Comments on Proposed Changes to the West Virginia Solid Waste Management Rule 33CSR1

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ABBREVIATIONS

HVHF	High volume hydraulic fracturing
MSW	Municipal solid waste
NORM	Naturally occurring radioactive materials
NPDES	National Pollutant Discharge Elimination System
POTW	Publically operated treatment works
RCRA	Resource Conservation and Recovery Act
WCSL	Wetzel County Sanitary Landfill
WVDEP	West Virginia Department of Environmental Protection
WWTP	Waste water treatment plant
USEPA	United States Environmental Protection Agency

1. INTRODUCTION

This report has been prepared at the request of the Wetzel County Solid Waste Authority to assist in its preparation for a public hearing regarding proposed changes to the West Virginia Solid Waste Management Rule[1] ("Rule"). The proposed changes to the Rule have already been temporarily put in place under an Emergency Rule, which was enacted on July 27, 2014. Because the Emergency Rule went into effect during the public comment period for the proposed changes, this report may reference the "Rule" and "Emergency Rule" interchangeably.

The proposed changes to the Rule deal largely with accommodating an increasing waste stream generated during unconventional development of hydrocarbon resources—commonly known as high volume hydraulic fracturing (HVHF)—by which well borings are advanced both vertically and horizontally to frequently achieve common total boring lengths of up to 12,000 feet (1). Due to a number of undesirable conditions created by managing large volumes of drill cuttings at or near the site of origin, such as unstable fill areas and environmental concerns, the 2011 Natural Gas Horizontal Well Control Act required the disposal of drill cuttings and associated drilling mud, collectively referenced as drilling waste, generated from any horizontal natural gas well, to be disposed of in an approved solid waste facility[2] unless specific permission is obtained from the surface owner to manage waste onsite.

Although drilling wastes have historically been allowed to be disposed in permitted West Virginia municipal solid waste (MSW) landfills, the result of the recent oil and gas industry expansion and newer policies is that at least since 2011, landfill tonnage reports indicate many hundreds of thousands of tons of drilling wastes, generated both in West Virginia and other states, have been placed in West Virginia MSW landfills.

Since 2011, several solid waste facilities accepting drilling waste have come close to, or in some cases greatly exceeded their permitted monthly tonnage limitations. To rectify the apparent contradiction of requesting that generators dispose of drilling waste in solid waste landfills while simultaneously causing landfill operators to exceed monthly tonnage limitations by accepting these wastes, the WVDEP issued a July 26, 2013 memorandum to solid waste landfill permittees clarifying the West Virginia Department of Environmental Protection (WVDEP) policy for compliance options (2).[3] Operators were provided with two options:

(1) Class B facilities could apply to expand to a Class A facility in order to increase monthly tonnage limits from 9,999 tons to 30,000 tons, or
(2) Class A or Class B facilities could construct a specific cell or cells for accepting only drilling wastes, in which case the disposal of drilling wastes would not count toward a facility's monthly tonnage limitation.

On March 14, 2014, H.B. 107 was enacted to amend Article 15 of WV Code, §22-15-8 and §22-15-11 which implements the new policy regarding monthly tonnage limitations and also required that WVDEP develop rules:

> "… to establish limits for unique toxins associated with drill cuttings and drilling waste including, but not limited to heavy metals, petroleum related chemicals, (benzene, toluene, xylene, barium, chlorides, radium and radon) and establish the procedures the facility must follow if that limit is exceeded: Provided, That said rules shall establish and set forth a procedure to provide that any detected radiation readings above any established radiation limits will require that the solid waste landfill immediately

[1] 33 Code of State Rules (CSR) 1.
[2] W. Va. Code §22-6A-8(g)(2)/
[3] A previous memo from February 21, 2013 set earlier deadlines for the submission of applications for minor permit modifications and construction of the special waste cells.

cease accepting all affected drill cuttings and drilling waste until the secretary has inspected said landfill and certified pursuant to established rules and regulations that radiation levels have returned to below the established radiation limits. Any truck load of drill cuttings or drilling waste which exceeds the radiation reading limits shall not be allowed to enter the landfill until inspected and approved by the Department of Environmental Protection."

2. DRILLING WASTE

In this report, we focus our discussion on drilling waste from the Marcellus Shale because it represents the greatest portion of drilling wastes currently being generated. Neither the existing rule nor the Emergency Rule exclude landfills from accepting drilling wastes from other shale formations or any other source of drilling waste.[4] This is significant, because West Virginia and surrounding states are likely in the early stage of development of not only the Marcellus Shale, but also other formations such as the Utica Shale. The following sections provide a brief overview of anticipated drilling waste volumes and the associated constituents that may persist as contaminants in the environment.

2.1 Waste volume

The Marcellus formation is a Middle Devonian shale found at various depths and thicknesses throughout its extent. In West Virginia and Pennsylvania, it is typically found between 5,000 and 8,000 feet below the surface, with thickness between about 50 to more than 350 feet (3). Accessing these depths by drilling translates to approximately 500 tons of rock cuttings plus drilling mud for a typical 12,000-foot horizontal Marcellus well (1). While this figure calculates the anticipated weight of rock cuttings, personal communications with WVDEP indicate an average 1,000 tons of drilling waste generated per Marcellus well (4).

As of March 2014, 2,322 Marcellus wells have been developed in West Virginia alone (5). The sheer quantity of waste makes management in MSW landfills a challenging issue, particularly as the waste stream is anticipated to increase significantly over the next several years. A 2010 projection prepared by the United States Department of Energy (USDOE) National Energy Technology Laboratory (NETL) estimated that the pace of drilling for Marcellus Shale gas would increase substantially and grow to approximately 900 wells per year by 2020, with an increasing trend for horizontal wells and a declining trend for vertical wells (6).

2.2 Environmental contaminants in drilling waste

The composition of the drilling waste stream may present an even greater management challenge to MSW landfills than the sheer volume.

Drilling wastes will, at a minimum, consist of drill cuttings from the overburden geology from the vertical portion of the wellbore, organic-rich layers from the shale formation, and components of the muds and chemicals used to lubricate the drilling tools and assist with the return of drill cuttings to the surface.

The broken bits of the geological formations in the drill cuttings include naturally occurring salts, metals, reduced minerals, and organic-rich geology. The exact nature and concentration of constituents will depend on local geological conditions and may vary considerably over distance, and potentially even within the same well bore. The reduced minerals from the cuttings may oxidize when exposed to air and water near the surface to produce acidic, metals-rich leachate (7). Once oxidized by interactions above the ground surface, both metals and radionuclides may become much more water soluble, especially under acidic conditions. The naturally occurring radioactive material (NORM) ^{226}Radium, a product of the ^{238}Uranium decay series, is soluble in water and chemically behaves similarly to calcium, strontium, and barium (7). As such, it can be found in the formation water that returns to the surface during the drilling process, drill cuttings, drilling mud, scale and sludge build-ups, fluids from spills, treatment residuals, and other waste products at concentrations exceeding the background environmental levels.

Drilling waste is a chemically complex mixture of fluid and solid organics, salts, minerals, metals, and radionuclides. Metals and radionuclides do not degrade significantly in the environment or with time. As

[4] 33 CSR 1

components of drilling waste mixtures, their environmental mobility may be enhanced over natural conditions.

With regard to the shale itself, which will be a substantial portion of the drill cuttings generated for any horizontal boring, Middle Devonian Marcellus Shale is recognized from other geologic formations in gamma ray wireline logs by its high radioactivity (8). This radioactivity is a result of the naturally occurring radioactive materials (NORMs) uranium and thorium and their decay products, including ^{226}Radium (9). These radioactive elements are brought to the surface with the return of drilling mud, and are then considered to be TENORM, or Technologically Enhanced Naturally Occurring Radioactive Material (10). However, absent a consistent federal program for management of these wastes, it is currently being managed on a state-by-state basis (10). Drill cuttings and produced water are currently exempt from the Resource Conservation and Recovery Act (RCRA) Subtitle C hazardous waste regulations, although it is still subject to regulation under Subtitle D, which applies to solid waste regulation at landfills (10).

As reported by the United States Environmental Protection Agency (USEPA), disposal of these waste that contain gamma emitting radionuclides, which would including drilling waste, in landfill burial sites will require assessments of both gamma radiation emissions and radionuclide concentrations in solids and liquids (11). ***No such comprehensive assessment of drilling wastes placed in municipal waste landfills has yet to be completed.*** As such, we are very much in the experimental phase with managing drilling waste.

However, several studies have analyzed samples of drilling wastes in the field and provide a sufficient body of evidence to suggest some of the environmental implications for MSW landfills.

In 2013, the West Virginia Water Research Institute conducted a WVDEP-sanctioned water and waste stream study. Both liquid and solid samples of drill cuttings and muds were collected and analyzed from the ***vertical*** portion of the well bore (12). The authors noted the following results:

> "With the exception of arsenic, mercury, nitrate and selenium, the average concentrations of the primary and secondary drinking water parameters in drilling muds were in excess of all of the inorganic drinking water standards. They also exceeded the drinking water standards for benzene and surfactant (MBAS). Drilling muds contained very high concentrations of sodium, potassium and chloride. TPH (diesel range) was present in all drilling muds. Concentrations ranged from 23 to 315 mg/L." (12)

With regard to radiation levels, the authors further noted:

> "Background levels of radiation ranged from 0.005 millirems per hour (mrem/hr) to 0.013 mrem/hr. Sample levels of radiation ranged from 0.009 mrem/hr to 0.016 mrem/hr. The standard for contamination is typically twice background. A review of the individual background levels of radiation indicated that this criterion was not exceeded." (12)

It is again significant to note that ***none*** of these samples were collected from the lateral or horizontal portion of the well bore.

In a later article, the lead author of the 2013 WVDEP-sanctioned study presented an expanded conclusion based on the same data:

> "At present little is known about the risks associated with the solid wastes from hydraulic fracturing in the Marcellus: spent drilling mud, drill cuttings and filtrates/precipitates from flowback. Characterization of their inorganic, organic and radioactive contaminants is at present, incomplete. A systematic study including worker, environmental and community risks is needed." (1)

More comprehensive assessments are currently underway by USEPA, the Pennsylvania Department of Environmental Protection (PADEP), a cooperative effort between the Pennsylvania Independent Oil and Gas

Association (PIOGA) and Marcellus Shale Coalition (MSC), and USDOE. However, none of these studies are complete and results have not been made publicly available. Therefore, an accurate characterization and understanding of the environmental fate and transport mechanisms for drilling wastes, particularly in MSWs, is simply unknown.

3. OBSERVED TRENDS IN LANDFILL LEACHATE DATA

To gain perspective on drilling waste contaminant trends in leachate, we reviewed a limited set of landfill leachate data for two West Virginia landfills that have been accepting large quantities of drilling wastes. Multiple landfills across West Virginia currently legally accept drilling wastes. Since 2011, WVDEP has required that MSW landfill permittees accepting drill cuttings analyze their leachate effluent for certain parameters to help evaluate the environmental performance of MSWs in retaining contaminants associated with drilling wastes. We conduct a limited analysis of leachate data reported from 2011 to 2013 for each site we reviewed.

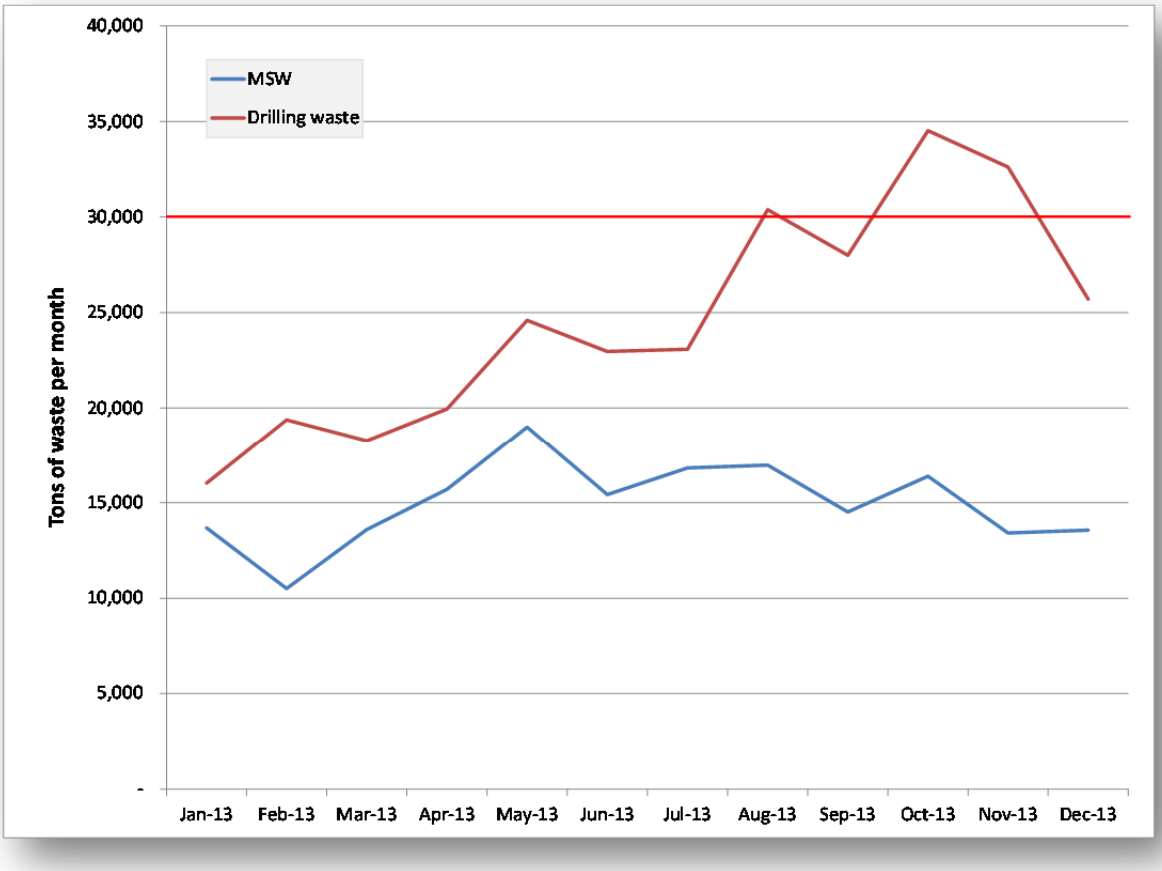
One landfill, Meadowfill Landfill, Inc. ("Meadowfill"), has, since 2011, placed an increasing portion of the drilling waste it receives in a permitted cell dedicated for drilling waste. Here, after pretreatment and storage, leachate is discharged to a Publicly Operated Treatment Works (POTW) facility, where it undergoes further treatment prior to discharging to Simpson Creek. The other facility, the Wetzel County Sanitary Landfill (WCSL), has no dedicated cell and has always intermixed drilling waste with MSW. Treated leachate is discharged directly into the Ohio River.

3.1 Meadowfill Landfill, Inc.

Meadowfill is located in Harrison County, just north of Bridgeport, West Virginia. Meadowfill is a Class A permitted facility and can accept 30,000 tons of waste per month.

It applied in 2011 to construct a dedicated cell for drilling wastes under a minor permit modification, which has been in use since 2012. Prior to the completion of the dedicated cell, drilling wastes were placed in the active areas of the landfill and intermixed with the other MSW. This practice continued, at least through 2013, but at a much lower rate than prior to construction of the dedicated drilling waste cell. The reported volume of drilling waste disposed of in the dedicated cell was larger than the tonnage for all other municipal wastes for every month in 2013, as presented in Figure 1. From August through December 2013, drilling waste disposal into the dedicated cell was approximately double the tonnage for all other municipal wastes combined.

Figure 1: Meadowfill monthly tonnage data



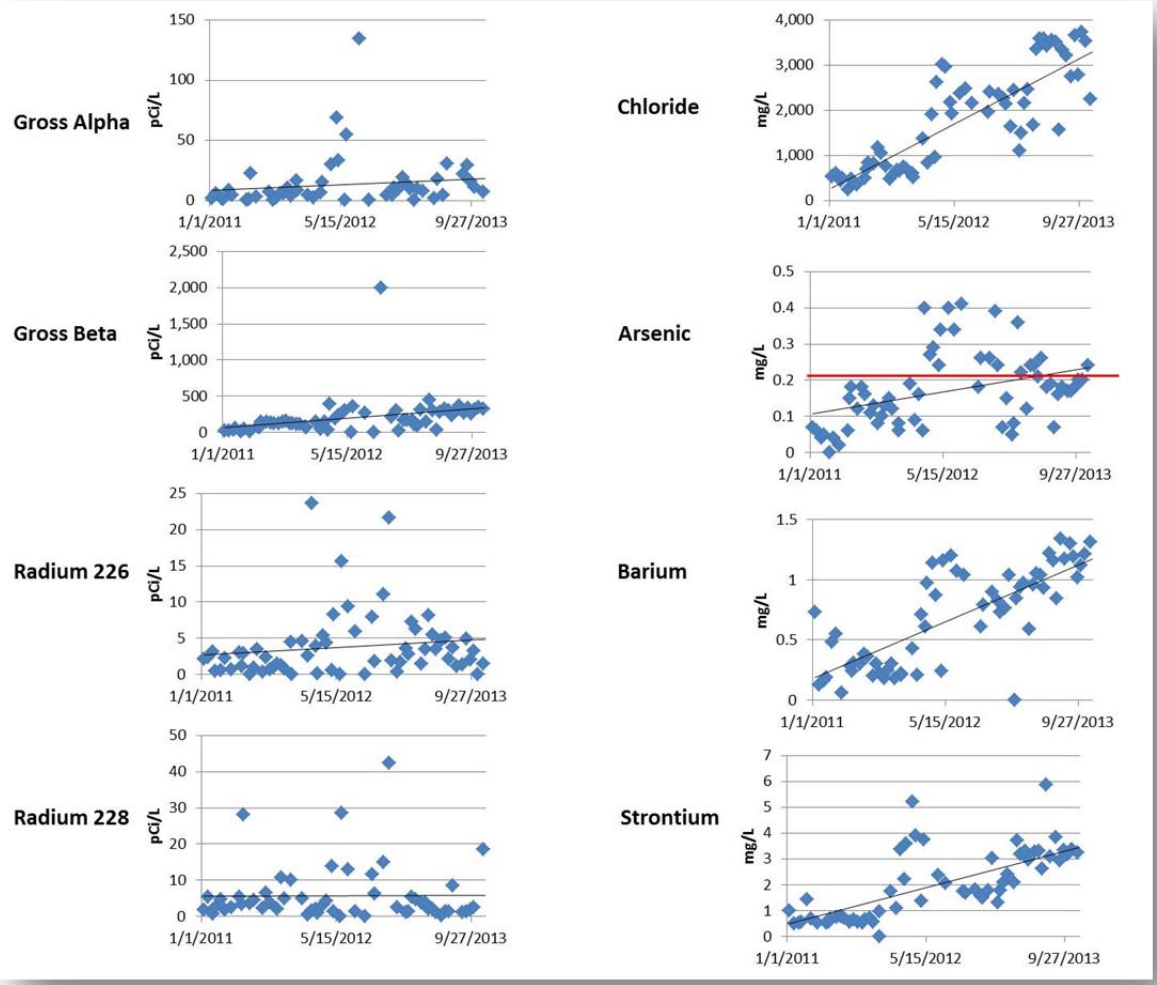
Source: Meadowfill Landfill, Inc. monthly tonnage reports submitted to WVDEP according to 33CSR1 (4.12.b), 2013. The red horizontal line indicates the permitted monthly tonnage limit for the landfill.

All leachate from Meadowfill, including the leachate from the dedicated drilling waste cell, is collected in a leachate pre-treatment holding pond. The resulting pond effluent is piped to a POTW, the City of Bridgeport Waste Water Treatment Plant (WWTP). Meadowfill discharges, on average, 1.5 million gallons per month to the WWTP— equivalent to approximately three Olympic-sized swimming pools. While proposed changes to the Rule will require separate monitoring for leachate from the dedicated drilling waste cells, samples from 2011 through 2013 were collected after the two leachate streams mixed. Therefore, our review utilizes sampling data representing the combined leachate from the MSW cell and dedicated drilling waste cell. Although leachate will undergo some level of additional treatment prior to discharge to surface waters and it is not used as a source of drinking water, for reference we provide comparison to federal maximum contaminant levels (MCLs) for public drinking water supply systems, where they are available.

As shown in Figure 2 below, radiological parameters in pre-treated leachate show clear increasing trends at Meadowfill. A distinctly steeper trend is noted for the more soluble ^{226}Radium as compared to ^{228}Radium. Both radium isotopes are primarily alpha and beta emitters, which also show increasing trends in leachate. There are several months where concentrations of ^{226}Radium and ^{228}Radium ***individually*** exceeded the MCL for combined ^{226}Radium and ^{228}Radium of 5 pCi/L.

Figure 2 also shows increased leachate concentrations for several inorganic parameters consistent with drilling wastes. In Meadowfill, chloride, arsenic, barium, and strontium showed distinct upward trends for 2011 through 2013. Benzene also follows this trend, but is not graphed here.

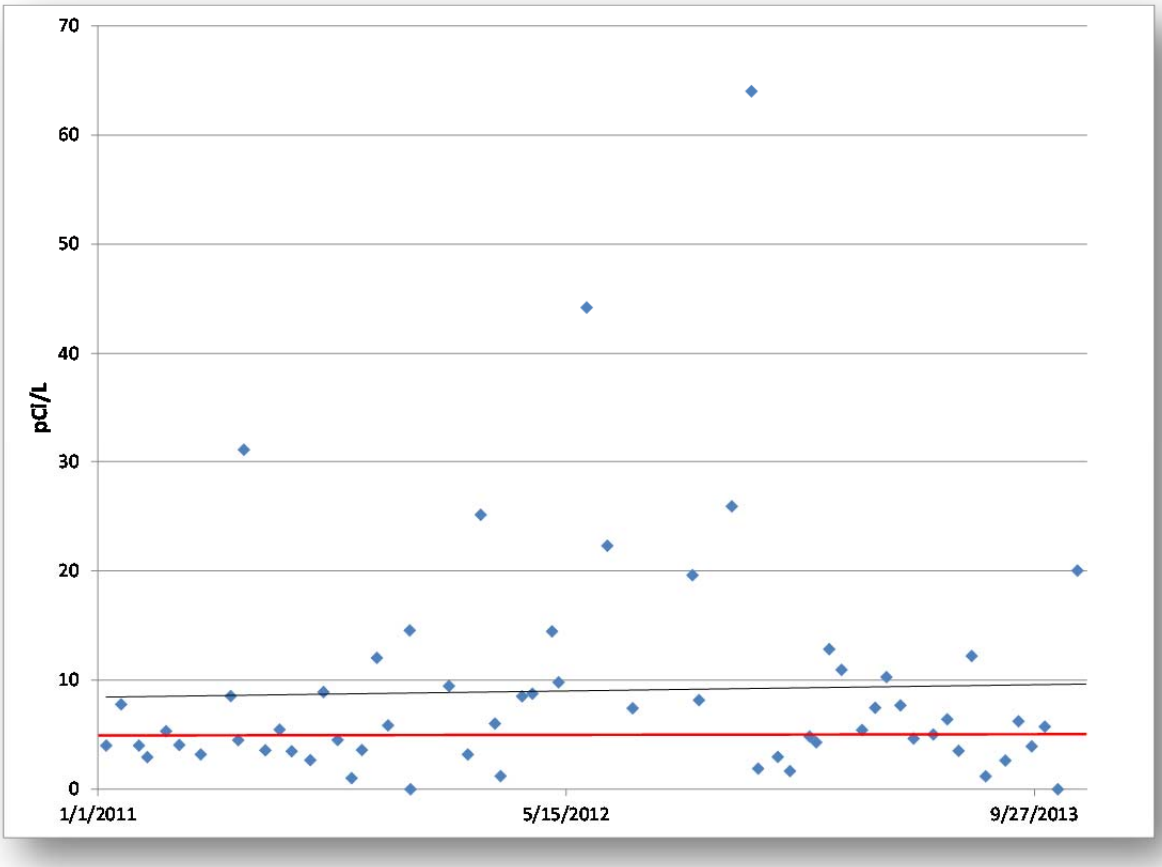
Figure 2: Results from select parameters from leachate analysis at Meadowfill Landfill



Source: Data summarized from leachate monitoring reports submitted to WVDEP, 2011-2013. Red lines on the graphs indicate MCLs from USEPA 2012 Edition of the Drinking Water Standards and Health Advisories (13). Black lines indicate data trend lines..

As depicted in Figure 3, leachate at Meadowfill exceeded the MCL for combined ^{226}Radium and ^{228}Radium of 5 pCi/L during certain months.

Figure 3: Results from ^{226}Radium and ^{228}Radium combined at Meadowfill Landfill

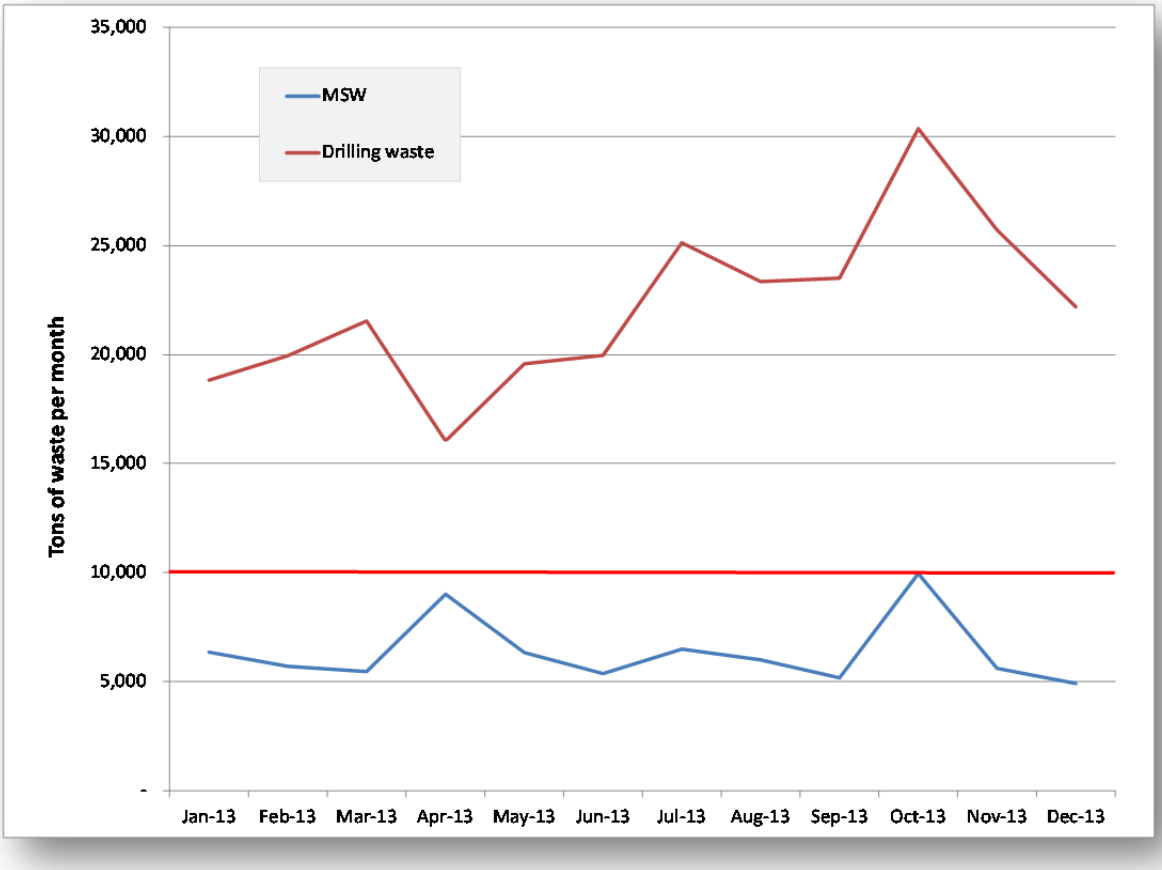


Source: Source: Data summarized from leachate monitoring reports submitted to WVDEP, 2011-2013. Red lines on the graphs indicate MCLs from USEPA 2012 Edition of the Drinking Water Standards and Health Advisories (13). Black lines indicate data trend lines.

3.2 Wetzel County Sanitary Landfill

WCSL is located near New Martinsville, West Virginia. It is a Class B permitted facility, and can accept 9,999 tons per month. WCSL is in the process of obtaining approval for the construction of dedicated drilling waste cell. In 2013, monthly tonnage limits were exceeded by at least double for every month, due to drill cuttings.

Figure 4: Wetzel County monthly tonnage data

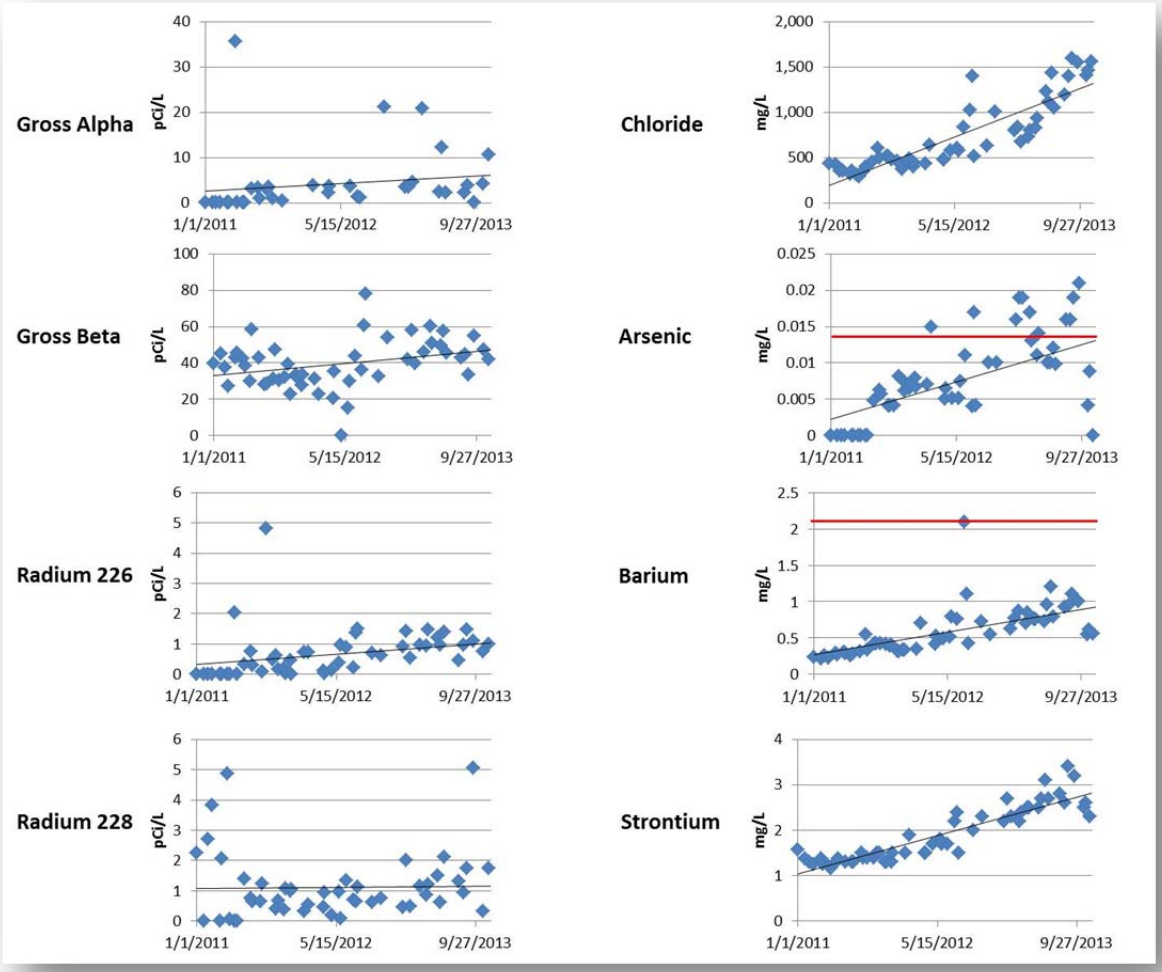


Source: Wetzel County Sanitary Landfill monthly tonnage reports submitted to WVDEP according to 33CSR1 (4.12.b), 2013. The red horizontal line indicates the permitted monthly tonnage limit for the landfill.

WCSL treats all leachate on site prior to discharging the treated leachate directly into the Ohio River. The treatment process directs all collected leachate through an ozone reactor, a primary and secondary aeration basin, a primary and secondary clarifier, and an ultraviolet disinfection unit before entering the river.

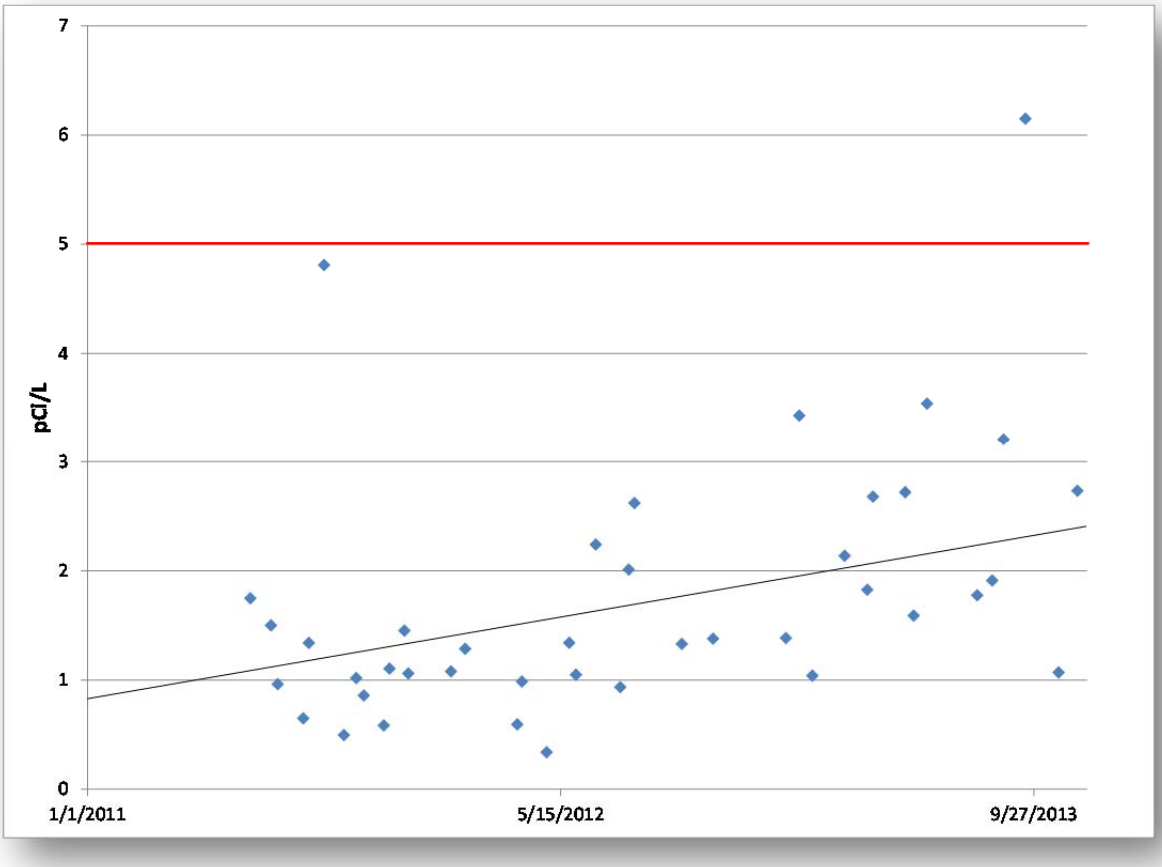
Leachate sampling results show increasing trends from 2011 through 2013 for several parameters associated with drilling waste (Figure 5). Specifically, chloride, arsenic, and barium showed increasing trends. Chloride values tripled during the 2011 through 2013 monitoring period. Gross alpha, gross beta, and ^{226}Radium also showed increases. There were no individual ^{226}Radium or ^{228}Radium values reported above 5 pCi/L at WCSL during this period, but there was one exceedance of the MCL when ^{226}Radium and ^{228}Radium were combined (Figure 6).

Figure 5: Results from select parameters from leachate analysis at WCSL



Source: Source: Data summarized from leachate monitoring reports submitted to WVDEP, 2011-2013. Red lines on the graphs indicate MCLs from USEPA 2012 Edition of the Drinking Water Standards and Health Advisories (13). Black lines indicate data trend lines.

Figure 6: Results from ^{226}Radium and ^{228}Radium combined at WCSL



Source: Data summarized from leachate monitoring reports submitted to WVDEP, 2011-2013. Red lines on the graphs indicate MCLs from USEPA 2012 Edition of the Drinking Water Standards and Health Advisories (13). Black lines indicate data trend lines

3.3 Difficulties in tracking contaminants in leachate

It is currently not possible to evaluate the effectiveness of the leachate treatment systems for either of the landfills we reviewed because appropriate data are not collected. It is currently not possible to evaluate if leachate treatments systems are effective at removing drilling waste contaminants before they are discharged to the environment because the parameters required for leachate monitoring prior to treatment are not also required for NPDES permits that monitor discharges from treatment systems.

As shown in our review of leachate data, there is legitimate concern that concentrating large quantities of Marcellus Shale drilling wastes is already increasing the concentration of contaminants in leachate that must then be managed.

Metals and radionuclides may not degrade significantly in the environment or with time, and their environmental mobility may be altered by interactions within drilling waste mixtures. These and other drilling waste components, such as chlorides, are not typically removed or efficiently recovered during conventional treatment methods at POTWs. Even at industrial treatment facilities, a portion of drilling waste contaminants may persist in the effluent after treatment and be discharged to the environment. A relevant example of this occurred in Pennsylvania, where a study of river sediments ***downstream*** of an industrial brine treatment facility that accepted drillings wastes found ^{226}Radium concentrations at levels nearly 200 times above

upstream and background samples (14). This was true even though the treatment process was reported to have reduced ^{226}Radium levels by more than 90% from the original waste stream (14). This clearly demonstrates the need to monitoring both fluid effluents and sediments in water bodies that receive contributions from drilling waste streams.

Proposed changes to the Rule require the monitoring of leachate from the designated drilling waste cells prior to any treatment for a number of parameters, including several metals, organics, semivolatile organics, gross alpha/gross beta, ^{226}Radium, ^{228} Radium, and ^{90}Strontium (Table 1). However, the same parameters are not required for monitoring under the NPDES permit. At WCSL, the NPDES permit requires monitoring of the effluent from the landfill leachate treatment system before discharging to the Ohio River.

As an industrial user, Meadowfill effluent from the leachate pretreatment and storage pond is monitored before it goes to the City of Bridgeport WWTP. The City of Bridgeport WWTP NPDES permit requires monitoring at the WWTP outfall to Simpson Creek. Because WVDEP classifies the construction of dedicated drilling waste cells as a minor permit modification, there is no regulatory driver for corresponding changes to WWTP NPDES permit. The current NPDES permits require a much more limited set of testing parameters than the leachate sampling (Table 1) under the proposed Rule, and therefore there is no requirement to test for many of the contaminants in drilling waste leachate before discharge to surface waters. Most notably, there is no monitoring for radionuclides once leachate leaves the landfills.

HB107 has amended W.Va. Code §22-15 8(j) to read:

> "On or before July 1, 2015, the secretary shall submit an investigation and report to the Joint Legislative Oversight Commission on Water Resources and the Legislature's Joint Committee on Government and Finance which examines: (1) The hazardous characteristics of leachate collected from solid waste facilities receiving drill cuttings and drilling waste, including, but not limited to, the presence of heavy metals, petroleum related chemicals (benzene, toluene, xylene, etc.) barium, chlorides, radium and radon; (2) the potential negative impacts on the surface water or groundwater resources of this state associated with the collection, treatment and disposal of leachate from such landfills;"

It is unclear how WVDEP will be able to evaluate potential negative impacts on surface water, as required by W.Va. Code §22-15 8(j), under the Emergency Rule if the NPDES permit does not require monitoring for all of the parameters required in the legislation for current leachate treatment systems at landfills or POTWs.

Table 1: Comparison of monitoring parameters in drilling waste leachate stream

Parameter	Leachate monitoring from dedicated cells required by CSR33	WCSL leachate treatment NPDES outfall	Meadowfill leachate to WWTP	NPDES outfall from City of Bridgeport WWTP
Flow		✓	✓	✓
BOD-5 day		✓	✓	✓
BOD, % removal				✓
Suspended solids, % removal				✓
Total dissolved solids				✓
pH				✓
Total suspended solids	✓	✓	✓	✓
Chloride	✓	✓		
Aluminum	✓	✓		
Arsenic	✓	✓	✓	✓
Total recoverable cadmium	✓	✓	✓	✓
Copper	✓	✓	✓	✓
Cyanide	✓	✓	✓	✓
Hexavalent chromium	✓	✓	✓	✓
Iron		✓		
Lead		✓	✓	✓
Manganese		✓		
Mercury	✓	✓	✓	✓
Nickel	✓	✓	✓	✓
Selenium		✓		
Silver	✓	✓	✓	✓
Zinc	✓	✓	✓	✓
Dissolved oxygen		✓		✓
Fecal coliform		✓		✓
Sulfate	✓			✓
Ammonia nitrogen	✓			✓
Nitrogen nitrate	✓	✓		
Nitrogen nitrite	✓			
Nitrogen, Kjeldahl total			✓	
Fluoride	✓			
Benzene	✓			
Phthalate esters	✓			
Barium	✓			
Antimony	✓			
Dibromochloromethane	✓			
Boron	✓			
Chlorobenzene	✓			
Beryllium	✓			
Gross alpha	✓			
Gross beta	✓			
Radium 226	✓			
Radium 228	✓			
Strontium	✓			
Strontium 90	✓			
Lithium	✓			
Total nitrated hydrocarbons	✓			
Fluoranthene	✓			
Bis(2-ethylhexyl)	✓			
Phthalate	✓			
Chromium	✓			
Vanadium	✓			
1,2-Dichlorobenzene	✓			

Parameter	Leachate monitoring from dedicated cells required by CSR33	WCSL leachate treatment NPDES outfall	Meadowfill leachate to WWTP	NPDES outfall from City of Bridgeport WWTP
1,3-Dichlorobenzene	✓			
1,4-Dichlorobenzene	✓			
a-Terpineol		✓		
Benzoic acid		✓		
p-Cresol		✓		
Phenol		✓		
Priority pollutants		✓		
Volatile organics		✓		
Base neutrals		✓		
Acid extractables		✓		
Pesticides		✓		
Acute toxicity-pimephales promelas		✓		
Acute toxicity-daphnia magna or pulex		✓		

4. SPECIFIC COMMENTS ON THE PROPOSED RULE

4.1 Minor or major modification?

Given the significant increases in total waste volumes and the types of contaminants present in drilling wastes, a review of Subsection 3.18 of the Rule makes it difficult to contemplate how WVDEP has allowed landfills, for several years, to accept drilling waste in traditional MSW cells without requiring a major permit modification. Accepting large volumes of drilling wastes would be expected to stress landfill environmental management systems for air, landfill gas, leachate, groundwater, stormwater, and numerous other systems. WVDEP has not required major permit modifications to allow landfills to accept these increased amounts of drilling waste, even when dedicated cells are created.

There are several activities pertaining to drilling wastes that WVDEP has permitted as minor modifications under the previous and Emergency Rules. Minor permit modifications have been issued to:

- allow operators to accept drilling wastes from individual generators and to
- allow landfill operators to construct dedicated cells for accepting drilling wastes.

While it appears appropriate to allow landfills to accept drilling wastes from individual generators under a minor permit modification, the construction of dedicated cells to continuously receive waste volumes that required modification of facility tonnage limitations is an activity that would appear to fit squarely within the criteria that the Rule presents as causes for a major permit modification:

- The performance, efficiency, or longevity of the liner system or the final cover (cap) will be decreased;
- The efficiency or performance of the leachate management system will be decreased;
- The efficiency or performance of a gas management system will be decreased;
- The efficiency or performance of the surface water control system will be decreased;
- A decrease in the quality or quantity of data from any environmental monitoring system will occur;
- The permitted disposal surface area boundary will be increased;
- A remedial action to protect groundwater is necessary;
- The permit is to be transferred to a new permittee; or
- Other similar modifications as determined by the Secretary. “Similar Modification” means those modifications that have a significant potential impact upon the environment, human health and safety, and those parameters set out in W. Va. Code §22-15-8. Similar modifications also include those modifications that have a significant potential impact upon the operation and management of a commercial solid waste facility. (33 CSR 1 §3.18.b.2)

A major permit modification would allow a more thorough process to better evaluate engineering design and the stresses created by the huge volume of drilling wastes on landfill environmental management systems for air, landfill gas, leachate, groundwater, stormwater, and numerous other systems.

Subsections 3.18.b.1 presents the criteria for a minor modification:

> “Minor Modification. -- Permits may be modified by the Secretary at any time except for major modifications as listed in paragraph 3.18.b.2 of this rule. Minor modification does not require the preparation of a draft permit or the completion of the public notice procedures.” (33 CSR 1 §3.18.b.1)

> "A minor modification may be approved by the Secretary for a permittee proposing to increase the volume of solid waste accepted at the facility by an ***amount of ten percent (10%) or less*** upon application in alternate years, unless such an increase requires a change in the classification of the facility." (33 CSR 1 §3.18.b.1.A., emphasis added)

The limited review of tonnage reports we performed from 2011 through 2013 would already appear to require a major permit modification. At Meadowfill, for example, total annual waste tonnage increased by 44% from 2012 to 2013.

Regardless, as we enter the later phase of the public comment period for the currently proposed changes to the Rule, now enacted under the Emergency Rule, we address our specific comments below.

4.2 Drilling waste characterization

4.2.1 *Questions about representative sampling of drilling waste streams*

Section 5.6.c.1.B of the Rule proposes that the receiving landfill must obtain at least one composite sample from the lateral or horizontal portion of each well bore unless otherwise approved by the Secretary:

> The facility must obtain at least one composite sample from the lateral or horizontal portion of each well bore unless otherwise approved by the Secretary. The American Petroleum Institute (API) well number must be included in the profile.

It is commendable that WVDEP intends for waste characterization samples to be collected from the lateral or horizontal portion of the wellbore, because drilling wastes generated from this geologic interval may represent a significant portion of the "unique toxins associated with drill cuttings and associated drilling wastes" cited by WVDEP in the Emergency Rule. This is especially true for NORM, petroleum hydrocarbons, and certain inorganic constituents.

WVDEP should also require separate waste characterization samples to be collected from the vertical portion of the wellbore for each API number, because drilling wastes generated from these geologic intervals may have different characteristics relevant to waste management.

The proposed rule requires samples for each well, as identified by API number. As WVDEP compiles information submitted for multiple wells on the same well pad, it will eventually be able to determine whether drill cuttings generated from the same well pad are reasonably uniform. If so, then it would be reasonable for WVDEP to revisit this rule and allow samples to be taken on a per-pad, rather than a per-well, basis for each minor permit modification. This approach could also be applied to larger geographic areas or specific geologic formations once sufficient data is generated.

Currently, drill cuttings are submitted by generators to MSW landfills under a minor permit modification of the landfill permit for disposal of special wastes. In order for landfills to receive this modification, generators are required to complete the WVDEP Waste Characterization Form, which includes a section to apply for this minor permit modification. The characterization process outlined on the form relies on generator certification that the wastes are or are not hazardous, and a recommended sampling frequency and the relevant laboratory analyses required. The number of samples recommended for all special wastes on a weight-per-sample basis is provided in a summary table on the form (Table 2), although WVDEP provides latitude to reduce the total number of samples if the wastes are very uniform or to add samples if they are variable.

Table 2: Number of samples recommended by WVDEP Waste Characterization Form

Waste amount	Analyze one sample per:
First 3,000 tons	300 tons
Next 6, 000 tons	600 tons
Each additional 1,000 tons	1,000 tons

Source: WVDEP Waste Characterization Form, May7, 2004.

Using the initial approach recommended on the WVDEP Waste Characterization Form, the estimated 1,000 tons (1) of drilling waste generated for a typical horizontal Marcellus well would require three composite samples.

How many composite samples will WVDEP require generators to submit for each Special Waste Minor Permit Modification?

We examined one minor permit modification issued for WCSL to accept drill cuttings from an unspecific generator. The modification states that the WVDEP Office of Solid Waste had reviewed information provided by that generator and determined that drill cuttings are not a hazardous waste under RCRA. We were unable to review the laboratory analysis submitted along with the Minor Permit Modification Application. The number of samples analyzed is also not confirmed. The permit modification allows WCSL to accept 50,000 tons of drill cuttings per year, roughly equivalent to the drilling waste generated from 50 typical horizontal Marcellus wells. The permit lasts for two years and requires annual samples to be analyzed for TCLP metals, TPH, and percent solids.

If the initial approach recommended on the WVDEP Waste Characterization Form was used, we calculate that 56 samples would be required for a permit modification for 50,000 tons of drilling waste. This equates to slightly more than one sample per well and a single minor permit modification.

If the approach in the Rule was used to collect one sample for each API number (from the lateral or horizontal portion of the well bore), then for 50 wells, this would equate to one sample per well and 50 minor permit modifications.

This exercise illustrates that more guidance is needed from WVDEP so that generators and landfill operators understand clearly how many samples are required for each minor permit modification.

Composite sampling may mischaracterize drilling wastes through the sample collection process itself.

How many subsamples will WVDEP require for each composite sample of drilling waste?

Does WVDEP provide guidance to generators and/or landfill permittees regarding approved methods for composite sample collection?

Are qualifications or training required for individuals collecting composite samples so that WVDEP is assured that sampling is representative?

Will generators be required to develop quality assurance/quality control plans for drilling waste characterization sampling?

4.2.2 *Questions with drilling waste characterization analyses*

The Emergency Rule includes a specific set of parameters that WVDEP will require for permitting of drilling waste disposal prior to delivery to the receiving MSW landfill:

> "At a minimum the following analyses must be submitted with each special waste minor permit modification application:
>
> Toxicity Characterization Leaching Procedure (TCLP) Metals, EPA Method 1311; TCLP Volatile Organic Compounds, EPA Method 8260B; TCLP Semivolatile Organic Compounds, EPA Method 8270C; and Total Petroleum Hydrocarbons (TPH), EPA Method 8015C. Sampling results for these parameters must not exceed the limits of 40 CFR § 261.24." (33 CSR 1 §5.6.c.1.C.1)

Table 3 presents the parameters that have specified limits in 40 CFR § 261.24.

Table 3: Parameters with specified limits under 40 CFR § 261.24

Parameters		
Arsenic	2,4-D	Methoxychlor
Barium	1,4-Dichlorobenzene	Methyl ethyl ketone
Benzene	1,2-Dichloroethane	Nitrobenzene
Cadmium	1,1-Dichloroethylene	Pentrachlorophenol
Carbon tetrachloride	2,4-Dinitrotoluene	Pyridine
Chlordane	Endrin	Selenium
Chlorobenzene	Heptachlor (and its epoxide)	Silver
Chloroform	Hexachlorobenzene	Tetrachloroethylene
Chromium	Hexachlorobutadiene	Toxaphene
o-Cresol	Hexachloroethane	Trichloroethylene
m-Cresol	Lead	2,4,5-Trichlorophenol
p-Cresol	Lindane	2,4,5-Trichlorophenol
Cresol	Mercury	

Source: 40 CFR § 261.24

Analysis for total petroleum hydrocarbons (TPH) is a collective measure for a large group of carbon compounds in a sample, some of which are included in 40 CFR § 261.24. TPH does not have a specified limit in 40 CFR § 261.24. As a collective measurement, TPH analysis will not provide results for individual compounds and therefore, there is no way to compare TPH results to the specified limits in in 40 CFR § 261.24. For example, benzene, cresol, nitrobenzene, and several other parameters would be included a TPH analysis result if they were present in drilling waste, but there is no way to compare their individual concentrations to the limits of 40 CFR § 261.24.

The toxicity characteristics leachate procedure (TCLP) is a laboratory extraction method used to simulate leaching of contaminants in a landfill. Results provide a value to determine if a waste would be classified as a characteristic hazardous waste under 40 CFR Part 261 Subpart C. As such, TCLP analysis does not report the total concentration of a parameter in a waste stream, only the amount anticipated to leach from the waste in a landfill.

WVDEP has already required that permittees monitor leachate on a monthly or semi-monthly basis for a specific list of parameters if drilling wastes are disposed (Table 1). This list includes, among other things, measures of radioactive particle activity and several radioactive isotopes: gross alpha, gross beta, ^{226}Radium, ^{228}Radium, total strontium, and total ^{90}Strontium. However, incoming drilling waste streams are not characterized for radionuclides. It is unclear how WVDEP would gain information about drilling waste if

appropriate parameters are not analyzed. It would appear that this knowledge would be highly valuable to future waste management decision-making.

Will WVDEP provide justification that radionuclide contaminants would not be monitored in drilling wastes prior to obtaining a special waste permit to dispose of drilling wastes at a landfill?

Will WVDEP consider adding analysis for uranium, thorium, radium, and their decay products and measures of alpha, beta, and gamma activity to the analysis required to be submitted with each Special Waste Minor Permit Modification?

Wastes that are measured at pH levels below 2 or above 12.5 are classified as a Characteristic Hazardous Waste under 40 CFR Part 261. Because WVDEP is already attempting to determine other toxicity characteristics of drilling wastes listed under 40 CFR Part 261 by requiring TCLP analysis, ***will WVDEP explain why corrosivity and ignitability characteristics of drilling wastes are not also required under proposed subsection 5.6.c.1.C. of the Rule?***

Does WVDEP allow other special waste streams to enter MSW landfills without testing for these characteristic hazards when the waste stream has not been previously characterized?

4.3 Leachate monitoring

The management of leachate figures prominently in the Rule and is addressed throughout. In subsection 4.5.d.1.A.3, which addresses liners, an effective leachate treatment capability is required. As discussed in previous sections, under current monitoring practices for at least two West Virginia landfills, there is no way to confirm if the treatment systems are effectively treating drilling waste leachate because drilling waste parameters are not monitored in the effluent of on-site treatment systems and POTWs. We assume these landfills to be reasonable examples of the drilling waste management practices in West Virginia, because both are situated squarely in regions generating significant volumes of drilling waste.

Will WVDEP promulgate additional changes to the Rule that require monitoring of NPDES discharges from on-site leachate treatment systems and receiving POTWs, at a minimum, for the parameters proposed in the Rule for leachate monitoring?

Will WVDEP require monitoring of sediments in receiving streams below leachate treatment system discharges, whether treatment is performed on-site at the landfill or treated off-site at POTWs?

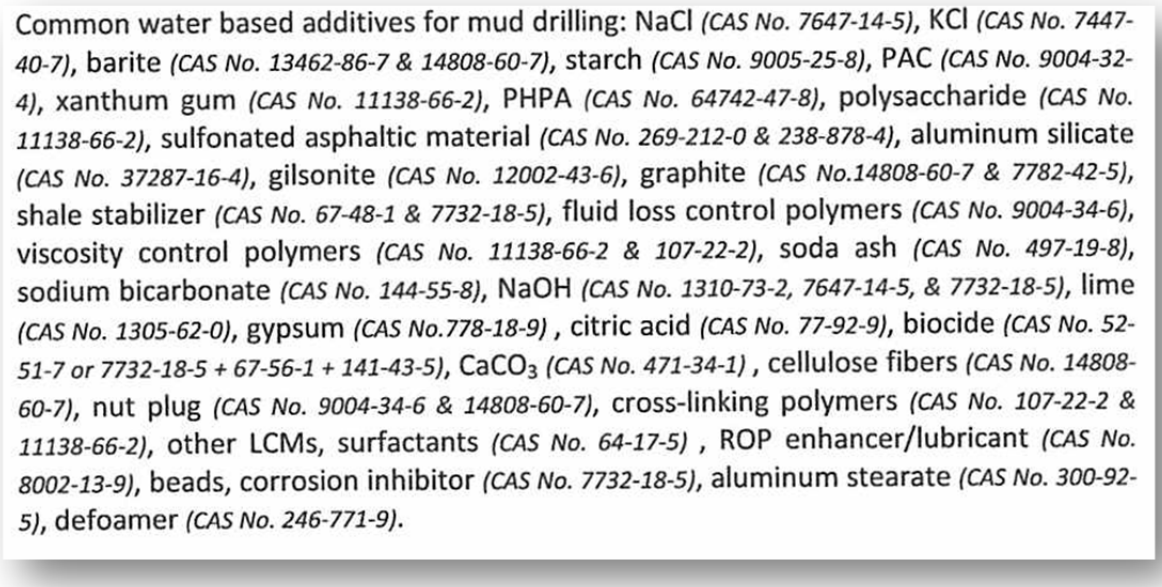
Has WVDEP prepared cost estimates, calculations, or evaluated potential scenarios to ensure that bonding requirements or other permittee financial resources are sufficient to complete remediation associated with drilling waste, even during and after post-closure?

Has WVDEP required, or do they intend to require, that landfill operators submit additional bonding to secure potential financial obligations associated with cleanup of drilling wastes?

Will WVDEP make financial resources available to landfill operators if cleanup or treatment of drilling wastes is indicated through leachate monitoring?

Figure 7 presents the list of drilling mud additives disclosed to WVDEP in a well work permit issued for a shale gas well in West Virginia.

Figure 7: Disclosed list of chemical additives used during drilling


Common water based additives for mud drilling: NaCl *(CAS No. 7647-14-5)*, KCl *(CAS No. 7447-40-7)*, barite *(CAS No. 13462-86-7 & 14808-60-7)*, starch *(CAS No. 9005-25-8)*, PAC *(CAS No. 9004-32-4)*, xanthum gum *(CAS No. 11138-66-2)*, PHPA *(CAS No. 64742-47-8)*, polysaccharide *(CAS No. 11138-66-2)*, sulfonated asphaltic material *(CAS No. 269-212-0 & 238-878-4)*, aluminum silicate *(CAS No. 37287-16-4)*, gilsonite *(CAS No. 12002-43-6)*, graphite *(CAS No.14808-60-7 & 7782-42-5)*, shale stabilizer *(CAS No. 67-48-1 & 7732-18-5)*, fluid loss control polymers *(CAS No. 9004-34-6)*, viscosity control polymers *(CAS No. 11138-66-2 & 107-22-2)*, soda ash *(CAS No. 497-19-8)*, sodium bicarbonate *(CAS No. 144-55-8)*, NaOH *(CAS No. 1310-73-2, 7647-14-5, & 7732-18-5)*, lime *(CAS No. 1305-62-0)*, gypsum *(CAS No.778-18-9)* , citric acid *(CAS No. 77-92-9)*, biocide *(CAS No. 52-51-7 or 7732-18-5 + 67-56-1 + 141-43-5)*, $CaCO_3$ *(CAS No. 471-34-1)* , cellulose fibers *(CAS No. 14808-60-7)*, nut plug *(CAS No. 9004-34-6 & 14808-60-7)*, cross-linking polymers *(CAS No. 107-22-2 & 11138-66-2)*, other LCMs, surfactants *(CAS No. 64-17-5)* , ROP enhancer/lubricant *(CAS No. 8002-13-9)*, beads, corrosion inhibitor *(CAS No. 7732-18-5)*, aluminum stearate *(CAS No. 300-92-5)*, defoamer *(CAS No. 246-771-9)*.

Source: WW-9 Addendum to Horizontal 6A Well Work Permit, submitted by Stone Energy Corporation to WVDEP, issued August 29, 2013, for API Well Number 45-10302920.

Has WVDEP reviewed well work permit applications, conducted sampling, or conducted a literature review to confirm drilling mud additives such that appropriate leachate monitoring parameters have been required to detect these contaminants?

Potassium is typically a substantial component of drilling muds and is fairly mobile in the environment. Although not usually a concern in terms of toxicity, these characteristics make it a good indicator parameter of environmental transport mechanisms for other drilling waste contaminants in leachate, groundwater, and surface water.

Will WVDEP consider adding potassium to the list of required parameters for leachate monitoring?

4.4 Radiation monitoring

In the proposed changes to the Rule, subsection 5.6.d indicates that fixed radiation detection equipment must be installed at the entrance to the facility and that all drilling waste must be evaluated by this equipment. This type of monitoring system has not previously been required at West Virginia landfills.

Will WVDEP provide landfill operators with information for fixed monitoring equipment that is approved by its manufacturer to reliably detect at 10 µrem/hour above background?

In subsection 5.6.d.4, WVDEP references a rejection threshold for drilling waste loads that contain 5 pCi/g above average local background level for ^{226}Radium and ^{228}Radium combined. This threshold will apply only to confirmatory testing results conducted after fixed radiation detection equipment determines levels at 10 µrem/hour above background.

Does WVDEP have guidance available to assist landfill operators with establishing average local background for radioactive isotopes in soil?

USEPA uses health-based screening criteria of 5 pCi/g for the single isotope ^{226}Radium in surface soil and a non–health-based screening level of 15 pCi/g for ^{226}Radium in subsurface soil at uranium mill cleanup sites. These screening levels differ from the rejection threshold proposed by WVDEP in two ways. They are not added to natural background and they do not combine the ^{226}Radium and ^{228}Radium isotopes.

Could WVDEP provide an explanation of how the radiation rejection criterion for incoming loads of drilling waste was developed?

4.5 Groundwater monitoring

Subsection 4.11.a should be amended for any facility receiving drilling waste to ensure that all analysis required for leachate monitoring in the Emergency Rule are also included in the Phase 1 detection monitoring program for groundwater.

4.6 Air and gas monitoring

Proposed subsection 5.6.d.6 will require that facilities prepare a radiation health program and radiation monitoring plan.

Will WVDEP require monitoring for radon gas in the landfill gas management system?

Will WVDEP require monitoring of radiological parameters in fugitive dust near drilling waste solidification and waste placement areas?

It has been reported through personal communications with WVDEP staff that landfills may perform solidification of incoming waste streams on-site and that this designated area must be constructed such that all leachate is collected in the facility leachate collection system. This can and does include solidification of drilling wastes (15). In such areas, there is a potential for the generation of airborne dust if appropriate dust suppression methods are not used.

Will WVDEP require modifications to existing landfill air permits and monitoring programs to address metals and radionuclides introduced by drill cutting waste streams?

4.7 Stormwater

As discussed, drilling wastes may be mechanically handled at MSW landfill sites prior to placement, particularly if solidification is performed on site. Therefore, there is a potential that facility stormwater collection features may be affected by airborne particulates generated during the solidification and waste handling process. Over time, airborne contaminants may be deposited and accumulate within facility stormwater infrastructure and ultimately be discharged through the stormwater management system.

Stormwater at Meadowfill Landfill, for example, is managed with five sediment control basins. There were previously three outlets, but they have since been modified to flow in series such that there is now a single NPDES outlet discharging into Smiths Run, which flows to the West Fork River.

Stormwater at WCSL is managed with three sedimentation basins and two NPDES outlets. These outlets discharge into an unnamed tributary of Peach Fork Creek, which then flows to the Ohio River.

The set of monitoring parameters for these stormwater outlets is limited:

- flow,
- total suspended solids,
- BOD_5,
- COD,
- nitrogen-nitrate,
- chloride,
- zinc, and
- oil and grease.

Will WVDEP require revision of stormwater monitoring parameters in the NPDES permit to account for potential influences from drilling waste fugitive dust?

5. CONCLUSIONS AND RECOMMENDATIONS

We appreciate this opportunity to provide comments to the Wetzel County Solid Waste Authority on proposed changes to the Rule. In the time available, we have attempted to provide analysis and comments on specific areas that we hope will be useful to the Authority as it prepares comments regarding the proposed changes.

To facilitate the public comment process, we have organized key points and comments from our review below:

1. As shown in our review of data, drilling wastes contaminants show increasing trends in landfill leachate.
2. Could WVDEP explain how they intend to evaluate potential negative impacts on surface water, as required by W. Va. Code §22 15 8.(j), under the Emergency Rule if all of the parameters required in the legislation are not monitored in the NPDES permits for current leachate treatment systems at landfills or POTWs?
3. Will WVDEP continue to allow construction of dedicated drilling waste cells under a minor permit modification?
4. A Major Modification would appear to provide a better process for the construction of dedicated cells to evaluate landfill engineering design and the environmental management systems for air, landfill gas, leachate, groundwater, and stormwater. Can WVDEP please clarify why construction of dedicated drilling waste cells is not performed under a Major Permit Modification?
5. WVDEP should also require separate waste characterization samples to be collected from the vertical portion of the wellbore for each API number, because drilling wastes generated from these geologic intervals may have different characteristics relevant to waste management.
6. The proposed rule requires samples for each well, as identified by API number. As WVDEP compiles information submitted for multiple wells on the same well pad, it will eventually be able to determine whether drill cuttings generated from the same well pad are reasonably uniform. If so, then it would be reasonable for WVDEP to revisit this rule and allow samples to be taken on a per-pad, rather than a per-well, basis for each minor permit modification. This approach could also be applied to larger geographic areas or specific geologic formations once sufficient data is generated.
7. How many composite samples will WVDEP require generators to submit for each Special Waste Minor Permit Modification?
8. How many subsamples will WVDEP require for each composite sample of drilling waste?
9. Does WVDEP provide guidance to generators and/or landfill permittees regarding approved methods for composite sample collection?
10. Are qualifications or training required for individuals collecting composite samples so that WVDEP is assured that sampling is representative?
11. Will generators be required to develop quality assurance/quality control plans for drilling waste characterization sampling?
12. Will WVDEP provide justification that radionuclide contaminants would not be monitored in drilling wastes prior to obtaining a special waste permit to dispose of drilling wastes at a landfill?
13. Will WVDEP consider adding analysis for uranium, thorium, radium, and their decay products and measures of alpha, beta, and gamma activity to the analysis required to be submitted with each Special Waste Minor Permit Modification?
14. Will WVDEP explain why corrosivity and ignitability characteristics of drilling wastes are not also required under proposed subsection 5.6.c.1.C. of the Rule?
15. Can WVDEP explain why TPH analysis is required to obtain a minor permit modification for disposal of drilling wastes if there is limit for this parameter in 40 CFR § 261.24? Does WVDEP intend to monitor for the individual components included in TPH analysis?

16. Does WVDEP allow other special waste streams to enter MSW landfills without testing for these characteristic hazards when the waste stream has not been previously characterized?
17. Will WVDEP promulgate additional changes to the Rule that require monitoring of NPDES discharges from on-site leachate treatment systems and receiving POTWs, at a minimum, for the parameters proposed in the Rule for leachate monitoring?
18. Has WVDEP prepared cost estimates, calculations, or evaluated potential scenarios to ensure that bonding requirements or other permittee financial resources are sufficient to complete remediation associated with drilling waste, even during and after post-closure?
19. Has WVDEP required, or do they intend to require, that landfill operators submit additional bonding to secure potential financial obligations associated with cleanup of drilling wastes?
20. Will WVDEP make financial resources available to landfill operators if cleanup or treatment of drilling wastes is indicated through leachate monitoring?
21. Will WVDEP require monitoring of sediments in receiving streams below leachate treatment system discharges, whether treatment is performed on-site at the landfill or treated off-site at POTWs?
22. Has WVDEP reviewed well work permit applications, conducted sampling, or conducted a literature review to confirm all additives to drilling muds such that appropriate leachate monitoring parameters have been required to detect these contaminants?
23. Will WVDEP consider adding potassium to the list of required parameters for leachate monitoring?
24. How will WVDEP evaluate radon in landfill groundwater monitoring programs?
25. Will WVDEP provide landfill operators with information for fixed monitoring equipment that is approved by its manufacturer to reliably detect at 10 µrem/hour above background?
26. Does WVDEP have guidance available to assist landfill operators with establishing average local background for radioactive isotopes in soil?
27. Could WVDEP provide an explanation of how the radiation rejection criterion for incoming loads of drilling waste was developed?
28. Subsection 4.11.a should be amended for any facility receiving drilling waste to ensure that all analysis required for leachate monitoring in the Emergency Rule are also included in the Phase 1 detection monitoring program for groundwater.
29. Will WVDEP require monitoring for radon gas in the landfill gas management system?
30. Will WVDEP require monitoring of radiological parameters in fugitive dust near drilling waste solidification and waste placement areas?
31. Will WVDEP require revision of stormwater monitoring parameters in the NPDES permit to account for potential influences from drilling waste fugitive dust?
32. How will WVDEP evaluate radon in landfill groundwater monitoring programs?
33. How will WVDEP evaluate potential impacts from heavy metals, petroleum related chemicals (benzene, toluene, xylene, etc.) barium, chlorides, radium and radon in stormwater?
34. The Rule does not make reference to use of a manifest system for tracking drilling wastes from the well site to the disposal location will be performed? Does WVDEP intend to implement a manifest system for tracking of drilling wastes?

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