



ASTSWMO, Providing Pathways to Our
Nation's Environmental Stewardship Since 1974

Beneficial Use of Drill Cuttings, Produced Water and Fluids in the U.S.

**Supplemental Report to the ASTSWMO Beneficial Use Task Force's March 2015
Oil and Gas Exploration and Production Waste Management Survey Report**

November 2017

**Prepared by the
Beneficial Use Task Force of the
ASTSWMO Materials Management Subcommittee**

**Association of State and Territorial Solid Waste Management Officials
1101 17th Street, N.W.
Washington, D.C.**

Acknowledgement

This Supplemental Report on the Beneficial Use of Drill Cuttings, Produced Water and Fluids in the U.S. was prepared by the Beneficial Use Task Force of the ASTSWMO Materials Management Subcommittee.

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement X1- 83614401 to the Association of State and Territorial Solid Waste Management Officials (ASTSWMO). The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.

Beneficial Use of Drill Cuttings, Produced Water and Fluids in the U.S.

Introduction

In March 2015, the ASTSWMO Beneficial Use Task Force (BUTF) published the Oil and Gas Exploration and Production Waste Management Survey Report (Survey Report), a report on a survey of the States and Territories (States) regarding management of exploration and production wastes (E&P wastes) from development of oil and gas resources in the United States. This survey and report were intended to elucidate several aspects of E&P waste management, including the administrative structures by which various States regulate E&P waste; the regulatory classification of E&P waste in various States; methods of disposal of identified waste streams; specific analytical and radiological testing performed, and criteria for evaluation of results, to determine waste management; and modes of beneficial use.

In the Survey Report, the BUTF recommended further exploration of how E&P waste streams are currently beneficially used in various States, and whether information on current uses – whether formally regulated or not – may support increased beneficial use of particular E&P wastes, or may point to any limitations for beneficial use.

This Supplemental Report to the March 2015 Survey Report summarizes the BUTF's efforts to implement this recommendation, through a less formal polling of a subset of "generator" States regarding beneficial use of E&P wastes. Generator States are those that identified themselves as generators of E&P wastes in the 2015 survey. The follow-up effort focused on only three waste streams identified in the report as "high-volume" waste streams: Drill Cuttings, Produced Water, and Water-Based Drilling Fluids/Muds.

The BUTF developed a short list of questions and undertook polling of generator States through electronic mail and by phone between February and June 2016. The following information was drawn from responses and reflects the status of State activities as of the time of the poll.

General Results from the Poll

The BUTF conducted its original Oil and Gas Exploration and Production Waste Management survey of the States in late 2013 and early 2014, receiving responses from 40 States. Of those who responded, 27 States indicated that they generate or have generated E&P wastes. The BUTF focused this follow-up poll on these States only. Of the 27 generator States, BUTF members received responses from 20 States. One of these States clarified that no development of oil and gas, or generation of E&P waste, is happening in that State at the present time.

Poll Results by Targeted E&P Waste Streams

Beneficial Use of Drill Cuttings

The 2015 Survey Report noted that drill cuttings and production water were the most frequently identified E&P wastes considered for beneficial use. Cuttings were indicated as being frequently used either as a fill material or as an aggregate for Portland cement concrete or asphalt pavement. However, the 2016 polling found that only four States have approved the use of cuttings, and two of these only on a pilot basis. On-site placement of cuttings, which some States may consider more of a disposal option than beneficial use, may account for differences between survey and poll results.

Beneficial Use of Produced Water

Six States reported in the 2015 Survey using produced water, otherwise termed production brine, to formulate drilling fluids for use at other drilling sites, or off-site to treat roads for dust control or de-icing. The BUTF poll narrowed this group to five States who allow road treatment use of brine on a widespread basis for dust control. Three of these States allow brine for both dust control and de-icing.

One State, who had not participated in the initial 2013-14 Survey, reported in the BUTF poll that some produced water (mainly from water injected for enhanced oil recovery) can be treated and used for agricultural irrigation, with restriction to non-food crops such as cotton.

Beneficial Use of Water-Based Drilling Fluids/Muds

Out of the 27 respondents to the BUTF poll, only one State reported allowing any beneficial use of water-based drilling fluids or muds, and only after treatment. Furthermore, these treated fluids are only used, with the State's approval, to formulate drilling fluids at other oil and gas development sites.

Poll Results by Question

Question 1: As a State where oil and gas E&P waste is generated, have you allowed beneficial use of any of the BUTF's three targeted streams (drill cuttings, produced water, or water-based drilling fluids/muds)?

Eleven States responded to the BUTF poll that no beneficial use of E&P waste has been approved. Eight States responded positively that beneficial use is allowed. Of these eight: six States allow cuttings beneficial use, though two have only approved it on a pilot/R&D basis; seven have allowed use of produced water. Only one State responded that it allows use of drilling fluids, and only after treatment, and only for re-use in formulation of drilling or fracturing fluids at other drilling sites.

It is noteworthy that six States responding that they have not yet approved beneficial use also commented that no entity has ever requested beneficial use. An implication could be derived from subsequent responses that if proposed, beneficial use would be considered, likely on a case-specific basis similar to other industrial wastes in their State.

Question 2: Is this use codified in law or regulation? Is it allowed through policy or guidance? If so, is it on a generic or on a case-by-case basis? Are any uses specifically prohibited for any of these streams?

No State responded that any State law specifically authorizes beneficial use of E&P wastes. One State responded that E&P wastes in fact fall under an exemption from solid waste law and regulation, but primarily to transfer regulation of E&P wastes from the State's solid waste program to its oil and gas regulation program. One State passed legislation requiring the selection of at least one commercial oilfield special waste recycling facility, with a pending beneficial use application, to operate as a pilot facility and further required the designated agency to develop standards for recycling the oilfield special waste. Six States indicated that regulations have been promulgated to address beneficial use; except for one State, none of these regulations specifically name E&P waste but cover beneficial use of any waste streams, municipal, commercial and/or industrial. A sense from the responses from all States was that

beneficial use of E&P waste, where currently allowed is (or, if it were proposed, would be) addressed in the same manner as other commercial or industrial waste streams.

Some States did report guidance existing in various forms to more specifically address the beneficial use of E&P waste where law or regulation does not. Six States reported having published guidance (see Appendix). One State, which allows some beneficial use of all three streams, has provided direction for specific modes of use by means of general permits, though cuttings have only been allowed on a pilot basis. One State has issued a general permit for road treatment use of brine in accordance with its authorizing regulation. Two States have published guidance regarding use of produced water for road treatment. One of these State's guidance specifically prohibits the use of drilling or fracturing fluids for road treatment.

Nearly all States who allow beneficial use of E&P waste, according to poll results, do so on a case-by-case basis. A few stated allowing cuttings use on a generic basis if meeting chemical and physical criteria, but if not, the cuttings must be reviewed on a case-specific basis.

Question 3: In evaluating the beneficial use of these three waste streams, what criteria, e.g. physical requirements, maximum concentrations of constituents of concern, or other, did you consider?

States report using their own groundwater or surface water quality criteria to evaluate liquid wastes, or leaching test data from solid materials, for potential impact to the environment in proposed beneficial use. States allowing use of cuttings in place of soil or fill generally do so on the basis of public health or environmental protection-based soil reuse concentration limits, or background soil concentrations. One State allows less restrictive soil reuse concentrations for cuttings used on the site of drilling, for example, in site restoration, than when cuttings are proposed for use at other sites. Most States who allow produced water application on roads impose concentration criteria, but one State has instead imposed limits on application rates, times and places to minimize environmental impact. Another State answered that it considers the environmental impact that beneficially-used materials might have in the future if the site of use is abandoned or excavated, and further considers the management of the materials during processing or transport/storage (e.g., speculative accumulation, mismanagement, spillage, eventual disposal).

Prevention of environmental harm is one objective of beneficial use determination for any waste material; comparison to similar commercially-available materials, or evaluation of functional benefit, is another. Three States made specific mention of the functional principle, stating in general that the E&P waste must "*confer a benefit*" or that it is "*compared to commercial products*", or through the evaluation of physical characteristics, e.g., grain size distribution, which often support or refute a functional benefit. General permits for produced water for ice and snow control in two States prescribe not only maximum concentrations of trace nuisance or toxic constituents, but also *minimum* concentrations for sodium or calcium chloride and similar salts. Salt content in produced water from specific sources is essential to demonstrating these function equivalently to commercial de-icing products (and in one State, for dust control).

Question 4: Are changes being considered to either restrict or allow more beneficial use of these E&P waste streams in your State? If so, what are the reasons?

Of States who currently allow beneficial use of E&P wastes, several report regulation changes in various stages at the time of the poll that are specific to beneficial use of E&P waste. One State has convened a working group to evaluate agricultural use of produced water; another State is monitoring academic studies, and other States' decisions, to determine if rule changes should be considered; and one State has been tasked by its Legislature to specifically evaluate beneficial use of oilfield waste. In States that have existing rules, one State has published rule changes for public review; and another is watching results of a pilot study concerning cuttings as fill that may support expanded use of cuttings in this manner, under existing rules. One State, where beneficial use of E&P waste is not currently addressed in law or regulation, reported that new oil and gas development regulations have been proposed which include allowing use of materials on the site of drilling for site restoration. Two other States mention pending changes to beneficial use rules or guidance that would apply in general to all waste materials.

Reasons for rule changes offered by States include 1) efforts to make criteria and review procedures more consistent for all waste materials considered for beneficial use, 2) to reduce disposal through injection wells and landfills if materials can be safely reused; and 3) heightened public concern.

Question 5: Have you either: A. Rejected a proposal for beneficial use of one of these waste streams, and what was the reason/criterion used for rejecting this proposal? B. Observed environmental problems or other issues with an approved beneficial use of one of these waste streams, and what was the problem?

Seven States responded that they have denied requests to beneficially use cuttings or produced water. One State rejected cuttings for use as aggregate in asphalt pavement due to the unfavorable grain size characteristics and performance of the cuttings in this use. This State also reviewed use of cuttings as aggregate in cast Portland-cement concrete barriers, but no credible use or market for the barriers could be demonstrated. Two States who allow road treatment using produced water, under guidance or generic approvals, have rejected requests from or rescinded approvals to specific users -- one reporting many requests being rejected since produced water failed to meet concentration criteria; and another citing non-compliance with the conditions of its generic approval, dumping of brine, and lack of recordkeeping. One State, who allows road treatment with produced water, has in at least one instance rejected oil-well brine. This State indicated that oil-well brine may pose two problems for use in-road treatment: a dilute salt content diminishing its usefulness for de-icing or dust control; and at the same time, excessive BTEX¹ and grease content that could impact surface waters through runoff. One State, who has not approved beneficial use of E&P waste to date, described a specific instance where cuttings were proposed for on-site restoration, but the request was denied in part because of the site's location in a floodplain. Another State cited concern about cuttings originating from an oil field and the variable presence of BTEX in disapproving their use for road stabilization following a pilot project.

Problems reported by States with authorized beneficial use of E&P wastes include poor performance of the materials; no actual market emerging for the wastes or "products" made with them; and non-compliance with guidance or directions for use. The boom in E&P that has only recently ended, and sharp

¹ BTEX refers to "benzene, toluene, ethylbenzene and xylene", the typical fingerprint of light petroleum hydrocarbons indicative of the presence of oil in groundwater or produced water.

increase in volumes of E&P waste in the last several years, together with heightened public concern, has caused several States to monitor beneficial use and disposal of E&P wastes more closely. One State reported that during its review of proposed horizontal-well shale gas extraction that the intense public concern about this “fracking” method also extended to the use of produced water from conventional gas wells, even such that some highway departments and private companies have voluntarily ceased using conventional gas well brine on roads. One State reported evaluating public concerns about using production water for agricultural irrigation, particularly alleged use on food crops in violation of State approvals.

General Conclusions

From the BUTF poll, it does not appear that beneficial use of E&P wastes -- in particular, the identified high-volume streams (drill cuttings, produced water, and water-based drilling fluids or muds) -- is widespread. Management options for E&P wastes mostly focus on disposal. Some States have explored more use of drill cuttings as a construction material (fill or aggregate) through allowing pilot projects, but results of these to date have not encouraged expanded use. Furthermore, the sharp fall in petroleum prices since 2014 has depressed oil and gas development, and in turn reduced the generation of E&P wastes, which may account for lowered impetus to find beneficial uses of E&P wastes.

Regulators going forward will need to recognize the following potential barriers to beneficial use of E&P wastes:

NORM and TENORM. All E&P waste streams, depending on the formation of origin, may contain naturally-occurring radioactive material (NORM). The U.S. Environmental Protection Agency (USEPA) recently expanded its definition of technologically-enhanced NORM (TENORM), a category of waste requiring special handling and secure disposal. Traditionally, TENORM has included NORM that is concentrated intentionally or incidentally through processing of NORM-containing materials. USEPA has stated TENORM may also include NORM-containing materials which are transferred to locations where the public is subject to increased exposure (e.g., when cuttings, cutting-filled drilling muds, or produced water are brought to the surface in the drilling process and production phase); the NORM does not necessarily need to be processed or concentrated to constitute TENORM. To the extent that E&P wastes may be identified as TENORM, States would be unlikely to allow their beneficial use. Even if not classed as TENORM, E&P wastes have continued to evoke public and regulatory concern due to the frequent presence of NORM.

Salinity. E&P wastes, especially produced water, typically contain high concentrations of salts, as measured by total dissolved solids or through analysis for chlorides, sodium, calcium and/or magnesium. These chemical species originate from groundwater in natural formations at depths typical of oil or gas extraction. Their concentrations may approach solution saturation in some produced waters, or be weak in others, especially in formations where water has been injected to enhance petroleum recovery. Depending on their concentration, sodium and calcium salts may be useful – on one hand, if high, for ice, snow and dust control on roads, or for solidifying/stabilizing soil in construction subgrades and unpaved roads. On the other hand, if salt concentrations are low, it becomes feasible to use produced water for crop irrigation (one State allows this use but restricts to non-food crops).

Trace constituents. All E&P waste streams may contain non-beneficial, potentially harmful or nuisance constituents at relatively low concentrations (less than 100 milligrams per kilogram or liter). These may

include chlorides or sulfates of barium, strontium, or radium (the latter as radioisotopes Ra-226 and R-228, typically). Petroleum compounds, including BTEX, and heavier hydrocarbon compounds, oils and greases can be present in dissolved form or as light non-aqueous layers. The potential for public health and environmental impacts from these constituents should be examined versus the benefit of using any E&P waste materials. When trace constituents are considered, one E&P waste material that may pose little or no impact may be cuttings from air- or water-drilled boreholes through rock strata overlying a petroleum-bearing formation. Such cuttings consist of inert rock, and may be useful in place of quarried soil or gravel for construction.

APPENDIX:

Bibliography of State Resources Relevant to Beneficial Use of Oil and Gas E&P Waste

Appendix
Bibliography of State Resources Relevant to Beneficial Use of Oil and Gas
Extraction & Production Wastes

STATE	RESOURCE DOCUMENT
AK	Criteria for Exemption from Alaska Solid Waste Regulation of Treated Gravel from Well Drilling Operations, (April 7, 2015; revised May 26, 2016); see "Treated Gravel From Well Drilling Operations" on the guidance documents list at: http://dec.alaska.gov/eh/sw/guidance.html
MI	Michigan Department of Natural Resources and Environment, Groundwater Discharge General Permit 2215-10-5: Application of Brines for Ice and Dust Control and Soil and Road Stabilization www.deq.state.mi.us/documents/deq-wmd-gwp-Rule2215OilFieldBrine-1.pdf
MT	Guide to Beneficial Use Determinations of Waste Industrial and Manufacturing By-Products https://deq.mt.gov/Portals/112/Land/SolidWaste/Documents/newapplications/BUD-0110.pdf
ND	Guidelines for the Use of Oilfield Salt Brines for Dust and Ice Control https://www.ndhealth.gov/WQ/gw/pubs/IceDustControlUsingOilfieldBrine_20130321.pdf
NY	Beneficial Use Determinations (Includes Road Treatment Using for Gas and Oil Well or Gas Storage Facility Brine) http://www.dec.ny.gov/chemical/8821.html
OH	Spreading Oil-Field Brine for Dust and Ice Control in Ohio: A Guidance for Local Authorities (October 1993; revised September 2004) https://oilandgas.ohiodnr.gov/portals/oilgas/pdf/Brine.pdf
PA	Roadspreading of Brine for Dust Control and Road Stabilization (8000-FS-DEP1801, Revised March 2017) http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-116247/8000-FS-DEP1801.pdf
WV	Memorandum of Agreement, WVDOH/WVDEP Salt Brine from Gas Wells Agreement (12/22/2011) http://www.dep.wv.gov/WWE/Documents/WVDOHWVDEP%20Salt%20Brine%20Agreement.pdf