



pennsylvania
DEPARTMENT OF ENVIRONMENTAL
PROTECTION

MEMO

TO: Regional Directors
Assistant Regional Directors
Environmental Cleanup and Brownfield Program Managers
Oil and Gas Program Managers

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THROUGH: Kurt Klappkowski *KSK*
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RE: Program Clarification
Common Constituents for Oil and Gas-Related Spills and Releases

DATE: October 3, 2014

The purpose of this Memo is to delineate procedures to evaluate the cleanups of spills and releases which impact soil and groundwater at oil and gas well sites. DEP needs to make sure that spills and releases are remediated to meet the human health and environmental protection requirements of the Oil and Gas Act, the Clean Streams Law, the Solid Waste Management Act, the Land Recycling and Environmental Remediation Standards Act (Act 2), and the regulations, policies and technical guidance issued under the authority of those statutes.

When a spill or release occurs, immediate actions must be taken 1) to prevent and minimize contamination of surface water, 2) to remove solid waste materials; and 3) prevent and minimize runoff from solid waste materials from migrating to uncontaminated areas. In addition, water supplies that are polluted or diminished as a result of the drilling, alteration, or operation of an oil or gas well must be restored (58 Pa.C.S. § 3218). This Memo does not address immediate actions, the replacement of water supplies, or the remediation of sediment or surface water.

Wastes and products commonly used at these sites may contain many constituents. Individual chemicals within the material released may include non-toxic compounds, naturally occurring elements, or carcinogens and systemic toxicants. Therefore, constituents need to be evaluated

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for threats to human health and the environment based on their properties and the specific conditions of the site, under the requirements of the various statutes.

Table 1 of this Memo contains a list of common wastes generated and products used at oil and gas well sites. The list includes the constituents typically found in such materials and that should be evaluated for each spill impacting soil or groundwater. The list includes analytical methods to detect the constituents and field screening that can guide containment and immediate soil removal operations. Circumstances may exist that require additional evaluation of other constituents (for example, materials that contain TENORM).

It may not be possible to address constituents that are not identified on Table 1 under Act 2. Material Safety Data Sheets can be used to identify constituents that may be present in the spill or release. The release of certain chemicals may cause public nuisances that constitute pollution under the Clean Streams Law or may impact site restoration requirements under the Oil and Gas Act and therefore should be remedied. Regional office personnel should coordinate approaches with central office programs on constituents that are not addressed under Act 2.

Remediation of Chloride Compounds

Typical constituents found within brine include chloride compounds which are detected through a total chloride test method and reported as "chlorides". Chloride anions are present in foods, drugs and naturally in the human body.

Drinking Water Criteria

Under the federal Safe Drinking Water Act, EPA has promulgated a secondary Maximum Contaminant Level (MCL) of 250 mg/l for chlorides, based on aesthetic (taste and odor) impacts. 25 Pa. Code §109.202(b) (relating to State MCLs, MRDLs and treatment technique requirements) incorporates the federal secondary MCLs by reference and 25 Pa. Code § 109.202(a) establishes secondary MCLs as enforceable drinking water standards. Because of the federal MCL, the statewide health standard medium-specific concentration for groundwater under Act 2 is 250 mg/l for both residential and nonresidential uses.

Human Health Threats in Soil

The National Academies, Institute of Medicine, Food and Nutrition Board *Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate* (2005) provides a Tolerable Upper Intake Level (UL) for chloride from sodium chloride of 2,300 mg/day for children and 3,600 mg/day for adults. The UL is defined as the highest average daily nutrient intake level that is likely to pose no risk of adverse health effects to almost all individuals in the general population. As intake increases above the UL, the potential risk of adverse effects may increase. This UL for chloride was determined on molar basis equal to the UL for sodium, since most chloride is ingested in the form of sodium chloride. Although these UL values are based on the chloride anions (chloride) in sodium

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chloride, it is acceptable to apply these values to the chloride in the other chloride substances. Exposures to daily intakes of chloride below 2,300 mg/day should pose no risk of adverse health effects to children or adults.

Based on the default ingestion rates of soil used in Chapter 250 (100 mg/day for children and 50 mg/day for adults) even if "soil" was 100% salt (which contains 39.3% by weight of sodium and 60.7% by weight of chloride), the chloride daily intake through incidental soil ingestion for children would be 60.7 mg/day. This intake level would be well below the 2,300 mg/day UL value. This demonstrates that chloride does not pose a threat to human health from ingestion and inhalation of soil or through dermal contact with soils, even at high concentrations.

Site Restoration Impacts

Salinity or sodicity in soils may develop from high concentrations of chloride compounds and other salts released into soils. These conditions can cause vegetation impacts, depending on the climate, type of soils, extent of contamination, and salt tolerance of various species.

Based on this information, the following procedure should be used for evaluating the remediation of chloride contamination.

1. The responsible party should act immediately to abate impacts and potential impacts to surface water and prevent the spread of contamination. Impacts to surface water and sediment should be assessed and remedied pursuant to the Clean Streams Law.
2. Regulated substances with MSCs identified in tables 1-8 of Appendix A under 25 PA Code 250 must be addressed under Act 2, or under the small spills or alternative remediation requirements of the "Addressing Spills and Releases at Oil and Gas Well Sites" technical guidance (800-5000-001).
3. If the spill or release is not a small spill and the concentration of total chlorides in soil does not attain the Act 2 background standard, an Act 2 site-specific standard, or the background standard requirements under the alternate remediation procedure, then total chlorides can be addressed as follows.
 - a. Total chloride concentrations in soil above levels that would leach in excess of the secondary groundwater MCL (250 mg/l) must be removed. The Synthetic Precipitation Leaching Procedure test (method 1312 of SW-846, Test Methods for Evaluating Solid Waste, promulgated by the EPA) should be used to determine leachability of soil. Sampling from the bottom and side walls of the excavated

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area where any remaining contamination would most likely be found, should be performed in a biased manner as outlined below.

- i For 250 cubic yards excavated, five (5) samples should be collected.
 - ii For each additional 100 cubic yards of excavated contaminated soil, one (1) sample should be collected.
 - iii For excavations over 1,000 cubic yards of contaminated soil, a sampling plan should be submitted to DEP for approval.
- b. The soil on site should be monitored and assessed for the ability to meet site restoration requirements under the Oil and Gas Act. Additional soil restoration efforts may be needed to address saline or sodic soil conditions that interfere with site restoration.

**Table 1
Common Constituents/Indicators of a Release**

Waste	Constituents	Analytical method	
		Soil	GW

DIESEL	Refer to the Land Recycling Program Technical Guidance Manual - Section IV.E.3 Table IV-9: Short List of Petroleum Products
MOTOR OIL	
UNLEADED GASOLINE	

CRUDE OIL/ CONDENSATE	Constituents	Soil	GW
	benzene	EPA 5035/8021B or 5035/8260B	EPA 5030B/8021B, 8260B or 524.2
	toluene		
	ethyl benzene		
	xylene		
	sec-butyl benzene		
	tert-butyl benzene		
	cyclohexane		
	1,3,4-trimethylbenzene		
	1,3,5-trimethylbenzene		
	cumene		
	naphthalene	EPA 8270C or 8310	EPA 8270C, 8310 or 525.2
	acenaphthene		
	anthracene		
	benzo(a)anthracene		
	benzo(a)pyrene		
	benzo(b)fluoranthene		
	benzo(g,h,i) perylene		
	chrysene		
	fluoranthene		
	fluorene		
indeno(1,2,3-c,d)pyrene	EPA 9065	EPA 420.1	
2-methylnaphthalene			
phenanthrene			
pyrene			
1,1 biphenyl			
phenol			

**Table 1
Common Constituents/Indicators of a Release**

CUTTINGS	aluminum	EPA 6010C	EPA 200.7
	barium		
	boron		
	chromium		
	copper		
	iron		
	manganese		
	vanadium		
	strontium		
	zinc		
	arsenic		
	lead		
BRINE	aluminum	EPA 6010C, EPA300 (Chlorides)	EPA 200.7
	barium		
	boron		
	chloride ¹		
	iron		
	lithium		
	manganese		
	strontium		
	vanadium		
	zinc		
	selenium		
	Dehydrating unit/scale inhibitor	ethylene glycol	EPA 8015
benzene (if from dehy unit)		EPA 5035/8021B, 8260B	EPA 5030B/8021B, 8260B, 524.2
Obtain MSDS sheets from responsible party. Evaluate for chemicals without MSCs (see note below).			
Hydraulic oil	Obtain MSDS sheets from responsible party. If detailed information is unavailable, use VOA and SVOA analysis.		
Base Oil	Obtain MSDS sheets from responsible party. If detailed information is unavailable, use VOA and SVOA analysis. DRO can be used to define extent of impact for base oil but not valid for attainment.		
Drilling Mud	Obtain MSDS sheets from responsible party. If diesel based use diesel short list and any additives. Should usually include barium. If detailed information is unavailable, use inorganic analyses similar to cuttings analysis list and VOA and SVOA.		
Surfactants	Obtain MSDS sheets from responsible party. If detailed information is unavailable, use VOA and SVOA analysis with TICs. MBAS can be used to define extent of impact in water but not valid for attainment.		

**Table 1
Common Constituents/Indicators of a Release**

Frac Fluid	Use brine list and add any additives that may be present in the release.
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1 - No soil MSC available for use within the Statewide Health Standard as described in 25 PA Code § 250 subchapter C.

Notes on Chemicals without MSCs under the Statewide Health Standard

The Act 2 Statewide health standard is not available for compounds identified in MSDS that have no carcinogenic or systemic toxicological data listed in sources identified in 25 Pa Code § 250.605. Remediation endpoints of these compounds need to satisfy Clean Stream Law, Solid Waste Management Act and/or Oil and Gas Act requirements. Liability relief through Act 2 can be achieved through the background or site-specific standard.

Acronyms used	MSDS - Material Safety Data Sheet
	VOA - Volatile organic analysis
	SVOA - Semivolatile organic analysis
	DRO - Diesel range organics
	TICs - Tentatively identified compounds
	MBAS - Methylene blue active substance
	FRAC - Abbreviated term for hydraulic fracturing
	MSC - Medium specific concentration

Suggested Field Screening Values for Interim Remedial Actions

Screening values are not appropriate for attainment sampling and cannot be used to demonstrate attainment with an Act 2 standard. However they are a useful tool to collect real time data to indicate if a problem may exist. Values outside of this range need to be considered for further evaluation:

pH - Water	6 to 9
Conductivity - Water	<50 us/cm
Conductivity - Soil	<1 ms/cm
PID for Organics (excluding methane)	<25 ppm