

The Dangers of Fracking Waste

Is There Any Safe Way to Dispose of It?

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Featured image: Drill cuttings being dumped at a landfill (Source: [FracTracker Alliance](#))

Commercial Landfills in Colorado have been advised that disposal of Oil and Gas Exploration and Production (E&P) waste is not exempt from [Colorado Solid Waste Regulations](#) [1], for example, 6 CCR 1007-2. Disposal of fracking waste is a nation-wide problem.

Fracking's vertical/horizontal drill tailings, flow-back/produced water, scale, and filter socks are all almost certainly radioactive at levels unacceptable for ordinary landfills. Pipe and tank scale exceed acceptable release levels the most due to their continuous build-up of waste [2].

Each oil-well completion destroys from 5 to 10 million gallons of fresh water [*Scientific American*, July 2015] — permanently removes it from the hydrologic cycle by deep-injection, waste-disposal wells; the lesser value if recycled once. Such injection is necessary because frack waste water is radioactive and otherwise dangerously polluted (benzene, biocides, formaldehyde, etc). Local Operators may or may not use filter socks, thus recycle their frack water. Water recycling is a typical claim, however, to deflect criticism of egregiously wasteful practices in a water-sensitive region.

The problem

Operators are likely dumping E&P waste at radiation levels highly in excess of TENORM (technically enhanced, normally occurring radioactive materials) guidelines. This has recently prompted CDPHE's concern. CDPHE approves radioactive releases at commercial landfills; COGCC at land spreads. Both claim it is the responsibility of ordinary waste recipients to guarantee that TENORM standards are being met. Acceptable release levels for Radium, for example, must be below 3pCi/gm [3]. Official corrective action should be taken (per the federal "AAL" or Analytic Action Level) for releases at levels greater than 210 pCi/gm.

Landfills and land spreads apparently have been relying on the measurements of Operators, who, in turn, justify their releases per a COGCC 2014 study [4]. That study, however, used a discredited measuring/testing protocol [5]. As a result, Operators are typically under measuring by at least factors of 100. Indeed, Table 1 of the [Gradient Corporation study](#) (cited above) cites a measurement of Radium in radioactive tank sludge at 1,293 pCi/gm, well above the TENORM-allowed release level of 3 pCi/gm. TENORM standards will require accurate testing for each radioactive dump load since radiation levels differ for each waste category and change over the large distances (2 to 3 mi) that a drilling pad's spacing

unit comprises.

Frack-waste's radioactivity derives, in part, from the alpha-active NORM elements Uranium (U), Thorium (Th), and Radium (Ra) which cannot be quantitatively measured, only detected, via the conventional Geiger-type or gamma measuring devices Operators have been using to justify their radioactive releases.

A principle radiation danger of frack-waste arises from ingestion of its alpha sources. Although alpha particle radiation cannot even penetrate one's skin, it can, once inside lungs and other internal organs, cause cancer. Radium is alpha active, water soluble, and bone-seeking. Ra-226 remains a threat for thousands of years—has a half-life of 1600 years. It can become airborne in dust from drill sites, uncovered transport trucks, disposal landfills and field spreads. It can migrate from top soil spills into groundwater.

Assessments conducted by Operators have greatly under measured alpha radiation because they were done on wet frack waste containing high total dissolved solids (TDS) such as salts. It takes [a special test for radioactivity in frack-water](#); the common drinking water test fails.

Ra levels can be underestimated by 99% [[Environmental Science & Technology Letters: 2014, DOI:10.1021/ez5000379](#)] Michael K. Shultz, prof of radiology, U of Iowa, showed EPA's drinking water test is unsuitable for frack-water's high TDS (concentration of ions). Indeed, the 'coprecipitation method' (of the EPA's 900 series protocol) accounts for less than 1% of the Ra present. Accordingly, Avner Vengosh, geochemist, Duke U, urges that Ra be measured in frack-water directly with gamma ray spectroscopy. [*Chemical and Engineering News*, ISSN 0009-2347, copyright @ 2017 American Chemical Society]

The EPA method (900 series protocol) simply doesn't work in high salt solutions. Even in treated frack-water, Ra levels can measure 200 times higher when proper protocols are used. The 21 day holding period of 900 series protocol is also inadequate.

See also, [Analysis of Radium-226 in High Salinity Wastewater from Unconventional Gas Extraction by Inductively Coupled Plasma-Mass Spectrometry](#), T. Zhang, Dept of Geology and Planetary Science, U of Pittsburg. [*Environmental Science & Technology*, 2015, 49(5), pp 2969-2976] Zhang outlines a method that requires only a several-hour holding period, and it matches gamma spectrometry results.

Using EPA's 900 series measuring protocol allows dumping of large quantities of dangerously radioactive waste into landfills, according to FrackTracker Alliance. A feature in [A Journal of Environmental and Occupational Health Policy](#) [publication 23 (i), 117-35 doi: 10.2190/ns 23.1.h] analyzed fracking's reserve pit sludge. It found total beta radiation of 1329 pCi/g in Barnett Shale sludge, which exceeded Texas regulatory guide lines by more than 800%.

Accurate radiation measurements of frack-waste require an expensive spectrometry device [6] and at least a 21-day holding period, which an ordinary land fill will not find practical. The cost of independent, third-party safety measurements of radiation should be borne by the Operator.

How has the state of Colorado dealt with these 2014-15 findings and revelations on radioactive E&P waste?

In November, 2014, the Colorado Oil and Gas Conservation Commission [COGCC] completed a special project 2136, [Analysis of NORM in Drill Cuttings Greater Wattenberg Field, Weld County Colorado](#). It was to provide regulatory oversight and guidance regarding TENORM. 12 samples of drill cuttings were compared to 12 background samples of soil using a procedure described in [Sampling and Analysis Plan for NORM in Oil and Gas Well Drill Cuttings](#) [COGCC 2014]. A gamma ray meter was used to identify “presence and degree” of NORM in cuttings (which as noted above will not quantitatively measure important alpha activity in radioactive waste). COGCC staff found no drill cuttings exceeded their background-sample levels of radiation, thus concluded that “the beneficial reuse of drill cuttings as an agricultural soils amendment does not pose impacts ... from radiation.”

The problem with this COGCC sampling

The inappropriate EPA 900 series protocol was used with no ‘holding times’ for “gross alpha solids” (necessary to account for daughter radiation). Also, the 900 series protocol for drinking water was used for “gross alpha aqueous” (inappropriate for high TDS, but this time with adequate holding time). Otherwise the testing was meticulously performed.

Several of the commercial labs that were cited as testing sources by State agencies and Operators were contacted to determine their protocols. None answered. Colorado State Agencies, however, continue to accept the discredited EPA 900 series testing protocol.

A more realistic, and better referenced, assessment of TENORM in fracking waste was completed Oct 3, 2017 by [Gradient Corporation, retained by Pawnee Waste](#), LLC. [See 2]. It reviewed publicly available information on the levels of radioactivity and benzene found in E&P wastes from oil and gas shale formations in Colorado (in the context of CDPHE’s administration levels for TENORM). Gradient found that radiation data from Colorado are similar to other areas of oil development across the US (even in Poland) thereby greatly increasing the amount of data in support of their assessments.

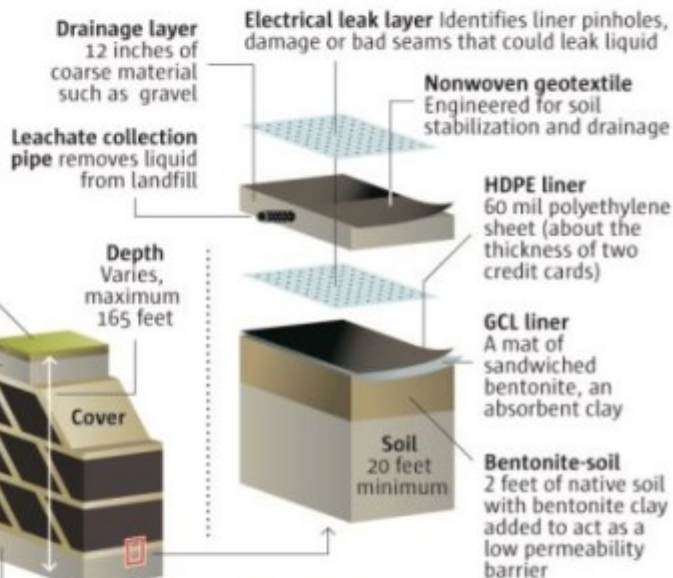
Colorado seeks safe burial for low-level radioactive waste

The oil and gas industry generates waste laced with radioactive elements found in the environment, such as uranium, thorium and potassium, as well as their decay products, including radium and radon. This waste, called TENORM, contains radioactive material brought to the surface through oil and gas exploration and production. A new landfill, designed by Pawnee Waste, will hold some of this TENORM waste.

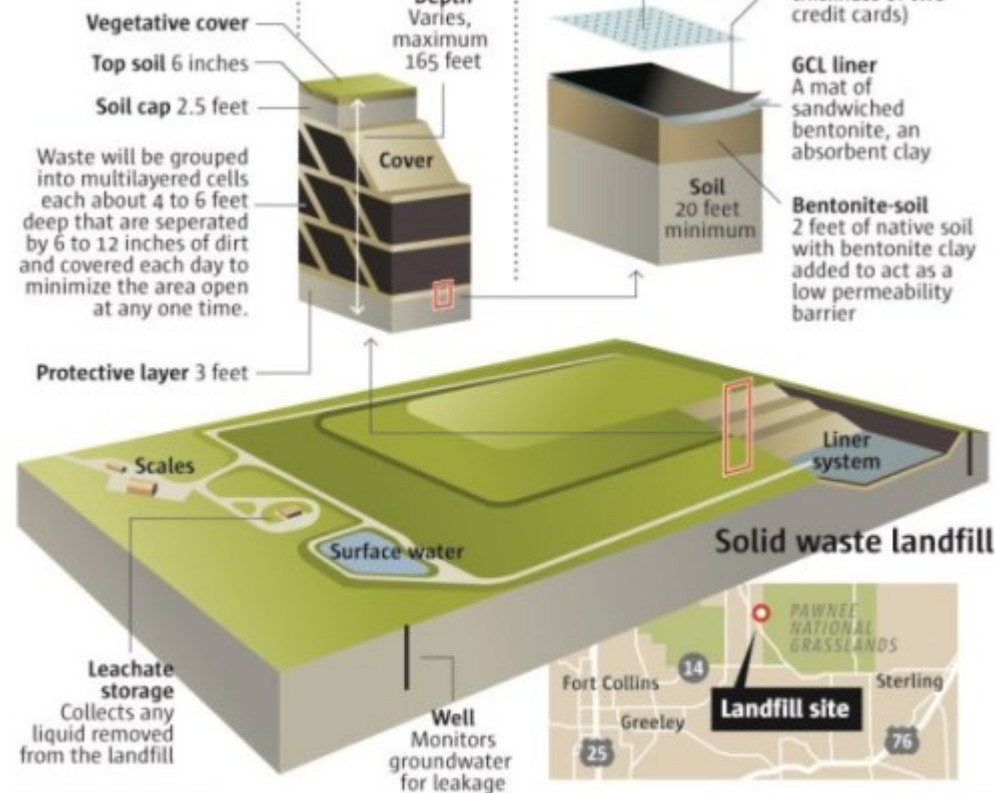
Some oil and gas TENORM comes from:

- Tank bottoms
- Waste pipeline and flowline sections
- Natural gas scrubbers, compressors, reflux pumps, control valves and product lines
- Horizontal drill cuttings
- Residual materials dislodged during cleaning and maintenance on crude oil and natural gas pipelines
- Liquid natural gas storage tanks

PROTECTIVE LAYER CROSS-SECTION



LANDFILL CROSS-SECTION



Source: Pawnee Waste

Jeff Neumann, The Denver Post

Radioactivity from radium-226 + radium-228 for drill cuttings consistently measured within the range 0.107-13.6 pCi/g, with Colorado's level at 7.42 pCi/g, thus above the maximum TENORM administrative release level of 3 pCi/g (the testing protocol was not disclosed). Gradient further stated that the oil and gas industry has known for decades that pipe and tank scale may have activity as high as 410,000 pCi/g [White and Rood, 2001 referenced therein]. A Gradient Corporation reference found soils impacted by scale cleaning operations [Wilson and Scott, 1992] tested from 6.75 to 1,681 pCi/g, thus considerably exceeded CDPHE administrative levels for radioactivity. Filtration wastes, sludge, and sump solids exhibited radioactivity levels between those of drill cuttings and scale.

Gradient cited references that found benzene in crude oil in excess of the COGCC standard by a factor of 86 to 212. The available data indicate that E&P wastes are likely to exceed the COGCC standard for BTEX (benzene, toluene, ethylbenzene, and total xylenes). [See 2]

Conclusion

With accurate measuring protocols and holding periods, ordinary landfill-targeted frack-waste cannot meet the TENORM standards needed to protect public health. Indeed, radiation levels are being under estimated by factors of 100 to 1000 (for scale). It is clearly inappropriately legal to land-dump E&P waste. Thus, TENORM land-dumping should be stopped until COGCC/CDPHE rules comply with current knowledge. In the meantime, Operators must find approved disposal sites in order to continue operation.

Wendell Bradley lives in Windsor, CO.

Notes

1. Colorado Dept. of Public Health and Environment (CDPHE), "Notice to Landfills": TENORM, May 12, 2017 rescinded in favor of "Management and Disposal of TENORM Generated by Oil and Gas Exploration and Production", Nov 7, 2017
2. [Gradient Corporation's Memorandum to Pawnee Waste](#), LLC, Oct 3, 2017. Subject: "Radioactivity and BETX in Shale-oil and Shale-gas Exploration and Production Wastes"
3. See (1) where release levels are: U < 30 pCi/gm, Ra (226 + 228) and Th < 3 pCi/gm. The Analytic Action Level (AAL) or level at which action must be taken is 210 pCi/gm
4. [Sampling and Analysis Plan for Naturally Occurring Radioactive Material in Oil and Gas Well Drill Cuttings](#), COGCC April, 2014
5. [Environmental Science & Technology Letters](#), 2 Apr 2016 by A. Nelson and M. Shultz
6. See (5)

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