
Appendix I

Waste Disposal Risks

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Introduction

The assessment presented in this appendix addresses the risks associated with the disposal and beneficial use of liquid or solid wastes generated during unconventional gas well development (UGWD). Liquid wastes include flowback of fracturing fluid, produced water, and spent treatment fluids. Solid wastes include: drill cuttings, drilling muds, sludges and exhausted filter media, and brine scales. The term “disposal” means that waste material is placed permanently and is not expected to be relocated or disturbed. The term “beneficial use” means that the waste product is reprocessed into additional materials or new products. The reuse of hydraulic fracturing fluids during the drilling and well stimulation, however, is covered in Appendix 3-Drilling Fluids and Cuttings. This assessment attempts to account for immediate as well as cumulative or long term risks. Summary risks are assessed on a method-material basis. For example the risks associated with the disposal of cuttings in solid waste landfills will consider the risks to ground water, surface water, and public health associated the disposal of the cuttings.

This assessment will provide an overview of related regulatory and/or State policies regarding the disposal of or reuse of UGWD wastes. That is followed by general descriptions of each type of waste generated during the UGWD process. The last portion of this assessment discusses the risks, probability and consequences, of various final waste disposal and beneficial use methods.

This appendix does not address the risks of transporting wastes, which is covered in another appendix. This appendix does not cover the actual capacity of the State to accommodate wastes. This appendix also does not evaluate disposal methods currently unavailable in the State of Maryland. Those methods include: direct discharge pursuant to a permit, discharge to publicly owned treatment works (POTW), and disposal in a Class II injection well.

Regulatory Overview

Federal regulations mandate that “there shall be no discharge of waste water pollutants into navigable waters from any source associated with production, field exploration, drilling, well completion, or well treatment (*i.e.*, produced water, drilling muds, drill cuttings, and produced sand)” (40 CFR 435.32). Thus, the direct discharge of flowback or other brine is already prohibited.

EPA has committed to develop standards to ensure that wastewaters from gas extraction receive proper treatment and can be properly handled by POTWs. EPA plans to propose a rule for shale gas wastewater

in 2014. Until these regulations are in place, MDE has requested that POTWs not accept these wastewaters without prior consultation with MDE. MDE does not intend to authorize any POTW that discharges to fresh water to accept these wastewaters.

There are currently no Class II injection wells in Maryland, and the geology here is generally unfavorable for locating such wells. Class II injection wells in other states may accept wastes from gas production in Maryland. EPA and states that have experienced an increase in seismic events associated with Class II injection wells have recognized the risk and are taking steps to address it.

Solid wastes generated during the exploration, development, and production of crude oil, natural gas, and geothermal energy are exempt from federal hazardous waste regulations under Subtitle C of the Resource Conservation and Recovery Act (RCRA)(40 CFR 261.4(b)(5)). The federal rule was adopted by the Department; COMAR 26.13.02.04-1(A)(5) states that “Drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas, or geothermal energy;” are considered nonhazardous wastes. EPA has clarified the scope of the exemption: “All wastes located at E&P [exploration and production] sites are not necessarily exempt. To be considered an exempt waste, the waste must have been generated from a material or process uniquely associated with the exploration, development, and production of crude oil and natural gas. For example, a solvent used to clean surface equipment or machinery is not exempt because it is not uniquely associated with exploration, development, or production operations. Conversely, if the same solvent were used in a well, it would be exempt because it was generated through a procedure that is uniquely associated with production operations.” (EPA, 2002, p. 18). Many of the wastes generated at gas well pads in large quantities are exempt, including produced water, drilling fluids, drill cuttings, and well completion, treatment, and stimulation fluids. *Id.* at 10. They are nevertheless solid wastes, and must be managed and disposed of in accordance with laws governing nonhazardous solid wastes. Solid waste may be disposed of, recycled, or considered for beneficial reuse.

The non-exempt hazardous wastes generated by oil and gas exploration and production are similar to hazardous wastes generated by other industrial sectors and pose no unique risks. They will not be further considered in this risk assessment.

Wastewater may be suitable for disposal by spray irrigation or other land application. This requires a State Ground Water Discharge Permit. Such permits contain the limitations and requirements deemed necessary to protect public health and protect ground water quality.

Nonhazardous liquid wastes may only be disposed of at a solid waste acceptance facility that has been specifically authorized by the Department to handle those wastes. Liquid wastes may be mixed with sorbent or solidified to qualify. The presence of free liquids shall be determined by application of the free liquid test as specified in 47 FR 8311 (1982), which is commonly called the pint filter test.

Solid nonhazardous wastes can be disposed of in a county/municipal landfill. Solid waste acceptance (SWA) facilities must possess a Refuse Disposal (RD) Permit for the installation, alteration, or extension of a SWA facility. The RD Permit regulates the design, construction, operation, and monitoring of such facilities to minimize the impact on public health and the environment). The only SWA facilities regulated by a RD Permit included in this risk assessment are municipal landfills, rubble [construction and demolition (C&D) debris] landfills and non-hazardous industrial waste landfills.

Types of Waste

Liquids: Produced Water

In this risk assessment, produced water refers to all water that returns to the surface through the well borehole. It is made of returning hydraulic fracturing fluid and natural formation water. Flowback is composed of the fracturing fluids pumped into the well which return up the well to the surface and produced water, which is water trapped in underground formations that is brought to the surface during oil and gas exploration and production. The fracturing fluid flowback consists of water and additives; any new compounds that may have formed due to reactions between additives; and substances mobilized from within the shale formation due to the fracturing operation. Produced water from the Marcellus Shale is characterized by its high salinity and total dissolved solids and may contain a variety of elements such as potassium, calcium, silicon, sodium, magnesium, tin, sulfur, strontium, zinc, rubidium, arsenic, chromium, and naturally occurring radioactive materials. Produced water can also contain organic compounds, including volatile organic compounds (VOCs). A recent analysis of Marcellus shale produced water found that the organic molecules were principally saturated hydrocarbons, with relatively lower levels of aromatic, resin and asphaltene compounds (Maguire-Boyle & Barron, 2014).

Solids: Drill Cuttings, Drilling Muds, Sludges and Brine Scales

Drill Cuttings

The majority of the solid wastes generated during UGWD are drill cuttings. Cuttings are generated during well boring. Cuttings consist of small or fine grained rock chips and fragments that are brought to the surface as the borehole progresses through the formations. Cuttings return to the surface mixed with the drilling muds. They are separated from the muds through shaker screens, desanders, desilters, and centrifuges (NYSDEC, 2011, 5-129). Cuttings from the target formation can have elevated levels of naturally occurring radioactive materials (NORM) although some reports indicate levels of radioactivity

similar to background values. (NYSDEC, 2010, 5-34). Drill cuttings may be mixed with other materials to solidify them or stabilize them so that they can be disposed of on-site or at a solid waste facility (DWMIS).

Drilling Muds

Drilling mud is the mixture that helps maintain borehole stability, push rock fragments to the surface and also serves to cool and keep the drill head lubricated during the drilling phase of the UGWD process. The most common freshwater mud constituent is bentonite clay, but it may also contain weighting agents, clay, polymers, surfactants and other chemicals. (MDE and MDNR, 2014). A barium sulfate weighting agent may be added to bentonite drilling muds. (King, 2012); Bentonite clays are naturally occurring cationic silicate clays that have cation exchange capacity, often involving Ca⁺ and Mg⁺. Sodium bentonite, the bentonite used in drilling operations, has the ability to absorb great amounts of water enabling it to seal and lubricate the borehole.

Once the drilling has progressed past the freshwater aquifers other potassium chloride/polymer-based oil lubricant, or synthetic oil based muds are used to drill the horizontal portion of the well (NYSDEC, 2011 5-32, King 2012). Water based muds are not reused, but the synthetic or oil lubricated muds can be reused in the drilling process (DWMIS, King, 2012).

Sludges

Sludges and exhausted filter media are generated during the treatment process that allows the fluid and mud returns to be reused in the drilling process. The constituents of the sludge and filter media vary widely depending upon the treatment process utilized. Sludges can be generated in a number of ways such as the separation of liquids from solids within the flowback, the addition of coagulants, and the precipitation of the dissolved solids. Sludges and spent filter media may be dried to a solid cake after bulking with fly ash or some other additive which makes transport and disposal easier (Hackney & Weisner, 1996). Sludges must be converted to solids for disposal in a landfill.

Brine Scales

Brine scales are generated during the drilling process as a result of the precipitation of scale forming metals such as barium, strontium, calcium, and magnesium found in the formation water co-produced during the drilling process (NYSDEC, 2011). Brine scales often interfere with the returns process as they greatly narrow the width of the bore hole and pipe. This issue is alleviated with the addition of additives such as ammonium chloride to the drilling fluid mixture. Classified as solids, brine scales may also be disposed of along with drill cuttings (NYSDEC, 2011).

Waste Treatment, Reuse and Disposal Options

Treatment and disposal of solid waste from UGWD is generally achieved by sending the wastes to landfills, a treatment facility, or a Class II injection well.

Beneficial Uses

Road Application (formation water only)

The states that allow the spreading of liquid wastes generated during UGWD generally allow the spreading of only the formation water. This is the portion of the produced water considered in this risk assessment.

Dust control is defined in the *2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control* as “controlling the suspension of dust particles from construction activities.” The purpose of dust control is to “prevent blowing and movement of dust from exposed soil surfaces to reduce on and off-site damage including health and traffic hazards.” Dust control measures must be employed to any “areas subject to dust blowing and movement where on and off-site damage is likely without treatment.” The following substances can be used for dust control: mulches, vegetative cover, tillage (brings heavier dirt clumps to the surface), irrigation (water), barriers such as silt fences, and chemical treatment” This assessment applies the same definition to post-construction or other applications of materials to surfaces for the purpose of dust control.

The *State Highway Administration (SHA) Salt Management Plan*, legislated in 2010 House Bill 0903 and Senate Bill 0775, defines brines as a liquid anti-icing agent that SHA and other agencies use prior to winter storm events. The brines are a pre-treatment practice intended to keep ice from bonding to pavement facilitating easier snow removal. Brines can also be mixed with road salts to better facilitate deicing operations (MSHA).

Agricultural Soil Amendments

In this assessment agricultural soil amendments refer to the one-time application of drilling muds to a field that is, and will continue to be, used to grow crops. Bentonite clays can and have been used in less developed countries and rural areas for soil amendments. The clays themselves are cheap and readily available in large deposits all over the world. In general, a decline in organic matter minimizes soil’s capacity to retain nutrients (fertilizer). Bentonite helps the soils to retain the cation exchange capability

aiding in the retention of fertilizers and other nutrients, and minimizing the potential for nutrient loss through leaching (Czaban J. et al., 2013).

Road construction (cuttings)

The drilling industry is rapidly identifying ways in which wastes can be put to beneficial use, rather than disposed of at a landfill or some other facility. Cuttings may potentially be used in the construction of access roads or well pads. Other possible construction applications include use in road pavements, bitumen, and asphalt or use in cement manufacture (Haut, 2012).

Waste disposal methods

On-site Disposal

On-site disposal is the permanent placement of solid drilling waste into a pit within the disturbed area used for HVHF operations. Once filled, the area is reclaimed to prevent erosion.

Landfill Disposal

Landfills are facilities designed for the disposal of municipal and industrial wastes. Generally waste materials are placed in lined pits called cells and covered at regular intervals. In Maryland, municipal, industrial and rubble landfills must have liners and leachate collection systems.

Land farming

Land farming can be considered both a treatment and disposal method. The wastes are applied to the surface so that organisms in the soil will metabolize, transform and assimilate waste constituents. The surface can be tilled and water, nutrients, manure, etc. may be added to speed the microbial action. (DWMIS). <http://web.ead.anl.gov/dwm/techdesc/land/index.cfm>

Out-of-State Transport

Out-of-state transport is the final disposal or beneficial use of waste material generated by the UGWD process wholly outside of the state of Maryland.

Assessment of Risks

Although the waste from UNGD is generally excluded from the definition of hazardous waste, solid waste regulations apply to their handling and disposal. Beneficial uses must be legitimate and not present a hazard.

Liquids - Road Application (formation water only)

Activity & Risk Identification

The salt in formation water, like any brine, is easily mobilized from road surfaces with precipitation, running off into surface waters or infiltrating into ground waters (SHA). Salt can harm plants and aquatic life, wildlife and pets, adversely affect the soil, and damage infrastructure and vehicles.

In a comment response to New York's consideration of formation brine as a beneficial use, EPA stated that "produced water may still contain some of the chemicals used in the hydraulic fracturing fluids if not all the fluids returned in the initial flowback period. Moreover, the actual concentration and/or radioactivity of contaminants in the produced water spread on land or roads would be unknown at any given time since the amount and type of contaminants in produced water varies from well to well and even in the same well over time unless each truckload is tested which would be a monumental task given the amount of produced water that is expected to be generated from Marcellus and Utica shale gas extraction and available for road spreading. In addition, road spreading of any type of natural gas non-domestic wastewater could lead to violations of the Clean Water Act's no direct discharge prohibition due to runoff of contaminated storm water and snowfall. Furthermore, such a practice, depending on the make-up of the soils along the roadway, could lead to surface infiltration of the produced water and risk contamination of the underlying aquifer." (EPA, 2012).

There are no State referenced controls incorporated into COMAR, beyond dust control during construction, which regulates these activities. Outside of state highways, the purview for such operations falls to the counties. The Salt Management Plan mandated by legislature consists of guidance and recommended BMPs, and each county and municipality must develop their own plans.

Risk Mitigation (Current Regulation & Proposed BMPs)

Maryland proposed the following BMPs that are relevant to the management and disposal of produced water:

- The application for a well permit must include a plan that addresses waste handling, treatment and disposal.
- Flowback, produced water, residue from treatment of flowback and produced water should be tested for radioactivity and disposed of in accordance with law.
- Flowback and produced water shall be recycled to the maximum extent practicable. Unless the applicant can demonstrate that it is not practicable, the permit shall require that not less than 90 percent of the flowback and produced water be recycled, and that the recycling be performed on the pad site of generation.
- The permittees must keep a record of the volumes of wastes and wastewater generated on-site, the amount treated or recycled on-site, and a record of each shipment off-site, including confirmation that the full shipment arrived at the facility. The records may take the form of a log, invoice, manifest, bill of lading or other shipping documents

Risk Assessment

The necessary implication of these recommendations is that flowback and produced water may not be applied to roads for de-icing. On a case-by-case basis, if the waste management plan proposes to use flowback for de-icing, the Department will consider whether the constituents and concentrations of the flowback are suitable as a substitute for commercial de-icing formulations. Because of the requirement for recycling, the probability of this use is low, and the consequence of this use is moderate because it could have considerable adverse impact on people or the environment in a localized area.

Agricultural Soil Amendments

Activity & Risk Identification

Application of drilling muds to land meant for food or forage production could introduce pollutants and heavy metals into humans or animals consuming the crops or forage. The pollutants could also run off or infiltrate, degrading surface water or ground water.

While bentonite may be used as a soil amendment, it has also been documented that the bentonite clay structure and cation orientation allow it to readily adsorb heavy metals from solution. Montmorillonite showed good adsorbance for removal of toxic heavy metals as (Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni and Zn). The overall effectiveness of the adsorption depends on a number of factors such as pH and the overall concentration of metals in solution (Vega J.L et al., 2014).

Bentonite based drilling muds that have come into contact with formation brines early in the well drilling process will most likely contain lower levels of metals as the TDS and salinity of the brines increases in the latter drilling stages (NYSDEC, 2011, 6-117; Haluszczak et al. 2012). However, there are several types of bentonite clays, calcium bentonite, potassium, and sodium bentonite, the latter being used in UGWD operations. This type of bentonite clay is not favored or very suitable as a soil amendment because of the high water absorption during the drilling process. This absorption makes these types of muds difficult to incorporate into soils and may create a barrier preventing water infiltration.

Risk Mitigation (Current Regulation & Proposed BMPs)

Maryland proposed the following BMPs that are relevant to the use of drilling mud as an agricultural soil amendment:

- The application for a well permit must include a plan that addresses waste handling, treatment and disposal.
- Drilling muds should be tested for radioactivity and disposed of in accordance with law.

- The permittees must keep a record of the volumes of wastes and wastewater generated on-site, the amount treated or recycled on-site, and a record of each shipment off-site, including confirmation that the full shipment arrived at the facility. The records may take the form of a log, invoice, manifest, bill of lading or other shipping documents

Risk Assessment

The necessary implication of these recommendations is that drilling muds may not be applied to agricultural land as a soil amendment. On a case-by-case basis, if the waste management plan proposes to use drilling muds for this purpose, the Department will consider whether the constituents and concentrations of the drilling muds are suitable for that use. The probability that bentonite clay would be used as an agricultural soil amendment is low because it is not well suited for this application. If it were used, there could be a considerable adverse impact on people and the environment in a localized area. For this reason, the consequence is judged to be moderate.

Solids - Road construction (cuttings only)

Activity & Risk Identification

Use of cuttings for road construction would pose a risk to people and the environment if the cuttings were to leach pollutants into surface or ground water due to run-off and infiltration. This could degrade habitat and drinking water.

Industry case studies have demonstrated that cuttings could be treated to render them safe for handling and recycling. Some methods considered involve an encapsulation process that binds the pollutants of concern, while others have found success by thermally treating the cuttings at a facility such as an asphalt plant. The thermal treatment process may release VOCs, but will be mitigated by the emissions standards established for such a facility. Once treated, the resulting material is relatively clean (DWMIS; Haut, 2012; Burnett & Platt, 2014). Although feasible, the development of such technologies is limited to a few case studies, with even fewer companies possessing the necessary technology. Texas and Louisiana are currently the only states that allow the use of recycled UGWD cuttings as road material. Use in these states is limited to UGWD pads and access roads. Several other states are considering the prospect pending further research (Haut, 2012).

Risk Mitigation (Current Regulation & Proposed BMPs)

The best practices report did not address the possibility of using cuttings for road construction. It considered landfilling and on-site disposal.

Maryland proposes the following BMPs that are relevant to road applications of cuttings:

- The application for a well permit must include a plan that addresses waste handling, treatment and disposal.

- The cuttings must be tested for radioactivity other contaminants, including sulfates and salinity, before disposal and disposed of in accordance with law.

Risk Assessment

Cuttings material from the fresh water aquifer drilling phase of UGWD could potentially be recycled as road material as long as the cuttings themselves meet current use guidelines for road base/road construction material. It is unlikely that cuttings generated later in the process could be reused as road or construction material since the necessary technology to render it innocuous is still in the very early development stage.

As with drilling mud, if the waste management plan proposes to use cuttings for road construction, the Department will consider, on a case-by-case basis, whether the constituents and concentrations of the cuttings are suitable for that use. . The probability that cuttings capable of leaching pollutants would be used for road construction is low because the cuttings must be tested before approval could be granted. If it were used and contaminants leached, there could be a considerable adverse impact on people and the environment in a localized area. For this reason, the consequence is judged to be moderate.

On-site Disposal

Activity & Risk Identification

On-site disposal is the permanent placement of solid drilling waste into a pit or depression in the ground, after which it is covered with soil and reclaimed. On-site disposal of cuttings would pose a risk to people and the environment if the cuttings were to leach pollutants into the soil or ground water. This could degrade the soil and ground water. If contaminated ground water is used for drinking water, human health could be adversely affected.

Cuttings generated from the uppermost part of the vertical borehole are more likely to be considered for on-site disposal because the uppermost portion is less likely to have high salt content or NORM. Once cuttings have come into contact with the oil-based muds they will most likely not be suitable for on-site burial (NYSDEC, 2011, p. 5-129).

Risk Mitigation (Current Regulation & Proposed BMPs)

Maryland proposes the following BMPs that are relevant to on-site disposal of cuttings:

- The application for a well permit must include a plan that addresses waste handling, treatment and disposal.
- The cuttings must be tested for radioactivity other contaminants, including sulfates and salinity, before disposal and disposed of in accordance with law.

Risk Assessment

During the pit filling process water may accumulate or become separated from the cuttings due to settling. The probability of this occurring decreases dramatically if the cuttings are mixed with bulking materials like fly ash. Stormwater is most likely the primary source of water that may accumulate in the on-site disposal pit (DWIMS). There is some potential to impact ground waters associated with the on-site burial method.

If the waste management plan proposes to dispose of cuttings on-site, the Department will consider, on a case-by-case basis, whether the constituents and concentrations of the cuttings are suitable for that use. The probability that cuttings capable of leaching pollutants would be buried on-site is low because the cuttings must be tested before approval could be granted. If it were used and contaminants leached, there could be a considerable adverse impact on people and the environment in a localized area. For this reason, the consequence is judged to be moderate.

Disposal in a Landfill

If landfills are not properly designed, constructed, and operated, leachate could contaminate ground water. If waste materials are not properly spread, compacted and covered, wastes could be exposed to precipitation leading to contaminated runoff.

Risk Mitigation (Current Regulation & Proposed BMPs)

Maryland has a robust permitting program for landfills. In Maryland, municipal, industrial and rubble landfills are required to have liners and leachate collection systems that facilitate the collection of leachate and prevent migration of pollutants out of the landfill to adjacent subsurface soil, ground water, and surface water. The landfills are also required to do routine ground water monitoring to detect any releases. Permits for the landfills establish limitations on what the landfills may accept for disposal. (MDE & DNR, 2014).

Maryland proposes the following BMPs that are relevant to disposal of cuttings in a landfill:

- The application for a well permit must include a plan that addresses waste handling, treatment and disposal.
- The cuttings must be tested for radioactivity other contaminants, including sulfates and salinity, before disposal and disposed of in accordance with law.

Risk Assessment

Because of Maryland's regulatory requirements for landfills, the probability that contaminants from cuttings would be released from a permitted landfill is low. Leachate collected from the landfill will contain pollutants, but the testing of the waste for radioactivity and other contaminants before landfilling will reduce this risk. Exposure of landfill workers or the public to the waste, or release of pollutants due to a failure of the liner or leachate collection system or improper handling of leachate

could cause an adverse affect on people or the environment, although this would be localized. For this reason, the consequence is judged to be moderate.

Land farming

If done improperly, land farming can result in a buildup of salts, hydrocarbons, and heavy metals in the soil, leading to reduced productivity and contamination of ground water and surface water.

This could cause harm to people and the environment. Humans and animals could come into contact with the wastes while they remain on the surface.

Risk Mitigation (Current Regulation & Proposed BMPs)

Current Maryland regulations provide “Land farming of cuttings shall be permitted only on approval from the Department and shall require: (1) Soils analysis before site preparation; (2) Cuttings analysis as directed by the Department; and (3) Post land farming soils analysis.” (COMAR 26.19.01.10W). The land farming is to occur in areas of disturbance (COMAR 26.19.01.06F(2)(g)).

Maryland proposes the following BMPs that are relevant to on-site disposal of cuttings:

- The application for a well permit must include a plan that addresses waste handling, treatment and disposal.
- The cuttings must be tested for radioactivity other contaminants, including sulfates and salinity, before disposal and disposed of in accordance with law.

Risk Assessment

If the waste management plan proposes to land farm cuttings on-site, the Department will consider, on a case-by-case basis, whether the constituents and concentrations of the cuttings are suitable for land farming. The probability that cuttings capable of leaching pollutants would be land farmed on-site is low because the cuttings must be tested before approval could be granted. If it were used and contaminants leached, there could be a considerable adverse impact on people and the environment in a localized area. The location restrictions and setbacks would limit exposure. For this reason, the consequence is judged to be moderate.

Out-of-State Transport

Disposal out of state presents no risk to Marylanders. The laws and regulations of the federal government and other states can be assumed to be adequately protective.

Conclusion

The probability of harm associated with treatment or disposal of wastes from HVHF is low. The consequence if the harm were to occur is moderate. The overall risk ranking is low.

Summary Table of Probability, Consequence and Risk Ranking

Operation	Occurrence	Environmental Impact	Probability	Consequence	Risk Ranking
Road application of brine	Release of contaminants in the brine	Harm to plants and aquatic life, wildlife and pets, adverse effect on soil, and damage infrastructure and vehicles	Low	Moderate	Low
Agricultural Soil Amendment	Release of contaminants from drilling mud	Introduction of pollutants into the human or animal food chain; pollutants could run off or infiltrate, degrading surface water or ground water.	Low	Moderate	Low
Road construction	Release of contaminants from cuttings	Contamination of surface and ground water, degradation of habitat and drinking water	Low	Moderate	Low
On-site disposal	Release of contaminants from cuttings	Degradation of the soil ,ground water and drinking water	Low	Moderate	Low
Disposal in a landfill	Release of contaminants by stormwater runoff and contamination of leachate	Soil, surface water and ground water	Low	Moderate	Low
Land farming	Release of contaminants and buildup of salts, hydrocarbons, and heavy metals in the soils	Reduced productivity of soil, surface water and ground water	Low	Moderate	Low
Disposal out of state	Does not occur in Maryland	NA	NA	NA	NA

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