Support "Sustainable Land Application Conference"	**Completed**	The proceedings (many of the papers prepared from the presentations) from the Sustainable Land Application Conference were published in a special issue of Journal of Environmental Quality (JEQ) in February 2005.
13	Review Criteria for Molybdenum in Land-applied Treated Sewage Sludge	**Underway**	EPA is evaluating molybdenum using additional data developed since 2000, including results from the Targeted National Sewage Sludge Survey released in 2009. A draft-final risk characterization document for molybdenum has undergone peer review and follow-up activities are underway at this time.
14	Improve Stakeholder Involvement and Communication	**Ongoing**	EPA is working to make EPA information on biosolids and other topics more readily available to the public through the web. Available are a biosolids webpage (https://www.epa.gov/biosolids) and a Public Involvement webpage (http://www2.epa.gov/international-cooperation/how-evaluate-public-involvement).

Source: U.S. EPA.

APPENDIX C

United States Environmental Protection Agency

Office of Water EPA
822-F-15-001
March 2015

2011 Biosolids Biennial Review

Summary

EPA has published online its 2011 biennial review of information to evaluate potential harm to human health or the environment from use or disposal of sewage sludge, also called biosolids. In 1993, EPA established comprehensive, health-based numeric standards for 10 metals and operational standards for microbial organisms to address different uses and disposal of sewage sludge. EPA reviews sewage sludge regulations every two years to identify additional toxic pollutants and sets regulations for those pollutants if sufficient scientific evidence shows they may harm human health or the environment. At this time, EPA has not identified additional toxic pollutants in biosolids for regulation under Clean Water Act section 405(d)(2)(C).

Background

The purpose of the biennial reviews EPA conducts is to identify, where possible, additional toxic pollutants and promulgate regulations for those pollutants consistent with the requirements set forth in the Clean Water Act. In fulfilling this commitment for Biennial Review Cycles 2005, 2007, 2009, and 2011, EPA conducted a review of publicly available information. The Agency searched known databases and the published literature to capture available information on occurrence, fate and transport and human health or ecological effects, as well as other relevant information, for pollutants that may occur in U.S. sewage sludge. The available exposure or toxicity data are not sufficient at this time for many of the pollutants for EPA to run current biosolids models and conduct risk assessments. We will continue these investigations subject to availability of resources and overall program priorities.

Standards for the Use of Disposal of Sewage Sludge

Under Clean Water Act section 405(d), EPA establishes numeric limits and management practices that protect public health and the environment from the reasonably anticipated adverse effects of chemical and microbial pollutants in sewage sludge. In 1993, EPA promulgated Standards for the Use or Disposal of Sewage Sludge (found in Code of Federal Regulations (CFR) Title 40 Part 503), resulting in numeric standards for 10 metals and operational standards for microbial organisms. The 1993 rule established requirements for the final use or disposal of sewage sludge when it is: (1) applied to land as a fertilizer or soil amendment; (2) placed in a surface disposal site, including sewage sludge-only landfills; or (3) incinerated.

These requirements apply to publicly and privately owned treatment works that generate or treat domestic sewage sludge and to anyone who uses or disposes of sewage sludge.

EPA Reviews of the "Part 503" Standards

Since promulgation of 40 CFR 503, there have been three subsequent rounds of review: (1) the Agency's decision in 2001 that regulation of dioxin and dioxin- like compounds disposed via incineration or land- filling was not needed for adequate protection of public health and

the environment; (2) the Agency's decision in 2003 that regulation of dioxin and dioxin-like compounds in land-applied sewage sludge was not needed for adequate protection of public health and the environment (Federal Register Volume 68, Issue 206, Page 61084); and (3) a review that resulted in the ongoing analysis of nine pollutants and molybdenum. By late 2015, EPA expects to complete evaluation of these 10 pollutants using available data and the Targeted National Sewage Sludge Survey (TNSSS) results prior to taking action or determining whether to propose regulating any of these pollutants under Clean Water Act section 405(d). See EPA's TNSSS Technical Report on our biosolids website at: http://water.epa.gov/scitech/wastetech/biosolids/in dex.cfm#tnsss

2011 Biennial Review

In conducting the biennial review for 2011, EPA collected publicly available information on pollutants. The purpose of reviewing information on pollutants, or potential pollutants, is to assess the availability and sufficiency of the data to conduct exposure and hazard assessments. Exposure and hazard assessments, where sufficient data exist, allow the Agency to determine the potential for harm to public health or the environment following use or disposal of biosolids. Some of the information generally needed to conduct exposure and hazard assessment includes the ability to detect and quantify a given pollutant in sewage sludge, concentration data in sewage sludge, fate and transport data for pollutants that may be present in sewage sludge, chemical and physical properties, and toxicity to human and ecological receptors. The Agency assessed whether data for pollutants were sufficient to conduct human health and ecological exposure and hazard assessments.

Results of the Literature Search

The Agency's search of the literature for Biennial Review 2011 identified information for 23 pollutants relevant to human health or ecological assessments. Some pollutants have been reported in previous biennial reviews. EPA revisits previously evaluated pollutants when literature searches of bibliographic databases reveal newer data. Two main criteria were established for selecting a pollutant for an exposure and hazard evaluation if relevant exposure data are available: 1) the pollutant has human health or ecological toxicity values (e.g., studies that are adequate for evaluating hazards following acute or chronic exposure) and (2) the data on pollutant concentrations in U.S. sewage sludge are adequate (i.e., data are considered adequate when sufficient details are provided regarding sampling, handling, and analysis) based on a suitable analytical methodology for detecting and quantifying pollutant concentrations.

As its first priority, EPA is in the process of evaluating 10 of the chemicals that were previously found in EPA's TNSSS and thus have source concentration data ((i.e., barium, beryllium, manganese, molybdenum, silver, 4-chloroaniline, fluoranthene, pyrene, nitrate, and nitrite). On a longer term basis, EPA will continue evaluating the other 135 chemicals found in the TNSSS, investigating alternative tools for estimating missing data (e.g., environmental properties, human health and ecotoxicity values, and acceptable concentration data in sewage sludge), and performing screening-level deterministic assessments to estimate human health and ecological risk for biosolids land application scenarios.

The Agency will continue to assess the availability of sufficient information for these and other pollutants identified during the biennial review activities pursuant to Clean Water Act section 405(d)(2)(C).

Where can I find more information?

To get more information about EPA's Biosolids Program, please contact Rick Stevens at (202) 566-1135 or email him at stevens.rick@epa.gov. You may also visit EPA's Biosolids website at: http://water.epa.gov/scitech/wastetech/biosolids/

APPENDIX D

46 Red Fox Lane
Mount Bethel, PA 18343

801 Riverton Road
Bangor, PA. 18013

June 7, 2017

Phillip Durgin, Executive Director
Legislative Budget and Finance Committee
Room 400A Finance Building
6B North Street
PO Box 8737
Harrisburg, PA 17105

RE: HOUSE RESOLUTION 60 BIOSOLIDS STUDY

Dear Mr. Durgin:

House Resolution 60 (HR60) directs the Legislative Budget and Finance Committee "to undertake a comprehensive review" of Pennsylvania's practice of land applying sewage sludge. As a followup to our April 29, 2017 "HR60 Workshop," we offer highlights of the information given by our panel of experts, amplified by experiences from our communities, as well as excerpts from the testimony of residents affected by sewage sludge. This collective body of knowledge forms the basis for our recommendations for each of HR60's five directives.

DIRECTIVE 1: THE METHODS CURRENTLY USED FOR BIOSOLIDS USE AND DISPOSAL IN THIS COMMONWEALTH.

Workshop panelist, Dr. Murray McBride, is an environmental toxicology expert from Cornell University.[1] He was a research consultant for the EPA when the federal regulations for land applying sewage sludge were first written in 1992, which became known as "the 503 rule." With regard to the methods currently used for sludge disposal, McBride articulated the hazardous risks. While Pennsylvania's Right to Farm Act characterizes sludge as fertilizer, McBride stated that wastewater treatment plants are not designed to produce a clean product for farmers to use. In fact, ***90 to 95 percent of persistent organic pollutants and metals in wastewater end up in biosolids. To date, regulatory monitoring has been limited to ten heavy metals.*** This narrow focus ignores thousands of organic chemicals in present day sludges. He referenced the EPA's own report, which states that the Agency has not taken action to address discharges of hundreds

[1] See Exhibit A for Dr. McBride's slide presentation.

Appendix D (Continued)

of toxic chemicals from wastewater treatment plants.[2] These chemicals, along with pathogens and pharmaceuticals, contaminate the air, soil and ground and surface waters. McBride quoted the US EPA 2000 Report which warned, **"[the] EPA cannot assure the public that current land application practices are protective of human health and the environment".[3]**

The National Research Council (NRC) also sounds an alarm. The NRC is the research arm of the National Academy of Sciences, Engineering and Medicine, providing nonpartisan, objective guidance for decision makers on pressing issues. Commissioned by the EPA to review the nation's present sludge policy, this esteemed body of scientists recognized the inadequacies of the 503 Rule. At the workshop, McBride quoted from the NRC report:

> … even if a summary index of an adverse response to mixtures was available, it would not necessarily reflect the total hazards of exposure to biosolids because of the inability to identify all of its hazardous constituents and their potential for interaction in vivo … the degree of uncertainty requires some form of active health and environmental tracking.[4]

To date, in Pennsylvania no comprehensive tracking has been done. To protect the air, soil and drinking water sources from the "hazardous constituents" in biosolids, a total ban on land application is needed. **Our recommendation is to move away from current land application practices and towards alternative technologies that eliminate the need for land applying sludge.**

In your personal communication to Dr. Howard Klein, you asked if Synagro's proposed Class A sludge drying plant in Plainfield Township is the answer.[5] It is not. As Dr. McBride explained, the terms Class B and Class A sludge refer only to a pathogen designation. In all other respects ***Class B and Class A sludges are the same.*** In the drying process, toxic indicator bacteria are reduced. But once introduced into the environment, pathogen reduction does not last -- bacterial regrowth occurs. ***This makes Class A sludge just as toxic as Class B***. Furthermore, to provide the equivalent nitrogen and phosphorus levels as Class B, the farmer must use higher rates of application for Class A, which creates an even bigger environmental hazard. **Therefore, until a complete phase out occurs, we recommend that the DEP extend the same Class B permitting regulations to Class A biosolids.**

Presently, consumers are unable to determine if commercially available bagged compost, garden soils and fertilizers contain sewage sludge. Words such as "organic" and "natural" are deceptive and misleading. **We recommend that bagged Class A products sold in Pennsylvania be clearly labelled when they contain sewage sludge.**

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[2] "More Action is Needed to Protect Water Resources From Unmonitored Hazardous Chemicals,EPA Office of Inspector General, September 29, 2014.

[3] EPA Office of Inspector General Report 2000.

[4] "Biosolids Applied to Land: Advancing Standards and Practices", National Research Council Report 2002.

[5] Email to Lower Mount Bethel Supervisor Dr. Howard Klein, December 13, 2016.

Appendix D (Continued)

DIRECTIVE 2: THE COSTS INVOLVED WITH CURRENT METHODS OF BIOSOLIDS USE AND DISPOSAL

While Directive 2 was beyond the scope of the Workshop, we hope that your report includes the amount of taxpayer dollars used by PA municipalities to pay sludge companies such as Synagro. We estimate the annual statewide cost to be well over $50,000,000. New sewage processing methods have the possibility of transforming this economic equation for the benefit of the taxpayer. To arrive at the true cost of land applying sludge, the following must be included in the total cost: well water contamination; soil contamination; mounting litigation costs; and diminished property values which results in reduced tax revenues. **At a minimum, we recommend surveying realtors who sell homes near sludged fields and tracking sales data to determine the degree to which sludge negatively affects the values of neighboring property.**

DIRECTIVE 3: THE METHODS USED TO ADMINISTER AND ENFORCE THE PROGRAM ESTABLISHED UNDER 25 PA. CODE CH. 271 SUBCH. J BY THE DEPARTMENT OF ENVIRONMENTAL PROTECTION.

The methods used to administer and enforce the program are grossly inadequate. For example, when HR60 passed in the 200th General Assembly Session (June 23, 2016), Representative Michael Hanna expressed his concerns about a sludge permit issued by the DEP in a source water protection zone in Burnside Township, Centre County. He said:

> Mr. Speaker, adoption of HR 60 is crucial, particularly after recently listening to a recording from a borough council meeting in my district. During this meeting a registered professional geologist from DEP was asked if DEP looks at source water protection plans prior to issuing a permit. The geologist replied, **"Right now we do not have a policy requiring every reviewer to check in their files to make sure there is a source water protection plan in that area." He went on to say that once the permit is issued, DEP lacked the resources to ensure permit compliance . . .**[6]

Similarly, in Upper Mount Bethel Township, Northampton County, the DEP failed to apply the Delaware River Basin Commission (DRBC) standards when they issued three sludge permits on farms that drain into the "Special Protected Waters" section of the Delaware River -- the drinking water source for 16 million people downstream in Easton, Trenton, and Philadelphia. Sludge Free UMBT (Upper Mount Bethel Township) filed a Legal Appeal of the permits. The deposition testimony of ***DEP's Northeast Biosolids Coordinator, Mr. Timothy Craven,***[7] ***revealed that in his twelve years of issuing biosolids permits along the Delaware River, he never abided by the DRBC regulations****!*

> Q. Okay. Do you have any familiarity with the Delaware River Basin Commission's regulations?

---

[6] http://www.legis.state.pa.us/WU01/LI/HJ/2016/0/20160623.pdf#page=19 (pg 1458).

[7] The full deposition transcript of Timothy Craven is available at www.sludgefreeumbt.org.

Appendix D (Continued)

CRAVEN: Very little.

Q. Have you ever utilized the DRBC's water standards, water quality standards in your work?

CRAVEN: With biosolids?

Q. Yes

CRAVEN: No.

Q. Do you know whether this site is located within the DRBC's Special Protection Waters?

CRAVEN: I don't know ... how far expanding the DRBC's Special Protection watersheds go or ---.

Q. You don't know?

CRAVEN: I don't know, yes.

Q. Okay. And as I understand from your answer before about having never applied the DRBC's water quality standards in the consideration of biosolids, that whether it was or wasn't in the Special Protection Waters wouldn't change how you would handle an application; correct?

CRAVEN: That's correct.[8]

* * * *

Q. Do you know whether Chapter 93[9] incorporates the DRBC standards at all?

CRAVEN: I don't know what our regulations --- when they were developed or how they correlate with DRBC. I don't know how DRBC affects our regulations.

* * * *

Q. ***So you can't determine whether any application is consistent with the standards set out by the DRBC; correct?***

CRAVEN: ***That'd be correct.***

[8] Deposition of Timothy Craven, September 30, 2014, pgs 93-94, EHB Docket No. 2014-015-L. See www.sludgefreeumbt.org.

[9] Chapter 93, Water Quality Standards, PA Code.

Appendix D (Continued)

Q. Is it your job overall to determine compliance with Chapter 93?

CRAVEN: Yes.[10]

Therefore, by the DEP's own admission, all of the sludge permits they have issued on farms that drain into the Special Protection Waters are effectively illegal!

The DEP relies completely on the sludge hauler, (e.g. Synagro) to self-monitor its regulatory compliance. The Department doesn't know what is in the sludge, nor the amount and frequency of its application. In the deposition testimony of Craven, he was specifically asked about these issues:

Q. Do you look at … how frequently the sludge is going to be applied and in what concentrations as part of the approval process?

CRAVEN: I don't look at what's going to be potentially land applied because I don't know. I don't know until the material has gone to the farm and land applied….

Q. And you don't require ... the submittal of sampling from each of the source facilities; correct?

CRAVEN: That's correct.

Q. And you don't require the Applicants to tell you how frequently they're going to apply the sludge; correct?

CRAVEN. That's correct.

Q. So you have no way of doing that math as part of the approval process to know whether the CPLR [Cumulative Pollutant Load Requirement] will be exceeded, correct?

CRAVEN. Hypothetically, yes.

Q. Well, practically. You don't have the input---

CRAVEN. Yeah, I don't.[11]

Indeed, in denying Synagro's early motion to dismiss Sludge Free Upper Mount Bethel Township's Legal Appeal, Judge Bernard Labuskes, Jr. wrote **"If the Appellants [Sludge Free**

[10] Craven Deposition, pp. 160-161. See www.sludgefreeumbt.org.

[11] Craven Deposition, pp 120-124. See www.sludgefreeumbt.org.

UMBT] are correct, their interpretation of the law could have broad-reaching impacts on the way the [DEP] evaluates [sludge permits] within the Delaware River Basin."[12]

It appears that the historical role of the DEP as guardian of the environment has been recast as the permitting agency for the waste industry. When HR60 passed in the 200th General Assembly Session (June 23, 2016), Representative Hanna articulated the Department's unfathomable degradation:

> It does not make much sense to me that . . . **a State department charged with protecting our drinking water, would approve a permit for sewage sludge application on land without first verifying whether or not the land is covered by a source water protection plan.[13]**

These shortcomings cannot be ignored. In fact, our State Constitution under Article 1, Section 27 guarantees that the people of Pennsylvania have a **"right to . . . pure water."**

Substantial deficiencies in the existing regulatory framework and in the DEP's review of requests to land apply sewage sludge/biosolids also need to be addressed. Here are some examples:

First, **no site-specific review** is required for Class A sludge application. Rather, an entity that wants to land apply Class A biosolids to a property for the first time need only notify the DEP 24 hours in advance of anticipated land application. While the Department technically has the authority to require more protections for Class A application, without information on site characteristics provided to it in advance, **the Department is not in a position to be able to require protections that may be needed, much less prevent land application from occurring at an unsuitable location.** This is exacerbated by the ever-increasing constraints on the DEP's finances and staff time. The rare instance in which advance review of a Class A land application proposal may occur is if the proposal is in an Exceptional Value (EV) watershed. **Site-specific review must be required for both Class A and Class B biosolids given that both pose the same threats to the local environment and public health, for the reasons discussed above regarding unregulated compounds.**

Second, residents are largely unaware of the biosolids land application until the tractor trailers roll in with the sewage sludge. Only adjacent property owners receive notice in advance, and that notice is limited to Class B.[14] General public notice of Class B approval is via the Pennsylvania Bulletin -- a legal publication that is obscure to the layperson. It is even worse for Class A. The general rule is that no advance notice to anyone is required and approvals are not published. **Residents must be given the ability to weigh in on proposed land application before any approval decision is made, and must have the ability to bring a challenge at the Environmental Hearing Board before the first sludge truck arrives at the site.**

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[12] http://ehb.courtapps.com/content/adjudications/Adjudications&Opinions-2015-Vol%202%20(pp.469-959).pdf (p. 487).
[13] http://www.legis.state.pa.us/WU01/LI/HJ/2016/0/20160623.pdf#page=19 (pp.1458-1459).
[14] 25 Pa. Code § 271.913(g)

Appendix D (Continued)

Third, the DEP's review is not about whether the site is suitable for biosolids application, but rather on ensuring that the bare regulatory minimum is met. This is substantially inadequate from an environmental protection and public health perspective. For example, if the slopes on the site are less than 25 percent, the Department generally allows biosolids application.[15] Thus, even if the slope is 24 percent, which may result in biosolids running off into adjacent properties, it will generally allow application to occur. It also does not look at the slopes of adjacent properties, despite the fact that it may be obvious that, due to slopes off site, runoff will occur. This poses a threat not only to residents nearby, but also to local water resources, including those relied upon by endangered and threatened species.

In the Sludge Free UMBT case, slopes at one site dropped off down into wetlands. The site also was flagged for the presence of an endangered salamander species. A stormwater engineer commissioned by the residents in the appeal found that the combination of slopes and general lack of vegetative buffer would lead to biosolids running off into the wetlands, with minimal reduction in pollutant levels. This is compounded by the lack of requirement of any real barrier between areas of sludge application and water resources – such as silt socks, hay bales, or other stormwater best management practices. Rather, the most that occurs is that sludge is not applied to the ground in a particular area, even though sludge-filled runoff may travel directly through that area into the water resource. An additional problem in the case was that neither the Pennsylvania Fish and Boat Commission or the DEP actually reviewed the impact to the endangered species of biosolids runoff, relying instead on each other's findings of no impact and site suitability. Thus, if the species had lived in the wetlands, no consideration to actual impact occurred.[16]

The issue of surface water runoff and the lack of protections is further compounded because no stormwater review occurs for biosolids application sites. The DEP instead requests a soil conservation plan which is designed to conserve soil erosion -- not address water runoff like engineered stormwater plans would. A conservation plan is simply not a replacement for a stormwater analysis, especially since it only considers the soil underneath the biosolids. From the aspect of the soil conservation plan, biosolids application is seen as a positive because it prevents erosion of the soil. The plan simply does not account for biosolids that may be mobilized by surface water. Even worse, the DEP does not review the soil conservation plan for adequacy. The plan is merely a checklist item on the way to getting an approval to land apply sewage sludge.

Engineered stormwater plans would give the DEP sufficiently more information on water runoff patterns and offsite impacts that could inform a proper analysis of impacts to nearby property owners, waterways, and endangered and threatened species. Requiring stormwater best management practices such as silt socks, hay bales, silt fences, adequate

[15] Craven deposition p. 100. See www.sludgefreeumbt.org

[16] Erosion, Sedimentation, and Stormwater Review of Proposed Class B Biosolids Placement on Angle I, Angle II, and Angle III Farm Sites, Upper Mount Bethel Twp, Northampton Cty, PA, Princeton Hydro, Feb. 13, 2015. See sludgefreeumbt.org.

vegetative buffers, or other practices would also apply a level of protection that is currently lacking.

Another example of review deficiency occurs in regard to groundwater that residents rely on for domestic and agricultural use. In the Sludge Free UMBT case, one of the three proposed land application sites had abandoned test wells onsite. A prior development proposal for the site involving a golf course had used the wells to test water withdrawal amounts. That test resulted in drawdown of some residents' domestic water wells, demonstrating interconnection between the site and home water wells. Despite knowledge of these wells, the DEP allowed sludge application right up to the wells, and had no understanding of whether the wells would be a conduit for sludge contaminants to enter nearby residents' drinking water supply. The DEP did not require a sludge isolation buffer because the wells were not in use. Residents who appealed the DEP approval had to commission the expert report at their own expense.[17] This report demonstrated that the onsite wells posed a direct pathway for groundwater contamination, as did the site's fractured bedrock geology. Furthermore, the fractured geology at the other two sites posed a contamination risk for nearby water sources. ***Thus, had the sludge application gone ahead, significant degradation to home water wells likely would have occurred -- leaving residents without potable water in their homes.***

Also hindering the DEP's ability to project short-term, long-term, and cumulative impacts to residents and local water quality is the lack of information on the sludge before it is applied at the site. Presently, if biosolids have never been applied at a site, the DEP does not consider cumulative impacts in advance of land application.[18] Even if it were to undertake such an analysis, the DEP does not know the actual amount of sludge to be applied until after it has gone down as the amounts needed to meet nutrient requirements will vary depending on the characteristics of each sludge batch. Moreover, ***the chemical pollutant composition cannot be known in advance because each batch of biosolids varies.*** **These issues must be addressed through better recordkeeping, sampling, and analysis.**

Lastly, setbacks from buildings such as homes and schools as well as water sources, must be increased. For example, Class B biosolids may be applied up to a point 300 feet from an occupied building or from a water source.[19] There are no required setbacks for Class A application.[20]

DIRECTIVE 4. ALL APPROPRIATE ALTERNATIVES TO CURRENT USE AND DISPOSAL METHODS EMPLOYED IN THIS COMMONWEALTH AND IN OTHER STATES, PARTICULARLY IN REGARD TO THEIR ECONOMIC FEASIBILITY AND EFFECTS ON THE ENVIRONMENT AND ON PUBLIC HEALTH IN COMPARISON TO CURRENT USE AND DISPOSAL METHODS.

[17] Evaluation of Hydrogeologic Impacts From Application of Biosolids to Three Agricultural Properties in Upper Mount Bethel Twp., Northampton Cty, PA, Jan. 26, 2015 Matthew J. Mulhall, P.G. Pennsylvania Professional Geologist No. PG002756G M2 Associates Inc. See sludgefreeumbt.org
[18] Craven Deposition pp. 104-105. See sludgefreeumbt.org
[19] 25 Pa. Code § 271.913(c)
[20] 25 Pa. Code § 271.911(b)(1)

Appendix D (Continued)

In order to research alternatives to current uses, you must first study the effects on the environment and on public health from the present land application of sludge. This was made clear on June 23, 2016, when the House of Representatives voted to adopt HR60. When the Resolution's prime sponsor, Rep. Joe Emrick, stood for interrogation, he was asked by Rep. Robert Freeman to clarify this issue:

Mr. FREEMAN. … I do want to clarify ... in directing the Legislative Budget and Finance Committee to look at beneficial uses … that they also could identify any potential shortcomings or concerns that the application of biosolids may raise. I know there is some concern, particularly from an environmental standpoint, as to how that could impact soils and groundwater, and I realize it is your intent to look for good possible uses for it, but they would not in any way … be prohibited from giving a balanced assessment of the application in your resolution. Is that correct? … [Do] you also agree that there is nothing in this resolution which would prohibit the Legislative Budget and Finance Committee, in the course of their examination of beneficial uses, to highlight where there may be concerns, particularly in terms of the environmental impacts of the application of biosolids?

Mr. EMRICK. That is correct, Mr. Speaker. There is nothing that would prohibit that. In fact, ***that is part of what the goal here is, to find out if there are contaminants, heavy metals, other things in here that we need to be aware of***.

Mr. FREEMAN. Okay.

Mr. EMRICK. ***That is what we are trying to find out***.

Mr. FREEMAN. Thank you, Mr. Speaker. Just to clarify again – and I beg the gentleman's indulgence so I understand your resolution – even though it is looking at the potential beneficial effects, they do in fact have it within their purview ***to examine any shortcomings, environmental impacts, particularly impacts on soil and groundwater.***

Mr. EMRICK. Yes; that is correct.

Mr. FREEMAN. Okay.

Mr. EMRICK. That is correct.[21]

The 192 Representatives who voted unanimously to adopt HR60, did so with the understanding that the goal of your review includes identifying the contaminants in sludge, as well as how those toxins impact the air, soils and groundwater. Many sludge contaminants did not exist 25 years ago when the 503 Rule was promulgated. As Pennsylvania is the largest importer of waste, its citizens are uniquely vulnerable. Pollutants entering regional

[21] http://www.legis.state.pa.us/WU01/LI/HJ/2016/0/20160623.pdf#page=19 p.1458

wastewater treatment plants from industries and hospitals need to be identified. The resulting highly concentrated toxic sludge cake needs to be tested for these contaminants.

For example, in 2008, Milwaukee Public Schools closed 30 fields and playgrounds after Class A sewage sludge that met the "most stringent safety regulations" created numerous health and safety problems. Chemical analysis of Milwaukee's Class A sludge revealed that tons of it, which had already been spread across Milwaukee County, were contaminated with high levels of cancer-causing PCBs. Until the topsoil could be removed and buried at a hazardous waste site, the City was required to fence off the fields where over 16,000 youths and adults played softball, soccer and kickball.[22] [23]

Scientific experts on our panel, Dr. Fred Silver[24] and Rustin Holmes[25], emphasized the need for testing. Silver focused on the dangers of endotoxins -- an almost indestructible bacteria in biosolids which are airborne and travel off site. At a minimum, endotoxins cause gastrointestinal difficulties. At a maximum, endotoxins cause meningitis and even death. Holmes noted the exponential growth in pharmaceuticals, such as the anti-diabetic metforman and the antidepressant prozac. For example, in 2009 there were 12.9 million prescriptions for prozac and by 2014 this number more than doubled to 28.3 million prescriptions. These drugs are designed not to break down in the body -- they are excreted unchanged and end up in sludge. **To ethically uphold Rep. Emrick's explicit representations to the House, your report must include new, independent sludge testing.**

Odor is NOT just a nuisance. It means the sludge has destabilized -- it is putrefying and producing endotoxins and other bioaerosols. At our Workshop, and in the sampling of testimonies[26] included with this letter, people who live near sludge sites and smell the odors describe being sickened by similar illnesses -- burning eyes, skin rashes, serious breathing and sinus complications, nausea, vomiting and diarrhea, MRSA and and other staph infections. These illnesses are consistent with the types of illnesses experienced by sewage sludge workers and documented in several scientific studies.[27] In Pennsylvania, sludge has been linked the deaths of Tony Behun and Daniel Pennock. The EPA's microbiologist, Dr David Lewis, published evidence that an otherwise healthy

[22] D. Behm and J. Garza, MPS closes 25 athletic fields, Journal Sentinel, July 24, 2007.
[23] Ty Milburn, Parks still closed, questions mounting, NBC affiliate TMJ4 Milwaukee, August 22, 2007.
[24] See Exhibit B for Dr. Silver's slide presentation.
[25] See Exhibit C for Mr. Rustin Holme's presentation.
[26] See Exhibit D for testimonies of residents living near sludged fields..
[27] Work-Related Health Effects on Wastewater Treatment Plant Workers, The International Journal of Occupational and Environmental Medicine, Vol 2 No 4, October, 2011. MA Al-Batanony, MK El-Shafie.
Respiratory Function in Sewage Workers, American Journal of Industrial Medicine, 23:751-761 (1993).
Health Among Municipal Sewage and Wastewater Treatment Workers, Toxicology in Industrial Health, Vol 3, No 3, 1987.

teenager of New Hampshire, Shayne Conner died of respiratory complications from airborne sewage sludge toxins that blew into his bedroom through a broken window.[28] [29]

In 2013 the University of North Carolina's Gillings School of Global Public Health did a study documenting the relationship between illness and sludge applications.[30] This kind of institutional study needs to be done in Pennsylvania. It is unfair for our Legislators to expect citizens to bear the epidemiological burden of proof that links their diseases to sludge applications. For an individual this is insurmountable. **We recommend that the PA Department of Health conduct epidemiological studies in accordance with the protocol outlined in the NRC's 2002 report on biosolids.**

In a recent case of sludge dumping on farmland in York County, plaintiffs claimed sludge had taken away the enjoyment of their properties and was making them sick. The following governmental agencies and industry associations stood AGAINST the residents of Pennsylvania and with Synagro: The PA DEP, the PA Attorney General, the PA Department of Agriculture, the City of Philadelphia, the PA Municipal Authorities Association, the Allegheny County Sanitary Authority, the PA Farm Bureau, the PennAg Industries Association, the Mid–Atlantic Biosolids Association, the PA Water Environment Association, and the PA Septage Management Association.[31]

Likewise, 99 Upper Mount Bethel Township residents, similar to the York County plaintiffs, were forced to take matters into their own hands and file a lawsuit against Synagro in 2016.[32]

We recommend that State create a new position -- a "public sludge advocate" to be the voice of the residents who are powerless to protect themselves via the political process.

DIRECTIVE 5: ANY ALTERNATIVE BENEFICIAL USE, INCLUDING BUT NOT LIMITED TO, ELECTRIC POWER GENERATION AND ABANDONED MINE RECLAMATION, AND ANY OBSTACLES THAT MAY HINDER THE EXPANSION OF ANY ALTERNATIVE BENEFICIAL USE OF BIOSOLIDS.

Synagro's proposed Class A sludge drying plant in Plainfield Township, known as the Slate Belt Heat Recovery Center, would pelletize the sludge by simply converting it from Class B to Class A. This does not constitute an "alternative beneficial use". While the waste industry is busy repackaging sludge into so-called benign products, science doesn't support this new makeover. True alternative technologies that turn sludge into energy can be implemented at source facilities,

[28] "Interactions of pathogens and irritant chemicals in land-applied sewage sludges (biosolids)," David Lewis, et al, *BMC. Public Health,* 2:11. June 28, 2002. https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-2-11

[29] Shane's family sued Synagro. The suit was settled out of court with terms that restrain Shane's family from publicly speaking about the case.

[30] "Land Application of Treated Sewage Sludge: Community Health and Environmental Justice," *Environmental Health Perspectives*, Amy Lowman, et al. March 11, 2013.

[31] Gilbert v. Synagro, 634 Pa. 651.

[32] Abrahamsen v. Synagro, Docket No. C480V2016-8675, Northampton Cty, filed 10/3/16.

and eliminate massive hauling costs. One such technology is the Omniprocessor from Janicki Bioenergy, funded by the Bill Gates Foundation.[33] Others include plasma arc technology.[34] **We recommend you research alternatives that will not involve putting the resulting ashes or residuals on land.**

SUMMARY OF INTERIM RECOMMENDATIONS

We recognize it will take time to completely phase out the land application of all classes of sewage sludge. **Therefore, to reduce economic impacts and risks to health, soil, and water here is our summary of interim recommendations:**

1. Immediately ban Class B and Class A sewage sludge/biosolids spreading in source water protection zones and all areas protected by the Delaware River Basin Commission.

2. Require a comprehensive review of Class A notices and Class B permits issued previously in proximity to source water protection zones and areas protected by the DRBC to determine if they should have been granted in the first place.

3. Extend Class B land application permitting regulations to Class A biosolids that are land applied in bulk quantities.

4. Make substantial improvements to the regulatory regime and agency review of requests for land application. These improvements must include, at a minimum, the following requirements:

a) at least a 30 day notice of a request to land apply for all Classes of biosolids;
b) site-specific review for all Classes of biosolids;
c) a geologic and hydrogeologic study to understand potential impacts to groundwater and surface water resources, including to domestic drinking water wells, agricultural water resources, and waters relied on by endangered and threatened species;
d) a stormwater management plan, which includes an erosion and sedimentation control plan, prepared by an independent engineer and that requires stormwater best management practices be employed;
e) an analysis of the interrelationship between site characteristics (slopes, soil types, proximity to and potential to impact water resources, etc.) and how that interrelationship affects the site's suitability for biosolids;

[33] https://www.janickibioenergy.com/
[34] Plasma Gasification: A Significant Global Waste-to-Energy Opportunity, L. J. Circeo, Applied Plasma Arc Technologies, LLC, Atlanta, Georgia, and L Bardari, Italplasma Casandrino (Naples), Italy, Venice 2012, Fourth Int'l Symposium on Energy from Biomass and Waste.

Appendix D (Continued)

f) a chemical analysis of the characteristics of the sludge before it is applied, including the range of parameters expected, so that an impact analyses (short-term, long-term and cumulative) beyond nitrogen may be performed;
g) larger setbacks from buildings and water sources;
h) a setback that protects against biosolids application where it can take a direct conduit to groundwater; and
i) baseline water quality monitoring, including water sources found to be connected hydrologically and hydrogeologically to the site of proposed land application.

5. Require all Class A products sold in Pennsylvania be clearly labelled when they contain sewage sludge.

6. Direct the Pennsylvania Department of Health to undertake the epidemiological studies outlined in the National Research Council's report on biosolids.

7. Undertake a rigorous, unbiased, independent study of sludge that tests for hazardous contaminants including endotoxins and pharmaceuticals.

8. Implement a Statewide reassessment that lowers the tax valuation of residential properties within a 2 mile radius of farms for which Class B sludge permits have been issued and/or Class A notices have been established.

9. Perform broad spectrum baseline and annual well water testing for homeowners living near sludged fields. Require the tests and any needed remediation be paid for by the waste hauler.

10. Create a State level "Public Sludge Advocate" to be the voice of residents who are powerless to protect themselves via the political process.

11. Given the impossibility of a State level agency to know the environmental nuances in every locality, reestablish local control at the Township level to ensure protection of our health, soil and water.

Biosolids/sewage sludge are not simply "fertilizer" like manure. It is an industrial product that deserves advanced environmental review and consideration before being placed on the ground where our food supply is grown, where residents live, work, recreate, and get their water for daily use, and where species key to our ecosystem's health live and breed. The Commonwealth has an obligation as a trustee to "conserve and maintain" public natural resources such as agricultural soils, surface and groundwater, and the species that are part of our ecosystem for "the benefit of all the people."[35] Therefore, **the Commonwealth must do substantially more to fulfill its trustee obligations and protect citizens and the environment from the threats posed by land application of biosolids.**

[35] Article I, Section 27 of the Pennsylvania Constitution.

Appendix D (Continued)

A full video of our April 29th 2017 HR60 Workshop can be viewed at www.sludgefreeumbt.org. If you have any questions or need further information, please contact Dr. Klein at 610-588-4347, and Mr. Bermingham at 602-703-3717.

Respectfully submitted,

John Bermingham, Esq.

Dr. Howard Klein

Attachments:* Exhibit A (McBride)
Exhibit B (Silver)
Exhibit C (Holmes)
Exhibit D (resident testimonies)

cc w/attachments:
The Sponsors of HR60 (Emrick, Millard, Sankey, Murt, Benninghoff, Major, Mustio, Kortz, Goodman, Maher, Hanna)
The Environmental Resources and Energy Committee (Maher, Bloom, Causer, Corbin, Everett, Gabler, James, Mackenzie, Marshall, Metzgar, Ortitay, Pyle, Rapp, Sankey, Tallman, Zimmerman, Carroll, Bullock, Comitta, Deasy, Gergely, Harris, Krueger-Braneky, McCarter, Neuman, Snyder, Warren)
The Legislative Budget and Finance Committee (Mensch, Brewster, McGarrigle, Tartaglione, Brooks, Wozniak, Barrar, Christiana, Conklin, Godshall, Schweyer, Wheatley)
Rep. Freeman
Rep. Hahn
Senator Scavello
Governor Wolf
Sludge Free LMBT
Sludge Free UMBT
Sludge Free Slate Belt
United Sludge Free Alliance

*LBFC Note: These attachments are available by contacting the LBFC office.

APPENDIX E

SYNAGRO MEMO

Date: 06.08.2017
To: Layne Baroldi
Cc:
From: Bala Vairavan, PE
SUBJECT: Lime Stabilization Process and Odor Control

Following is a summary of the lime stabilization process & odor potential based on past experiences and a general review of Environmental Protection Agency's (EPA) guidance documents.

The EPA's 40 CFR §503 Standards for the Use and Disposal of Sewage Sludge requires that the wastewater solids be stabilized before they can be beneficially used. The primary goal of a biosolids stabilization process is to protect public health by reducing pathogens. Two levels of pathogen reduction exist within 40 CFR §503, i.e., Class A and Class B. Class A pathogen reduction is more stringent compared to Class B and in general indicates that the number of organisms per unit mass of biosolids has been reduced to essentially undetectable levels. Class A biosolids are subject to minimal use restrictions and can be used like any commercial fertilizer. Class B biosolids, on the other hand, may still contain some low densities of potentially pathogenic organisms and, as such, their beneficial use is subject to more stringent regulation, including site-specific approvals by the environmental agencies of most states. It is important to note that both levels of pathogen reduction are considered protective of human health and the environment because of the added site restrictions and management practices that are required for Class B biosolids. In addition to pathogen reduction, Vector Attraction Reduction (VAR) is required to ensure that biosolids are not attractive to vectors such as flies, mosquitoes, flees, rodents, and birds that can potentially transmit pathogens.

Amongst the various biosolids treatment processes available to achieve Class A or Class B standards is alkaline/lime stabilization. Lime stabilization can be used to achieve either Class A or Class B standards depending on the amount of lime/alkaline material added, detention time, pH measurement, temperature monitoring, etc. Class B lime stabilization and VAR is achieved when the pH of the mixture biosolids and lime (alkali) is at 12 or above after 2 hours of contact (pathogen reduction phase) and at or above 11.5 after an additional 22 hours. Class A lime stabilization process usually involves addition of more lime than Class B and maintaining pH at or above 12 for at least 72 hours, with a temperature of 52 degrees Celsius for at least 12 hours. Note that there are variations of Class A lime stabilization processes not covered in this memo.

Nuisance odor is a potential issue with all forms of fertilizer, including biosolids and the nature of the biosolids odors can vary between sources and treatment processes used. Organic and inorganic forms of sulfur, mercaptans, ammonia, amines, and organic fatty acids are some of the odor causing compounds associated with biosolids. Odors can be generated at the time of processing at wastewater facilities and also at the time of land application.

Lime stabilization of the solids volatizes ammonia primarily along with other volatile organic compounds. Odors generated at processing sites can be relatively easily controlled via odor control systems.which include a system for air collection (suction hood, ducts, blowers), odor control scrubbers, and chemical addition systems.

Appendix E (Continued)

Once delivered to the beneficial use site, ammonia odor can also be released during the unloading and spreading operation, when the material is disturbed. These odors will dissipate but they cannot be immediately controlled readily by any specific system or additional odor control equipment. The main difference is that the processing site (i.e., the wastewater treatment plant) can be considered a point source for odor, i.e., relatively speaking it is a finite area within the treatment plant. However, because land application sites involve many acres of land, it is not technically practical or economically feasible to collect and treat these odors through an extensive odor control system at a land application site.

In order to overcome odor problems with a Class B lime stabilized product before it leaves the processing site/wastewater treatment plant, typically a major capital plant treatment process change is required. These process changes can vary from going to a Class A process or a different Class B process. Class A processed biosolids are generally considered more stable in terms of odor than Class B. Capital costs associated with Class A processes are generally more expensive than Class B processes. Class A processes include heat drying, advanced anaerobic digestion (Thermal Hydrolysis, Thermophilic digestion, biological hydrolysis), composting, etc. Process change can also include upgrading to a different Class B process such as anaerobic digestion. Anaerobic digestion is a very common stabilization process utilized at many wastewater treatment plants around the country to produce Class B biosolids and is generally considered more stable in terms of odor generation potential compared to undigested biosolids. Just to give a perspective on costs, 5,000 – 15,000 dry tons per year digestion facility can range from $5.5 million - $43 million depending on type of digesters (steel, concrete), presence/absence of electric generation, usability of excess gas, etc.. Incremental increase in operations cost for operation of pre-thickening facilities, digestion and associated equipment can range from $250,000-$750,000 per year. Cost savings for avoiding lime addition is not factored into the operations cost. The above estimation assumes that existing dewatering facilities are adequate and can be repurposed for post digestion dewatering and are meant solely to give a perspective for potential cost increases to a municipality.

It should be noted that even with Class B digested sludge additional site management practices are necessary. Following are some of the reliable methods to reduce odors at land application sites and is applicable to all Class B material.

- Process control at the treatment plant including proper operation of the lime stabilization process
- Offsite storage of biosolids should be based on stability and quantity
- Subsurface injection or incorporation into the soil
- Air drying of the material at the processing plant with adequate odor control.
- Avoiding wind conditions that can potentially transport odors to residential areas.
- Process change for stabilization if odor issues are persistent.

APPENDIX F

Response to This Report

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

July 5, 2017

Philip R. Durgin
Executive Director
Legislative Budget and Finance Committee
Room 400 Finance Building
613 North Street
Post Office Box 8737
Harrisburg, PA 17105-8737

Dear Mr. Durgin:

Thank you for the opportunity to provide comments of the Legislative and Budget Finance Committee Report: PA's Program for Beneficial Use of Biosolids (Sewage Sludge) by Land Application Conducted Pursuant to HR 2016-60. We appreciate your willingness to work with the Department of Environmental Protection (DEP) to address comments that we had on the report.

As we are all aware, the land application and beneficial use of biosolids is important to both land appliers and generators of biosolids and the citizens of Pennsylvania. It is important that we continue to evaluate the biosolids program to ensure that we are not only providing for a safe and sustainable program, but that we address issues as we become aware of them.

The report recognizes that the beneficial use of biosolids is an integral part of the practice of farming in Pennsylvania and that generally, the program is similar to biosolids programs in surrounding states. More specifically, the report recognizes odor as a major issue to address. The report recommends that DEP incorporate Odor Management into the requirements for coverage under the biosolids general permit. We are currently updating and revising the biosolids general permits and will take the recommendation under consideration.

The report includes a discussion of DEP's inspections based on information from the Environment Facility Application Compliance Tracking System (*e*FACTS). A small subset of generation sites (twelve sites across four regions) and active farm sites (six per region) were used to determine the percentage of inspections performed at each. This information was then used to extrapolate the percentage of inspections conducted state wide. This analysis does not account for the unequal distribution of farm sites and generation sites across the state. The South-Central Region has approximately 65%-75% of the land application sites in the state and 50%-60% of the generation sites. The report concludes that "an annual administrative review was conducted on only approximately 30 percent of application sites"; however, all six of the sites in the South-Central Region had administrative inspections for each of the years that were reviewed. All of the generation sites in the South-Central Region would have also had administrative inspections conducted. Using the information from eFACTS may not be the most accurate approach in determining the inspection frequency at permitted farm or generation sites. There may be some inconsistency between the regions in terms of eFACTS entry. As a frame of reference, there are over 1,000 farm sites approved and hundreds of generators land applying biosolids across the state. While not every farm is used every year, a significant amount of acreage is land applied annually from sources within and outside of Pennsylvania. Given the limited number of staff currently overseeing all the land application activities in the state, five total state wide, the amount and type of inspections is commensurate with the current staffing levels.

If you have additional questions, please contact Sarah Clark, Director of Legislative Affairs, by e-mail at saraclark@pa.gov or by telephone at 717.783.8303 or Lee McDonnell, Director, Bureau of Clean Water, by e-mail at lmcdonnell@pa.gov or by telephone at 717.787.5017.

Respectfully,

Patrick McDonnell
Secretary