

# **Offsite Commercial Disposal of Oil and Gas Exploration and Production Waste: Availability, Options, and Costs**

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**Environmental Science Division**

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for  
U.S. Department of Energy  
Office of Fossil Energy and National Energy Technology Laboratory

by  
M. G. Puder and J. A. Veil  
Environmental Science Division, Argonne National Laboratory

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# CONTENTS

ACKNOWLEDGMENTS .....	iii
NOTATION.....	ix
SUMMARY .....	S-1
1 INTRODUCTION.....	1
1.1 Types of E&P Waste Managed by Offsite Commercial Disposal Facilities.....	1
1.2 Reasons for Using Offsite Commercial Disposal Facilities .....	2
1.3 Regulatory Considerations.....	3
1.3.1 Exemption from Federal Hazardous Waste Management Requirements under RCRA .....	3
1.3.2 Surface Discharge Regulation under the CWA .....	6
1.3.3 Underground Injection Control under the SDWA.....	6
1.3.4 State Regulation of Waste Management Operations .....	7
2 DATA COLLECTION METHODOLOGY .....	8
2.1 Phase One: Questions for Regulators .....	8
2.2 Phase Two: Questions for Disposal Companies .....	8
2.3 Challenges Encountered in Phase One and in Phase Two.....	9
3 PHASE ONE FINDINGS.....	10
4 PHASE TWO FINDINGS.....	11
4.1 Background.....	11
4.2 State-by-State Overview .....	12
4.2.1 Alabama.....	12
4.2.2 Alaska .....	13
4.2.3 Arizona.....	14
4.2.4 Arkansas.....	14
4.2.5 California .....	15
4.2.6 Colorado.....	15
4.2.7 Florida.....	16
4.2.8 Illinois .....	17
4.2.9 Indiana .....	17
4.2.10 Kansas .....	18
4.2.11 Kentucky.....	18
4.2.12 Louisiana.....	19
4.2.13 Michigan .....	21

**CONTENTS (Cont.)**

4.2.14	Mississippi .....	21
4.2.15	Missouri .....	22
4.2.16	Montana .....	22
4.2.17	Nebraska .....	23
4.2.18	New Mexico.....	23
4.2.19	New York.....	23
4.2.20	North Dakota.....	23
4.2.21	Ohio .....	24
4.2.22	Oklahoma.....	24
4.2.23	Pennsylvania .....	25
4.2.24	South Dakota .....	25
4.2.25	Texas.....	25
4.2.26	Tennessee.....	26
4.2.27	Utah.....	26
4.2.28	Virginia .....	26
4.2.29	West Virginia.....	26
4.2.30	Wyoming .....	27
4.3	Specific Survey Results: Disposal Costs by Disposal Method.....	27
4.3.1	Bioremediation .....	27
4.3.2	Burial .....	29
4.3.3	Caverns .....	34
4.3.4	Discharge .....	36
4.3.5	Evaporation.....	37
4.3.6	Injection .....	39
4.3.7	Land Application .....	44
4.3.8	Recycling .....	46
4.3.9	Thermal Treatment .....	47
4.3.10	Treatment.....	48
4.4	Specific Survey Results: Disposal Costs by Survey Waste Stream.....	51
4.4.1	Contaminated Soils.....	51
4.4.2	NORM.....	54
4.4.3	Oil-Based Muds and Cuttings.....	55
4.4.4	Produced Water.....	59
4.4.5	Tank Bottoms.....	64
4.4.6	Water-Based Muds and Cuttings .....	67
4.5	Transportation and Other Incidental Costs .....	72
5	CONCLUSIONS .....	74
6	REFERENCES .....	76
APPENDIX A: Database of Commercial E&P Waste Disposal Facilities in the United States .....		A-1



## TABLES

1	E&P Waste Stream Types and Volumes .....	1
2	Federal Laws Governing Waste Materials and Management Activities .....	4
3	Examples of Exempt and Nonexempt E&P Waste Streams .....	5
4	Offsite Commercial Disposal in the Oil-and-Gas-Producing States.....	10
5	Data Dictionary for Offsite Commercial Disposal Survey .....	12
6	E&P Waste Types in Louisiana .....	20
7	Disposal Techniques in Louisiana .....	21
8	Bioremediation.....	28
9	Landfill Burial.....	29
10	Pit Burial .....	33
11	Cavern Disposal in Texas .....	35
12	Discharge .....	37
13	Evaporation .....	38
14	Injection .....	39
15	Solids Injection .....	42
16	Land Application .....	45
17	Recycling .....	46
18	Thermal Treatment.....	47
19	Treatment .....	49
20	Disposal Fees for Contaminated Soils .....	52
21	Disposal Fees for NORM.....	55
22	Disposal Fees for Oil-Based Muds and Cuttings.....	56
23	Disposal Fees for Produced Water.....	60
24	Disposal Fees for Tank Bottoms.....	65
25	Disposal Fees for Water-Based Muds and Cuttings .....	68
A.1	Database of Commercial E&P Waste Disposal Facilities in the United States.....	A-3



## NOTATION

The following is list of the acronyms, initialisms, and abbreviations (including units of measure) used in this report. (Some acronyms and abbreviations used only in tables may be defined only in those tables.)

### ACRONYMS, INITIALISMS, AND ABBREVIATIONS

AL	Alaska
API	American Petroleum Institute
AR	Arkansas
AZ	Arizona
CA	California
CCR	<i>California Code of Regulations</i>
CCS	CCS Energy Services LLC
CFR	<i>Code of Federal Regulations</i>
CO	Colorado
CWA	Clean Water Act
DOE	U.S. Department of Energy
DNR	Louisiana Department of Natural Resources
E&P	exploration and production
EPA	U.S. Environmental Protection Agency
FL	Florida
FR	<i>Federal Register</i>
IL	Illinois
KS	Kansas
KY	Kentucky
LA	Louisiana
MI	Michigan
MO	Missouri
MS	Mississippi
MT	Montana
ND	North Dakota
NE	Nebraska
NM	New Mexico
NORM	naturally occurring radioactive material
NPDES	National Pollutant Discharge Elimination System
NY	New York
OH	Ohio
OK	Oklahoma
PA	Pennsylvania
POTW	publicly owned treatment works
RCRA	Resource Conservation and Recovery Act
RCT	Railroad Commission of Texas
SD	South Dakota

SDWA	Safe Drinking Water Act
TCLP	Toxicity Characteristic Leaching Procedure
TN	Tennessee
TPH	Total Petroleum Hydrocarbons
TX	Texas
UIC	underground injection control
USLL	US Liquids of Louisiana LP
UT	Utah
VA	Virginia
WV	West Virginia
WY	Wyoming

## **UNITS OF MEASURE**

bbbl	barrel(s)
°C	degree(s) Celsius
°F	degree(s) Fahrenheit
ft	foot(feet)
gal	gallon(s)
hr	hour(s)
L	liter(s)
lb	pound(s)
mg	milligram(s)
yd <sup>3</sup>	cubic yard(s)

## SUMMARY

A survey conducted in 1995 by the American Petroleum Institute (API) found that the U.S. exploration and production (E&P) segment of the oil and gas industry generated more than 149 million bbl of drilling wastes, almost 18 billion bbl of produced water, and 21 million bbl of associated wastes. The results of that survey, published in 2000, suggested that 3% of drilling wastes, less than 0.5% of produced water, and 15% of associated wastes are sent to offsite commercial facilities for disposal.

Argonne National Laboratory (Argonne) collected information on commercial E&P waste disposal companies in different states in 1997. While the information is nearly a decade old, the report has proved useful. In 2005, Argonne began collecting current information to update and expand the data. This report describes the new 2005–2006 database and focuses on the availability of offsite commercial disposal companies, the prevailing disposal methods, and estimated disposal costs.

The data were collected in two phases. In the first phase, state oil and gas regulatory officials in 31 states were contacted to determine whether their agency maintained a list of permitted commercial disposal companies dedicated to oil. In the second stage, individual commercial disposal companies were interviewed to determine disposal methods and costs.

The availability of offsite commercial disposal companies and facilities falls into three categories. The states with high oil and gas production typically have a dedicated network of offsite commercial disposal companies and facilities in place. In other states, such an infrastructure does not exist and very often, commercial disposal companies focus on produced water services. About half of the states do not have any industry-specific offsite commercial disposal infrastructure. In those states, operators take their wastes to local municipal landfills if permitted or haul the wastes to other states.

This report provides state-by-state summaries of the types of offsite commercial disposal facilities that are found in each state. In later sections, data are presented by waste type and then by disposal method. The categories of waste in the database include:

- Contaminated soils
- Naturally occurring radioactive material (NORM),
- Oil-based muds and cuttings,
- Produced water,
- Tank bottoms, and
- Water-based muds and cuttings.

The different waste management or disposal methods in the database include:

- Bioremediation,
- Burial,
- Salt cavern,

- Discharge,
- Evaporation,
- Injection,
- Land application,
- Recycling,
- Thermal treatment, and
- Treatment.

The disposal costs vary extensively on the basis of the location of the disposal facility, the method used for disposing of the waste, the type of waste, and the extent of competition in the local or regional area. Costs may be reported in different units—per barrel, per cubic yard, or per ton. The costs of offsite commercial disposal vary significantly, depending on the disposal method, the host state of disposal operations, and the degree of competition in the area. The cost ranges for each type of waste are presented below, using only per barrel cost figures. In nearly all cases, most costs fall within a narrower band. Multiple disposal methods are used for each type of waste. By far, the most common commercial disposal method for produced water is injection.

- Contaminated soil disposal costs range from \$1.00/bbl to \$22/bbl.
- NORM disposal costs range from \$40/bbl to \$300/bbl. Some municipal landfills charge lower tipping fees for wastes with low levels of NORM.
- Oil-based muds and cuttings disposal costs range from \$2.00/bbl to \$40.00/bbl.
- Produced water injection costs range from \$0.30/bbl to \$10.00/bbl, but in most cases do not even reach \$1.00/bbl.
- Tank bottom disposal costs range from \$0.85/bbl to \$40/bbl.
- Water-based muds and cuttings disposal costs range from \$0.50/bbl to \$40/bbl.

Although disposal costs are important to an operator when determining which commercial waste disposal company to choose, transportation costs, container washout costs, laboratory fees, and other costs weigh heavily in the operator's final decision. Because transportation costs typically increase proportionately with distance or time from well site to disposal site, economic incentives exist for operators to send their wastes to disposal facilities located within a reasonably short distance from the oil and gas E&P site. Generally, operators will not be inclined to transport waste more than 50 to 75 miles unless no other alternatives are available.

## 1 INTRODUCTION

In April 1997, Argonne National Laboratory (Argonne) prepared a report entitled *Costs for Offsite Disposal of Nonhazardous Oil Field Wastes: Salt Caverns versus Other Disposal Methods* for the U.S. Department of Energy (DOE) (Veil 1997). The study attracted significant interest and national attention. In the early summer of 2005, DOE decided to task Argonne with updating the data concerning offsite exploration and production (E&P) waste disposal methods and costs. This report presents Argonne's findings.

### 1.1 TYPES OF E&P WASTE MANAGED BY OFFSITE COMMERCIAL DISPOSAL FACILITIES

In the United States, most E&P wastes generated at onshore oil and gas wells are disposed of or otherwise managed at the well site. Some types of wastes are not suitable for onsite management, and some well locations in sensitive environments cannot be used for onsite management. In these situations, operators must transport the wastes offsite.

The quantities of drilling wastes generated in the United States were estimated in 1985 and 1995 surveys (Wakim 1987; API 2000) published under the auspices of the American Petroleum Institute (API). The findings are summarized in Table 1.

The API survey (API 2000) was not restricted to API members. The intent was to develop a survey sample that was representative of the industry. The sample of E&P operators was stratified by size—small, medium and large producers. The operator list from which the

Waste Stream	1985 (million bbl)	1995 (million bbl)
Drilling Waste (to offsite commercial disposal facilities)	360 28%	149 3%
Associated Waste (to offsite commercial disposal facilities)	12 52%	21 15%
Produced Water (to offsite commercial disposal facilities)	21,000 2%	17,911 0.5%
Total E&P wastes	21,372	18,081

Sources: Wakim (1987) and API (2000).

survey sample was selected was compiled from a variety of sources, including the *Oil and Gas Journal*, state oil and gas associations and independent operator associations, API membership, and others (Petrusak 2005). The study focused on onshore operations.

This current study provides survey information for several E&P waste streams. These include water-based muds and cuttings, oil-based muds and cuttings, produced water, contaminated soils, tank bottoms, and naturally occurring radioactive material (NORM).

- Drilling muds and cuttings are drilling waste streams. Muds are used in the E&P process to control subsurface pressures, lubricate the drill bit, stabilize the well bore, and carry the cuttings to the surface. Mud is pumped from the surface through the hollow drill string, exits through nozzles in the drill bit, and returns to the surface through the annular space between the drill string and the walls of the hole. Mud systems can be freshwater-based, saltwater-based, oil-based, and synthetic. Drill cuttings are the rock particles ground up by the drill bit. As the drill bit grinds rocks into drill cuttings, these cuttings become entrained in the mud flow and are carried to the surface.
- Produced water is the water brought to the surface along with the oil and gas. It occurs naturally in the formation and is typically salty or brackish. The ratio of produced water to oil increases over the life of the well.
- Contaminated soils and oil debris are waste classes of relatively small-volume wastes—so-called associated wastes—generated as a result of activities related to oil and gas E&P, but are not drilling wastes or produced water.
- Tank bottoms are the settlings—sediment, dirt, oil emulsified with water and free water—that accumulate in the bottom of storage tanks. The tank bottoms are periodically cleaned up, and settlings can be disposed of or treated by chemicals to recover additional hydrocarbons.
- NORM refers to radionuclides that occur naturally in the environment. When NORM accumulates as the result of a technological activity, including as oil and gas E&P, it is sometimes called Technologically Enhanced NORM (or TENORM). When NORM accumulates at levels above natural background levels, it may present a human health risk and warrant special management requirements. Radionuclides naturally present in subsurface formations can become concentrated in certain oil and gas production and processing waste streams, including produced water, scale deposits, sludge, contaminated equipment, contaminated soils, and biofilm deposits.

## **1.2 REASONS FOR USING OFFSITE COMMERCIAL DISPOSAL FACILITIES**

Oil and gas companies use commercial disposal facilities for various reasons. The primary reason is compliance with applicable regulatory requirements. States have the lead role,



and most (except California) follow the federal hazardous waste exemption for E&P wastes. Thus, not all conceivable disposal methods are equally available across the board. The regulatory agency with jurisdiction may not allow onsite disposal for the type of drilling waste or the specific location. Examples of inappropriate wastes for onsite disposal include certain saltwater muds or very oily cuttings. Examples of locations that are not appropriate for onsite burial (pits and landfills) or land application (land farming and land treatment) include areas with high seasonal water tables, marshy environments, or tundra.

A second reason for sending waste to commercial facilities is that it may be more cost-effective. If an operator has a relatively small volume of waste, it may make sense to send it offsite rather than have the responsibility for constructing, operating, and closing an onsite facility.

Another conceivable motivation could be that some operators may not want the responsibility of managing their waste and prefer to send the waste to a third party for management. Although this practice appears to shift the burden of responsibility and liability to the third party, the company that originally generates the waste maintains liability indefinitely under the U.S. Superfund law, that is, the Comprehensive Environmental Response, Compensation, and Liability Act. If the disposal company improperly manages the waste, the government may come back to all companies that generated the wastes disposed of at the commercial facility to share in the cost of remediation. It is important to review the business practices and compliance history of an offsite commercial disposal company to minimize the risk of future liability.

Superfund liability can also discourage oil and gas waste management officials from sending their wastes to numerous different commercial disposal companies because once their waste becomes part of that site, they face potential liability in the site. Decisions to select or switch to new or alternate waste management companies or sites will therefore reflect not only the current disposal costs, but also the assurance that the disposal company will follow standards and practices in compliance with all applicable legal requirements.

### **1.3 REGULATORY CONSIDERATIONS**

The major federal laws governing waste materials and management activities include the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), and the Safe Drinking Water Act (SDWA). Table 2 provides a quick-reference synopsis of the major federal laws governing waste materials and management activities.

#### **1.3.1 Exemption from Federal Hazardous Waste Management Requirements under RCRA**

In 1980, Congress conditionally exempted oil and gas E&P wastes, including produced water, from the hazardous waste management requirements of Subtitle C of RCRA,

TABLE 2 Federal Laws Governing Waste Materials and Management Activities		
Law	Material Subject of Regulation	Activity Subject to Regulation
CWA	Aqueous waste streams	Surface discharge
RCRA	Solid and hazardous wastes (unless excluded or exempted)	Generation, transportation, and treatment; storage and disposal
SDWA	Waste fluids or slurries	Underground injection

Sections 3001(b)(2)(A), 8002(m). In addition to directing the U.S. Environmental Protection Agency (the EPA or the Agency) to study these wastes and submit a report to Congress on the status of their management, Congress required the Agency either to promulgate regulations under Subtitle C of RCRA or make a determination that such regulations were unwarranted. In 1988, the EPA published its regulatory determination in the *Federal Register* (53 FR 25447 July 6, 1988) and, along with it, lengthy lists of wastes determined to be either exempt (e.g., produced water, drilling fluids, and drill cuttings) or nonexempt (unused fracturing fluids or acids, waste solvents, and hydraulic fluids). The EPA rearticulated the exemption in the *Code of Federal Regulations* (40 CFR §261.4(b)(5)). In 1993, the EPA published a clarification of its regulatory determination in the *Federal Register* (58 FR 15284, March 22, 1993). And, in 2002, the EPA published an information booklet on the subject. The EPA explained that wastes uniquely associated with E&P operations were exempt. With respect to petroleum production, primary field operations include activities occurring at or near the wellhead or production facility, but before the point where the custody of the petroleum is transferred from an individual field activity or centrally located facility to a carrier for transport to a refiner. Without a transfer of custody, the primary field operation ends at the last point of separation. Crude oil stock tanks are considered separation devices.

Wastes derived from treatment of an exempted waste generally remain exempt, and offsite transportation does not negate the exemption. However, some wastes derived from treatment of an exempt waste may not be exempt. Nonexempt E&P wastes include, independent of where generated, those wastes that are not uniquely associated with an E&P activity. All wastes that are not associated with primary field operations are nonexempt and subject to further scrutiny for purposes of classification. Table 3 presents examples of exempt and nonexempt E&P wastes.

The federal RCRA Subtitle C exemption for E&P wastes, however, does not preclude these wastes from control under other federal regulations and state regulations—including oil and gas conservation programs and some hazardous waste programs. For example, the E&P exemption was also incorporated into the *California Code of Regulations* (22 CCR, Sections 66261.4(b)(2) and 66261.24(a)(1)), but it is limited in scope. The exemption applies in

Exempt E&P Waste Streams	Nonexempt E&P Waste Streams
Caustics if used as drilling fluid additives Cement slurry returns and cement cuttings Debris, crude-oil soaked/crude-oil stained Drill cuttings/solids Drilling fluids/muds Drilling fluids and cuttings from offshore operations disposed of onshore Liquid hydrocarbons removed from the production stream Liquid and solid wastes generated by crude oil and tank bottom reclaimers Pit sludges and contaminated bottoms from storage or disposal of exempt wastes Produced sand Produced water Produced water constituents removed before disposal Soils, crude-oil contaminated Tank bottoms and basic sediment from storage facilities that hold product and exempt waste (including accumulated materials such as hydrocarbons, solids, sand, and emulsion from production separators, fluid treating vessels, and production impoundments) Volatile organic compounds from exempt wastes in reserve pits or impoundments or production equipment Well completion, treatment, and stimulation, and packaging fluids Workover wastes (blowdown, swabbing and bailing wastes)	Batteries (lead-acid and nickel-cadmium) Caustic or acid cleaners Cement slurries, unused Chemicals, surplus/unusable Compressor oil, filters, and blowdown waste Debris, lube oil (contaminated) Drilling fluids (unused) Drums/containers, containing chemicals/lubricating oil Drums, empty and rinsate Hydraulic fluids (used) Oil, equipment lubricating (used) Sandblast media Scrap metal Soil, chemical-contaminated, lube oil-contaminated, and mercury-contaminated Solvents, spent (including waste solvents) Thread protectors, pipe dope-contaminated Vacuum truck rinsate (from tanks containing nonexempt waste) Well completion, treatment and stimulation fluids (unused)

California in cases where the waste is hazardous solely by meeting the federal characteristic for toxicity under the Toxicity Characteristic Leaching Procedure (TCLP). Thus, a waste that is hazardous solely by meeting or exceeding the maximum contaminant concentration for constituents extracted by TCLP, and for which federal regulatory thresholds have been established, is exempted from regulation as hazardous waste in California. The exemption does not apply if toxicity is determined based on criteria other than TCLP, or the waste meets any of the other three characteristics of hazardous waste—ignitability, corrosivity, and reactivity (22 CCR, Article 3, Sections 66261.20 et seq.).

Water and waste management in connection with oil and gas E&P involves discharge and injection operations. The main laws governing these activities include the CWA and the SDWA. The EPA may authorize willing and able states to take the lead responsibility for day-to-day program implementation and enforcement. Otherwise, the EPA Regions run the programs in direct implementation.

### **1.3.2 Surface Discharge Regulation under the CWA**

The CWA requires that all discharges of pollutants to surface waters (streams, rivers, lakes, bays, and oceans) must be authorized by a (general or individual) permit issued under the National Pollutant Discharge Elimination System (NPDES) program. Facilities are responsible for taking the steps necessary to demonstrate compliance with NPDES permit limits. Permits instruct each facility operator relative to the frequency for collecting wastewater samples, the location for sample collection, the pollutants to be analyzed, and the laboratory procedures to be used in conducting the analyses. Detailed records of these “self-monitoring” activities must be retained by the facility for at least three years. Furthermore, each facility is required to submit the results of these analyses to the regulators on a periodic basis. For most facilities, the reporting frequency is monthly or quarterly, but in no case may it be less than once per year. NPDES permits may also require operational or environmental effects monitoring. This includes the preparation of best management practice plans or spill prevention plans.

Numerical effluent limits present the primary mechanism for controlling discharges of pollutants to receiving waters. The EPA’s effluent limits describe the pollutants subject to monitoring as well as the appropriate quantity or concentration of pollutants. Permit writers derive effluent limits from the applicable technology-based effluent limitation guidelines and water quality-based standards. The more stringent of the two will be written into the permit.

### **1.3.3 Underground Injection Control under the SDWA**

The SDWA gave the EPA the authority for underground injection control (UIC) regulation. The UIC program is designed to protect underground sources of drinking water. For regulatory control purposes, underground injection is grouped into five classes of injection wells. An injection well is defined as any bored, drilled or a driven shaft or a dug hole, where the depth is greater than the largest surface dimension that is used to inject fluids underground. Class I wells are used for the emplacement of hazardous and nonhazardous fluids (industrial and municipal wastes) into isolated formations beneath the lowermost underground source of drinking water. Class II wells inject brines and other fluids associated with oil and gas production. Class III wells inject fluids associated with solution mining of minerals. Class IV wells, which involve the injection of hazardous or radioactive wastes into or above an underground source of drinking water, are banned unless authorized under other statutes for groundwater remediation. Class V wells include underground injection wells not included in Classes I through IV. Wells used for injecting oil field waste materials associated with E&P operations are considered Class II wells. Class II subclasses include disposal wells (Class II-D) and enhanced recovery wells (Class II-R).

The EPA’s regulations establish minimum standards for state programs prior to receiving primary responsibility (primacy) for the UIC program under Section 1422 of the SDWA. The federal requirements governing application, construction, operating, monitoring, and reporting for Class II wells are found in 40 CFR Parts 144 and 146. It should be noted that a state program can always be more stringent than the federal blueprint. In 1981, Congress added Section 1425 to the SDWA, which relieves oil- and gas-related injection well programs in the states from having

to meet the technical requirements in the federal UIC regulations. Instead, the demonstration can be made that the state has an effective program (including adequate oversight, record keeping, and reporting) in place to prevent the endangerment of underground sources of drinking water by underground injection operations. Because the Section 1425 approval route offers greater flexibility, most states have obtained UIC primacy in this way.

#### **1.3.4 State Regulation of Waste Management Operations**

Federal laws and regulations generally establish minimum federal standards. States have the lead role in the regulation of E&P and general industrial waste disposal. In light of the varying geological, climatological, ecological, topographic, economic, geographic, and age differences among oil and gas drilling and production sites across the country, the laws and regulations of authorized states relative to oil and gas waste management operations exhibit differences in detail and scope when compared with the federal blueprints or other state programs.

## 2 DATA COLLECTION METHODOLOGY

The data were collected in two phases. First, state oil and gas regulatory officials were contacted to determine whether their agency maintained a list of permitted commercial disposal companies dedicated to oil (Phase One). In the second phase, representatives of individual commercial disposal companies were interviewed to determine disposal methods and costs (Phase Two).

### 2.1 PHASE ONE: QUESTIONS FOR REGULATORS

1. Are there any commercial facilities in your state that are permitted/licensed to accept different types of E&P wastes that are moved off of the well site (offsite commercial disposal facilities)?
2. If *yes*, could you please provide a list of these facilities?
3. If *no*, where would operators in your state take E&P wastes that must be removed from the well site (municipal landfill [with the permission of local government], industrial/hazardous waste landfill, haul out of state, publicly owned treatment works/wastewater treatment facility, other)?
4. Would it be possible to provide any other information related to the issue of offsite disposal?

### 2.2 PHASE TWO: QUESTIONS FOR DISPOSAL COMPANIES

1. What types of E&P wastes (water-based muds and cuttings, oil-based muds and cuttings, produced water, contaminated soils, tank bottoms, NORM, other) do you accept?
2. What type of treatment/disposal process do you use? Is it the same for all types of wastes that you accept or does it differ?
3. What are your fees for accepting E&P wastes? Do the rates vary for different types of wastes? Please provide units (\$/bbl, \$/ton, \$/yd<sup>3</sup>, etc.). If possible, please provide a cost sheet.
4. Does your company provide trucking service to pick up wastes from a well site and transport them to the disposal site? If so, what is the cost for this service? [Please provide units: \$/bbl, \$/mi, \$/hr, etc.]
5. What is the fee for cleaning out trucks or containers and disposing of the wash water? [Please provide units: \$/bbl, \$/hr, \$/truck load, etc.]

6. Do you charge a fee for laboratory analysis of the incoming waste? If so, how much is the fee? Is it charged on every load or on some intermittent frequency?
7. What other types of fees do you charge?
8. Does your process generate any by-products or residues? If so, what do you do with them?

### **2.3 CHALLENGES ENCOUNTERED IN PHASE ONE AND IN PHASE TWO**

State agencies were very responsive in providing their data, to the extent available. Thirty of 31 oil-and-gas-producing states responded, one state declined. Some agencies sent detailed lists that are also available on the Internet, while others provided their information verbally or through electronic mail. In many instances, the authors had to undertake additional detective work to ascertain the appropriate contact person, current telephone numbers, and other data elements.

In general, most of the companies identified in Phase One willingly lent their assistance. Some companies cited competitive pressures and business confidentiality as primary reasons for providing cost ranges rather than snapshot figures. A few companies declined to partake in the study because they did not want to share any information with third parties.

### 3 PHASE ONE FINDINGS

The degree to which states host offsite commercial disposal companies and facilities may be described by way of three categories. The states with high oil and gas production typically have in place a dedicated network of offsite commercial disposal companies and facilities. These are generally tracked by the oil and gas regulatory agency. In other states, such an infrastructure usually does not exist, and very often, commercial disposal companies focus on produced water services. About half of the states do not have any industry-specific offsite commercial disposal infrastructure. Table 4 sorts the oil-and-gas-producing states into three different categories on the basis of availability of offsite commercial disposal companies and facilities.

<b>TABLE 4 Offsite Commercial Disposal in the Oil-and-Gas-Producing States</b>	
Category Description	States
Eight states with a dedicated industry-specific network of offsite commercial disposal companies and facilities	AR, CO, LA, NM, OK, TX, UT, WY
Seven states with fewer offsite commercial disposal companies or produced-water-focused infrastructure of commercial disposal companies and facilities	AL, MI, MS, ND, NE, PA, WV
Fifteen states without industry-specific offsite commercial disposal facilities and companies	AK, AZ, CA, FL, IL, IN, KS, KY, MO, MT, NY, OH, TN, SD, VA



## 4 PHASE TWO FINDINGS

### 4.1 BACKGROUND

On the basis of lists provided by the agencies, the individual offsite commercial disposal companies and facilities in the various states were contacted. The representatives were asked about disposal options and costs for water-based muds and cuttings, oil-based muds and cuttings, produced water, contaminated soils, tank bottoms, NORM. The information was recorded on a worksheet for each facility and subsequently entered into a Microsoft® Access Database. Table 5 presents the data elements used to capture the survey findings. The authors intend to make available the full database in searchable format on the website of the Environmental Science Division of Argonne National Laboratory ([http://www.evs.anl.gov/project/dsp\\_topicdetail.cfm?topicid=18](http://www.evs.anl.gov/project/dsp_topicdetail.cfm?topicid=18)) within a few weeks after the report is released.

The populated database now contains about 570 records for roughly 220 facilities. The database is by no means all-inclusive. The lists provided by the agencies may not have contained all of the commercial disposal companies operating in their state. Moreover, some of the companies from the state lists declined to participate in the study. However, the sheer volume of data captured should provide a high confidence level for understanding trends and ranges.

In addition to thematic sorting and querying, the database format allows for the convenient generation of tailored reports. The terminology for the different disposal categories was chosen to capture and harmonize the essence of the management processes described by the participating companies. Only one type of disposal is reported for each waste stream managed by a facility to avoid double counting. Disposal methods involving more than one process are summarized in the comments field. Most disposal company representatives characterized their disposal fee schedules as approximate figures. The figures represent a snapshot for the survey window between October 2005 and April 2006. Thus, these costs may not reflect the actual costs that would be charged to specific customers at a given point in time. The authors have not attempted to independently confirm the costs reported by the disposal companies. However, the draft report was reviewed by waste management specialists from several large oil and gas companies, and they generally agreed with the information included in the report.

During the data collection phase, costs have been reported in different units of measurement. Most costs have been expressed as \$/bbl, but others have been indicated as \$/yd<sup>3</sup> and \$/ton. The \$/yd<sup>3</sup> unit appears when the wastes are predominantly solids, and the \$/ton unit is commonly used by landfills because costs for disposal of municipal solid waste are typically based on this measure of weight. Consideration of the specific gravity of a certain waste stream facilitates the conversion of volume-based units (bbl, yd<sup>3</sup>) into weight-based units (tons). If one assumes that oil field waste has a specific gravity that is 1.5 times that of water, the conversion factors are: 1 yd<sup>3</sup> = 4.81 bbl, and 1 ton = 3.81 bbl. The conversions are not shown in the database query tables but are provided in several report narratives to describe overall cost patterns.

<b>TABLE 5 Data Dictionary for Offsite Commercial Disposal Survey</b>
Data Elements
Disposal state
Disposal company name—facility name
Disposal company contact (telephone number)
Disposal company address
Type of waste
Type of disposal
By-product/residue generated?
Fees charged for disposal
Trucking service provided? If yes, fees?
Fees for cleaning trucks/containers and disposing of wash water
Laboratory analysis conducted? If yes, fees?
Comments

After an introductory overview of each survey state (Section 4.2), targeted database queries are used to provide cost information by disposal method (Section 4.3) and by waste stream (Section 4.4). When making specific waste management decisions, however, oil and gas companies look beyond tipping or disposal fees as a single decision factor. They understand that transportation and other incidental costs play a significant role when it comes to the cost-effectiveness of a specific waste management choice.

## **4.2 STATE-BY-STATE OVERVIEW**

This section provides an overview of E&P waste management initiatives, trends and requirements across the nation. The specific contact information for each state regulatory agencies, including names, addresses, and telephone numbers, can be accessed online through the regulatory module of Argonne's Drilling Waste Management Information System (<http://web.ead.anl.gov/dwm/regs/index.cfm>).

### **4.2.1 Alabama**

Contact: Dave Bolin, State Oil and Gas Board of Alabama.

The State Oil and Gas Board of Alabama regulates Class II injection facilities that are used for the disposal of E&P wastes. The board's regulations do not classify Class II disposal facilities or wells as being operated for private use or commercially for profit. Most of Alabama's Class II facilities are being operated privately, or exclusively to service a single operator's production operations. However, on the basis of affidavits in the files, the State Oil and Gas Board of Alabama has identified five saltwater disposal facilities in south Alabama that accept Class II fluids from other oil and gas operators, and therefore are apparently being operated commercially for profit. The in-state and two out-of-state operators of the five facilities in Alabama were contacted. All three provided responses.

Disposal facilities associated with offsite surface discharge and land application of E&P wastes in Alabama are regulated by the Alabama Department of Environmental Management. Other wastes that are sent offsite go to a reclamation facility (particularly tank bottoms), a local landfill, or a hazardous waste disposal facility. They may also be hauled to an out-of-state disposal facility. The State Oil and Gas Board of Alabama regulates the offsite transportation of E&P wastes associated with oil and gas operations. The rules of the State Oil and Gas Board of Alabama require operators to use transporters approved by the board, and they require operators, transporters, and disposers to adhere to a manifest system.

The study identified two landfills and a company that combines injection and separation for various oil field waste streams. The company's "Contained Separation" process, which was developed using 80 years of water treating and waste treatment experience, specifically treats acid flowback and other problematic water streams. The two landfills, the treatment facility, and two injection facilities were contacted. All five facilities responded.

#### **4.2.2 Alaska**

Contact: Tom Maunder, Alaska Oil and Gas Conservation Commission.

In Alaska, all waste disposal facilities are owned by the operators on their respective leases. Waste disposal is controversial and generally handled by the given operator. The actual number of "facilities" is limited and drilling wastes are generally hauled to the facility sites. For example, Marathon brings all its waste to its processing facility in the Kenai Gas Field.

The grind and inject facility at Prudhoe Bay could probably be termed "near commercial," since third-party small operators have negotiated the ability to bring their E&P wastes to that facility. This facility operates 24 hours a day, 8 months a year, and injects approximately 2,500 yd<sup>3</sup> of drilling waste every day. ConocoPhillips has accepted some wastes (mostly liquid) from small operators near Kuparuk. For the most part, operators are very reluctant to accept any waste from others. No operator in Cook Inlet accepts third-party wastes.

With regard to grind and inject, costs are not shared with the regulators. A few years ago, the cost was about \$100.00/yd<sup>3</sup>. The fee was applied to the full capacity of the "super suckers" that transported the cuttings; the tanks on the trucks were at best two-thirds full. Costs to dispose of liquid mud were less since these wastes do not require storing and grinding. The cost was about \$3.00/bbl.

Municipal landfills have been used on occasion for solid wastes. The tipping fee for the Anchorage landfill lies in the neighborhood of \$45.00/ton. It is unknown whether cuttings would be accepted at the Anchorage landfill. Cuttings may have been disposed of at the landfills in Wasilla (Matanuska-Susitna Borough) and Kenai (Kenai Peninsula Borough).

Pits may be constructed, but they are very limited. Out-of-state hauling is an option for some wastes but is very expensive. Small operators are at a disadvantage because of what has become standard practice in Alaska—no pits.

Management of offshore waste that cannot be discharged (because of oil contamination) is usually very expensive. In one example where it became necessary to truck and rail the offshore waste to the North Slope, the ultimate cost was \$250.00/bbl (mainly for transportation).

### **4.2.3 Arizona**

Contact: Steven Rauzi, Arizona Geological Survey.

Arizona does not have much production activity. All production occurs on the Navajo Nation in the northeast corner of the state. In all likelihood, companies in the Farmington, New Mexico, area handle most oil field services in northeastern Arizona. One operator used salt mud in a well that it drilled about an hour north of Tucson earlier this year. The operator used an in-state company to haul and dispose of the salt mud. The company was contacted.

### **4.2.4 Arkansas**

Contacts: Gary Looney, Arkansas Oil and Gas Commission, and Laura Stuart-Leslie, Arkansas Department of Environmental Quality.

Oil field wastes or E&P wastes, such as drilling fluids, muds, and produced water, are all handled through the various permitting authorities between the Arkansas Department of Environmental Quality and the Arkansas Oil and Gas Commission.

In general, drilling fluids and muds are collected in temporary pits (reserve pits) at each well site. These fluids are then hauled to one of five permitted land application facilities in Arkansas. These facilities have aboveground pits for the collection of produced water and mud. Once the fluids and muds have separated, the muds are spread onto designated fields; then depending on their permits, management activities such as tilling into the soil and revegetating must occur. Routine sampling of these fields is also required. The remaining water is either pumped to tanks for injection into wells (Class II under the authority of the Arkansas Oil and Gas Commission) or hauled to one of these facilities with a commercial Class II well. These are the only current options for disposal of muds. Alternative methods, such as onsite disposal in the reserve pits or application to another site, are considered on a case-by-case basis but rarely have been authorized in the past. The five facilities permitted by the Arkansas Department of Environmental Quality for land application were all contacted. Three companies responded.

Currently, only produced water is permitted through the Arkansas Oil and Gas Commission for disposal into Class II commercial saltwater disposal wells. No other applications to dispose (subsurface) of E&P waste (other than those related to produced saltwater) have been filed. The Arkansas Oil and Gas Commission identified two in-state and three out-of-state operators. All five companies were contacted and four responded.

Tank bottoms are typically handled by commercial reclaimers. The reclaimers come to the oil field site and clean out the tank bottoms. The tank bottoms are taken back to the

reclaimers' facilities where they are treated. One reclaimer responded to the study questionnaire. If volumes of recoverable and marketable product are high, no charges accrue.

#### **4.2.5 California**

Contact: Mike Stettner, California Department of Conservation.

The California Department of Conservation regulates the drilling, operation, maintenance, and plugging of oil, natural gas, and geothermal wells; the Regional Water Quality Control Boards regulate the discharge of wastes to land or surface waters; the California Integrated Waste Management Board regulates E&P wastes disposed of in nonhazardous waste landfills; and the California Air Resources Board regulates emissions to air, including organic compound emissions from open pits and tanks. On the basis of a report prepared in 2002 by the California Department of Toxic Substances Control (CalEPA 2000), the most common method of disposal for drilling wastes involves onsite burial of drilling pit contents after aggregation of the aqueous component with cement. This method has regional limitations and may not be appropriate for non-water-based drilling muds. An alternate disposal method involves shipment to a commercial disposal facility. Oily sludges are generally shipped to commercial facilities accepting exploration production wastes. Otherwise, tank bottoms and other sludges are often recycled and used for fabrication of road mix. The sludge material is processed at an onsite facility, and the resulting material is applied to private roads within the facility because of its dust-suppressing properties. Disposal methods for produced water include discharge into municipal sewers and percolation ponds under permits issued by the Regional Water Quality Control Boards, injection into disposal wells, and recycling for other uses.

In the course of the first phase of this survey, the California Conservation Commission canvassed all districts for commercial E&P waste disposal operations. Kern County in the Bakersfield area seems to be the only area with commercial waste disposal sites. The EPA closed the surface disposal site in Casmalia.

Three commercial E&P waste facilities, all located in proximity to major oil production fields in Kern, were identified. One disposes of hazardous waste and designated waste, the other manages designated waste only. The third facility manages petroleum-contaminated soil, tank bottoms, sump sediments, and process waters. All three facilities responded.

#### **4.2.6 Colorado**

Contacts: Brian Macke, Colorado Oil and Gas Conservation Commission; Debbie Baldwin, Colorado Oil and Gas Conservation Commission; and Donna Stoner, Colorado Department of Public Health and Environment.

The Colorado Oil and Gas Conservation Commission does not track volumes of E&P wastes. Produced water is managed in many ways. Most produced water goes down injection wells operated for enhanced recovery projects and/or disposal by individual operators. In some

cases, produced water goes down commercial injection wells. In other cases, produced water is discharged to surface water under the Colorado Discharge Permit System (CDPS, Colorado's NPDES program) or into individual well/lease site pits operated by individual operators. Some produced water is managed at centralized waste management facilities operated by individual operators. Most drill cuttings are buried on site. Some county and city landfills accept oily soils.

The Colorado Oil and Gas Conservation Commission does not permit offsite commercial disposal facilities that handle E&P waste. Those are permitted by the Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division, Solid Waste Unit.

Nearly all the commercial E&P waste facilities in Colorado are located on the Western Slope. The disposal facilities are evaporative impoundments. No commercial E&P injection facilities are in use. In La Plata County (Southwestern Colorado), operators haul wastes to a commercial waste facility in New Mexico.

The six active facilities on the West Slope and one facility undergoing closure and remediation in Weld County (north of Denver) were contacted. Four companies responded, but two were reluctant to share information.

In addition, a major landfill facility was identified. The facility accepts nonhazardous solid E&P wastes.

#### **4.2.7 Florida**

Contacts: Ed Garrett, Bob Caughey, and John Leccese, Florida Department of Environmental Protection.

Waste materials generated in the Northwest Florida Fields are generally shipped to disposal facilities in Alabama. Anything contaminated with NORM is contained (e.g., in the case of pipe, through spraying with foam on each end) and shipped to Philip Environmental Services in Morgan City, Louisiana. Contaminated soil from spills is trucked to Timberlands Landfill north of Brewton, Alabama. All facilities were contacted

The picture differs for South Florida Fields. Oil-spill-contaminated limerock and soils are transported to the Rinker incinerator near Miami. Workover fluids are run through the separator to split saltwater from oil. The oil is sold, and the saltwater goes down a disposal well. Drilling fluids in South Florida are only bentonite muds, since no oil/diesel-based muds are used. The drilling fluids are disposed of into the boulder zone, either through a disposal well, or in most cases are pumped down the annulus between the surface casing and the intermediate casing. No NORM problems have been found in South Florida. Drill cuttings are stacked on the drill pad to dry out. They are sampled and analyzed for metals, including arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. If no significant metals are found, then cuttings are used as "clean fill." Oily cuttings go to the Rinker incinerator. In practice, landowners want clean cuttings for road improvement in their grove or farm. If no one wants the cuttings, then

operators find someone who will let them spread the clean cuttings on their land. Petro Operating Co. (Blackjack Creek Field) hauls its contaminated soil to Perdido Landfill in Alabama through SWS of Pensacola, Florida. The landfill and incinerator owners were contacted and provided responses.

The Rinker facility takes nonhazardous waste oils, hydrocarbons, and other organic contaminants out of the environment completely. It uses them either as an alternate fuel source or processes them in ultra-high-temperature kilns. This process incorporates any remaining inert matter into a component of cement. This recycling of petroleum-contaminated material offers companies an economical alternative to landfilling these materials. These contaminated materials are processed using consideration for safety, while protecting the client from any future liability. Contaminated soil is directed to a thermal desorber to rid it of volatile petroleum prior to being fed as a clean raw material in cement production. All that is left of the cleaned soils and solids after processing at 2,800°F is an inert glassy material called “clinker.” The clinker is processed and ground with gypsum to become cement. Before any material is accepted, a representative analysis must be submitted to ensure that it meets all regulatory and company internal requirements. In addition to this precertification, the contaminated material is rechecked at its own state-certified laboratory. The laboratory also provides certified field sampling and precertification analysis for customers desiring “one-stop project services.” Rinker Materials maintains a fleet of transport equipment dedicated to serve clients’ solid and liquid petroleum contamination requirements. This fleet consists of tanker trailers, dump trailers and specially equipped flat trailers for drums and small containers. In addition to truck transport, Rinker Materials provides railcar services that can accommodate a wide variety of special waste management requirements that customers face.

#### **4.2.8 Illinois**

Contact: Doug Shutt, Illinois Department of Natural Resources.

The Illinois Department of Natural Resources does not maintain a list of commercial waste disposal companies. Oil field waste disposal is not regulated by the department unless a material (mainly produced water) is injected into a Class II Well. The Department of Natural Resources does not distinguish between commercial wells and normal wells. Oil field waste that is not disposed of onsite is sent offsite to sanitary landfills or transported out of state.

#### **4.2.9 Indiana**

Contacts: Danny Allison, Indiana Department of Natural Resources, and Mike Nickolaus, Ground Water Protection Council.

Indiana does not have commercial facilities. Most E&P wastes are disposed of onsite. Oil-based muds are not used in the state. Some onsite land farming occurs. Other wastes may be sent offsite to sanitary landfills. Rates vary between \$16.00/yd<sup>3</sup> and \$20.00/yd<sup>3</sup>. The state is currently deliberating over management of NORM wastes.

#### **4.2.10 Kansas**

Contact: Bill Bryson, Kansas Geological Survey.

Kansas has no permitted offsite commercial disposal facilities for E&P waste. The state does have some “centralized” facilities where an operator involved in a certain area of drilling and/or workover activity has a centrally located pit where drilling muds and E&P waste are hauled from several well locations. Sometimes the drilling location is located in a sensitive groundwater area where the pit contents cannot be buried in place. The Kansas Corporation Commission and the Kansas Department of Health and Environment do not keep a list of centralized facilities. The Kansas Corporation Commission has promulgated a regulation governing the transfer of wastes; however, challenges are encountered relative to enforcement from each drilling location. Most drilling wastes in Kansas are buried onsite at the drilling location through proper closure of the pit(s).

Transporting waste to a municipal landfill requires permission from the Kansas Department of Health and Environment but is not an option deemed attractive by very many operators. The Kansas Department of Health and Environment views landfill disposal of drilling waste as poor public policy in light of the scarcity of landfill space. Some waste is hauled out of state, but none goes to a publicly owned treatment works (POTW).

#### **4.2.11 Kentucky**

Contacts: Rick Bender, Kentucky Division of Oil and Gas Conservation, and Ron Gruzsky, Kentucky Department for Environmental Protection.

Kentucky’s Oil and Gas Well Operators Manual covers the approved disposal methods for E&P waste. Kentucky has no statutes, regulations, or policies that specifically address slurry injection, subfracture injection, and annular injection of drill cuttings and drilling muds. Approved disposal methods for produced water include injection into an approved, permitted, or rule-authorized underground injection well; surface discharge covered under a Kentucky Pollutant Discharge Elimination System (KPDES) permit; transportation offsite to a UIC well; and enhanced evaporation. Kentucky No Discharge Operational Permits (KNDOPs) have not been issued to oil and gas operators for land application of produced water.

The specifics and disposal methods vary from site to site, and costs vary greatly. A commercial UIC Class II injection well can receive produced water from any formation and operator. A UIC Class II well that is restricted relative to operator and formation, however, would be in violation if it injected produced water originating at another operator’s facility or from a different formation. A representative of a facility listed in the 1997 study offered that it does not accept third-party E&P waste streams at this point.



Almost any material except hazardous and TSCA wastes can be sent to a contained landfill in Kentucky. Many have the ability to solidify liquid waste. A list of approved landfills in Kentucky was obtained, and several contained landfills were contacted.

#### **4.2.12 Louisiana**

Contacts: Joe Ball, Louisiana Department of Natural Resources, and Gary Snellgrove, Louisiana Department of Natural Resources.

RCRA-exempt E&P waste in Louisiana is regulated by the Department of Natural Resources, Office of Conservation, under Statewide Order 29B. Commercial E&P waste storage, treatment, and disposal facilities are permitted and monitored by the Injection and Mining Division of the Department of Natural Resources (Office of Conservation). These facilities include Class II disposal wells, land treatment systems, chemical fixation systems, and NORM treatment systems. Approval of waste disposal operations can be granted to oil and gas service companies on a case-by-case basis (Form UIC-23) to dispose of E&P waste at a commercial facility. The Office of Conservation publishes a list of currently permitted commercial facilities on its Web site (DNR 2000).

E&P waste is defined as drilling wastes, saltwater, and other wastes associated with the exploration, development, or production of crude oil or natural gas wells, which are not regulated by the provisions of, and, therefore, exempt from the Louisiana Hazardous Waste Regulations and the RCRA. E&P waste materials include, but are not limited to, those listed in Table 6. Table 7 displays the codes and descriptions of disposal techniques.

All 16 companies and facilities on the list provided by the Office of Conservation were contacted. Fifteen companies responded, including the three largest operators—CCS Energy Services LLC, Newpark Environmental Services, and US Liquids of Louisiana LP. These companies have an extensive network of transfer stations in place, to which oil and gas companies can transport wastes. The waste management companies consolidate the waste at the transfer stations, by then they move it by barge to one or more central treatment facilities, where wastes are managed by using injection, land treatment, or other treatment.

<b>TABLE 6 E&amp;P Waste Types in Louisiana</b>	
Code	E&P Waste Description
01	Saltwater (produced brine or produced water), except for saltwater whose intended and actual use is in drilling, workover, or completion fluids, or in enhanced mineral recovery operations, process fluids generated by approved salvage oil operators who only receive oil (basic sediment and water) from oil and gas leases, and natural gas plant processing waste fluid that is or may be commingled with produced formation water.
02	Oil-based drilling wastes (mud, fluids, and cuttings).
03	Water-based drilling wastes (mud, fluids, and cuttings).
04	Completion; workover and stimulation fluids.
05	Production pit sludges.
06	Storage tank sludge from production operations, onsite and commercial saltwater disposal facilities, salvage oil facilities that only receive waste oil [basic sediment and water] from oil and gas leases, and sludges generated by service company and commercial facility or transfer station wash water systems.
07	Produced oily sands and solids.
08	Produced formation freshwater.
09	Rainwater from firewalls, ring levees, and pits at drilling and production facilities.
10	Washout water and residual solids generated from the cleaning of containers that transport E&P waste and are not contaminated by hazardous waste or material: washout water and solids (E&P Waste Type 10) is or may be generated at a commercial facility or transfer station by the cleaning of a container holding a residual amount of E&P Waste.
11	Washout pit water and residual solids from oil-field-related carriers and service companies that are not permitted to haul hazardous waste or material.
12	Nonhazardous natural gas plant processing waste solids.
13	(Reserved).
14	Pipeline test water that does not meet discharge limitations established by the appropriate state agency or pipeline pigging waste (i.e., waste fluids/solids generated from the cleaning of a pipeline).
15	E&P wastes that are transported from permitted commercial facilities and transfer stations to permitted commercial treatment and disposal facilities, except those E&P wastes defined as Waste Types 01 and 06.
16	Crude oil spill cleanup waste.
50	Salvageable hydrocarbons bound for permitted salvage oil operators.
99	Other E&P waste not described above; a description of these wastes and written approval from the Office of Conservation is required and must be attached to the manifest prior to transport.

Code	E&P Waste Management Description
1	Slurry fracture injection
2	Cavern disposal
3	Solidification
4	Salvageable oil
5	RCRA hazardous waste landfill
6	Mechanical/chemical separation—wastewater treatment plant and landfill cover
7	Thermal desorption
8	Incineration
9	Storage barges
10	Mechanical/chemical separation—injection and landfill cover
11	Storage tanks
12	Land treatment
13	Storage pit
14	Injection well
15	Mechanical/chemical separation
16	Stabilization

#### **4.2.13 Michigan**

Contacts: Harold Fitch, Raymond Vugrinovich, and Gunther Schmidt, Michigan Department of Environmental Quality.

Michigan does not have any commercial facilities that are specifically licensed for the primary purpose of disposal of solid waste from oil and gas E&P operations. Offsite brine disposal wells are permitted to accept oil field brine and other liquid oil field wastes. The majority of these wells accept only the operator's own wastes; only a limited number are commercial wells. Michigan has a total of 651 brine disposal wells. Solid waste landfills are allowed to accept solid waste from oil and gas E&P operations. The Office of the Geological Survey does not maintain a list of those landfills authorized to accept E&P waste.

Several of the brine-injection-well facilities from a list provided by the Michigan Department of Environmental Quality were contacted to identify facilities that accept third-party-generated E&P waste streams on a commercial basis. Three facilities of this much narrower universe provided information.

#### **4.2.14 Mississippi**

Contacts: Walter Boone, Mississippi Oil and Gas Board, and Mark Williams, Mississippi Department of Environmental Quality.

Mississippi does not have a developed infrastructure dedicated to commercial disposal of E&P wastes. Most waste materials are injected downhole or land applied onsite or nearby. Disposal of muds in municipal solid waste landfills is much more costly.

The Mississippi Oil & Gas Board has regulatory authority over commercial disposal of E&P wastes in Class II wells. All other commercial disposal operations are regulated by the Department of Environmental Quality.

One commercial disposal facility under the jurisdiction of the Department of Environmental Quality receives waste materials (muds) from offshore. The muds are transported to a facility in Alabama for dewatering. The residue then goes to a landfill in Jackson County on the Gulf Coast. This facility and three other landfills supporting the offshore industry were contacted. Three landfill facilities responded. In addition, four commercial UIC Class II companies were identified and contacted; three of them responded.

A proposed facility for Northern Mississippi involves a commercial UIC Class I well envisaged to accept nonhazardous industrial wastes and oil field wastes. It is not clear whether this facility will ever become operational.

#### **4.2.15 Missouri**

Contact: Bob Archer, Missouri Department of Natural Resources.

Commercial waste disposal facilities are regulated by Missouri's Hazardous and Solid Waste Programs, not the Missouri Oil and Gas Council. In Missouri, operators dispose of E&P liquid material (waste oil and water) in onsite injection wells. Cuttings are allowed to settle and are then covered over when the cuttings pits are closed. In the 1980s and early 1990s, a few producers hauled water offsite to another water injection well. In general, waste is most economically handled onsite in accordance with state-approved disposal methods.

#### **4.2.16 Montana**

Contact: Tom Richmond, Montana Board of Oil and Gas Conservation.

The Montana Board of Oil and Gas Conservation encourages onsite bioremediation of oily wastes. It does not have the authority to permit off-lease disposal (other than water injection wells). One commercial facility remediates and reuses E&P waste. A representative of the company was contacted and responded.

#### **4.2.17 Nebraska**

Contact: Stan Belieu, Nebraska Oil and Gas Conservation Commission

Injection of produced water to (commercial) UIC Class II wells is authorized by the Nebraska Oil and Gas Conservation Commission. Most produced water disposal operations occur onsite. General municipal landfills may accept E&P wastes. One incinerator facility accepts a variety of industrial, including E&P wastes, but not NORM. The company was contacted and provided information.

#### **4.2.18 New Mexico**

Contact: Ben Stone, New Mexico Energy, Minerals and Natural Resources Department.

The New Mexico Energy, Minerals and Natural Resources Department provided a list of 28 approved commercial disposal facilities. Most companies responded. Some facilities proved to be operated by the same companies. Others could not be contacted or were not willing to communicate. Seventeen companies provided survey information. Land farming, land filling, and treatment and recycling were the prevalent disposal techniques.

#### **4.2.19 New York**

Contacts: Kathleen Sanford and Scott Menrath, New York Department of Environmental Conservation.

The Division of Mineral Resources of the New York Department of Environmental Conservation does not permit or license commercial disposal facilities, nor does it officially track disposal of E&P wastes that are removed from well sites. New York State has few active brine disposal wells. Use of those wells is governed by permits issued by both the EPA and the Division of Water of the New York Department of Environmental Conservation. Two facilities reported that they did not accept offsite materials; the third facility is located in West Virginia.

Cuttings may be taken to landfills if they are not buried onsite. The New York Department of Environmental Conservation does not maintain a list of E&P waste-specific landfills. According to the regional managers, most brine and drilling mud is taken to an out-of-state treatment plant in Pennsylvania. The chemical precipitation facility was contacted and a representative responded.

#### **4.2.20 North Dakota**

Contact: Mark Bohrer, North Dakota Industrial Commission.

North Dakota hosts commercial saltwater disposal wells regulated by the North Dakota Industrial Commission. The facilities take produced water, pit water, and slop from anywhere. Some operators of saltwater disposal wells only accept produced water. Other operators take a combination of produced water and pit water that they haul themselves, knowing that the materials are fairly clean. The North Dakota Health Department regulates a few special use landfills that take oil field waste. The North Dakota Industrial Commission (Oil and Gas Division) forwarded a list of commercial disposal facilities—15 saltwater disposal wells operated by 7 companies, and 5 industrial, special waste, and municipal landfills. All operators were contacted. Information was obtained for 9 commercial saltwater disposal facilities operated by 3 companies, and for 3 landfills.

#### **4.2.21 Ohio**

Contacts: Scott Kell, Ohio Department of Natural Resources, Division of Mineral Resources, and Ernie Stull, Ohio Environmental Protection Agency.

The Ohio Department of Natural Resources, Division of Mineral Resources does not permit or regulate commercial offsite facilities for disposal of solid E&P wastes. Most oil field wastes generated in Ohio are disposed of onsite. Wastes that cannot be disposed of onsite are sent to local sanitary or industrial landfills or to commercial disposal facilities in other states.

Disposal of solid wastes is prohibited except as authorized by the Ohio Environmental Protection Agency. Because Ohio was selected as an example of a northern state in which solid waste landfills are used for oil field waste disposal, additional data on landfills were collected. The Ohio Environmental Protection Agency provided a list of 41 authorized landfills. Seven landfills, located in oil- and gas-producing parts of the state, were contacted. Five facilities responded.

#### **4.2.22 Oklahoma**

Contact: Tim Baker, Oklahoma Corporation Commission.

The Oklahoma Corporation Commission reports that Oklahoma has commercial disposal wells and commercial disposal pits. Commercial disposal pits are restricted to taking only water-based drilling muds. One exception involves salt-contaminated soils. Some of the facilities are designed for high-chloride muds. Those facilities can accept salt-contaminated soils from saltwater spills. Commercial disposal wells can accept all wastes that come out of a well bore and are RCRA exempt. Oil field wastes can go to municipal landfills if the owner of the facility will accept it.

The Oklahoma Corporation Commission forwarded an active commercial pits inventory. All 15 facilities were called. However, five facilities appeared to be no longer operational, since searches of phone directories and the Internet were not successful. One additional facility was being sold. Six facilities responded to the study questions. Two operators expressed much

criticism of the practice of land farming. They stated that environmentally safe and protective pit operations were costly, and thus were disadvantaged compared with land farming. In addition, two larger commercial saltwater disposal companies were contacted. Together they operate nine disposal wells. As of last year, more than 220 commercial disposal wells were operational in Oklahoma.

#### **4.2.23 Pennsylvania**

Contact: Ron Gilius, Pennsylvania Department of Environmental Protection.

The Pennsylvania Department of Environmental Protection provided a list of eight commercial treatment facilities. All were contacted, and five facilities responded. Treatment and discharge were the most commonly used disposal methods.

#### **4.2.24 South Dakota**

Contact: Fred Steece, South Dakota Department of Environmental and Natural Resources.

The Oil and Gas Section in the South Dakota Department of Environmental and Natural Resources does not track offsite commercial disposal operations. Most E&P wastes are disposed of onsite or nearby. Wastes destined offsite go to municipal solid waste landfills or out-of-state.

#### **4.2.25 Texas**

Contacts: Jill Hybner and Steven Seni, Railroad Commission of Texas. (Note: Mr. Seni left the Railroad Commission before this report was finalized)

In Texas, the Railroad Commission regulates “nonhazardous oil and gas waste” (NOGW). Information concerning permitted commercial E&P waste disposal facilities is posted on the Texas Railroad Commission Web site (RRC 2006a). Information pertains to surface disposal facilities (RRC 2006b) and injection and cavern disposal wells (RRC 2006c). The Railroad Commission regularly updates the information and provides an Operator Directory (RRC 2006d).

In Texas, the big commercial disposal companies, including CCS Energy Services LL, Newpark Environmental Services, and US Liquids of Louisiana LP provided survey information. Otherwise, less than half of the commercial surface disposal companies opted to participate in the study: three of six pit facility operators, three of seven stationary treatment companies, and two of seven land farm operators responded. However, all seven cavern disposal companies and several injection facility operators provided information.

#### **4.2.26 Tennessee**

Contacts: Ronald Zurawski and Michael K. Burton, Tennessee State Oil and Gas Board.

The State of Tennessee does not track commercial offsite disposal operations, other than maintaining a list of all UIC Class II injection wells. No facilities were contacted.

#### **4.2.27 Utah**

Contacts: John Baza and Brad Hill, Utah Department of Natural Resources.

The Utah Division of Oil, Gas and Mining of the Utah Department of Natural Resources permits and regulates numerous facilities that are approved to accept RCRA-exempt E&P wastes. The list of facilities maintained by the division includes a notation of the types of wastes that can be taken at each facility. All 10 facilities were contacted, and information was obtained from 7 operators. The main disposal methods included land farming, pit, and evaporation. In addition, one commercial landfill and one incinerator provided data.

#### **4.2.28 Virginia**

Contact: Bob Wilson, Virginia Department of Mines, Minerals and Energy.

The Division of Gas and Oil in the Virginia Department of Mines, Minerals and Energy (DMME) does not track commercial offsite disposal operations. The vast majority of production activity in Virginia relates to gas. Thus, the Commonwealth has a very small oil waste disposal problem. Brine stemming from coal bed methane gas operations represents the principal waste material. Most of it is disposed of in operator-owned UIC wells regulated by the EPA's Region 3. Wastewater (brine) that is not injected into in-state operator-owned UIC wells is hauled to permitted sites in other states. Drilling muds from the few wells that have used that fluid have been disposed of in permitted out-of-state facilities. (Since the vast majority of wells in Virginia are drilled using air and foam, drilling muds are a rare issue.) Oil wastes and tank bottoms are usually taken to waste oil recycling operations. Solid waste other than cuttings (which are disposed of onsite) are, by regulation, to be disposed of in a facility permitted to accept that type of waste. In a few instances, drilling waters from remote exploratory wells have been disposed of at wastewater treatment facilities.

#### **4.2.29 West Virginia**

Contacts: James Martin and BJ Chestnut, West Virginia Department of Environmental Protection.



The State of West Virginia does not have large-scale offsite commercial disposal operations. The West Virginia Department of Environmental Protection provided a list of five landfills and three commercial injection well operators managing E&P waste streams. All were contacted, and five facilities responded.

#### **4.2.30 Wyoming**

Contacts: Don Likwartz and Craig Eggerman, Wyoming Oil and Gas Commission, and Larry Robinson, Wyoming Department of Environmental Quality.

The Wyoming Oil and Gas Commission does not regulate commercial sites. Those sites are under the jurisdiction of the Wyoming Department of Environmental Quality. Different staff members were contacted, depending on the medium intended for disposal.

The Wyoming Department of Environmental Quality does not maintain a list of sites specifically and exclusively approved to accept E&P exempt wastes. These wastes could go to any municipal solid waste landfill willing to accept them, as long as they do not have free liquids. However, that decision would be the discretion of a given facility. Wyoming has a number of industrial landfills, but they only dispose of waste they generate at their own industrial sites and are not specifically permitted as “commercial” facilities.

The Wyoming Department of Environmental Quality, however, provided a list of 27 commercial facilities (operated by 15 companies) authorized to receive drilling fluids, produced water, or industrial waste. Those facilities include pits, lagoons, and ponds. In addition, a list of eight commercial UIC Class I disposal wells that can be used to dispose of nonhazardous waste was received. In some cases, the Water Quality Division also may approve a land application or road application. All facilities on the two lists were contacted.

Answers were obtained from 10 commercial companies mainly using land farming, pit, and evaporation techniques. In addition, three of the UIC Class I disposal well facilities responded. Several facilities proved to be inactive, closed, or company-exclusive.

### **4.3 SPECIFIC SURVEY RESULTS: DISPOSAL COSTS BY DISPOSAL METHOD**

The following sections were derived from querying the database by disposal method. The disposal techniques yielded by the survey include bioremediation, burial, cavern, discharge, evaporation, injection, land application, recycling, thermal treatment, and treatment. The introductory descriptions are based on Veil et al. (2004).

#### **4.3.1 Bioremediation**

Bioremediation (also known as biological treatment or biotreatment) uses microorganisms to biologically degrade hydrocarbon-contaminated waste into nontoxic residues.

Bioremediation is designed to accelerate the natural decomposition process by controlling oxygen, temperature, moisture, and nutrient parameters. Advantages of biological treatment accrue from being relatively environmentally benign, generating few emissions, converting wastes into products, and requiring minimal, if any, transportation. Sometimes bioremediation is used as an interim treatment or disposal step, which reduces the overall level of hydrocarbon contamination prior to final disposal. It should be noted that E&P wastes typically contain high levels of solids. Therefore, once the TPH fraction is reduced, these solids typically require additional treatment or disposal. Some treated solids may be used for other purposes in accordance with the applicable state regulations. Bioremediation can create a drier, more stable material for land filling, thereby reducing the potential to generate leachate. Some solids, however, may contain a high salt content and would require additional treatment.

Specific bioremediation approaches can differ depending on the type of soils involved. Depending on the composition of the hydrocarbon components, the bioremediation environment, and the type of treatment utilized, bioremediation may be a fairly slow process and require months or years to reach the desired result. In the process, wastes are mixed with bulking agents, such as wood chips, straw, rice hulls, or husks, to increase porosity and aeration potential for biological degradation. The bulking agents provide adequate porosity to allow aeration even when moisture levels are high. Composting is similar to land treatment, but it can be more efficient. Also, in the case of composting systems, treated waste is contained within the composting facility where its properties can be readily monitored. Mixtures of the waste, soil (to provide indigenous bacteria), and other additives may be placed in piles to be tilled for aeration, or placed in containers or on platforms to allow air to be forced through the composting mixture. In general, the compost mixture is maintained at 40 to 60% water by weight to optimize moisture conditions for biodegradation. Elevated temperatures (86 to 158°F) in compost mixtures increase microbial metabolism. Tilling the soil pile or forced aeration can help control temperature and oxygen levels. Composting in closed containers can control volatile emissions. Composted wastes that meet health-based criteria can be used to condition soil, cover landfills, and supply clean fill. Table 8 presents the survey findings for bioremediation.

Waste Type	Disposal Fee	State	Facility
Contaminated soils	\$20.00/yd <sup>3</sup>	NM	JFJ Landfarm Inc.
	\$50.00/ton	MT	PetroComp
	\$50.00–\$120.00/yd <sup>3</sup>	WY	Newpark Environmental Services
Oil-based muds and cuttings	\$20.00/yd <sup>3</sup>	NM	JFJ Landfarm Inc.
	\$40.00/bbl	MT	PetroComp
	\$50.00–\$120.00/yd <sup>3</sup>	WY	Newpark Environmental Services
Tank bottoms	\$20.00/yd <sup>3</sup>	NM	JFJ Landfarm Inc.
	\$40.00/bbl	MT	PetroComp
Water-based muds and cuttings	\$20.00/yd <sup>3</sup>	NM	JFJ Landfarm Inc.
	\$40.00/bbl	MT	PetroComp

Two companies in New Mexico and Wyoming use blending and composting for biodegradation. Another company in Montana describes its bioremediation as bacteria-based. The disposal costs in New Mexico are \$20.00/yd<sup>3</sup> for contaminated soils, oil-based muds and cuttings, tank bottoms, and water-based muds and cuttings. In Montana, disposal costs are \$50.00/ton for contaminated soils and \$40.00/bbl for oil-based muds and cuttings, tank bottoms, and water-based muds and cuttings. The disposal costs range between \$50.00/yd<sup>3</sup> and \$120.00/yd<sup>3</sup> for contaminated soils and oil-based muds and cuttings in Wyoming.

### 4.3.2 Burial

Burial is the placement of waste in constructed or natural excavations, such as landfills or pits. Burial is a common onshore disposal technique used for disposing of drilling wastes.

*Burial (landfills).* Landfills are used for disposing of large volumes of municipal, industrial, and hazardous wastes. In landfills, wastes are placed in an engineered impoundment in the ground. At the end of each day or based on some other cycle, the waste is covered with a layer of clean soil or some other inert cover material. Modern design standards require clay or synthetic liners. Landfills can be used for disposing of drilling wastes and other oil field wastes. Wastes suitable for burial are generally limited to solid or semisolid, low-salt, low-hydrocarbon content inert materials. In certain locations, landfills accept E&P wastes only, and would hence be considered monofills for E&P wastes. Table 9 presents the survey findings for burial (landfills).

Waste Type	Disposal Fee	State	Facility
Contaminated soils	\$14.00/bbl	TX	US Liquids of Louisiana LP - Galveston (Transfer)
	\$14.00–\$42.00/ton	NM	Lea Land Inc.
	\$15.00–\$22.00/bbl	ND	Dishon Disposal Inc. - Dishon Landfill
	\$15.00–\$30.00/ton	ND	Prairie Disposal Inc. - Krenz Landfill
	\$15.00–\$50.00/ton	OH	American Landfill Inc.
	\$16.00–\$65.00/ton	OH	Countywide Landfill and Landfill Gas Processing Plant
	\$18.00/ton	OH	Waste Management Inc. - Coshocton Landfill
	\$18.00/ton	OH	Waste Management Inc. - Mahoning Landfill
	\$18.00/ton	OH	Waste Management Inc. - Suburban Landfill
	\$18.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
	\$18.00/yd <sup>3</sup>	NM	Sundance Services Inc.
	\$2.50–\$28.00/ton	CO	Clean Harbors Environmental Services - Deer Trail LLC
	\$20.00–\$30.00/ton	MS	MacLand Disposal Center
	\$28.00/ton	FL	Perdido Landfill Escambia County
	\$28.75/ton	WV	Allied Waste Management Inc. - Sycamore Landfill
	\$30.00–\$60.00/ton	WV	Waste Management Inc. - Northwestern Landfill
\$32.00/ton	AL	BFI Timberlands Sanitary Landfill	
\$35.00–\$80.00/ton	ND	Indian Hills Disposal Inc. - Indian Hill Landfill	

<b>TABLE 9 Landfill Burial</b>			
Waste Type	Disposal Fee	State	Facility
	\$38.00/ton	MS	Waste Management - Central Landfill
	\$38.00–\$128.00/ton	MS	Waste Management Inc. - Pecan Grove Sanitary Recycling and Disposal Facility
	\$38.00–\$75.00/ton	WV	Waste Management Inc. - Meadowfill Landfill
	\$56.00/ton	KY	Allied Waste Management - Green Valley Landfill General Partnership
	\$6.67/bbl	TX	US Liquids of Louisiana LP - Zapata (Direct)
	\$65.00–\$70.00/ton	CA	Waste Management Inc. - McKittrick Facility
	\$68.00–\$80.00/drum	UT	Clean Harbors Environmental Services - Grassy Mountain Landfill
	\$7.71/bbl	TX	US Liquids of Louisiana LP - Rincon (Direct)
	\$70.00/ton	AL	Waste Management Inc. - Chastang Landfill
\$75.00–\$250.00/ton	LA	Chemical Waste Management Inc.	
NORM	\$135.00/ton	UT	Clean Harbors Environmental Services - Grassy Mountain Landfill
	\$15.00–\$50.00/ton	OH	American Landfill Inc.
	\$16.00–\$65.00/ton	OH	Countywide Landfill and Landfill Gas Processing Plant
	\$18.00/ton	OH	Waste Management Inc. - Coshocton Landfill
	\$18.00/ton	OH	Waste Management Inc. - Mahoning Landfill
	\$18.00/ton	OH	Waste Management Inc. - Suburban Landfill
	\$30.00–\$60.00/ton	WV	Waste Management Inc. - Northwestern Landfill
	\$38.00–\$75.00/ton	WV	Waste Management Inc. - Meadowfill Landfill
Oil-based muds and cuttings	\$70.00/ton	AL	Waste Management Inc. - Chastang Landfill
	\$12.75/bbl	TX	US Liquids of Louisiana LP - Galveston (Transfer)
	\$14.00–\$42.00/ton	NM	Lea Land Inc.
	\$15.00–\$22.00/bbl	ND	Dishon Disposal Inc. - Dishon Landfill
	\$15.00–\$30.00/ton	ND	Prairie Disposal Inc. - Krenz Landfill
	\$15.00–\$50.00/ton	OH	American Landfill Inc.
	\$16.00/yd <sup>3</sup>	NM	Gandy Marley Inc.
	\$16.00–\$65.00/ton	OH	Countywide Landfill and Landfill Gas Processing Plant
	\$18.00/ton	OH	Waste Management Inc. - Coshocton Landfill
	\$18.00/ton	OH	Waste Management Inc. - Mahoning Landfill
	\$18.00/ton	OH	Waste Management Inc. - Suburban Landfill
	\$18.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
	\$18.00/yd <sup>3</sup>	NM	Sundance Services Inc.
	\$2.50–\$28.00/ton	CO	Clean Harbors Environmental Services - Deer Trail LLC
	\$20.00–\$30.00/ton	MS	MacLand Disposal Center
	\$28.75/ton	WV	Allied Waste Management Inc. - Sycamore Landfill
	\$30.00–\$60.00/ton	WV	Waste Management Inc. - Northwestern Landfill
	\$32.00/ton	AL	Bfi Timberlands Sanitary Landfill
	\$35.00–\$80.00/ton	ND	Indian Hills Disposal Inc. - Indian Hill Landfill
	\$38.00/ton	MS	Waste Management - Central Landfill
\$38.00–\$128.00/ton	MS	Waste Management Inc. - Pecan Grove Sanitary Recycling and Disposal Facility	
\$38.00–\$75.00/ton	WV	Waste Management Inc. - Meadowfill Landfill	
\$56.00/ton	KY	Allied Waste Management - Green Valley Landfill General Partnership	

<b>TABLE 9 Landfill Burial</b>			
Waste Type	Disposal Fee	State	Facility
	\$6.67-8.50/bbl	TX	US Liquids of Louisiana LP - Zapata (Direct)
	\$65.00-\$70.00/ton	CA	Waste Management Inc. - McKittrick Facility
	\$68.00-\$80.00/drum	UT	Clean Harbors Environmental Services - Grassy Mountain Landfill
	\$7.71-\$9.25/bbl	TX	US Liquids of Louisiana LP - Rincon (Direct)
	\$70.00/ton	AL	Waste Management Inc. - Chastang Landfill
Produced water	\$15.00-\$22.00/bbl	ND	Dishon Disposal Inc. - Dishon Landfill
	\$15.00-\$50.00/ton	OH	American Landfill Inc.
	\$16.00-\$65.00/ton	OH	Countywide Landfill and Landfill Gas Processing Plant
	\$18.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
	\$30.00-\$60.00/ton	WV	Waste Management Inc. - Northwestern Landfill
	\$35.00-\$80.00/ton	ND	Indian Hills Disposal Inc. - Indian Hill Landfill
	\$37.00/ton	AZ	Diversified Transportation
	\$38.00/ton	MS	Waste Management - Central Landfill
	\$38.00-\$128.00/ton	MS	Waste Management Inc. - Pecan Grove Sanitary Recycling and Disposal Facility
	\$38.00-\$75.00/ton	WV	Waste Management Inc. - Meadowfill Landfill
	\$55.00-\$75.00/ton	MS	MacLand Disposal Center
	\$56.00/ton	KY	Allied Waste Management - Green Valley Landfill General Partnership
	\$75.00-\$250.00/ton	LA	Chemical Waste Management Inc.
Tank bottoms	\$10.50/bbl	TX	US Liquids of Louisiana LP - Rincon (Direct)
	\$10.50/bbl	TX	US Liquids of Louisiana LP - Zapata (Direct)
	\$14.00/bbl	TX	US Liquids of Louisiana LP - Galveston (Transfer)
	\$15.00-\$22.00/bbl	ND	Dishon Disposal Inc. - Dishon Landfill
	\$15.00-\$30.00/ton	ND	Prairie Disposal Inc. - Krenz Landfill
	\$15.00-\$50.00/ton	OH	American Landfill Inc.
	\$16.00-\$65.00/ton	OH	Countywide Landfill and Landfill Gas Processing Plant
	\$18.00/ton	OH	Waste Management Inc. - Coshocton Landfill
	\$18.00/ton	OH	Waste Management Inc. - Mahoning Landfill
	\$18.00/ton	OH	Waste Management Inc. - Suburban Landfill
	\$18.00/yd <sup>3</sup>	NM	Sundance Services Inc.
	\$2.50-\$28.00/ton	CO	Clean Harbors Environmental Services - Deer Trail LLC
	\$28.75/ton	WV	Allied Waste Management Inc. - Sycamore Landfill
	\$30.00-\$60.00/ton	WV	Waste Management Inc. - Northwestern Landfill
	\$32.00/ton	AL	BFI Timberlands Sanitary Landfill
	\$35.00-\$80.00/ton	ND	Indian Hills Disposal Inc. - Indian Hill Landfill
	\$38.00/ton	MS	Waste Management - Central Landfill
	\$38.00-\$128.00/ton	MS	Waste Management Inc. - Pecan Grove Sanitary Recycling and Disposal Facility
	\$38.00-\$75.00/ton	WV	Waste Management Inc. - Meadowfill Landfill
	\$55.00-\$75.00/ton	MS	MacLand Disposal Center
	\$56.00/ton	KY	Allied Waste Management - Green Valley Landfill General Partnership
	\$65.00-\$70.00/ton	CA	Waste Management Inc. - McKittrick Facility
\$68.00-\$80.00/drum	UT	Clean Harbors Environmental Services - Grassy Mountain	

<b>TABLE 9 Landfill Burial</b>			
Waste Type	Disposal Fee	State	Facility
			Landfill
	\$70.00/ton	AL	Waste Management Inc. - Chastang Landfill
	\$75.00–\$250.00/ton	LA	Chemical Waste Management Inc.
Water-based muds and cuttings	\$10.75/bbl	TX	US Liquids of Louisiana LP - Galveston (Transfer)
	\$14.00–\$42.00/ton	NM	Lea Land Inc.
	\$15.00–\$22.00/bbl	ND	Dishon Disposal Inc. - Dishon Landfill
	\$15.00–\$30.00/ton	ND	Prairie Disposal Inc. - Krenz Landfill
	\$15.00–\$50.00/ton	OH	American Landfill Inc.
	\$16.00/yd <sup>3</sup>	NM	Gandy Marley Inc.
	\$16.00–\$65.00/ton	OH	Countywide Landfill and Landfill Gas Processing Plant
	\$18.00/ton	OH	Waste Management Inc. - Coshocton Landfill
	\$18.00/ton	OH	Waste Management Inc. - Mahoning Landfill
	\$18.00/ton	OH	Waste Management Inc. - Suburban Landfill
	\$18.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
	\$18.00/yd <sup>3</sup>	NM	Sundance Services Inc.
	\$2.50–\$28.00/ton	CO	Clean Harbors Environmental Services - Deer Trail LLC
	\$2.61/bbl	TX	US Liquids of Louisiana LP - Zapata (Direct)
	\$20.00–\$30.00/ton	MS	MacLand Disposal Center
	\$24.00–\$27.00/ton	AZ	Diversified Transportation
	\$28.75/ton	WV	Allied Waste Management Inc. - Sycamore Landfill
	\$3.25/bbl	TX	US Liquids of Louisiana LP - Rincon (Direct)
	\$30.00–\$60.00/ton	WV	Waste Management Inc. - Northwestern Landfill
	\$32.00/ton	AL	BFI Timberlands Sanitary Landfill
	\$35.00–\$80.00/ton	ND	Indian Hills Disposal Inc. - Indian Hill Landfill
	\$38.00/ton	MS	Waste Management - Central Landfill
	\$38.00–\$128.00/ton	MS	Waste Management Inc. - Pecan Grove Sanitary Recycling and Disposal Facility
	\$38.00–\$75.00/ton	WV	Waste Management Inc. - Meadowfill Landfill
	\$56.00/ton	KY	Allied Waste Management - Green Valley Landfill General Partnership
	\$65.00–\$70.00/ton	CA	Waste Management Inc. - McKittrick Facility
\$68.00–\$80.00/drum	UT	Clean Harbors Environmental Services - Grassy Mountain Landfill	
\$70.00/ton	AL	Waste Management Inc. - Chastang Landfill	
\$75.00–\$250.00/ton	LA	Chemical Waste Management Inc.	

The survey identifies landfilling as an additional management option in states with a dedicated network of offsite commercial disposal companies. Land filling can present a very significant offsite management option in states where such an infrastructure is not available. Many landfills, especially those operated by the big national companies, have solidification capabilities. In other cases, the wastes are disked and dried, or land is spread prior to land filling. Prior treatment results in higher disposal fees. Disposal fees at landfills accepting E&P waste across the United States range considerably—from as low as \$2.50/ton in Colorado to

\$250.00/ton in Louisiana. Most charges, however, fall into a range of \$14.00/ton /ton to \$80.00/ton. Prior treatment (solidification) of liquid waste streams leads to higher disposal fees. Landfills accepting NORM were reported for Alabama, California, Ohio, Utah, and West Virginia.

*Burial (pits).* The use of earthen or lined pits is integral to drilling waste management. In the course of most U.S. onshore drilling operations, the cuttings separated by the shale shaker are sent to a pit located near the drill rig—the so-called reserve pit. The pit is generally open to the atmosphere, so it also accumulates storm water and wash water from the rig. The strategic location of small pits near drilling sites can also help minimize spillage of waste materials. Unless site characteristics are such that no significant threat to water resources can occur, liners are generally required. Where pits must be constructed adjacent to water bodies or on sloping terrain, engineering precautions incorporated into the design help to ensure pit integrity. At the end of the drilling job, any hydrocarbon products floating on top of the pits are recovered and any free water or other liquids are collected and disposed of, usually in an injection well. The remaining cuttings are covered in place using native soils; the surface is graded to prevent water accumulation; and the area is revegetated with native species to reduce the potential for erosion and promote full recovery of the area’s ecosystem. For wastes with constituent concentrations only slightly higher than those allowed for traditional pit burial, the wastes may be blended with clean, local soil to dilute and reduce the high concentrations to acceptable levels before the waste-soil mix is buried. The objective of this approach is to incorporate wastes that meet required criteria into the soil at a level below the major rooting zone for plants but above the water table. Table 10 presents the survey findings for burial (pits).

Waste Type	Disposal Fee	State	Facility
Contaminated soils	\$1.00/bbl	OK	T & S Mud Disposal
	\$10.00/yd <sup>3</sup>	OK	Scott J. Inc. Oilfield Mud Disposal
	\$36.00/yd <sup>3</sup>	UT	Nick’s Disposal Pit LLC
	\$8.00/bbl	UT	Brennan Bottom Disposal
Oil-based muds and cuttings	\$17.00/bbl	WY	High Plains Resources Inc. - Parkman Reservoir
	\$2.00–\$8.00/bbl	WY	Jim’s Water Service - McBeth Pits
	\$30.00/yd <sup>3</sup>	TX	J. Moss Investments Inc. - Bustamante Facility
	\$8.00/bbl	UT	Brennan Bottom Disposal
Produced water	\$0.35/bbl	OK	Femco (Webb Dozer)
	\$0.87/bbl	UT	Brennan Bottom Disposal
	\$1.50/bbl	WY	Jim’s Water Service - McBeth Pits
	\$1.75–\$4.00/bbl	WY	High Plains Resources Inc. - Parkman Reservoir
Tank bottoms	\$17.00/bbl	WY	High Plains Resources Inc. - Parkman Reservoir
	\$5.00/bbl	UT	Brennan Bottom Disposal

Waste Type	Disposal Fee	State	Facility
Water-based muds and cuttings	\$1.00/bbl	OK	O'Daniel
	\$1.00/bbl	OK	T & S Mud Disposal
	\$1.00/bbl	OK	Trout Disposal
	\$1.00–\$2.00/bbl	OK	Scott J. Inc. Oilfield Mud Disposal
	\$1.00–\$2.00/bbl	TX	Basic Energy Services - Duval
	\$1.20/bbl	OK	Safe Earth Inc.
	\$1.25/bbl	OK	Femco (Webb Dozer)
	\$1.50/bbl	OK	Hamm & Phillips Service Company (Guard)
	\$17.00/bbl	WY	High Plains Resources Inc. - Parkman Reservoir
	\$2.00/bbl	TX	Karon Smith
	\$2.00–\$8.00/bbl	WY	Jim's Water Service - McBeth Pits
	\$3.00/bbl	TX	Mo-Vac Service Co. Inc. - Ganaway Facility
	\$7.00/bbl	TX	J. Moss Investments Inc. - Bustamante Facility
	\$8.00/bbl	UT	Brennan Bottom Disposal

The survey found that commercial pit operations seem on the retreat, judging by the number of companies that seemed no longer operational as well as the comments made by some respondents. Pit disposal is still reported in Oklahoma (seven companies), Texas (four companies), Utah (two companies), and Wyoming (two companies). Disposal fees in Oklahoma are \$1.00/bbl /bbl to \$2.10/bbl (\$10.00/yd<sup>3</sup>) for contaminated soils, \$0.35/bbl for produced water, and \$1.00/bbl /bbl to \$2.00/bbl for water-based muds and cuttings. In Texas, the disposal fee ranges between \$1.00/bbl and \$7.00/bbl for water-based muds and cuttings. One company accepting oil-based muds and cuttings asks for \$30.00/yd<sup>3</sup>. The disposal fees in Utah are \$7.50/bbl (\$36.00/yd<sup>3</sup>) to \$8.00/bbl for contaminated soils, \$8.00/bbl for oil- and water-based muds and cuttings, \$0.87/bbl for produced water, and \$5.00/bbl for tank bottoms. In Wyoming, disposal fees are \$2.00/bbl /bbl to \$17.00/bbl for oil- and water-based muds and cuttings, \$1.50/bbl /bbl to \$4.00/bbl for produced water, and \$17.00/bbl for tank bottoms.

### 4.3.3 Caverns

Underground salt deposits are found in the continental United States. Salt domes are large, fingerlike projections of nearly pure salt that have risen to near the surface. Bedded salt formations typically contain multiple layers of salt separated by layers of other rocks. Salt beds occur at depths of 500 to more than 6,000 ft below the surface. Salt caverns used for oil field waste disposal are created by solution mining. Well drilling equipment is used to drill a hole from the surface to the depth of the salt formation, and a smaller diameter pipe called tubing is lowered through the middle of the well. This arrangement creates two pathways into and out of the well. In the course of the process, the well operator pumps freshwater through one of the pipes. As the freshwater comes in contact with the salt formation, the salt dissolves until the water becomes saturated with salt. Cavern space is created by the removal of the salt-laden brine. Wastes are brought to the cavern site in trucks and unloaded into mixing tanks where they are blended with water or brine to make a slurry. Grinding equipment may be used to reduce particle



size. The waste slurry is then pumped into the caverns. The incoming waste displaces the brine, which is brought to the surface and either sold or injected into a disposal well. Inside the cavern, the solids, oils, and other liquids separate into distinct layers: solids sink to the bottom, the oily and other hydrocarbons float to the top, and brine and other watery fluids remain in the middle. Caverns are appropriate for E&P wastes because they can readily accept wastes that contain excessive levels of solids. Some other forms of drilling waste disposal, like slurry injection, require much more careful control of solids size. The oil content of the injected waste is not as critical for injection, thereby reducing operational costs. The surface footprint and chance of surface-related problems are greatly reduced from that of a land treatment or landfill operation. Wastes are placed deep underground in an impermeable and self-healing matrix of salt. No leaks or releases have been observed from the limited number of caverns used for disposal. Table 11 presents the survey findings for cavern disposal.

The survey presents information for seven companies and multiple facilities, all located in Texas. All waste streams are amenable to being managed by way of cavern disposal. One company accepts NORM. The disposal fees range from \$2.00/bbl to \$15.00/bbl for contaminated soils, oil-based muds and cuttings, water-based muds and cuttings, and tank bottoms. In the case of produced water, the low end of the range starts at \$0.30/bbl to \$0.40/bbl offered by Coastal Caverns. One company, Lotus, manages NORM for a disposal fee between \$150.00/bbl and \$300.00/bbl. These costs appear competitive with other oil field waste disposal companies operating in the same geographic area. Interest has grown for siting new commercial disposal caverns near the coast that can receive wastes from offshore operations. Louisiana adopted cavern disposal regulations in May 2003; one company, CCS Energy Services LLC, plans to open Louisiana cavern in the near future.

**TABLE 11 Cavern Disposal in Texas**

Waste Type	Disposal Fee	Facility
Contaminated soils	\$2.00–\$7.00/bbl	Coastal Caverns Inc.
	\$3.50/bbl	Wasson Solid Waste Disposal System LLC
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Andrews (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Big Spring (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Fort Stockton (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Plains (Direct)
	\$6.00/bbl	Taylor Disposal Operating Inc. - Caverns 1 & 2
	\$6.00–\$15.00/bbl	CCS Energy Services LLC - Kiva (Direct)
	\$6.00–\$15.00/bbl	CCS Energy Services LLC - Moss Bluff (Direct)
NORM	\$150.00–\$300.00/bbl	Lotus LLC
Oil-based muds and cuttings	\$2.00–\$7.00/bbl	Coastal Caverns Inc.
	\$3.50/bbl	Wasson Solid Waste Disposal System LLC
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Andrews (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Big Spring (Direct)

<b>TABLE 11 Cavern Disposal in Texas</b>		
Waste Type	Disposal Fee	Facility
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Fort Stockton (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Plains (Direct)
	\$6.00/bbl	Taylor Disposal Operating Inc. - Caverns 1 & 2
	\$6.00–\$15.00/bbl	CCS Energy Services LLC - Kiva (Direct)
	\$6.00–\$15.00/bbl	CCS Energy Services LLC - Moss Bluff (Direct)
Produced water	\$0.30–\$0.40/bbl	Coastal Caverns Inc.
	\$3.50/bbl	Wasson Solid Waste Disposal System LLC
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Andrews (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Big Spring (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Fort Stockton (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Plains (Direct)
	\$6.00/bbl	Taylor Disposal Operating Inc. - Caverns 1 & 2
	\$0.50–\$3.00/bbl	CCS Energy Services LLC - Kiva (Direct)
\$0.50–\$15.00/bbl	CCS Energy Services LLC - Moss Bluff (Direct)	
Tank bottoms	\$2.00–\$7.00/bbl	Coastal Caverns Inc.
	\$3.50/bbl	Wasson Solid Waste Disposal System LLC
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Andrews (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Big Spring (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Fort Stockton (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Plains (Direct)
	\$6.00/bbl	Taylor Disposal Operating Inc. - Caverns 1 & 2
	\$6.00–\$15.00/bbl	CCS Energy Services LLC - Kiva (Direct)
	\$6.00–\$15.00/bbl	CCS Energy Services LLC - Moss Bluff (Direct)
Water-based muds and cuttings	\$2.00–\$7.00/bbl	Coastal Caverns Inc.
	\$3.50/bbl	Wasson Solid Waste Disposal System LLC
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Andrews (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Big Spring (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Fort Stockton (Direct)
	\$5.00–\$10.00/bbl	Newpark Environmental Services - Permian Basin - Plains (Direct)
	\$6.00/bbl	Taylor Disposal Operating Inc. - Caverns 1 & 2
	\$6.00–\$15.00/bbl	CCS Energy Services LLC - Kiva (Direct)
\$6.00–\$15.00/bbl	CCS Energy Services LLC - Moss Bluff (Direct)	

#### 4.3.4 Discharge

Water pollution degrades surface waters, thereby making them unsafe for drinking, fishing, swimming, and other activities. Authorized by the CWA, the NPDES permit program control water pollution by regulating point sources that discharge pollutants into waters of the United States. In most cases, the NPDES permit program is administered by authorized states. Industrial facilities must obtain permits if their discharges go directly to surface waters. POTWs

collect wastewater and transport it through a series of pipes (known as a collection system) to the treatment plant. There, the POTW removes harmful organisms and other contaminants from the sewage so that it can be discharged safely into the receiving stream. POTWs also receive wastewater from industrial users. The General Pretreatment Regulations under the CWA establish the responsibilities of federal, state, and local governments; industry; and the public to implement pretreatment standards to control pollutants, which may pass through or interfere with POTW treatment processes, from industrial users. Table 12 presents the survey findings for discharge.

The survey identified three companies in Pennsylvania and one company in Wyoming discharging under NPDES authority. In Pennsylvania, Hart Resources Technologies and Pennsylvania Brine Treatment Company use chemical precipitation to generate a nonhazardous residual sludge that is subsequently land-filled offsite at a Pennsylvania Department of Environmental Protection-permitted facility. Tunnelton Liquids Co. uses an innovative process to treat produced water. It combines acid mine drainage from an abandoned coal mine with the produced water. Chemical constituents in the mine drainage help remove contaminants from the produced water. Any solids are sent to a landfill. Following treatment, the three facilities discharge the treated wastewater to a river under the authority of an NPDES permit. The disposal fees range from \$0.045/gal to \$0.055/gal (\$2.25/bbl to \$2.75/bbl) for produced water. In Wyoming, Newpark Environmental Services uses reverse osmosis to treat produced water prior to discharge under an NPDES permit. The disposal fees for discharge range between \$2.50/bbl and \$3.50/bbl for produced water. Two companies in Pennsylvania—Moshannon Valley Sewer Authority and Castle Environmental—discharge produced water to a POTW. Both companies treat the produced water prior to discharge. The disposal fees range between \$0.015/gal and \$0.050/gal (\$0.75/bbl and \$2.50/bbl).

<b>TABLE 12 Discharge</b>			
Waste Type	Disposal Fee	State	Facility
<i>Discharge (NPDES)</i>			
Produced water	\$0.055/gal	PA	Pennsylvania Brine Treatment
	\$0.045/gal	PA	Tunnelton Liquids Co.
	\$0.0525/gal	PA	Hart Resource Technologies
	\$2.50–\$3.50/bbl	WY	Newpark Environmental Services
<i>Discharge (POTW)</i>			
Produced water	\$0.015/gal	PA	Moshannon Valley Sewer Authority
	\$0.025–\$0.050/gal	PA	Castle Environmental Inc.

#### 4.3.5 Evaporation

In semiarid regions, evaporation constitutes one means of disposing of oil and gas E&P wastes. Successful use of the technique requires that evaporation exceeds the total influent to the

evaporation system (including precipitation). Net evaporation then is the difference between the evaporation and precipitation during any time period.

The main evaporation technology involves the use of ponds. Evaporation ponds refer in general to lined retention facilities (Pochop 1985). Evaporation rates depend on the size and depth of the pond and the characteristics of the influent. For example, in semiarid regions, hot, dry air moving from a land surface will result in higher evaporation rates for smaller ponds. The evaporation rate of a solution will decrease as the solids and chemical composition increase. Depending upon its origin, evaporation pond influent may contain contaminants of various amounts and composition. In the case of produced water, spray evaporation is available. In the course of freeze-thaw evaporation, the produced water is air-sprayed in the winter. Ice pads form and heavier brine collects at the bottom. Table 13 presents the survey findings for bioremediation.

The survey found that disposal companies using evaporation are all located in Colorado, New Mexico, Utah, and Wyoming. In Colorado, the disposal fees are \$45.00/ton for contaminated soils, \$1.20/bbl to \$3.95/bbl for produced water, and \$4.00/bbl to \$20.00/bbl for water-based muds and cuttings. One company asks a high \$84.00/bbl for produced water. The disposal fees in New Mexico for produced water range from \$0.40/bbl to \$0.78/bbl. In Utah, the disposal fees are \$0.85/bbl for water-based muds and cuttings and tank bottoms, and \$0.50/bbl to \$1.23/bbl for produced water. In Wyoming, which hosts the largest network of evaporation facilities, disposal fees are \$8.50/bbl for contaminated soils, oil-based muds and cuttings, and water based muds and cuttings, and \$2.00/bbl to \$3.50/bbl for produced water.

Waste Type	Disposal Fee	State	Facility
Contaminated soils	\$45.00/ton	CO	Four Mile Creek Facility
	\$8.50/bbl	WY	Piney Company
	\$8.50/bbl	WY	R&G Inc.
	\$8.50/bbl	WY	Waste Inc.
Oil-based muds and cuttings	\$8.50/bbl	WY	Piney Company
	\$8.50/bbl	WY	R&G Inc.
	\$8.50/bbl	WY	Waste Inc.
Produced water	\$0.40/bbl	NM	Sundance Services, Inc.
	\$0.50–\$0.75/bbl	UT	MC & MC Disposal
	\$0.60/bbl	NM	Loco Hills Water Disposal
	\$0.78/bbl	NM	T-N-T Environmental Inc.
	\$0.85/bbl	UT	R.N. Industries
	\$1.00/bbl	UT	A-1 Tank Rental and Brine Services Inc.
	\$1.20/bbl	CO	R.N. Industries
	\$1.23/bbl	UT	Montezuma Well Service
	\$1.50/bbl	CO	Unnamed

Waste Type	Disposal Fee	State	Facility
	\$1.95–\$3.95/bbl	CO	Four Mile Creek Facility
	\$2.02/bbl	WY	Samson Resources - Wamsutter
	\$2.05/bbl	WY	Oilfield Disposal Services Inc.
	\$2.05/bbl	WY	Piney Company
	\$2.05/bbl	WY	R&G Inc.
	\$2.05/bbl	WY	Waste Inc.
	\$2.50–\$3.00/bbl	WY	Sweetwater County Solid Waste Disposal District #1
	\$3.50/bbl	WY	Anticline Disposal LLC
	\$84.00/bbl	CO	Reams Construction 80-Ponds
Tank bottoms	\$0.85/bbl	UT	R.N. Industries
Water-based muds and cuttings	\$0.85/bbl	UT	R.N. Industries
	\$4.00–\$20.00/bbl	CO	Four Mile Creek Facility
	\$7.00/bbl	CO	R.N. Industries
	\$8.50/bbl	WY	Piney Company
	\$8.50/bbl	WY	R&G Inc.
	\$8.50/bbl	WY	Waste Inc.

#### 4.3.6 Injection

Disposal by injection is a process in which liquids are pumped into a well for placement into porous rock or sand formations below the ground surface. The fluids may be water, wastewater, or water mixed with chemicals. Oil field practices across the United States have established underground injection as a viable alternative method for the disposal of these types of industrial wastes. The EPA estimates that more than 2 billion gallons of brine from oil and gas operations are injected every day. Injection operations are governed by UIC programs under the SDWA. Table 14 presents the survey findings for injection.

The survey found that injection was almost exclusively used to manage produced water. Disposal fees for injection of produced water range between \$0.30/bbl and \$10.00/bbl across the United States. The majority of the facilities surveyed reported disposal fees under \$1.00/bbl. One company in Alabama injects water-based muds and cuttings for a disposal fee of \$0.50/bbl.

Disposal Fee	State	Facility
<i>Produced Water</i>		
\$0.30/bbl	OK	Nichols Water Service Inc. - A.R. Turner
\$0.30/bbl	OK	Nichols Water Service Inc. - Nichols 1
\$0.30/bbl	OK	Nichols Water Service Inc. - Nichols 2

<b>TABLE 14 Injection</b>		
Disposal Fee	State	Facility
\$0.30/bbl	OK	Nichols Water Service Inc. - Nichols 3
\$0.35/bbl	OK	T & S Mud Disposal
\$0.35–\$0.50/bbl	AL	T.K. Stanley Inc.
\$0.37/bbl	MS	Radzewicz Operating Corporation
\$0.40/bbl	AR	Fugo Services
\$0.40/bbl	NM	Chaparral Service Inc.
\$0.40/bbl	OK	Fugo Services – Blizzard
\$0.40/bbl	OK	Fugo Services – Buckner
\$0.40/bbl	OK	Fugo Services – Mackey
\$0.40/bbl	OK	Fugo Services – Nichols
\$0.40/bbl	OK	Fugo Services – Quinton
\$0.40–\$4.00/bbl	TX	S & D Services – Floyd
\$0.45/bbl	AL	Zinn Petroleum Company
\$0.50/bbl	AL	Wastewater Disposal Service, Inc.
\$0.50/bbl	LA	Charles Holston, Inc.
\$0.50/bbl	LA	Guillory Tank Truck Service
\$0.50/bbl	LA	Louisiana Tank, Inc.
\$0.50/bbl	MI	Seiler Tank Truck Service Inc.
\$0.50/bbl	ND	Missouri Basin Well Service, Inc. - H.T. Knudtson #1
\$0.50/bbl	ND	Missouri Basin Well Service, Inc. - Zenith-Newton Unit #5
\$0.50/bbl	NM	O K Hot Oil Service Inc.
\$0.50/bbl	TX	Mo-Vac Service Co. Inc. - Andrews
\$0.50/bbl	TX	Wasson Solid Waste Disposal System LLC - RCC District 8A/Yoakum County
\$0.50–\$10/bbl	LA	Saline Injection Systems Co.
\$0.55/bbl	AR	Eastern Tank Service
\$0.55/bbl	AR	Property Transfer Corp.
\$0.60/bbl	LA	Houma Salt Water Disposal Corp. - Off LA Hwy 316
\$0.60/bbl	MS	Earth Resources
\$0.60/bbl	NM	Gandy Marley Inc.
\$0.60/bbl	OK	Trout Disposal
\$0.60–\$0.65/bbl	OK	Safe Earth Inc.
\$0.65/bbl	LA	Philip Environmental Services (PSC Industrial Outsourcing, Inc.) - Morgan City Facility
\$0.67/bbl	LA	Habetz Oilfield Saltwater Service
\$0.70/bbl	ND	Ward-Williston Company – Carpentier
\$0.70/bbl	ND	Ward-Williston Company - Martin-Williams
\$0.70/bbl	ND	Ward-Williston Company – Montgomery
\$0.70/bbl	ND	Ward-Williston Company - Pan Am
\$0.70/bbl	ND	Ward-Williston Company - Theodore
\$0.70/bbl	TX	Taylor Disposal Operating Inc. - Butler
\$0.75/bbl	AR	Key Energy Services
\$0.75/bbl	LA	Key Energy Services, Inc. – Athens
\$0.75/bbl	LA	Key Energy Services, Inc. - Oil City
\$0.75/bbl	LA	O'Brian Energy Co.
\$0.75/bbl	TX	Key Energy Services, Inc. - Amando, Webb County School Land, Mckendrick, and Barker
\$0.75/bbl	TX	Key Energy Services, Inc. - Bettie Unit, Porter/Holland, and Sebesta Earl

<b>TABLE 14 Injection</b>		
Disposal Fee	State	Facility
\$0.75/bbl	TX	Key Energy Services, Inc. - Bloes and Thornton/Henry
\$0.75/bbl	TX	Key Energy Services, Inc. - Brown/Alma and Jeter-Farmer
\$0.75/bbl	TX	Key Energy Services, Inc. - Burns and Hanselman Unit 1
\$0.75/bbl	TX	Key Energy Services, Inc. - Carthage Loop, Deberry, Panola County Disposal, Reed, and Singleton (2)
\$0.75/bbl	TX	Key Energy Services, Inc. - Case
\$0.75/bbl	TX	Key Energy Services, Inc. - Cashburn
\$0.75/bbl	TX	Key Energy Services, Inc. - Cooper
\$0.75/bbl	TX	Key Energy Services, Inc. - Dasani
\$0.75/bbl	TX	Key Energy Services, Inc. - Early
\$0.75/bbl	TX	Key Energy Services, Inc. - Freestone County (2)
\$0.75/bbl	TX	Key Energy Services, Inc. - Gangl Unit
\$0.75/bbl	TX	Key Energy Services, Inc. - Gayle (2)
\$0.75/bbl	TX	Key Energy Services, Inc. - Gutierrez (2), Leonard, Medina/Lozano, Villareal (3), and Ramirez
\$0.75/bbl	TX	Key Energy Services, Inc. - Hunt/William and Brushy Creek Gas Unit
\$0.75/bbl	TX	Key Energy Services, Inc. - Hutson
\$0.75/bbl	TX	Key Energy Services, Inc. - Joaquin
\$0.75/bbl	TX	Key Energy Services, Inc. - Kinder/George
\$0.75/bbl	TX	Key Energy Services, Inc. - Kristina
\$0.75/bbl	TX	Key Energy Services, Inc. - Live Oak County
\$0.75/bbl	TX	Key Energy Services, Inc. - Mckeown and Meisenheimer
\$0.75/bbl	TX	Key Energy Services, Inc. - Moser
\$0.75/bbl	TX	Key Energy Services, Inc. - Nichols Unit
\$0.75/bbl	TX	Key Energy Services, Inc. - Peterson
\$0.75/bbl	TX	Key Energy Services, Inc. - South Texas Disposal Inc.
\$0.75/bbl	TX	Key Energy Services, Inc. - Standifer
\$0.75/bbl	TX	Key Energy Services, Inc. - Teeters
\$0.75/bbl	TX	Key Energy Services, Inc. - Vick and Lisa
\$0.75/bbl	TX	Key Energy Services, Inc. - Washington County, Clay Creek East Unit, and Linda G
\$0.75/bbl	TX	Key Energy Services, Inc. - Youngblood
\$0.85/bbl	LA	Pool Company – Minden
\$0.88/bbl	NM	Basin Disposal Inc.
\$035–\$0.75/bbl	ND	Black Hawk Resources LLC - Hatter
\$035–\$0.75/bbl	ND	Black Hawk Resources LLC - Klandl
\$1.00/bbl	LA	Hallar Enterprises Inc. Disposal Site
\$1.00/bbl	LA	US Liquids of Louisiana LP - Elm Grove (Direct)
\$1.00/bbl	WV	Base Petroleum
\$1.00/bbl	WV	Danny Web Construction
\$1.00–\$1.50/bbl	MI	Beckman Production Services Inc.
\$1.30–\$1.75/bbl	MI	Northeastern Exploration
\$2.00/bbl	WY	Mel's Water Service
\$3.00/bbl	LA	US Liquids of Louisiana LP - Mermenteau (Transfer)
\$3.00/bbl	WY	Joe Scott Enterprises LLC - Reed Fee
\$3.00/bbl	WY	Yellow Creek Production and Water Disposal LLC - Carpentre
\$3.00–\$7.00/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)

Disposal Fee	State	Facility
\$3.00–\$7.00/bbl	LA	US Liquids of Louisiana LP - Cameron (Transfer)
\$3.00–\$7.00/bbl	LA	US Liquids of Louisiana LP - Fourchon (Transfer)
\$3.00–\$7.00/bbl	LA	US Liquids of Louisiana LP - Intercoastal City (Transfer)
\$3.00–\$7.00/bbl	LA	US Liquids of Louisiana LP - Venice (Transfer)
\$65.00/load	ND	Energy Equity Company - Borgen
\$65.00/load	ND	Energy Equity Company - George Tank
\$65.00/load	ND	Energy Equity Company - Heckert
\$65.00/load	ND	Energy Equity Company - North Dickinson
\$7.00/bbl	LA	US Liquids of Louisiana LP - Bateman Island (Direct)
\$7.00/bbl	LA	US Liquids of Louisiana LP - Bourg (Direct)

Solids injection commands higher costs. One of the big commercial companies operating in Louisiana and Texas, Newpark Environmental Services, creates a slurry of liquids and solid particles prior to injection. This allows the company to manage the entire suite of waste streams studied in the survey. The disposal fees are \$5.00/bbl to \$10.50/bbl for contaminated soils, oil-based muds and cuttings, produced water, tank bottoms, and water-based muds and cuttings. Newpark Environmental Services offers NORM disposal at its Big Hill facility for \$150.00/bbl to \$300.00/bbl. Table 15 presents the survey findings for solids injection.

Waste Type	Disposal Fee	State	Facility
Contaminated soils	\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Farnett (Direct)
	\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Port Arthur (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Cameron (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon I (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon II (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Intercoastal City (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Morgan City (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Venice (Transfer)
	\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Galveston (Transfer)
\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Ingleside (Transfer)	
NORM	\$150.00–\$300.00/bbl	TX	Newpark Environmental Services - Big Hill (Direct)
Oil-based muds and cuttings	\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Farnett (Direct)
	\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Port Arthur (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Cameron (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon I (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon II (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Intercoastal City



<b>TABLE 15 Solids Injection</b>			
Waste Type	Disposal Fee	State	Facility
			(Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Morgan City (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Venice (Transfer)
	\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Galveston (Transfer)
	\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Ingleside (Transfer)
Produced water	\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Farnett (Direct)
	\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Port Arthur (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Cameron (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon I (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon II (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Intercoastal City (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Morgan City (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Venice (Transfer)
	\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Galveston (Transfer)
Tank bottoms	\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Ingleside (Transfer)
	\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Farnett (Direct)
	\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Port Arthur (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Cameron (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon I (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon II (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Intercoastal City (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Morgan City (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Venice (Transfer)
Water-based muds and cuttings	\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Galveston (Transfer)
	\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Farnett (Direct)
	\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Port Arthur (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Cameron (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon I (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon II (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Intercoastal City (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Morgan City (Transfer)
	\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Venice (Transfer)
	\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Galveston (Transfer)
	\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Ingleside (Transfer)
	\$0.50/bbl	AL	Wastewater Disposal Service Inc.

### 4.3.7 Land Application

The objective of applying drilling wastes to the land is to allow the soil's naturally occurring microbial population to metabolize, transform, and assimilate waste constituents in place. Land application is a form of bioremediation. It is reported separately in light of its importance. Several terms are used to describe this waste management approach, which can be considered both treatment and disposal. In general, land farming refers to the repeated application of wastes to the soil surface, whereas land spreading and land treatment are often used interchangeably to describe the one-time application to the soil surface of wastes with low levels of hydrocarbons and salts. Some practitioners do not follow the same terminology convention and may interchange the terms.

Land farming is the controlled and repeated application of wastes to the soil surface by using microorganisms in the soil to naturally biodegrade hydrocarbon constituents, dilute and attenuate metals, and transform and assimilate waste constituents. The addition of water, nutrients, and other amendments (e.g., manure and straw) can increase the biological activity and aeration of the soil, thereby preventing the development of conditions that might promote leaching and mobilization of inorganic contaminants. During periods of extended dry conditions, moisture control may also be needed to minimize dust. Periodic tillage of the mixture (to increase aeration) and nutrient additions to the waste-soil mixture can enhance aerobic biodegradation of hydrocarbons. After applying the wastes, hydrocarbon concentrations are monitored to measure progress and determine the need for enhancing the biodegradation processes. Operators control application rates to minimize the potential for runoff. Pretreating the wastes by composting and activating aerobic biodegradation by regular turning (windrows) or by forced ventilation (biopiles) can reduce the amount of acreage required for land farming. Wastes containing salt must also be carefully applied to soil. Salt, unlike hydrocarbons, cannot biodegrade but may accumulate in soils that have a limited capacity to accept salts. Another concern with land farming is that while lower molecular-weight petroleum compounds biodegrade efficiently, higher molecular-weight compounds biodegrade more slowly. This means that repeated applications can lead to accumulation of high molecular weight compounds. At high concentrations, these constituents can increase soil-water repellency, affect plant growth, reduce the ability of the soil to support a diverse community of organisms, and render the land farm no longer usable without treatment or amendment. Table 16 presents the survey findings for land application.

The survey found that land farming is a management method used in Arkansas (4 companies), New Mexico (12 companies), Texas (1 company), Utah (3 companies), and Wyoming (1 company). In Arkansas, disposal fees range between \$0.30/bbl and \$0.40/bbl for produced water, and between \$0.50/bbl and \$2.00/bbl for water-based muds and cuttings. Disposal fees in New Mexico are between \$10.00/yd<sup>3</sup> and \$57.14/yd<sup>3</sup> for contaminated soils, \$17.00/yd<sup>3</sup> to \$85.71/yd<sup>3</sup> for oil- and water-based muds and cuttings, \$5.12/bbl to \$18.00/bbl (\$7.50/yd<sup>3</sup> to \$85.71/yd<sup>3</sup>) for produced water, and \$18.00/yd<sup>3</sup> to \$85.71/yd<sup>3</sup> for tank bottoms. In Texas, the disposal fees are \$1.56/bbl to \$2.50/bbl (\$7.50/yd<sup>3</sup> to \$11.91/yd<sup>3</sup>) for water-based muds and cuttings. Disposal fees in Utah range between \$1.56/bbl and \$26.25/bbl (\$6.00/ton and \$100/ton) for contaminated soils, oil-based muds and cuttings, produced water, tank bottoms, and water-based muds and cuttings. One company in Wyoming reported a disposal fee of

<b>TABLE 16 Land Application</b>			
Waste Type	Disposal Fee	State	Facility
Contaminated soils	\$10.00/yd <sup>3</sup>	NM	Loco Hills Landfarm LLC
	\$10.00–\$12.00/yd <sup>3</sup>	NM	Saunders Landfarm LLC
	\$100.00/ton	UT	LaPoint Recycle and Storage
	\$12.00/bbl	NM	T-N-T Environmental Inc.
	\$14.00/yd <sup>3</sup>	NM	C & C Landfarm Inc.
	\$14.00/yd <sup>3</sup>	NM	Gandy Marley Inc.
	\$14.00/yd <sup>3</sup>	NM	Jay Dan Landfarm LLC
	\$14.00–\$22.00/yd <sup>3</sup>	NM	Environmental Plus
	\$17.00/yd <sup>3</sup>	NM	Contract Environmental Services Inc.
	\$18.00/yd <sup>3</sup>	NM	Goo Yea Corp. - Goo Yea Landfarm Inc.
	\$18.00/yd <sup>3</sup>	NM	Goo Yea Corp. - Rhino Oilfield Disposal Inc.
	\$25.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
	\$55.00/ton	WY	Sweetwater County Solid Waste Disposal District #1
	\$7.50/yd <sup>3</sup>	UT	A-1 Tank Rental and Brine Svs. Inc.
Oil-based muds and cuttings	\$100.00/ton	UT	LaPoint Recycle and Storage
	\$12.00/bbl	NM	T-N-T Environmental Inc.
	\$17.00–\$34.00/yd <sup>3</sup>	NM	Contract Environmental Services Inc.
	\$18.00/yd <sup>3</sup> –\$18.00/bbl	NM	Envirotech Inc.
	\$20.00/yd <sup>3</sup>	NM	JFJ Landfarm Inc.
	\$25.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
	\$4.00/bbl	UT	MC & MC Disposal
	\$55.00/ton	WY	Sweetwater County Solid Waste Disposal District #1
	\$7.50/yd <sup>3</sup>	UT	A-1 Tank Rental and Brine Svs. Inc.
Produced water	\$0.30–\$0.40/bbl	AR	Comer Mining Corp.
	\$100.00/ton	UT	LaPoint Recycle and Storage
	\$18.00/bbl	NM	Envirotech Inc.
	\$25.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
Tank bottoms	\$100.00/ton	UT	LaPoint Recycle and Storage
	\$18.00/yd <sup>3</sup> –\$18.00/bbl	NM	Envirotech Inc.
	\$34.00/yd <sup>3</sup>	NM	Contract Environmental Services Inc.
	\$4.00/bbl	UT	MC & MC Disposal
	\$55.00/ton	WY	Sweetwater County Solid Waste Disposal District #1
	\$7.50/yd <sup>3</sup>	UT	A-1 Tank Rental and Brine Svs. Inc.
Water-based muds and cuttings	\$0.50/bbl	AR	Fugo Services
	\$1.00–\$1.25/bbl	AR	Comer Mining Corp.
	\$1.75/bbl	AR	Eastern Tank Service
	\$100.00/ton	UT	LaPoint Recycle and Storage
	\$12.00/bbl	NM	T-N-T Environmental Inc.
	\$17.00/yd <sup>3</sup>	NM	Contract Environmental Services Inc.
	\$18.00/yd <sup>3</sup>	NM	Envirotech Inc.
	\$18.00/yd <sup>3</sup> –\$18.00/bbl	NM	Envirotech Inc.
\$2.00/bbl	AR	Property Transfer Corp.	

Waste Type	Disposal Fee	State	Facility
	\$20.00/yd <sup>3</sup>	NM	JFJ Landfarm Inc.
	\$25.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
	\$4.00/bbl	UT	MC & MC Disposal
	\$55.00/ton	WY	Sweetwater County Solid Waste Disposal District #1
	\$7.50/yd <sup>3</sup>	UT	A-1 Tank Rental and Brine Svs. Inc.
	\$7.50/yd <sup>3</sup> –\$2.50/bbl	TX	Basic Energy Services - Jefferson
	\$7.50/yd <sup>3</sup> –\$2.50/bbl	TX	Basic Energy Services - Jackson

\$55.00/ton for contaminated soils, oil-based muds and cuttings, tank bottoms, and water-based muds and cuttings.

#### 4.3.8 Recycling

Recycling turns materials that would otherwise become waste into valuable resources. The use of recovered materials as a substitute for virgin feedstocks conserves natural resources, reduces the energy used for manufacturing, and lessens the environmental impacts associated with the extraction and harvesting of raw materials. In addition, as a waste management technique, recycling diverts valuable materials from the waste stream and reduces the burden on other waste management facilities, including landfills and incinerators. Table 17 presents the survey findings for recycling.

The survey identified several recyclers and reclaimers. In Arkansas, the charges for tank bottoms come to \$127.00/hr. In California, fees are \$5.00/bbl for oil- and water-based muds and cuttings, produced water, and tank bottoms. The company asks \$15.00/ton for contaminated soils. In New Mexico, fees for recycling of tank bottoms range between \$3.75/bbl and \$5.00/bbl. Disposal fees in Oklahoma are \$8.00/yd<sup>3</sup> to 45.00/yd<sup>3</sup> for contaminated soils, \$16.00/bbl for oil-based muds and cuttings, \$25.00/load for produced water, \$5.00/bbl for tank bottoms, and \$75.00/load for water-based muds and cuttings.

Waste Type	Disposal Fee	State	Facility
Contaminated soils	\$15.00/ton	CA	Envirocycle
	\$8.00–\$45.00/yd <sup>3</sup>	OK	DRD Waste Treatment Solutions
Oil-based muds and cuttings	\$16.00/bbl	OK	DRD Waste Treatment Solutions
	\$5.00/bbl	CA	Envirocycle

Waste Type	Disposal Fee	State	Facility
Produced water	\$25.00/load	OK	DRD Waste Treatment Solutions
	\$5.00/bbl	CA	Envirocycle
Tank bottoms	\$127.00/hr	AR	Hydro-Kleen LLC
	\$3.75/bbl	NM	Gandy Marley Inc.
	\$5.00/bbl	CA	Envirocycle
	\$5.00/bbl	NM	Controlled Recovery Inc.
	\$5.00/bbl	OK	DRD Waste Treatment Solutions
Water-based muds and cuttings	\$5.00/bbl	CA	Envirocycle
	\$75.00/load	OK	DRD Waste Treatment Solutions

#### 4.3.9 Thermal Treatment

Thermal treatment uses high temperatures to reclaim or destroy hydrocarbon-contaminated material. This technology is the most efficient treatment for destroying organics. Moreover, it reduces the volume and mobility of inorganics such as metals and salts. Additional treatment may be necessary for metals and salts, depending on the final fate of the wastes. Waste streams high in hydrocarbons (typically 10 to 40%), like oil-based mud, are candidates for thermal treatment technology. Thermal treatment can be an interim process to reduce toxicity and volume and prepare a waste stream for further treatment or disposal (e.g., landfill, land farming, and land spreading). Or thermal treatment can be a final treatment process resulting in inert solids, water, and recovered base fluids. Thermal treatment technology is generally conducted in a fixed land-based installation. Thermal treatment technologies can be grouped into two categories. The first group uses incineration—for example, rotary kilns and cement kilns—to destroy hydrocarbons by exposing them to very high temperatures in the presence of air. The second group uses thermal desorption. In the course of this process, heat is applied directly or indirectly to the wastes to vaporize volatile and semivolatile components without incinerating the soil. In the case of some thermal desorption technologies, the offgases are combusted, and in others, such as in thermal phase separation, the gases are condensed and separated to recover heavier hydrocarbons. Thermal desorption technologies include indirect rotary kilns, hot oil processors, thermal phase separation, thermal distillation, thermal plasma volatilization, and modular thermal processors. Table 18 presents the survey findings for thermal treatment.

Waste Type	Disposal Fee	State	Facility
Contaminated soils	\$0.17–\$0.20/lb	UT	Clean Harbors Environmental Services - Aragonite
	\$0.19/lb (\$0.14–\$0.40/lb)	NE	Clean Harbors Environmental Services - Kimball
	\$0.55/lb	TX	Clean Harbors Environmental Services - Deer Park

Waste Type	Disposal Fee	State	Facility
	\$35.00/ton	FL	Rinker Materials Environmental Services
Oil-based muds and cuttings	\$0.19/lb (\$0.14–\$0.40/lb)	NE	Clean Harbors Environmental Services - Kimball
	\$0.45/lb	TX	Clean Harbors Environmental Services - Deer Park
	\$100.00/drum	FL	Rinker Materials Environmental Services
Produced water	\$0.02–\$0.20/lb	TX	Clean Harbors Environmental Services - Deer Park
Tank bottoms	\$0.19/lb (\$0.14–\$0.40/lb)	NE	Clean Harbors Environmental Services - Kimball Facility
	\$0.45/lb	TX	Clean Harbors Environmental Services - Deer Park
	\$200.00/ton	FL	Rinker Materials Environmental Services
Water-based muds and cuttings	\$0.19/lb (\$0.14–\$0.40/lb)	NE	Clean Harbors Environmental Services - Kimball
	\$0.45/lb	TX	Clean Harbors Environmental Services - Deer Park

The survey identified four thermal treatment facilities in Florida, Nebraska, Texas, and Texas. The Utah, Nebraska, and Texas facilities belong to Clean Harbors Services, a company offering a suite of waste disposal services across the United States. Disposal fees at Florida's Rinker facility are \$35.00/ton for contaminated soils, \$100.00/drum for oil-based muds and cuttings, and \$200.00/drum for tank bottoms. In Nebraska, disposal fees are \$280.00/ton to \$800.00/ton (\$0.14/lb to \$0.40/lb) for contaminated soils, oil-based muds and cuttings, tank bottoms, and water-based muds and cuttings. Disposal fees in Texas are \$1,100.00/ton (\$0.55/lb) for contaminated soils, and \$900.00/ton (\$0.45/lb) for oil-based muds and cuttings, tank bottoms, and water-based muds and cuttings. Interestingly, this facility also treats produced water for \$40.00/ton to \$400.00/ton (\$0.02/lb to \$0.20/lb). In Utah, disposal fees are \$340.00/ton to \$400.00/ton (\$0.17/lb to \$0.20/lb) for contaminated soils.

#### **4.3.10 Treatment**

The treatment methods reported in the survey involve cells, solidification/stabilization, and separation. Table 19 presents the survey findings for treatment. US Liquids of Louisiana LP manages the waste materials with earthen treatment cells. The free oil is removed and salvaged for resale. Soluble salts are removed through flushing solids with water (soil washing). The resulting salty water is then pumped through a collection system, placed in tanks, and typically disposed of at one of its commercial saltwater injection wells. All remaining waste is processed to remove organic contamination through biological degradation. The treatment process results in a reusable material as defined by the regulations of the Louisiana Department of Natural Resources. Treatment fees are \$9.50/bbl to \$14.00/bbl for contaminated soils, \$9.50/bbl to \$12.75/bbl for oil-based muds and cuttings, \$9.50/bbl to \$14.00/bbl for tank bottoms, and \$9.50/bbl to \$11.50/bbl for water-based muds and cuttings.

Eco Mud Disposal in Texas uses solidification/stabilization treatment methods. Trucks hauling liquid waste unload into three holding tanks. Dry material is stacked for treatment on

<b>TABLE 19 Treatment</b>			
Waste Type	Disposal Fee	State	Facility
Contaminated soils	\$12.50/bbl	LA	US Liquids of Louisiana LP - Bateman Island (Direct)
	\$12.50/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)
	\$12.50/bbl	LA	US Liquids of Louisiana LP - Bourg (Direct)
	\$14.00/bbl	LA	US Liquids of Louisiana LP - Cameron (Transfer)
	\$14.00/bbl	LA	US Liquids of Louisiana LP - Fourchon (Transfer)
	\$14.00/bbl	LA	US Liquids of Louisiana LP - Intercoastal City (Transfer)
	\$14.00/bbl	LA	US Liquids of Louisiana LP - Venice (Transfer)
	\$25.00–\$30.00/yd <sup>3</sup>	TX	Eco Mud Disposal - Alice Facility
	\$50.00/yd <sup>3</sup>	AL	CCS Energy Services LLC
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Cameron (Transfer)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Fourchon (Transfer)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Intercoastal City (Transfer)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Morgan City (Direct)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Venice (Transfer)
	\$9.50/bbl	LA	US Liquids of Louisiana LP - Elm Grove (Direct)
Oil-based muds and cuttings	\$11.50/bbl	LA	US Liquids of Louisiana LP - Bateman Island (Direct)
	\$11.50/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)
	\$11.50/bbl	LA	US Liquids of Louisiana LP - Bourg (Direct)
	\$12.75/bbl	LA	US Liquids of Louisiana LP - Cameron (Transfer)
	\$12.75/bbl	LA	US Liquids of Louisiana LP - Fourchon (Transfer)
	\$12.75/bbl	LA	US Liquids of Louisiana LP - Intercoastal City (Transfer)
	\$12.75/bbl	LA	US Liquids of Louisiana LP - Venice (Transfer)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Cameron (Transfer)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Fourchon (Transfer)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Intercoastal City (Transfer)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Morgan City (Direct)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Venice (Transfer)
	\$9.00/bbl	TX	Eco Mud Disposal - Alice Facility
\$9.50/bbl	LA	US Liquids of Louisiana LP - Elm Grove (Direct)	
\$9.50–\$14.50/bbl	AL	CCS Energy Services LLC	
Produced water	\$5.00/bbl	TX	Eco Mud Disposal - Alice Facility
	\$5.00–\$14.00/bbl	AL	CCS Energy Services LLC
Tank bottoms	\$10.50–\$14.50/bbl	AL	CCS Energy Services LLC
	\$12.00/bbl	TX	Eco Mud Disposal - Alice Facility
	\$12.50/bbl	LA	US Liquids of Louisiana LP - Bateman Island (Direct)
	\$12.50/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)
	\$12.50/bbl	LA	US Liquids of Louisiana LP - Bourg (Direct)
	\$14.00/bbl	LA	US Liquids of Louisiana LP - Cameron (Transfer)
	\$14.00/bbl	LA	US Liquids of Louisiana LP - Fourchon (Transfer)
	\$14.00/bbl	LA	US Liquids of Louisiana LP - Intercoastal City (Transfer)
	\$14.00/bbl	LA	US Liquids of Louisiana LP - Venice (Transfer)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Cameron (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Fourchon (Transfer)	

Waste Type	Disposal Fee	State	Facility
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Intercoastal City (Transfer)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Morgan City (Direct)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Venice (Transfer)
	\$9.50/bbl	LA	US Liquids of Louisiana LP - Elm Grove (Direct)
Water-based muds and cuttings	\$10.75/bbl	LA	US Liquids of Louisiana LP - Cameron (Transfer)
	\$10.75/bbl	LA	US Liquids of Louisiana LP - Fourchon (Transfer)
	\$10.75/bbl	LA	US Liquids of Louisiana LP - Intercoastal City (Transfer)
	\$10.75/bbl	LA	US Liquids of Louisiana LP - Venice (Transfer)
	\$3.00/bbl	TX	Eco Mud Disposal - Alice Facility
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Cameron (Transfer)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Fourchon (Transfer)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Intercoastal City (Transfer)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Morgan City (Direct)
	\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Venice (Transfer)
	\$7.50–\$9.50/bbl	LA	US Liquids of Louisiana LP - Elm Grove (Direct)
	\$8.50–\$12.50/bbl	AL	CCS Energy Services LLC
	\$9.50/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)
	\$9.50–\$11.50/bbl	LA	US Liquids of Louisiana LP - Bateman Island (Direct)
\$9.50–\$11.50/bbl	LA	US Liquids of Louisiana LP - Bourg (Direct)	

dump pads. Wastes are blended with dry chemicals in a pugmill to solidify and stabilize them. After the material has been processed, it is stored in a temporary holding area where it is allowed to fully cure before final disposition at the onsite disposal area. The process encapsulates sludge and transforms it into an inert dirt-like substance that will not leach hydrocarbons or heavy metals into the environment. Disposal fees are \$25.00/yd<sup>3</sup> to 30.00/yd<sup>3</sup> for contaminated soils, \$9.00/bbl for oil-based muds and cuttings, \$5.00/bbl for produced water, \$12.00/bbl for tank bottoms, and \$3.00/bbl for water-based muds and cuttings.

CCS Energy Services uses separation in its Alabama and Louisiana operations. In Louisiana, liquid waste streams managed by CCS Energy Services LLC undergo dewatering to separate the solids from the liquids by using desanders and decanter centrifuges. The liquid phase is further treated and either discharged to the city POTW (under a discharge permit) or disposed of by injection into a permitted saltwater injection well. The solid materials are stabilized with fly ash, off-specification oil field cement, wood chips, or similar materials, and trucked to a RCRA Subtitle D landfill for recycle as alternate daily cover. Oil-based mud and cuttings and remediation soils are more expensive to process than water-based muds and cuttings, and therefore command higher fees. High-chloride completion and stimulation fluids cost more to treat and dispose of. Disposal fees for contaminated soils, oil- and water-based muds and cuttings, and tank bottoms range from \$6.00/bbl to \$15.00/bbl. In Alabama, the disposal fees are \$50.00/yd<sup>3</sup> for contaminated soils, \$9.50/bbl to \$14.50/bbl for oil-based muds and cuttings, \$5.00/bbl to \$14.00/bbl for produced water, \$10.50/bbl to \$14.50/bbl for tank bottoms, and \$8.50/bbl to \$12.50/bbl for water-based muds and cuttings.



#### **4.4 SPECIFIC SURVEY RESULTS: DISPOSAL COSTS BY SURVEY WASTE STREAM**

The following sections were derived by querying the database by survey waste stream. The six survey waste streams include contaminated soils, NORM, oil-based muds and cuttings, produced water, tank bottoms, and water-based muds and cuttings.

##### **4.4.1 Contaminated Soils**

Table 20 presents the cost information for contaminated soils. Costs differ significantly depending on the disposal method.

Burial in landfills represents a significant cross-nation disposal option for contaminated soils. Volume-based costs range between \$6.67/bbl and \$14.00/bbl in Texas, \$18.00 yd<sup>3</sup> in New Mexico, and \$68.00/drum to \$80.00/drum in Utah. Weight-based costs vary significantly by state. For example, one company in Colorado indicates a cost between \$2.50/ton and \$28.00/ton, whereas another company in Louisiana charges between \$75.00/ton and \$250.00/ton. In general, landfill facilities that conduct solidification of liquid wastes or coaccept hazardous waste are more expensive. Landfill burial is particularly important in states where a network of dedicated commercial disposal companies is not offered. Examples include California, Ohio, Kentucky, and West Virginia, where costs range between \$15.00/ton and \$75.00/ton. Burial of contaminated soils in commercial pits is not widely reported. Two companies in Oklahoma and two companies in Utah indicate cost ranges between \$1.00/bbl and \$8.00/bbl, and between \$10.00/yd<sup>3</sup> and \$36.00/yd<sup>3</sup>.

Land application of contaminated soils is mainly offered in New Mexico (11 companies), but also in Utah (2 companies) and Wyoming (1 company). Costs range between \$7.50/yd<sup>3</sup> and \$126.00/yd<sup>3</sup> (volume-based) and \$9.45/ton and \$100.00/ton (weight-based). Most companies in New Mexico ask \$10.00/yd<sup>3</sup> to \$25.00/yd<sup>3</sup>.

Cavern disposal is a competitive option for contaminated soils in Texas. Five companies at multiple facilities offer their services for a cost between \$2.00/bbl and \$15.00/bbl.

Solids injection of contaminated soils is undertaken by one large commercial disposal company in Louisiana and Texas—Newpark Environmental Services. Costs range between \$5.00/bbl and \$10.50/bbl.

Treatment of contaminated soils is offered by three large disposal companies—CCS Energy Services LLC, Eco Mud Disposal, and US Liquids of Louisiana LP. Costs range from \$6.00/bbl to \$15.00/bbl in Louisiana, and from \$25.00/yd<sup>3</sup> to \$50.00/yd<sup>3</sup> in Alabama and Texas.

<b>TABLE 20 Disposal Fees for Contaminated Soils</b>		
Disposal Fee	State	Facility
<i>Bioremediation</i>		
\$20.00/yd <sup>3</sup>	NM	JFJ Landfarm Inc.
\$50.00/ton	MT	PetroComp
\$50.00–\$120.00/yd <sup>3</sup>	WY	Newpark Environmental Services
<i>Burial (landfill)</i>		
\$14.00/bbl	TX	US Liquids of Louisiana LP - Galveston (Transfer)
\$14.00–\$42.00/ton	NM	Lea Land Inc.
\$15.00–\$22.00/bbl	ND	Dishon Disposal Inc. - Dishon Landfill
\$15.00–\$30.00/ton	ND	Prairie Disposal Inc. - Krenz Landfill
\$15.00–\$50.00/ton	OH	American Landfill Inc.
\$16.00–\$65.00/ton	OH	Countywide Landfill and Landfill Gas Processing Plant
\$18.00/ton	OH	Waste Management Inc. – Coshocton Landfill
\$18.00/ton	OH	Waste Management Inc. - Mahoning Landfill
\$18.00/ton	OH	Waste Management Inc. - Suburban Landfill
\$18.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
\$18.00/yd <sup>3</sup>	NM	Sundance Services Inc.
\$2.50–\$28.00/ton	CO	Clean Harbors Environmental Services - Deer Trail LLC
\$20.00–\$30.00/ton	MS	MacLand Disposal Center
\$28.00/ton	FL	Perdido Landfill Escambia County
\$28.75/ton	WV	Allied Waste Management Inc. - Sycamore Landfill
\$30.00–\$60.00/ton	WV	Waste Management Inc. - Northwestern Landfill
\$32.00/ton	AL	BFI Timberlands Sanitary Landfill
\$35.00–\$80.00/ton	ND	Indian Hills Disposal Inc. - Indian Hill Landfill
\$38.00/ton	MS	Waste Management - Central Landfill
\$38.00–\$128.00/ton	MS	Waste Management Inc. - Pecan Grove Sanitary Recycling and Disposal Facility
\$38.00–\$75.00/ton	WV	Waste Management Inc. - Meadowfill Landfill
\$56.00/ton	KY	Allied Waste Management - Green Valley Landfill General Partnership
\$6.67/bbl	TX	US Liquids of Louisiana LP - Zapata (Direct)
\$65.00–\$70.00/ton	CA	Waste Management Inc. - McKittrick Facility
\$68.00–\$80.00/drum	UT	Clean Harbors Environmental Services - Grassy Mountain Landfill
\$7.71/bbl	TX	US Liquids of Louisiana LP - Rincon (Direct)
\$70.00/ton	AL	Waste Management Inc. - Chatang Landfill
\$75.00–\$250.00/ton	LA	Chemical Waste Management Inc.
<i>Burial (pit)</i>		
\$1.00/bbl	OK	T & S Mud Disposal
\$10.00/yd <sup>3</sup>	OK	Scott J. Inc. Oilfield Mud Disposal
\$36.00/yd <sup>3</sup>	UT	Nick's Disposal Pit LLC
\$8.00/bbl	UT	Brennan Bottom Disposal
<i>Cavern</i>		
\$2.00–\$7.00/bbl	TX	Coastal Caverns Inc.
\$3.50/bbl	TX	Wasson Solid Waste Disposal System LLC
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Andrews (Direct)

<b>TABLE 20 Disposal Fees for Contaminated Soils</b>		
Disposal Fee	State	Facility
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Big Spring (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Fort Stockton (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Plains (Direct)
\$6.00/bbl	TX	Taylor Disposal Operating Inc. - Caverns 1 & 2
\$6.00–\$15.00/bbl	TX	CCS Energy Services LLC - Kiva (Direct)
\$6.00–\$15.00/bbl	TX	CCS Energy Services LLC - Moss Bluff (Direct)
<i>Evaporation</i>		
\$45.00/ton	CO	Four Mile Creek Facility
\$8.50/bbl	WY	Piney Company
\$8.50/bbl	WY	R&G Inc.
\$8.50/bbl	WY	Waste Inc.
<i>Injection (solids)</i>		
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Farnett (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Port Arthur (Direct)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Cameron (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon I (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon II (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Intercoastal City (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Morgan City (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Venice (Transfer)
\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Galveston (Transfer)
\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Ingleside (Transfer)
<i>Land Application</i>		
\$10.00/yd <sup>3</sup>	NM	Loco Hills Landfarm LLC
\$10.00–\$12.00/yd <sup>3</sup>	NM	Saunders Landfarm LLC
\$100.00/ton	UT	LaPoint Recycle and Storage
\$12.00/bbl	NM	T-N-T Environmental Inc.
\$14.00/yd <sup>3</sup>	NM	C & C Landfarm Inc.
\$14.00/yd <sup>3</sup>	NM	Gandy Marley Inc.
\$14.00/yd <sup>3</sup>	NM	Jay Dan Landfarm LLC
\$14.00–\$22.00/yd <sup>3</sup>	NM	Environmental Plus
\$17.00/yd <sup>3</sup>	NM	Contract Environmental Services Inc.
\$18.00/yd <sup>3</sup>	NM	Goo Yea Corp. - Goo Yea Landfarm Inc.
\$18.00/yd <sup>3</sup>	NM	Goo Yea Corp. - Rhino Oilfield Disposal Inc.
\$25.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
\$55.00/ton	WY	Sweetwater County Solid Waste Disposal District #1
\$7.50/yd <sup>3</sup>	UT	A-1 Tank Rental and Brine Services. Inc.
<i>Recycling</i>		
\$15.00/ton	CA	Envirocycle
\$8.00–\$45.00/yd <sup>3</sup>	OK	DRD Waste Treatment Solutions
<i>Thermal treatment</i>		
\$0.17–\$0.20/lb	UT	Clean Harbors Environmental Services - Aragonite Facility
\$0.19/lb (\$0.14–\$0.40/lb)	NE	Clean Harbors Environmental Services - Kimball Facility
\$0.55/lb	TX	Clean Harbors Environmental Services - Deer Park LP

<b>TABLE 20 Disposal Fees for Contaminated Soils</b>		
Disposal Fee	State	Facility
\$35.00/ton	FL	Rinker Materials Environmental Services
<i>Treatment</i>		
\$12.50/bbl	LA	US Liquids of Louisiana LP - Bateman Island (Direct)
\$12.50/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)
\$12.50/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)
\$12.50/bbl	LA	US Liquids of Louisiana LP - Bourg (Direct)
\$14.00/bbl	LA	US Liquids of Louisiana LP - Cameron (Transfer)
\$14.00/bbl	LA	US Liquids of Louisiana LP - Fourchon (Transfer)
\$14.00/bbl	LA	US Liquids of Louisiana LP - Intercoastal City (Transfer)
\$14.00/bbl	LA	US Liquids of Louisiana LP - Venice (Transfer)
\$25.00–\$30.00/yd <sup>3</sup>	TX	Eco Mud Disposal - Alice Facility
\$50.00/yd <sup>3</sup>	AL	CCS Energy Services LLC
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Cameron (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Fourchon (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Intercoastal City (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Morgan City (Direct)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Venice (Transfer)
\$9.50/bbl	LA	US Liquids of Louisiana LP - Elm Grove (Direct)

Thermal treatment represents a more expensive disposal option for contaminated soils. Four facilities—located in Florida, Nebraska, Utah, and Texas—indicate a cost range between \$35.00/ton (Florida) and \$1,100.00/ton (Texas).

Bioremediation does not play a major role for contaminated soils. Costs range between \$20.00/yd<sup>3</sup> and \$120.00/yd<sup>3</sup> in New Mexico and Wyoming. One company in Montana charges \$50.00/ton.

Evaporation is not widely used for contaminated soils. Three companies in Wyoming offer their services for \$8.50/bbl. One company in Colorado asks for \$45.00/ton.

Recycling of contaminated soils is not widely reported. One company in California charges \$15.00/ton. Another company in Oklahoma indicates a cost range between \$8.00/yd<sup>3</sup> and 45.00/yd<sup>3</sup>.

#### **4.4.2 NORM**

Table 21 presents the cost information for NORM. The disposal costs by disposal method are \$15.00/ton to \$135.00/ton for landfill burial, and \$150.00/bbl to \$300.00/bbl for cavern disposal and solids injection.

<b>TABLE 21 Disposal Fees for NORM</b>		
Disposal Fee	State	Facility
<i>Burial (landfill)</i>		
\$135.00/ton	UT	Clean Harbors Environmental Services - Grassy Mountain Landfill
\$15.00–\$50.00/ton	OH	American Landfill Inc.
\$16.00–\$65.00/ton	OH	Countywide Landfill and Landfill Gas Processing Plant
\$18.00/ton	OH	Waste Management Inc. - Coshocton Landfill
\$18.00/ton	OH	Waste Management Inc. - Mahoning Landfill
\$18.00/ton	OH	Waste Management Inc. - Suburban Landfill
\$30.00–\$60.00/ton	WV	Waste Management Inc. - Northwestern Landfill
\$38.00–\$75.00/ton	WV	Waste Management Inc. - Meadowfill Landfill
\$70.00/ton	AL	Waste Management Inc. - Chastang Landfill
<i>Cavern</i>		
\$150.00–\$300.00/bbl	TX	Lotus LLC
<i>Injection (solids)</i>		
\$150.00–\$300.00/bbl	TX	Newpark Environmental Services - Big Hill (Direct)

The major national landfill operators include Clean Harbors Environmental Services and Waste Management Inc. Cavern disposal of NORM in Texas is offered by Lotus LLC. Solids injection of NORM is undertaken by Newpark Environmental Services at its Big Hill facility.

#### 4.4.3 Oil-Based Muds and Cuttings

Table 22 presents the cost information for oil-based muds and cuttings. Overall reported costs vary significantly by disposal method.

Burial in landfills represents a significant disposal option for oil-based muds and cuttings. Volume-based costs range between \$6.67/bbl and \$22.00/bbl in Texas and North Dakota, and \$16.00/yd<sup>3</sup> in New Mexico. Weight-based costs vary significantly by state. For example, one company in Colorado indicates a cost between \$2.50/ton and \$28.00/ton, whereas another company in Mississippi charges between \$38.00/ton and \$128.00/ton. In states without a dedicated offsite commercial infrastructure—for example, California, Ohio, Kentucky, and West Virginia—costs range between \$15.00/ton and \$75.00/ton. Burial of oil-based muds and cuttings in commercial pits is not widely reported. Two companies in Wyoming and one company in Utah indicate cost ranges between \$2.00/bbl and \$17.00/bbl.

<b>TABLE 22 Disposal Fees for Oil-Based Muds and Cuttings</b>		
Disposal Fee	State	Facility
<i>Bioremediation</i>		
\$20.00/yd <sup>3</sup>	NM	JFJ Landfarm Inc.
\$40.00/bbl	MT	PetroComp
\$50.00–\$120.00/yd <sup>3</sup>	WY	Newpark Environmental Services
<i>Burial (landfill)</i>		
\$12.75/bbl	TX	US Liquids of Louisiana LP - Galveston (Transfer)
\$14.00–\$42.00/ton	NM	Lea Land Inc.
\$15.00–\$22.00/bbl	ND	Dishon Disposal Inc. - Dishon Landfill
\$15.00–\$30.00/ton	ND	Prairie Disposal Inc. - Krenz Landfill
\$15.00–\$50.00/ton	OH	American Landfill Inc.
\$16.00/yd <sup>3</sup>	NM	Gandy Marley Inc.
\$16.00–\$65.00/ton	OH	Countywide Landfill and Landfill Gas Processing Plant
\$18.00/ton	OH	Waste Management Inc. - Coshocton Landfill
\$18.00/ton	OH	Waste Management Inc. - Mahoning Landfill
\$18.00/ton	OH	Waste Management Inc. - Suburban Landfill
\$18.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
\$18.00/yd <sup>3</sup>	NM	Sundance Services Inc.
\$2.50–\$28.00/ton	CO	Clean Harbors Environmental Services - Deer Trail LLC
\$20.00–\$30.00/ton	MS	MacLand Disposal Center
\$28.75/ton	WV	Allied Waste Management Inc. - Sycamore Landfill
\$30.00–\$60.00/ton	WV	Waste Management Inc. - Northwestern Landfill
\$32.00/ton	AL	BFI Timberlands Sanitary Landfill
\$35.00–\$80.00/ton	ND	Indian Hills Disposal Inc. - Indian Hill Landfill
\$38.00/ton	MS	Waste Management - Central Landfill
\$38.00–\$128.00/ton	MS	Waste Management Inc. - Pecan Grove Sanitary Recycling and Disposal
\$38.00–\$75.00/ton	WV	Waste Management Inc. - Meadowfill Landfill
\$56.00/ton	KY	Allied Waste Management - Green Valley Landfill General Partnership
\$6.67–\$8.50/bbl	TX	US Liquids of Louisiana LP - Zapata (Direct)
\$65.00–\$70.00/ton	CA	Waste Management Inc. - McKittrick Facility
\$68.00–\$80.00/drum	UT	Clean Harbors Environmental Services - Grassy Mountain Landfill
\$7.71–\$9.25/bbl	TX	US Liquids of Louisiana LP - Rincon (Direct)
\$70.00/ton	AL	Waste Management Inc. - Chastang Landfill
<i>Burial (pit)</i>		
\$17.00/bbl	WY	High Plains Resources Inc. - Parkman Reservoir
\$2.00–\$8.00/bbl	WY	Jim's Water Service - McBeth Pits
\$30.00/yd <sup>3</sup>	TX	J. Moss Investments Inc. - Bustamante Facility
\$8.00/bbl	UT	Brennan Bottom Disposal
<i>Cavern</i>		
\$2.00–\$7.00/bbl	TX	Coastal Caverns Inc.
\$3.50/bbl	TX	Wasson Solid Waste Disposal System LLC
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Andrews (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Big Spring (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Fort Stockton (Direct)

<b>TABLE 22 Disposal Fees for Oil-Based Muds and Cuttings</b>		
Disposal Fee	State	Facility
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Plains (Direct)
\$6.00/bbl	TX	Taylor Disposal Operating Inc. - Caverns 1 & 2
\$6.00–\$15.00/bbl	TX	CCS Energy Services LLC - Kiva (Direct)
\$6.00–\$15.00/bbl	TX	CCS Energy Services LLC - Moss Bluff (Direct)
<i>Evaporation</i>		
\$8.50/bbl	WY	Piney Company
\$8.50/bbl	WY	R&G Inc.
\$8.50/bbl	WY	Waste Inc.
<i>Injection (solids)</i>		
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Farnett (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Port Arthur (Direct)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Cameron (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon I (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon II (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Intercoastal City (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Morgan City (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Venice (Transfer)
\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Galveston (Transfer)
\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Ingleside (Transfer)
<i>Land Application</i>		
\$100.00/ton	UT	LaPoint Recycle and Storage
\$12.00/bbl	NM	T-N-T Environmental Inc.
\$17.00–\$34.00/yd <sup>3</sup>	NM	Contract Environmental Services Inc.
\$18.00/yd <sup>3</sup> –\$18.00/bbl	NM	Envirotech Inc.
\$20.00/yd <sup>3</sup>	NM	JFJ Landfarm Inc.
\$25.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
\$4.00/bbl	UT	MC & MC Disposal
\$55.00/ton	WY	Sweetwater County Solid Waste Disposal District #1
\$7.50/yd <sup>3</sup>	UT	A-1 Tank Rental and Brine Services Inc.
<i>Recycling</i>		
\$16.00/bbl	OK	DRD Waste Treatment Solutions
\$5.00/bbl	CA	Envirocycle
<i>Thermal Treatment</i>		
\$0.19/lb (\$0.14–\$0.40/lb)	NE	Clean Harbors Environmental Services - Kimball Facility
\$0.45/lb	TX	Clean Harbors Environmental Services - Deer Park LP
\$100.00/drum	FL	Rinker Materials Environmental Services
<i>Treatment</i>		
\$11.50/bbl	LA	US Liquids of Louisiana LP - Bateman Island (Direct)
\$11.50/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)
\$11.50/bbl	LA	US Liquids of Louisiana LP - Bourg (Direct)
\$12.75/bbl	LA	US Liquids of Louisiana LP - Cameron (Transfer)

Disposal Fee	State	Facility
\$12.75/bbl	LA	US Liquids of Louisiana LP - Fourchon (Transfer)
\$12.75/bbl	LA	US Liquids of Louisiana LP - Intercoastal City (Transfer)
\$12.75/bbl	LA	US Liquids of Louisiana LP - Venice (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Cameron (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Fourchon (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Intercoastal City (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Morgan City (Direct)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Venice (Transfer)
\$9.00/bbl	TX	Eco Mud Disposal - Alice Facility
\$9.50/bbl	LA	US Liquids of Louisiana LP - Elm Grove (Direct)
\$9.50–\$14.50/bbl	AL	CCS Energy Services LLC

Land application of oil-based muds and cuttings is mainly offered in New Mexico (five companies) but also in Utah (two companies) and Wyoming (one company). Costs range between \$4.00/bbl and \$85.71/bbl, \$7.50/yd<sup>3</sup> and \$34.00/yd<sup>3</sup>, and between \$55.00/ton and \$100.00/ton. One company in New Mexico explained that a wetter waste stream needing to be run through a blending facility can incur a higher charge of up to \$85.71/bbl.

Treatment of oil-based muds is offered by US Liquids of Louisiana LP, CCS Energy Services LLC in Louisiana and Alabama, and Eco Mud Disposal in Texas. Costs range between \$6.00/bbl and \$15.00/bbl.

Solids injection of oil-based muds and cuttings is undertaken by Newpark Environmental Services in Louisiana and Texas. Costs range between \$5.00/bbl and \$10.50/bbl.

Cavern disposal is a competitive option for oil-based muds and cuttings in Texas. Five companies at multiple facilities offer their services for a cost between \$2.00/bbl and \$15.00/bbl.

Evaporation of oil-based muds and cuttings is reported in Wyoming. Three companies offer their services for \$8.50/bbl.

Bioremediation does not play a major role for oil-based muds and cuttings. Costs range between \$20.00/yd<sup>3</sup> and 120.00/yd<sup>3</sup> in New Mexico and Wyoming. One company in Montana charges \$40.00/bbl.

Recycling of oil-based muds and cuttings is not widely reported. One company identified in California charges \$5.00/bbl. Another company in Oklahoma indicates a cost of \$16.00/bbl.

Thermal treatment represents a more expensive disposal option for oil-based muds and cuttings. Three facilities—located in Nebraska, Utah, and Texas—indicate a cost range between \$380.00/ton and \$900.00/ton. One facility in Florida asks \$100.00/drum.



#### 4.4.4 Produced Water

Table 23 presents the cost information for produced water by disposal method. Overall disposal costs are \$0.30/bbl to \$105.00/bbl. The highest costs are charged by a thermal treatment facility in Texas, an evaporation facility in Colorado, and a landfill facility in Louisiana. That landfill operator advised that not much produced water is managed at the facility. The lowest costs are charged by one cavern operator in Texas as well as several injection facilities in Oklahoma. By far, the most common commercial disposal method for produced water is injection, followed by evaporation and burial.

Injection of produced water on a commercial basis occurs throughout the United States. Texas, Louisiana, and Oklahoma hold the most significant shares in commercial disposal well operations. The disposal costs range between \$0.30/bbl and \$10.00/bbl. In most cases, costs do not even reach \$1.00/bbl. Newpark Environmental Services in Louisiana and Texas disposes of produced water through solids injection. Costs range between \$5.00/bbl and \$10.50/bbl.

Evaporation of produced water is most widely reported in Wyoming (seven companies), followed by Colorado (four companies), Utah (four companies), and New Mexico (three companies). Except in one case, the disposal costs range between \$0.40/bbl and \$3.95/bbl. One company in Colorado asks \$84.00/bbl.

Burial in landfills is available for produced water across the nation. However, solidification, which is generally required, drives up the costs. Volume-based costs range between \$3.00/bbl and \$22.00/bbl in Texas and North Dakota, and \$18.00 yd<sup>3</sup> in New Mexico. Weight-based costs vary significantly by state, but generally fall into a range between \$15.00/ton and \$80.00/ton. Mississippi and Louisiana report higher ranges of up to \$128.00/ton and \$250.00/ton, respectively. Burial of produced water in commercial pits is not widely reported. Three companies—one in Oklahoma, another in Utah, and yet another one in Wyoming—report costs ranging between \$0.35 and \$4.00/bbl.

Cavern disposal is a competitive option for produced water in Texas. Five companies at multiple facilities offer their services for a cost between \$0.30/bbl and \$10.00/bbl.

Discharge of produced water under an NPDES permit was reported by three companies in Pennsylvania and one company in Wyoming. The costs range between \$0.045/gal and \$0.055/gal (\$2.25/bbl and \$2.75/bbl) in Pennsylvania, and between \$2.50/bbl and \$3.50/bbl in Wyoming. All four companies apply treatment prior to discharge operations. Two facilities in Pennsylvania discharge produced water to a POTW for a disposal fee of \$0.015/gal to \$0.050/gal (\$0.75/bbl to \$2.50/bbl).

<b>TABLE 23 Disposal Fees for Produced Water</b>		
Disposal Fee	State	Facility
<i>Burial (landfill)</i>		
\$15.00–\$22.00/bbl	ND	Dishon Disposal Inc. - Dishon Landfill
\$15.00–\$50.00/ton	OH	American Landfill Inc.
\$16.00–\$65.00/ton	OH	Countywide Landfill and Landfill Gas Processing Plant
\$18.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
\$30.00–\$60.00/ton	WV	Waste Management Inc. - Northwestern Landfill
\$35.00–\$80.00/ton	ND	Indian Hills Disposal Inc. - Indian Hill Landfill
\$37.00/ton	AZ	Diversified Transportation
\$38.00/ton	MS	Waste Management - Central Landfill
\$38.00–\$128.00/ton	MS	Waste Management Inc. - Pecan Grove Sanitary Recycling and Disposal Facility
\$38.00–\$75.00/ton	WV	Waste Management Inc. - Meadowfill Landfill
\$55.00–\$75.00/ton	MS	MacLand Disposal Center
\$56.00/ton	KY	Allied Waste Management - Green Valley Landfill General Partnership
\$75.00–\$250.00/ton	LA	Chemical Waste Management Inc.
<i>Burial (pit)</i>		
\$0.35/bbl	OK	Femco (Webb Dozer)
\$0.87/bbl	UT	Brennan Bottom Disposal
\$1.50/bbl	WY	Jim's Water Service - McBeth Pits
\$1.75–\$4.00/bbl	WY	High Plains Resources Inc. - Parkman Reservoir
<i>Cavern</i>		
\$0.30–\$0.40/bbl	TX	Coastal Caverns Inc.
\$3.50/bbl	TX	Wasson Solid Waste Disposal System LLC
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Andrews (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Big Spring (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Fort Stockton (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Plains (Direct)
\$6.00/bbl	TX	Taylor Disposal Operating Inc. - Caverns 1 & 2
\$0.50–\$3.00/bbl	TX	CCS Energy Services LLC - Kiva (Direct)
\$0.50–\$3.00/bbl	TX	CCS Energy Services LLC - Moss Bluff (Direct)
<i>Discharge (NPDES)</i>		
\$ 0.055/gal	PA	Pennsylvania Brine Treatment
\$0.045/gal	PA	Tunnelton Liquids Co.
\$0.0525/gal	PA	Hart Resource Technologies
\$2.50–\$3.50/bbl	WY	Newpark Environmental Services
<i>Discharge (POTW)</i>		
\$0.015/gal	PA	Moshannon Valley Sewer Authority
\$0.025–\$0.050/gal	PA	Castle Environmental Inc.
<i>Evaporation</i>		
\$0.40/bbl	NM	Sundance Services, Inc.
\$0.50–\$0.75/bbl	UT	MC & MC Disposal
\$0.60/bbl	NM	Loco Hills Water Disposal

<b>TABLE 23 Disposal Fees for Produced Water</b>		
Disposal Fee	State	Facility
\$0.78/bbl	NM	T-N-T Environmental Inc.
\$0.85/bbl	UT	R.N. Industries
\$1.00/bbl	UT	A-1 Tank Rental and Brine Svs. Inc.
\$1.20/bbl	CO	R.N. Industries
\$1.23/bbl	UT	Montezuma Well Service
\$1.50/bbl	CO	Unnamed
\$1.95–\$3.95/bbl	CO	Four Mile Creek Facility
\$2.02/bbl	WY	Samson Resources – Wamsutter
\$2.05/bbl	WY	Oilfield Disposal Services Inc.
\$2.05/bbl	WY	Piney Company
\$2.05/bbl	WY	R&G Inc.
\$2.05/bbl	WY	Waste Inc.
\$2.50–\$3.00/bbl	WY	Sweetwater County Solid Waste Disposal District #1
\$3.50/bbl	WY	Anticline Disposal LLC
\$84.00/bbl	CO	Reams Construction 80-Ponds
<i>Injection</i>		
\$0.30/bbl	OK	Nichols Water Service Inc. - A.R. Turner 2-1
\$0.30/bbl	OK	Nichols Water Service Inc. - Nichols 1
\$0.30/bbl	OK	Nichols Water Service Inc. - Nichols 2
\$0.30/bbl	OK	Nichols Water Service Inc. - Nichols 3
\$0.35/bbl	OK	T & S Mud Disposal
\$0.35–\$0.50/bbl	AL	T.K. Stanley Inc.
\$0.37/bbl	MS	Radzewicz Operating Corporation
\$0.40/bbl	AR	Fugo Services
\$0.40/bbl	NM	Chaparral Service Inc.
\$0.40/bbl	OK	Fugo Services - Blizzard
\$0.40/bbl	OK	Fugo Services - Buckner
\$0.40/bbl	OK	Fugo Services - Mackey
\$0.40/bbl	OK	Fugo Services - Nichols
\$0.40/bbl	OK	Fugo Services - Quinton
\$0.40–\$4.00/bbl	TX	S & D Services - Floyd
\$0.45/bbl	AL	Zinn Petroleum Company
\$0.50/bbl	AL	Wastewater Disposal Service, Inc.
\$0.50/bbl	LA	Charles Holston, Inc.
\$0.50/bbl	LA	Guillory Tank Truck Service
\$0.50/bbl	LA	Louisiana Tank, Inc.
\$0.50/bbl	MI	Seiler Tank Truck Service Inc.
\$0.50/bbl	ND	Missouri Basin Well Service, Inc. - H.T. Knudtson
\$0.50/bbl	ND	Missouri Basin Well Service, Inc. - Zenith-Newton Unit
\$0.50/bbl	NM	O K Hot Oil Service Inc.
\$0.50/bbl	TX	Mo-Vac Service Co. Inc. - Andrews
\$0.50/bbl	TX	Wasson Solid Waste Disposal System LLC - RCC District 8A/Yoakum County (2)
\$0.50–\$10.00/bbl	LA	Saline Injection Systems Co.
\$0.55/bbl	AR	Eastern Tank Service
\$0.55/bbl	AR	Property Transfer Corp.

Disposal Fee	State	Facility
\$0.60/bbl	LA	Houma Salt Water Disposal Corp. - Off LA Hwy 316
\$0.60/bbl	MS	Earth Resources
\$0.60/bbl	NM	Gandy Marley Inc.
\$0.60/bbl	OK	Trout Disposal
\$0.60–\$0.65/bbl	OK	Safe Earth Inc.
\$0.65/bbl	LA	Philip Environmental Services (PSC Industrial Outsourcing, Inc.) - Morgan City Facility
\$0.67/bbl	LA	Habetz Oilfield Saltwater Service
\$0.70/bbl	ND	Ward-Williston Company - Carpentier
\$0.70/bbl	ND	Ward-Williston Company - Martin-Williams
\$0.70/bbl	ND	Ward-Williston Company - Montgomery
\$0.70/bbl	ND	Ward-Williston Company - Pan Am
\$0.70/bbl	ND	Ward-Williston Company - Theodore
\$0.70/bbl	TX	Taylor Disposal Operating Inc. - Butler
\$0.75/bbl	AR	Key Energy Services
\$0.75/bbl	LA	Key Energy Services, Inc. - Athens
\$0.75/bbl	LA	Key Energy Services, Inc. - Oil City
\$0.75/bbl	LA	O'Brian Energy Co.
\$0.75/bbl	TX	Key Energy Services, Inc. - Amando, Webb County School Land, Mckendrick, and Barker
\$0.75/bbl	TX	Key Energy Services, Inc. - Bettie Unit, Porter/Holland, and Sebesta Earl
\$0.75/bbl	TX	Key Energy Services, Inc. - Bloes and Thornton/Henry
\$0.75/bbl	TX	Key Energy Services, Inc. - Brown/Alma and Jeter-Farmer
\$0.75/bbl	TX	Key Energy Services, Inc. - Burns and Hanselman Unit 1
\$0.75/bbl	TX	Key Energy Services, Inc. - Carthage Loop, Deberry Panola County Disposal, Reed, and Singleton Fee (2)
\$0.75/bbl	TX	Key Energy Services, Inc. - Case
\$0.75/bbl	TX	Key Energy Services, Inc. - Cashburn
\$0.75/bbl	TX	Key Energy Services, Inc. - Cooper
\$0.75/bbl	TX	Key Energy Services, Inc. - Dasani
\$0.75/bbl	TX	Key Energy Services, Inc. - Early
\$0.75/bbl	TX	Key Energy Services, Inc. - Freestone County (2)
\$0.75/bbl	TX	Key Energy Services, Inc. - Gangl Unit
\$0.75/bbl	TX	Key Energy Services, Inc. - Gayle,(2)
\$0.75/bbl	TX	Key Energy Services, Inc. – Gutierrez (2), Leonard, Medina/Lozano, Villareal (3), and Ramirez
\$0.75/bbl	TX	Key Energy Services, Inc. - Hunt/William and Brushy Creek Gas Unit
\$0.75/bbl	TX	Key Energy Services, Inc. - Hutson
\$0.75/bbl	TX	Key Energy Services, Inc. - Joaquin
\$0.75/bbl	TX	Key Energy Services, Inc. - Kinder/George
\$0.75/bbl	TX	Key Energy Services, Inc. - Kristina
\$0.75/bbl	TX	Key Energy Services, Inc. - Live Oak County
\$0.75/bbl	TX	Key Energy Services, Inc. - Mckeown and Meisenheimer
\$0.75/bbl	TX	Key Energy Services, Inc. - Moser (2)
\$0.75/bbl	TX	Key Energy Services, Inc. - Nichols Unit
\$0.75/bbl	TX	Key Energy Services, Inc. - Peterson
\$0.75/bbl	TX	Key Energy Services, Inc. - South Texas Disposal Inc.

<b>TABLE 23 Disposal Fees for Produced Water</b>		
Disposal Fee	State	Facility
\$0.75/bbl	TX	Key Energy Services, Inc. - Standifer
\$0.75/bbl	TX	Key Energy Services, Inc. - Teeters
\$0.75/bbl	TX	Key Energy Services, Inc. - Vick and Lisa
\$0.75/bbl	TX	Key Energy Services, Inc. - Washington County, Clay Creek East Unit, and Linda G
\$0.75/bbl	TX	Key Energy Services, Inc. - Youngblood
\$0.85/bbl	LA	Pool Company - Minden
\$0.88/bbl	NM	Basin Disposal Inc.
\$0.35–\$0.75/bbl	ND	Black Hawk Resources LLC - Hatter
\$0.35–\$0.75/bbl	ND	Black Hawk Resources LLC - Klandl
\$1.00/bbl	LA	Hallar Enterprises Inc. Disposal Site
\$1.00/bbl	LA	US Liquids of Louisiana LP - Elm Grove (Direct)
\$1.00/bbl	WV	Base Petroleum
\$1.00/bbl	WV	Danny Web Construction
\$1.00–\$1.50/bbl	MI	Beckman Production Services Inc.
\$1.30–\$1.75/bbl	MI	Northeastern Exploration
\$2.00/bbl	WY	Mel's Water Service
\$3.00/bbl	LA	US Liquids of Louisiana LP - Mermenteau (Transfer)
\$3.00/bbl	WY	Joe Scott Enterprises LLC - Reed Fee
\$3.00/bbl	WY	Yellow Creek Production and Water Disposal LLC - Carpenté
\$3.00–\$7.00/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)
\$3.00–\$7.00/bbl	LA	US Liquids of Louisiana LP - Cameron (Transfer)
\$3.00–\$7.00/bbl	LA	US Liquids of Louisiana LP - Fourchon (Transfer)
\$3.00–\$7.00/bbl	LA	US Liquids of Louisiana LP - Intercoastal City (Transfer)
\$3.00–\$7.00/bbl	LA	US Liquids of Louisiana LP - Venice (Transfer)
\$65.00/load	ND	Energy Equity Company - Borgen
\$65.00/load	ND	Energy Equity Company - George Tank #1
\$65.00/load	ND	Energy Equity Company - Heckert
\$65.00/load	ND	Energy Equity Company - North Dickinson
\$7.00/bbl	LA	US Liquids of Louisiana LP - Bateman Island (Direct)
\$7.00/bbl	LA	US Liquids of Louisiana LP - Bourg (Direct)
<i>Injection (solids)</i>		
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Farnett (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Port Arthur (Direct)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Cameron (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon I (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon II (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Intercoastal City (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Morgan City (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Venice (Transfer)
\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Galveston (Transfer)
\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Ingleside (Transfer)
<i>Land Application</i>		
\$0.30–\$0.40/bbl	AR	Comer Mining Corp.
\$100.00/ton	UT	LaPoint Recycle and Storage

<b>TABLE 23 Disposal Fees for Produced Water</b>		
Disposal Fee	State	Facility
\$18.00/bbl	NM	Envirotech Inc.
\$25.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
<i>Recycling</i>		
\$25.00/load	OK	DRD Waste Treatment Solutions
\$5.00/bbl	CA	Envirocycle
<i>Thermal Treatment</i>		
\$0.02–\$0.20/lb	TX	Clean Harbors Environmental Services - Deer Park LP
<i>Treatment</i>		
\$5.00/bbl	TX	Eco Mud Disposal - Alice Facility
\$5.00–\$14.00/bbl	AL	CCS Energy Services LLC

Land application of produced water is offered in Arkansas (one company), New Mexico (two companies) and Utah (one company). Costs are \$0.30/bbl to \$0.40/bbl in Arkansas, \$5.18/bbl to \$18.00/bbl in New Mexico, and \$100/ton (\$26.25/bbl) in Utah.

Treatment of produced water is offered by CCS Energy Services LLC in Alabama and Eco Mud Disposal in Texas. Costs range from \$5.00/bbl to \$14.00/bbl.

Recycling of produced water is not widely reported. One company identified in California charges \$5.00/bbl. Another company in Oklahoma indicates a cost of \$25.00/load.

Thermal treatment of produced water is offered by Clean Harbors Environmental Services at its Deer Park facility. Costs range from \$0.02/lb to \$0.20/lb (\$40.00/ton to \$400/ton, or \$10.5/bbl to \$105.00/bbl).

#### **4.4.5 Tank Bottoms**

Table 24 presents the cost information for tank bottoms by disposal method. Disposal costs vary significantly by disposal method.

Burial in landfills represents a significant disposal option for tank bottoms. Volume-based costs range between \$6.67/bbl and \$22.00/bbl in Texas and North Dakota, and \$18.00/yd<sup>3</sup> in New Mexico. Weight-based costs vary significantly by state. For example, one company in Colorado indicates a cost between \$2.50/ton and \$28.00/ton, whereas another company in Louisiana charges between \$75.00/ton and \$250.00/ton. In states without a dedicated offsite commercial infrastructure—for example, California, Ohio, Kentucky, and West Virginia—costs range between \$15.00/ton and \$75.00/ton. Burial of tank bottoms in commercial pits is not

widely reported. One company in Utah and another in Wyoming indicate cost ranges between \$5.00/bbl and \$17.00/bbl.

Solids injection of tank bottoms is undertaken by Newpark Environmental Services in Louisiana and Texas. Costs range between \$5.00/bbl and \$10.50/bbl.

Treatment of tank bottoms is offered by US Liquids of Louisiana LP, CCS Energy Services LLC in Louisiana and Alabama, and Eco Mud Disposal in Texas. Costs range from \$6.00/bbl to \$15.00/bbl.

Cavern disposal is a competitive option for oil-based muds and cuttings in Texas. Five companies at multiple facilities offer their services for a cost between \$2.00/bbl and \$15.00/bbl.

Recycling of tank bottoms was reported in five survey states. The volume-based costs range between \$2.25/bbl and \$5.00/bbl. One company in Arkansas charges \$127.00/hr.

Land application of tank bottoms is mainly offered in Utah (three companies), but also in New Mexico (two companies) and Wyoming (one company). Costs are \$4.00/bbl, \$7.50/yd<sup>3</sup> to \$85.71/yd<sup>3</sup>, and \$55.00/ton to \$100.00/ton.

Evaporation of tank bottoms is reported in Utah. One company indicates a cost of \$0.85/bbl.

Thermal treatment represents a more expensive disposal option for tank bottoms. Costs reported from Florida, Nebraska, and Texas range from \$200.00/ton to \$900.00/ton

Bioremediation does not play a major role for tank bottoms. One company in New Mexico charges \$20.00/yd<sup>3</sup>, another company in Montana charges \$40.00/bbl.

<b>TABLE 24 Disposal Fees for Tank Bottoms</b>		
Disposal Fee	State	Facility
<i>Bioremediation</i>		
\$20.00/yd <sup>3</sup>	NM	JFJ Landfarm Inc.
\$40.00/bbl	MT	PetroComp
<i>Burial (landfill)</i>		
\$10.50/bbl	TX	US Liquids of Louisiana LP - Rincon (Direct)
\$10.50/bbl	TX	US Liquids of Louisiana LP - Zapata (Direct)
\$14.00/bbl	TX	US Liquids of Louisiana LP - Galveston (Transfer)
\$15.00–\$22.00/bbl	ND	Dishon Disposal Inc. - Dishon Landfill
\$15.00–\$30.00/ton	ND	Prairie Disposal Inc. - Krenz Landfill
\$15.00–\$50.00/ton	OH	American Landfill Inc.
\$16.00–\$65.00/ton	OH	Countywide Landfill and Landfill Gas Processing Plant
\$18.00/ton	OH	Waste Management Inc. - Coshocton Landfill
\$18.00/ton	OH	Waste Management Inc. - Mahoning Landfill

<b>TABLE 24 Disposal Fees for Tank Bottoms</b>		
Disposal Fee	State	Facility
\$18.00/ton	OH	Waste Management Inc. - Suburban Landfill
\$18.00/yd <sup>3</sup>	NM	Sundance Services Inc.
\$2.50–\$28.00/ton	CO	Clean Harbors Environmental Services - Deer Trail LLC
\$28.75/ton	WV	Allied Waste Management Inc. - Sycamore Landfill
\$30.00–\$60.00/ton	WV	Waste Management Inc. - Northwestern Landfill
\$32.00/ton	AL	BFI Timberlands Sanitary Landfill
\$35.00–\$80.00/ton	ND	Indian Hills Disposal Inc. - Indian Hill Landfill
\$38.00/ton	MS	Waste Management - Central Landfill
\$38.00–\$128.00/ton	MS	Waste Management Inc. - Pecan Grove Sanitary Recycling and Disposal Facility
\$38.00–\$75.00/ton	WV	Waste Management Inc. - Meadowfill Landfill
\$55.00–\$75.00/ton	MS	MacLand Disposal Center
\$56.00/ton	KY	Allied Waste Management - Green Valley Landfill General Partnership
\$65.00–\$70.00/ton	CA	Waste Management Inc. - McKittrick Facility
\$68.00–\$80.00/drum	UT	Clean Harbors Environmental Services - Grassy Mountain Landfill
\$70.00/ton	AL	Waste Management Inc. - Chastang Landfill
\$75.00–\$250.00/ton	LA	Chemical Waste Management Inc.
<i>Burial (pit)</i>		
\$17.00/bbl	WY	High Plains Resources Inc. - Parkman Reservoir
\$5.00/bbl	UT	Brennan Bottom Disposal
<i>Cavern</i>		
\$2.00–\$7.00/bbl	TX	Coastal Caverns Inc.
\$3.50/bbl	TX	Wasson Solid Waste Disposal System LLC
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Andrews (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Big Spring (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Fort Stockton (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Plains (Direct)
\$6.00/bbl	TX	Taylor Disposal Operating Inc. - Caverns 1 & 2
\$6.00–\$15.00/bbl	TX	CCS Energy Services LLC - Kiva (Direct)
\$6.00–\$15.00/bbl	TX	CCS Energy Services LLC - Moss Bluff (Direct)
<i>Evaporation</i>		
\$0.85/bbl	UT	R.N. Industries
<i>Injection (solids)</i>		
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Farnett (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Port Arthur (Direct)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Cameron (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon I (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon II (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Intercoastal City (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Morgan City (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Venice (Transfer)
\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Galveston (Transfer)
\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Ingleside (Transfer)



<b>TABLE 24 Disposal Fees for Tank Bottoms</b>		
Disposal Fee	State	Facility
<i>Land Application</i>		
\$100.00/ton	UT	LaPoint Recycle and Storage
\$18.00/yd <sup>3</sup> –\$18.00/bbl	NM	Envirotech Inc.
\$34.00/yd <sup>3</sup>	NM	Contract Environmental Services Inc.
\$4.00/bbl	UT	MC & MC Disposal
\$55.00/ton	WY	Sweetwater County Solid Waste Disposal District #1
\$7.50/yd <sup>3</sup>	UT	A-1 Tank Rental and Brine Services Inc.
<i>Recycling</i>		
\$127.00/hr	AR	Hydro-Kleen LLC
\$3.75/bbl	NM	Gandy Marley Inc.
\$5.00/bbl	CA	Envirocycle
\$5.00/bbl	NM	Controlled Recovery Inc.
\$5.00/bbl	OK	DRD Waste Treatment Solutions
<i>Thermal Treatment</i>		
\$0.19/lb (\$0.14–\$0.40/lb)	NE	Clean Harbors Environmental Services - Kimball Facility
\$0.45/lb	TX	Clean Harbors Environmental Services - Deer Park LP
\$200.00/ton	FL	Rinker Materials Environmental Services
<i>Treatment</i>		
\$10.50–\$14.50/bbl	AL	CCS Energy Services LLC
\$12.00/bbl	TX	Eco Mud Disposal - Alice Facility
\$12.50/bbl	LA	US Liquids of Louisiana LP - Bateman Island (Direct)
\$12.50/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)
\$12.50/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)
\$12.50/bbl	LA	US Liquids of Louisiana LP - Bourg (Direct)
\$14.00/bbl	LA	US Liquids of Louisiana LP - Cameron (Transfer)
\$14.00/bbl	LA	US Liquids of Louisiana LP - Fourchon (Transfer)
\$14.00/bbl	LA	US Liquids of Louisiana LP - Intercoastal City (Transfer)
\$14.00/bbl	LA	US Liquids of Louisiana LP - Venice (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Cameron (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Fourchon (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Intercoastal City (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Morgan City (Direct)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Venice (Transfer)
\$9.50/bbl	LA	US Liquids of Louisiana LP - Elm Grove (Direct)

#### 4.4.6 Water-Based Muds and Cuttings

Table 25 presents the cost information for water-based muds and cuttings by disposal method. Overall reported costs are \$0.50/bbl to \$22.00/bbl, \$7.50/yd<sup>3</sup> to \$85.70/yd<sup>3</sup>, and \$2.50/ton to \$900/ton.

Burial in landfills represents a significant disposal option for water-based muds and cuttings. Volume-based costs range between \$2.61/bbl and \$22.00/bbl in Texas and North Dakota, and \$18.00/yd<sup>3</sup> in New Mexico. Weight-based costs vary significantly by state. For example, one company in Colorado indicates a cost between \$2.50/ton to \$28.00/ton, whereas another company in Louisiana charges between \$75.00/ton and \$250.00/ton. In states without a dedicated offsite commercial infrastructure—for example, California, Ohio, Kentucky, and West Virginia—costs range between \$15.00/ton and \$75.00/ton.

Burial of water-based muds and cuttings in commercial pits is still a common disposal method especially in Oklahoma, but also in Texas, Utah, and Wyoming. Costs range between \$1.00/bbl and \$1.50/bbl in Oklahoma, \$2.00/bbl to \$7.00/bbl in Texas, \$8.00/bbl in Utah, and \$1.50/bbl to \$17.00/bbl in Wyoming.

Land application of water-based muds and cuttings is a prevalent disposal method, especially in New Mexico (six companies). It is also offered in Arkansas (four companies), Utah (three companies), Texas (two companies), and Wyoming (one company). Costs are \$0.50/bbl (Arkansas) to \$85.71/bbl (New Mexico), \$7.50/yd<sup>3</sup> to \$25.00/yd<sup>3</sup>, and \$55.00/ton to \$100.00/ton. One company in Arkansas charges as low as \$0.50/bbl, whereas the charge of \$85.71/bbl in New Mexico is applied when wetter waste streams need to be run through a blending facility.

Treatment of water-based muds and cuttings is offered by US Liquids of Louisiana LP, CCS Energy Services in Louisiana and Alabama, and Eco Mud Disposal in Texas. Costs range from \$6.00/bbl to \$15.00/bbl.

Solids injection of water-based muds and cuttings is undertaken by Newpark Environmental Services in Louisiana and Texas. Costs range between \$5.00/bbl and \$10.50/bbl.

<b>TABLE 25 Disposal Fees for Water-Based Muds and Cuttings</b>		
Disposal Fee	State	Facility
<i>Bioremediation</i>		
\$20.00/yd <sup>3</sup>	NM	JFJ Landfarm Inc.
\$40.00/bbl	MT	PetroComp
<i>Burial (landfill)</i>		
\$10.75/bbl	TX	US Liquids of Louisiana LP - Galveston (Transfer)
\$14.00–\$42.00/ton	NM	Lea Land Inc.
\$15.00–\$22.00/bbl	ND	Dishon Disposal Inc. - Dishon Landfill
\$15.00–\$30.00/ton	ND	Prairie Disposal Inc. - Krenz Landfill
\$15.00–\$50.00/ton	OH	American Landfill Inc.
\$16.00/yd <sup>3</sup>	NM	Gandy Marley Inc.
\$16.00–\$65.00/ton	OH	Countywide Landfill and Landfill Gas Processing Plant
\$18.00/ton	OH	Waste Management Inc. - Coshocton Landfill
\$18.00/ton	OH	Waste Management Inc. - Mahoning Landfill

<b>TABLE 25 Disposal Fees for Water-Based Muds and Cuttings</b>		
Disposal Fee	State	Facility
\$18.00/ton	OH	Waste Management Inc. - Suburban Landfill
\$18.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
\$18.00/yd <sup>3</sup>	NM	Sundance Services Inc.
\$2.50–\$28.00/ton	CO	Clean Harbors Environmental Services - Deer Trail LLC
\$2.61/bbl	TX	US Liquids of Louisiana LP - Zapata (Direct)
\$20.00–\$30.00/ton	MS	MacLand Disposal Center
\$24.00–\$27.00/ton	AZ	Diversified Transportation
\$28.75/ton	WV	Allied Waste Management Inc. - Sycamore Landfill
\$3.25/bbl	TX	US Liquids of Louisiana LP - Rincon (Direct)
\$30.00–\$60.00/ton	WV	Waste Management Inc. - Northwestern Landfill
\$32.00/ton	AL	BFI Timberlands Sanitary Landfill
\$35.00–\$80.00/ton	ND	Indian Hills Disposal Inc. - Indian Hill Landfill
\$38.00/ton	MS	Waste Management - Central Landfill
\$38.00–\$128.00/ton	MS	Waste Management Inc. - Pecan Grove Sanitary Recycling and Disposal Facility
\$38.00–\$75.00/ton	WV	Waste Management Inc. - Meadowfill Landfill
\$56.00/ton	KY	Allied Waste Management - Green Valley Landfill General Partnership
\$65.00–\$70.00/ton	CA	Waste Management Inc. - McKittrick Facility
\$68.00–\$80.00/drum	UT	Clean Harbors Environmental Services - Grassy Mountain Landfill
\$70.00/ton	AL	Waste Management Inc. - Chastang Landfill
\$75.00–\$250.00/ton	LA	Chemical Waste Management Inc.
<i>Burial (pit)</i>		
\$1.00/bbl	OK	O'Daniel
\$1.00/bbl	OK	T & S Mud Disposal
\$1.00/bbl	OK	Trout Disposal
\$1.00–\$2.00/bbl	OK	Scott J. Inc. Oilfield Mud Disposal
\$1.00–\$2.00/bbl	TX	Basic Energy Services - Duval
\$1.20/bbl (\$100.00–\$150.00/load)	OK	Safe Earth Inc.
\$1.25/bbl	OK	Femco (Webb Dozer)
\$1.50/bbl	OK	Hamm & Phillips Service Company (Guard)
\$17.00/bbl	WY	High Plains Resources Inc. - Parkman Reservoir
\$2.00/bbl	TX	Karon Smith
\$2.00–\$8.00/bbl	WY	Jim's Water Service - McBeth Pits
\$3.00/bbl	TX	Mo-Vac Service Co. Inc. - Ganaway Facility
\$7.00/bbl	TX	J. Moss Investments Inc. - Bustamante Facility
\$8.00/bbl	UT	Brennan Bottom Disposal
<i>Cavern</i>		
\$2.00–\$7.00/bbl	TX	Coastal Caverns Inc.
\$3.50/bbl	TX	Wasson Solid Waste Disposal System LLC
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Andrews (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Big Spring (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Fort Stockton (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Permian Basin - Plains (Direct)
\$6.00/bbl	TX	Taylor Disposal Operating Inc. - Caverns 1 & 2

<b>TABLE 25 Disposal Fees for Water-Based Muds and Cuttings</b>		
Disposal Fee	State	Facility
\$6.00–\$15.00/bbl	TX	CCS Energy Services LLC - Kiva (Direct)
\$6.00–\$15.00/bbl	TX	CCS Energy Services LLC - Moss Bluff (Direct)
<i>Evaporation</i>		
\$0.85/bbl	UT	R.N. Industries
\$4.00–\$20.00/bbl	CO	Four Mile Creek Facility
\$7.00/bbl	CO	R.N. Industries
\$8.50/bbl	WY	Piney Company
\$8.50/bbl	WY	R&G Inc.
\$8.50/bbl	WY	Waste Inc.
<i>Injection</i>		
\$0.50/bbl	AL	Wastewater Disposal Service Inc.
<i>Injection (solids)</i>		
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Farnett (Direct)
\$5.00–\$10.00/bbl	TX	Newpark Environmental Services - Port Arthur (Direct)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Cameron (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon I (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Fourchon II (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Intercoastal City (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Morgan City (Transfer)
\$5.50–\$10.50/bbl	LA	Newpark Environmental Services - Venice (Transfer)
\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Galveston (Transfer)
\$5.50–\$10.50/bbl	TX	Newpark Environmental Services - Ingleside (Transfer)
<i>Land Application</i>		
\$0.50/bbl	AR	Fugo Services
\$1.00–\$1.25/bbl	AR	Comer Mining Corp.
\$1.75/bbl	AR	Eastern Tank Service
\$100.00/ton	UT	LaPoint Recycle and Storage
\$12.00/bbl	NM	T-N-T Environmental Inc.
\$17.00/yd <sup>3</sup>	NM	Contract Environmental Services Inc.
\$18.00/yd <sup>3</sup>	NM	Envirotech Inc.
\$18.00/yd <sup>3</sup> –\$8.00/bbl	NM	Envirotech Inc.
\$2.00/bbl	AR	Property Transfer Corp.
\$20.00/yd <sup>3</sup>	NM	JFJ Landfarm Inc.
\$25.00/yd <sup>3</sup>	NM	Controlled Recovery Inc.
\$4.00/bbl	UT	MC & MC Disposal
\$55.00/ton	WY	Sweetwater County Solid Waste Disposal District #1
\$7.50/yd <sup>3</sup>	UT	A-1 Tank Rental and Brine Svs. Inc.
\$7.50/yd <sup>3</sup> –\$2.50/bbl	TX	Basic Energy Services - Jefferson
\$7.50/yd <sup>3</sup> –\$2.50/bbl	TX	Basic Energy Services - Jackson
<i>Recycling</i>		
\$5.00/bbl	CA	Envirocycle
\$75.00/load	OK	DRD Waste Treatment Solutions

<b>TABLE 25 Disposal Fees for Water-Based Muds and Cuttings</b>		
Disposal Fee	State	Facility
<i>Thermal Treatment</i>		
\$0.19/lb (\$0.14–\$.40/lb)	NE	Clean Harbors Environmental Services - Kimball Facility
\$0.45/lb	TX	Clean Harbors Environmental Services - Deer Park LP
<i>Treatment</i>		
\$10.75/bbl	LA	US Liquids of Louisiana LP - Cameron (Transfer)
\$10.75/bbl	LA	US Liquids of Louisiana LP - Fourchon (Transfer)
\$10.75/bbl	LA	US Liquids of Louisiana LP - Intercoastal City (Transfer)
\$10.75/bbl	LA	US Liquids of Louisiana LP - Venice (Transfer)
\$3.00/bbl	TX	Eco Mud Disposal - Alice Facility
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Cameron (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Fourchon (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Intercoastal City (Transfer)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Morgan City (Direct)
\$6.00–\$15.00/bbl	LA	CCS Energy Services LLC - Venice (Transfer)
\$7.50–\$9.50/bbl	LA	US Liquids of Louisiana LP - Elm Grove (Direct)
\$8.50–\$12.50/bbl	AL	CCS Energy Services LLC
\$9.50/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)
\$9.50–\$11.50/bbl	LA	US Liquids of Louisiana LP - Bateman Island (Direct)
\$9.50–\$11.50/bbl	LA	US Liquids of Louisiana LP - Berwick (Transfer)
\$9.50–\$11.50/bbl	LA	US Liquids of Louisiana LP - Bourg (Direct)

Cavern disposal is a competitive option for water-based muds and cuttings in Texas. Five companies at multiple facilities offer their services for a cost between \$2.00/bbl and \$15.00/bbl.

Evaporation of water-based muds and cuttings is reported mainly in Wyoming (three companies), but also in Colorado (two companies) and Utah. The costs range between \$0.85/bbl and \$20.00/bbl.

Thermal treatment represents a more expensive disposal option for water-based muds and cuttings. One company in Nebraska asks \$380.00/ton, the other in Texas asks \$900.00/ton.

Bioremediation does not play a major role for water-based muds and cuttings. Costs are \$20.00/yd<sup>3</sup> in New Mexico and \$40.00/bbl in Montana.

Recycling of water-based muds and cuttings is not widely reported. One company identified in California charges \$5.00/bbl. Another company in Oklahoma indicates a cost of \$75.00/load.

## 4.5 TRANSPORTATION AND OTHER INCIDENTAL COSTS

Although disposal costs are important to an operator when determining the commercial waste disposal company of choice, transportation and other costs weigh heavily in the operator's final decision. Because transportation costs typically increase proportionately with distance or time from well site to disposal site, economic incentives exist for operators to send their wastes to disposal facilities located within a reasonably short distance from the oil and gas E&P site. Generally, operators will not be inclined to transport waste more than 50 to 75 miles unless no other alternatives are available.

The three large disposal companies in Louisiana and Texas (Newpark Environmental Services, CCS Energy Services LLC, and US Liquids of Louisiana LP) have established an extensive network of transfer stations along the Gulf Coast to reduce the distance that operators must transport their waste and to accommodate offshore wastes hauled back to shore. Operators can transport wastes to the transfer stations, where the waste management companies consolidate the waste, then move it by barge to one or more central treatment facilities. Throughout the tables in this report, the facilities operated by these three companies are designated as either Direct (treatment is performed at that site) or Transfer.

Most operators charge by the hour—typically, \$55.00/hr to \$175.00/hr. In many instances, a fuel surcharge is levied. Others use a per-load or per-container basis—for example, in one case \$1.00/bbl to \$3.00/bbl. Companies may also offer to contract out the transportation component. They then charge the contractor price augmented by a certain percentage. Distance, job sizes, preexisting and long-term relationships, and surging oil prices are important factors for calculating case-specific transportation fees. Disposal companies offer trucking and roll-off service. Trucking vehicles include regular dump trucks, vacuum trucks, bobtails, trailers, and tankers. In the course of roll-off service, the roll-off container is transported to the point of collection by a special collection vehicle, and then rolled off the collection vehicle and left for filling. When it is ready to be serviced, an empty container is delivered to the point of collection, rolled off, and the full container is loaded onto the collection vehicle and taken to the disposal facility.

In cases where business is generated from offshore, companies offer barges. Hopper barges have a capacity of 6,500 bbl. They are rented on a per-day or per-bbl basis. The cleaning fees for trucks, boats, and containers vary widely. Washouts trigger in most cases an hourly or flat fee. Reported ranges are between \$35.00/job and \$200.00/job. One company charges \$350 per 15-minute increments. The fee for cleaning out large dirty barges may be as high as \$10,000.00/job. In one case, the fee is calculated by volume—\$0.40/gal. Containers are also charged by the amount of wash water used or the amount of wash water going to disposal.

One company reports very specific transportation-related fees: \$95.00 for trucking/transportation; \$75.00 for Bobcat with operator; \$225.00 for crane with operator; \$75.00 for forklift with operator; and \$175.00 for track hoe with operator. The company also charges other handling fees: \$75.00 for container handling (dump and rinse 25 bbl or less); \$45.00 for container rehandling (25 bbl or less); \$150.00 for drum handling; \$100.00 truck washout without wash water; \$300.00 for gauging/waste volume verification; \$3,125.00 for

barge cleaning (open top shale, 1,500 bbl or less); and \$3,750.00 (open top shale, 1,500 to 3,000 bbl). Third-party equipment triggers cost plus 15%.

When laboratory tests are conducted the fees range between \$0.00/test and \$2,000.00/test, and in one case \$5,000.00/well. In many cases, facilities conduct tests to protect themselves. Generators are required to fill out paperwork concerning the waste materials.

## 5 CONCLUSIONS

No comprehensive national effort has been undertaken since 1997 to identify the commercial waste management facilities handling E&P wastes in the United States. This report provides current information on the names of the waste management facilities, their locations, the methods used to manage the wastes, and the costs they charge. The major conclusions of this report are provided below.

- At the federal level, the majority of oil field wastes are covered by the exemption from the hazardous waste provisions of RCRA. This simplifies the disposal of oil field waste and allows for reduced disposal costs. The federal exemption does not, however, preclude these wastes from control under other federal regulations and state regulations. All oil- and gas-producing states except California have adopted the federal exemption. In California, the exemption is narrower. The exemption does not apply if toxicity is determined on the basis of criteria other than TCLP, or the waste meets any of the other three characteristics of hazardous waste (ignitability, corrosivity, and reactivity).
- Oil field wastes are regulated at the state level. All oil- and gas-producing states allow onsite disposal of oil field wastes. Most companies choose onsite over offsite disposal because of cost savings and operational logistics.
- Yet, a significant market for offsite commercial disposal operations continues to exist. Interviews with oil and gas officials in 30 oil- and gas-producing states suggest three offsite disposal trends.
  - Eight states have a dedicated industry-specific network of offsite commercial disposal companies and facilities in place.
  - In seven states, a smaller number of offsite commercial disposal companies operate, and their services are primarily focused on produced water.
  - Fifteen states contain few or no disposal companies dedicated to oil and gas industry waste. The only offsite commercial disposal companies available include mainly general industrial waste disposal facilities or sanitary landfills.
- The disposal methods being used across the country include bioremediation, burial, cavern, discharge, evaporation, injection, land application, recycling, thermal treatment, and treatment.
- The costs of offsite commercial disposal vary significantly, depending on the disposal method, the host state of disposal operations, and the degree of



competition in the area. The cost ranges for each type of waste are presented below, using only per barrel cost figures. In nearly all cases, most costs fall within a narrower band. Multiple disposal methods are used for each type of waste. By far the most common commercial disposal method for produced water is injection.

- Contaminated soil disposal costs range from \$1.00/bbl to \$22/bbl.
  - NORM disposal costs range from \$40/bbl to \$300/bbl. Some municipal landfills charge lower tipping fees for wastes with low levels of NORM.
  - Oil-based muds and cuttings disposal costs range from \$2.00/bbl to \$40.00/bbl.
  - Produced water injection costs range from \$0.30/bbl to \$10.00/bbl, but in most cases do not even reach \$1.00/bbl.
  - Tank bottom disposal costs range from \$0.85/bbl to \$40/bbl.
  - Water-based muds and cuttings disposal costs range from \$0.50/bbl to \$40/bbl.
- When wastes are sent offsite for regulatory, economic, or other reasons, operators closely examine the total cost. In addition to the actual disposal costs, other cost factors include transportation and incidental activities.

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**APPENDIX A:  
COMMERCIAL E&P WASTE DISPOSAL FACILITIES  
IN THE UNITED STATES**



**TABLE A.1 Database of Commercial E&P Waste Disposal Facilities in the United States<sup>a</sup>**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
AL	BFI Timberlands Sanitary Landfill	Burial (landfill)	Contam. soils	\$32/ton	NA	NA	NA	Accepts nonhazardous, nonliquid oil field waste. Rates depend on volume. Facility does not own its own trucks. Any contracting would involve markup. Generator to analyze waste.
			OBMs and cuttings	\$32/ton				
			Tank bottoms	\$32/ton				
			WBMs and cuttings	\$32/ton				
AL	CCS Energy Services LLC	Treatment	Contam. soils	\$50/yd <sup>3</sup>	\$90/hr	\$200/truck	\$5,000/well	The patented ConSep process was developed using 80 years of water treating and waste treatment experience. ConSep, or "Contained Separation," specifically treats acid flowback and other problematic water streams. The system components can be fully customized to suit the customer's particular needs.
			OBMs and cuttings	\$9.50-\$14.50/bbl				
			Produced water	\$5-\$14/bbl				
			Tank bottoms	\$10.50-\$14.50/bbl				
			WBMs and cuttings	\$8.50-\$12.50/bbl				
AL	T.K. Stanley Inc.	Injection	Produced water	\$0.35-\$0.50/bbl	\$75-\$85/hr	NA	NA	Charge depends on volume. Chemicals bought from supplier.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
AL	Waste Management Inc. - Chastang Landfill	Burial (landfill)	Contam. soils	\$70/ton	\$112/hr	NA	NA	Sanitary landfill. Land filling disposal fee without treatment ranges between \$28/ton and \$36/ ton. NORM only exceptionally; levels must be lower than regulatory threshold.
			NORM	\$70/ton				
			OBM's and cuttings	\$70/ton				
			Tank bottoms	\$70/ton				
			WBM's and cuttings	\$70/ton				
AL	Wastewater Disposal Service Inc.	Injection	WBM's and cuttings	\$0.50/bbl	NA	NA	NA	Accepts water-based drilling waste only if waste materials meet specifications to avoid clogging. Mainly receives saltwater.
			Produced water	\$0.50/bbl				
AL	Zinn Petroleum Company	Injection	Produced water	\$0.45/bbl	NA	NA	NA	Generator conducts laboratory analysis.
AR	Comer Mining Corp.	Land application	Produced water	\$0.30-\$0.40/bbl	NA	NA	NA	NA
			WBM's and cuttings	\$1-\$1.25/bbl				
AR	Eastern Tank Service	Injection	Produced water	\$0.55/bbl	\$95/hr	NA	NA	NA
		Land application	WBM's and cuttings	\$1.75/bbl				
AR	Fugo Services	Injection	Produced water	\$0.40/bbl	\$85/hr	NA	NA	Fuel surcharge applied. Facility handles pit water. Fuel surcharge applied.
		Land application	WBM's and cuttings	\$0.50/bbl				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
AR	Hydro-Kleen LLC	Recycling	Tank bottoms	\$127/hr	\$127/hr	\$127/hr	NA	Reclamation process removes product and separates out saltwater and freshwater. Tank bottoms are placed in 20,000-gal-kettles and heated up to 140/150 degrees Fahrenheit. At times, chemicals are used to aid separation. If recovered product volume is large enough, no fees accrue. If the product is not marketable or small tanks are involved, fees could range up to \$127/hr. Saltwater is disposed of in a deep well or passed on to companies such as US Filter. Reclaimer conducts field surveys.
AR	Key Energy Services	Injection	Produced water	\$0.75/bbl	\$70/hr	NA	NA	NA
AR	Property Transfer Corp.	Injection	Produced water	\$0.55/bbl	\$95/hr	NA	NA	Emulsified oil to reclaimer.
		Land application	WBMs and cuttings	\$2/bbl				
AZ	Diversified Transportation	Burial (landfill)	Produced water	\$37/ton	\$90–\$95/hr	\$90–\$95/hr	\$1,500–\$2,000/test	Company is a woman-owned 8A business. Offers brokerage services. At present, it provides service for the exploration phase in the gas sector. Produced water goes to separate cells at landfills owned by Waste Management and Allied Waste. Transportation by tanker — rinsed off at landfill. Has handled 200,000 gal of brine water over a 14-month project.
			WBMs and cuttings	\$24–\$27/ton	\$70/hr	\$70/hr		
CA	Envirocycle	Recycling	Contam. soils	\$15/ton	NA	NA	\$400–\$500/test	NA
			OBMs and cuttings	\$5/bbl				
			Produced water	\$5/bbl				
			Tank bottoms	\$5/bbl				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			WBMs and cuttings	\$5/bbl				
CA	Waste Management Inc. - McKittrick Facility	Burial (landfill)	Contam. soils	\$65-\$70/ton	NA	NA	NA	Facility is a nonhazardous Class II facility. Landfilling disposal fee without treatment around \$45/ton.
			OBM's and cuttings					
			Tank bottoms					
			WBMs and cuttings					
CO	Clean Harbors Environmental Services - Deer Trail LLC	Burial (landfill)	Contam. soils	\$2.50-\$28/ton	NA	NA	NA	Certain nonhazardous solid waste priced around \$2.50/ton; treated and solidified waste at \$28/ton. Facility provides rolloff service, which triggers staging, rental, and roundtrip fees. Trucking service can be provided, and fees are distance-driven. For example, a Denver to Dear Trail trip is priced at \$1,000.
			OBM's and cuttings					
			Tank bottoms					
			WBMs and cuttings					
CO	Four Mile Creek Facility	Evaporation	Contam. soils	\$45/ton	NA	NA	NA	Facility recovers oil.
			Produced water	\$1.95-\$3.95/bbl				Price varies with total dissolved solids. Facility recovers oil.
			WBMs and cuttings	\$4-\$20/bbl				Price varies with percentage of solids. Facility recovers oil.
CO	R.N. Industries	Evaporation	Produced water	\$1.20/bbl	\$100/hr	\$100/hr	\$100-\$1,000/test	NA
			WBMs and cuttings	\$7/bbl				
CO	Reams Construction - 80 Ponds	Evaporation	Produced water	\$84/bbl	\$70/hr	\$70/hr	\$0	Nonhazardous solids are farmed out.



**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
CO	Unnamed	Evaporation	Produced water	\$1.50/bbl	NA	NA	NA	Facility declined to be listed by name. Facility uses a series of ponds in the course of forced evaporation, including settling and air sparge modules. Facility works with an out-of-state laboratory. Lab analysis fee covered by overall disposal fee. Any remaining solids land farmed and used for road construction.
FL	Perdido Landfill Escambia County	Burial (landfill)	Contam. soils	\$28/ton	NA	NA	NA	The Perdido Landfill rate of \$28/ton (\$7 minimum required) for Class I waste, ties Escambia County with one other county in Florida. Disposal fees range from \$23/ton to \$92/ton, with a statewide average of \$42/ton. Class I waste is primarily household garbage generated by residential type customers.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
FL	Rinker Materials Environmental Services	Thermal treatment	Contam. soils	\$35/ton	NA	NA	\$350/test	<p>Facility takes nonhazardous waste oils, hydrocarbons, and other organic contaminants and uses them either as an alternate fuel source or processes them in ultra-high temperature kilns. This incorporates any remaining inert matter into a component of Rinker Materials cement. Contaminated soil is directed to a thermal desorber to rid it of volatile petroleum prior to being fed as a clean raw material in cement production. All that is left of the cleaned soils and solids after processing at 2,800°F is an inert gaseous material called “clinker.” The clinker is processed and ground with gypsum to become cement. Before any material is accepted, a representative analysis must be submitted to ensure that it meets all regulatory and Rinker Materials requirements. In addition to this precertification, the contaminated material is rechecked at its own state-certified laboratory. The laboratory also provides certified field sampling and precertification analysis for its customers desiring “one-stop project services.” Rinker Materials maintains a fleet of transport equipment dedicated to serve clients’ solid and liquid petroleum contamination requirements. In addition to truck transport, Rinker Materials provides railcar services that can accommodate a wide variety of special waste management requirements that customers face.</p>
			OBMs and cuttings	\$100/drum				
			Tank bottoms	\$200/ton				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
KY	Allied Waste Management - Green Valley Landfill General Partnership	Burial (landfill)	Contam. soils	\$56/ton	NA	NA		Waste stream must not contain any free liquid and pass the paint filter test. Facility conducts profiling for state approval and internal company approval. This landfill has slurrification capability. In addition to the disposal fee of \$56/ton, a fee of \$5/load accrues.
			OBMs and cuttings	\$56/ton				
			Produced water	\$56/ton				
			Tank bottoms	\$56/ton				
			WBMs and cuttings	\$56/ton				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
LA	CCS Energy Services LLC - Cameron (Transfer)	Treatment	Contam. soils	\$6-\$15/bbl	\$55-\$75/hr	\$150/job	\$0	<p>Wastes are stabilized with fly ash, off-specification oil field cement, wood chips, etc., and trucked to a Subtitle D landfill for recycle use as alternate daily cover. CCS occasionally provides trucking services from the well site to its facilities. It does not provide trucking from its plant to the landfills because the landfill company takes title to these solids as they leave the gate at the CCS plant. There are times when CCS offers the trucking service as part of a turnkey fee, which is added to the waste price and presented to the generator as one lump sum \$/bbl fee—CCS only does this when the distance to be traveled is short. It should be noted that the majority of the business (+/-70%) is generated from offshore or near offshore operations. CCS uses its fleet of USCG-approved hopper barges (~ 6,500 bbl each) to transport this waste from its transfer stations to its treatment/disposal facilities. Many times the barge(s) is rented to the generator who places the barge(s) at the rig CCS either rents these barges on a \$/day rate (\$300/day-\$500/day) or adds it into its \$/bbl fee. When CCS rents out barges, it may either use its tugs or let the generator use its tugs for transportation to its facilities. The cleaning fees for trucks, boats, cuttings boxes, and others vary widely. Simple truck wash-outs may be \$150, while large dirty boat tanks may be \$10,000+. Boxes and containers are usually charged by the bbl of wash water used or</p>

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			OBMs and cuttings	\$6-\$15/bbl				added to the cost of mud disposal. Typically, no lab fees are charged to the generator unless there is a specific reason to conduct a more in-depth analysis. Each of CCS 's facilities is required to have its own lab. Every shipment of E&P waste must be analyzed for a few parameters (these will vary slightly from state to state)—typical analyses are NORM, EC, Cl, H <sub>2</sub> S, temperature, and pH. Many other fees can be charged depending on the job being performed (e.g., crane time, labor, other equipment time, and others).
			Tank bottoms	\$6-\$15/bbl				
			WBMs and cuttings	\$6-\$15/bbl				
LA	CCS Energy Services LLC - Fourchon (Transfer)	Treatment	Contam. soils	\$6-\$15/bbl	\$55-\$75/hr	\$150/job	\$0	Same as CCS —Cameron.
			OBMs and cuttings	\$6-\$15/bbl				
			Tank bottoms	\$6-\$15/bbl				
			WBMs and cuttings	\$6-\$15/bbl				
LA	CCS Energy Services LLC - ICY (Transfer)	Treatment	Contam. soils	\$6-\$15/bbl	\$55-\$75/hr	\$150/job	\$0	Same as CCS —Cameron.
			OBMs and cuttings	\$6-\$15/bbl				
			Tank bottoms	\$6-\$15/bbl				
			WBMs and cuttings	\$6-\$15/bbl				
LA	CCS Energy Services LLC - Morgan City (Direct)	Treatment	Contam. soils	\$6-\$15/bbl	\$55-\$75/hr	\$150/job	\$0	Same as CCS —Cameron.
			OBMs and cuttings	\$6-\$15/bbl				
			Tank bottoms	\$6-\$15/bbl				
			WBMs and cuttings	\$6-\$15/bbl				
LA	CCS Energy Services LLC - Venice	Treatment	Contam. soils	\$6-\$15/bbl	\$55-\$75/hr	\$150/job	\$0	Same as CCS —Cameron.
			OBMs and cuttings	\$6-\$15/bbl				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
	(Transfer)		Tank bottoms	\$6-\$15/bbl				
			WBMs and cuttings	\$6-\$15/bbl				
LA	Charles Holston, Inc.	Injection	Produced water	\$0.50/bbl	\$68/hr	NA	NA	NA
LA	Chemical Waste Management Inc.	Burial (landfill)	Contam. soils	\$75-\$250/ton	NA	NA	NA	Exploration and production (E&P) waste disposal costs range between \$75/ton and \$100/ton for direct landfill, and between \$150/ton and \$250/ton for wastes containing liquids. Transportation fees are \$.25 per truck mile, with a minimum charge of \$275.
			Produced water	\$75-\$250/ton				
			Tank bottoms	\$75-\$250/ton				
			WBMs and cuttings	\$75-\$250/ton				
LA	Guillory Tank Truck Service	Injection	Produced water	\$0.50/bbl	\$68/hr	NA	NA	NA
LA	Habetz Oilfield Saltwater Service	Injection	Produced water	\$0.67/bbl	NA	NA	NA	Facility charges \$80 per load (roughly 120 bbl).
LA	Hallar Enterprises Inc. Disposal Site	Injection	Produced water	\$1/bbl	\$70/hr	NA	NA	Waste stream must have passed the TCLP. Disposal and transportation fees vary according to volumes and distances.
LA	Houma Salt Water Disposal Corp. - Off LA Hwy 316	Injection	Produced water	\$0.60/bbl	NA	NA	NA	NA
LA	Key Energy Services, Inc. - Athens	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
LA	Key Energy Services, Inc. - Oil City	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
LA	Louisiana Tank, Inc.	Injection	Produced water	\$0.50/bbl	\$71.40/hr	NA	NA	NA
LA	Newpark Environmental Services - Cameron (Transfer)	Injection (solids)	Contam. soils	\$5.50–\$10.50/bbl	NA	NA	\$0	Disposal process involves slurrification and injection. Fees for contaminated soils will be at the higher end of the range. Disposal fees may be higher than the range indicated. The range given here includes a transfer-related increment of \$0.50/bbl. Newpark leases barges. It takes custody at the transfer station. Lab analysis is conducted for pH and Cl.
			OBMs and cuttings	\$5.50–\$10.50/bbl				
			Produced water	\$5.50–\$10.50/bbl				
			Tank bottoms	\$5.50–\$10.50/bbl				
			WBMs and cuttings	\$5.50–\$10.50/bbl				
LA	Newpark Environmental Services - Fourchon I (Transfer)	Injection (solids)	Contam. soils	\$5.50–\$10.50/bbl	NA	NA	\$0	Same as Newpark—Cameron.
			OBMs and cuttings	\$5.50–\$10.50/bbl				
			Produced water	\$5.50–\$10.50/bbl				
			Tank bottoms	\$5.50–\$10.50/bbl				
			WBMs and cuttings	\$5.50–\$10.50/bbl				
LA	Newpark Environmental Services - Fourchon II (Transfer)	Injection (solids)	Contam. soils	\$5.50–\$10.50/bbl	NA	NA	\$0	Same as Newpark—Cameron.
			OBMs and cuttings	\$5.50–\$10.50/bbl				
			Produced water	\$5.50–\$10.50/bbl				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			Tank bottoms	\$5.50–\$10.50/bbl				
			WBMs and cuttings	\$5.50–\$10.50/bbl				
LA	Newpark Environmental Services - ICY (Transfer)	Injection (solids)	Contam. soils	\$5.50–\$10.50/bbl	NA	NA	\$0	Same as Newpark—Cameron.
			OBMs and cuttings	\$5.50–\$10.50/bbl				
			Produced water	\$5.50–\$10.50/bbl				
			Tank bottoms	\$5.50–\$10.50/bbl				
			WBMs and cuttings	\$5.50–\$10.50/bbl				
LA	Newpark Environmental Services - Morgan City (Transfer)	Injection (solids)	Contam. soils	\$5.50–\$10.50/bbl	NA	NA	\$0	Same as Newpark—Cameron.
			OBMs and cuttings	\$5.50–\$10.50/bbl				
			Produced water	\$5.50–\$10.50/bbl				
			Tank bottoms	\$5.50–\$10.50/bbl				
			WBMs and cuttings	\$5.50–\$10.50/bbl				
LA	Newpark Environmental Services - Venice (Transfer)	Injection (solids)	Contam. soils	\$5.50–\$10.50/bbl	NA	NA	\$0	Same as Newpark—Cameron.
			OBMs and cuttings	\$5.50–\$10.50/bbl				
			Produced water	\$5.50–\$10.50/bbl				
			Tank bottoms	\$5.50–\$10.50/bbl				
			WBMs and cuttings	\$5.50–\$10.50/bbl				
LA	O'Brian Energy Co.	Injection	Produced water	\$0.75/bbl	\$80/hr	NA	NA	If completion fluids are involved, the fee increases to \$2/bbl. Transportation costs are also subject to a fuel surcharge.



**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
LA	Philip Environmental Services (PSC Industrial Outsourcing, Inc.) - Morgan City Facility	Manifesting (sampling)	NORM	\$50/hr	Contractor cost + 15%	NA	\$300/test	Facility accepts NORM-contaminated items consisting of tubulars (piping), vessels, and other equipment. Oil field activities provide the site with more than 95% of its business; the rest comes from power plants and other industrial concerns. NORM-contaminated material arrives primarily by trailer and rolloff truck. Decontamination of tubulars is accomplished with one of two technologies—high-pressure water lancing or dry reaming. Depending upon the strength of adherence of the scale to the metal, PSC can clean the vessels/equipment with a degreasing water flush, heat and/or high-pressure water lancing, or with a pneumatic needle gun. Vessels and equipment are typically cut up for scrap. Depending upon sampling, manifesting destination varies.
LA	Philip Environmental Services (PSC Industrial Outsourcing, Inc.) - Morgan City Facility	Injection	Produced water	\$0.65/bbl	\$68.25/hr	NA		Facility separates out crude. Water is disposed of through injection. By-products generated include waste solids, which are sent to landfills.
LA	Pool Company – Minden	Injection	Produced water	\$0.85/bbl	\$75/hr	NA	\$0	Disposal fee for completion fluids is \$1.70/bbl.
LA	Saline Injection Systems Co.	Injection	Produced water	\$0.50–\$10/bbl	\$75/hr	NA	NA	Fees range considerably on a case-by-case basis.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
LA	US Liquids of Louisiana LP - Bateman Island (Direct)	Treatment	Contam. soils	\$12.50/bbl	NA	NA	NA	<p>Wastes other than produced water are placed in treatment cells. The free oil is removed and salvaged for resale. In Louisiana., soluble salts are removed through flushing solids with water. The resulting process water and produced water are then pumped through a collection system, placed in tanks, and typically disposed of at one of the USLL commercial saltwater injection wells. All remaining waste is processed to remove organic contamination through biological degradation. USLL does not own or operate its own trucking service to pick up wastes from a well site and transport them to the disposal site. However, USLL does have a list of approved trucking companies for each of its operating locations to provide the operator if needed. The following are transportation-related fees: \$95 for trucking/transportation; \$75 for Bobcat with operator; \$225 for crane with operator; \$75 for forklift with operator; and \$175 for track hoe with operator. Other handling charges include: \$75 for container handling (dump and rinse 25 bbl or less); \$45 for container rehandling (25 bbl or less); \$150 for drum handling; \$100 truck washout without wash water; \$300 for gauging/waste volume verification; \$3,125 for barge cleaning (open top shale, 1,500 bbl or less); and \$3,750 (open top shale, 1,500 to 3,000 bbl). Third-party equipment triggers cost plus 15%. USLL performs analyses on incoming waste but does not charge for this service. USLL checks the following on all loads: pH,</p>

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
								EC (soluble salts), NORM screening, oil and grease content, mud weight, and percentage of solids. Lower end of fee range for WBMs is for less than 30,000 ppm Cl, higher end is for greater than 30,000 ppm Cl.
		Treatment	OBMs and cuttings	\$11.50/bbl				
		Injection	Produced water	\$7/bbl				
		Treatment	Tank bottoms	\$12.50/bbl				
		Treatment	WBMs and cuttings	\$9.50–\$11.50/bbl				
LA	US Liquids of Louisiana LP - Berwick (Transfer)	Treatment	Contam. soils	\$12.50/bbl	NA	NA	NA	Same as USLL—Bateman Island.
		Treatment	OBMs and cuttings	\$11.50/bbl				
		Injection	Produced water	\$3–\$7/bbl				
		Treatment	Tank bottoms	\$12.50/bbl				
		Treatment	WBMs and cuttings	\$9.50–\$11.50/bbl				
LA	US Liquids of Louisiana LP - Bourg (Direct)	Treatment	Contam. soils	\$12.50/bbl	NA	NA	NA	Same as USLL—Bateman Island.
		Treatment	OBMs and cuttings	\$11.50/bbl				
		Injection	Produced water	\$7/bbl				
		Treatment	Tank bottoms	\$12.50/bbl				
		Treatment	WBMs and cuttings	\$9.50–\$11.50/bbl				
LA	US Liquids of Louisiana LP - Cameron (Transfer)	Treatment	Contam. soils	\$14/bbl	NA	NA	NA	Same as USLL—Bateman Island.
		Treatment	OBMs and cuttings	\$12.75/bbl				
		Injection	Produced water	\$3–\$7/bbl				
		Treatment	Tank bottoms	\$14/bbl				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
		Treatment	WBMs and cuttings	\$10.75/bbl				
LA	US Liquids of Louisiana LP - Elm Grove (Direct)	Treatment	Contam. soils	\$9.50/bbl	NA	NA	NA	Same as USLL—Bateman Island.
		Treatment	OBMs and cuttings	\$9.50/bbl				
		Injection	Produced water	\$1/bbl				
		Treatment	Tank bottoms	\$9.50/bbl				
		Treatment	WBMs and cuttings	\$7.50–\$9.50/bbl				
LA	US Liquids of Louisiana LP - Fourchon (Transfer)	Treatment	Contam. soils	\$14/bbl	NA	NA	NA	Same as USLL—Bateman Island.
		Treatment	OBMs and cuttings	\$12.75/bbl				
		Injection	Produced water	\$3–\$7/bbl				
		Treatment	Tank bottoms	\$14/bbl				
		Treatment	WBMs and cuttings	\$10.75/bbl				
LA	US Liquids of Louisiana LP - ICY (Transfer)	Treatment	Contam. soils	\$14/bbl	NA	NA	NA	Same as USLL—Bateman Island.
		Treatment	OBMs and cuttings	\$12.75/bbl				
		Injection	Produced water	\$3–\$7/bbl				
		Treatment	Tank bottoms	\$14/bbl				
		Treatment	WBMs and cuttings	\$10.75/bbl				
LA	US Liquids of Louisiana LP - Mermonteau (Transfer)	Injection	Produced water	\$3/bbl	NA	NA	NA	Same as USLL—Bateman Island.
LA	US Liquids of Louisiana LP - Venice	Treatment	Contam. soils	\$14/bbl	NA	NA	NA	Same as USLL—Bateman Island.
		Treatment	OBMs and cuttings	\$12.75/bbl				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
	(Transfer)	Injection	Produced water	\$3-\$7/bbl				
		Treatment	Tank bottoms	\$14/bbl				
		Treatment	WBMs and cuttings	\$10.75/bbl				
MI	Beckman Production Services Inc.	Injection	Produced water	\$1-\$1.50/bbl	\$70/hr	NA	NA	Well disposes of brine only.
MI	Northeastern Exploration	Injection	Produced water	\$1.30-\$1.75/bbl	NA	NA		Facility accepts oil field brines. It provides its own trucking and works this into the overall disposal fee. No fees are charged for lab analyses.
MI	Seiler Tank Truck Service Inc.	Injection	Produced water	\$0.50/bbl	\$75/hr	\$75/hr	NA	Facility manages only brines.
MS	Earth Resources	Injection	Produced water	\$0.60/bbl	\$90/hr	NA	NA	Facility accepts produced water only.
MS	Johnie Stringer Moving and Storage Inc.	Transportation	Produced water	NA	\$85/hr	\$85/hr	NA	Facility hauls in brine using only its own trucks.
MS	MacLand Disposal Center	Burial (landfill)	Contam. soils	\$20-\$30/ton	\$85/hr	\$85/hr	NA	NA
			OBMs and cuttings	\$20-\$30/ton				
			Produced water	\$55-\$75/ton				
			Tank bottoms	\$55-\$75/ton				
			WBMs and cuttings	\$20-\$30/ton				
MS	Radzewicz Operating Corporation	Injection	Produced water	\$0.37/bbl	NA	NA	NA	Facility handles brine only. Fees are case-specific. Trucking services can be arranged.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
MS	Waste Management - Central Landfill	Burial (landfill)	Contam. soils	\$38/ton	NA	NA		The landfill accepts only nonhazardous solid wastes. Constituents of concern include benzene and heavy metals. Moreover, the flashpoint may be an issue. The direct-landfill fee (solids, dewatered sludges) amounts to \$38/ton. The Central Landfill does not have liquefix capability. If necessary, this service is accomplished at the nearby Pecan Gove facility. The additional costs range between \$40/ton and \$90/ton. In addition, taxes of \$1/ton apply. The generator is responsible for conducting the laboratory work and filling out the profile sheet.
			OBMs and cuttings	\$38/ton				
			Produced water	\$38/ton				
			Tank bottoms	\$38/ton				
			WBMs and cuttings	\$38/ton				
MS	Waste Management Inc. - Pecan Grove Sanitary Recycling and Disposal Facility	Burial (landfill)	Contam. soils	\$38-\$128/ton				The landfill accepts only nonhazardous solid wastes. Constituents of concern include benzene and heavy metals. Moreover, the flashpoint may be an issue. The range reflects the direct-landfill fee (solids, dewatered sludges) of \$38/ton and the additional liquefix spread of \$40/ton and \$90/ton. In addition, taxes of \$1/ton apply. The generator is responsible for conducting the laboratory work and filling out the profile sheet.
			OBMs and cuttings	\$38-\$128/ton				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			Produced water	\$38-\$128/ton				
			Tank bottoms	\$38-\$128/ton				
			WBMs and cuttings	\$38-\$128/ton				
MT	PetroComp	Bioremediation	Contam. soils	\$50/ton	NA	NA		NORM only to the extent found in the incoming solid or liquid E&P waste streams, and only in accordance with all applicable regulatory requirements. Trucking fee schedule varies. Facility uses independent laboratories. Remediation process is bacteria-based. Stable solids yielded after remediation are used as landfill cover.
			OBMs and cuttings	\$40/bbl				
			Tank bottoms	\$40/bbl				
			WBMs and cuttings	\$40/bbl				
ND	Black Hawk Resources LLC - Hatter	Injection	Produced water	\$0.35-\$0.75/bbl	NA	NA	NA	Facility charges \$0.35/bbl when its pipeline is used. If produced water is trucked in, the fee is \$0.75/bbl.
ND	Black Hawk Resources LLC - Klandl	Injection	Produced water	\$0.35-\$0.75/bbl	NA	NA	NA	Facility charges \$0.35/bbl when its pipeline is used. If produced water is trucked in, the fee is \$0.75/bbl.
ND	Dishon Disposal Inc. - Dishon Landfill	Burial (landfill)	Contam. soils	\$15-\$22/bbl	\$65/85/hr	NA	NA	Higher disposal fee of \$22/bbl is charged for waste streams with diesel/oil. Facility offers two sizes of trucks.
			OBMs and cuttings	\$15-\$22/bbl				
			Produced water	\$15-\$22/bbl				
			Tank bottoms	\$15-\$22/bbl				
			WBMs and cuttings	\$15-\$22/bbl				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
ND	Energy Equity Company - Borgen	Injection	Produced water	\$65/load	NA	NA	NA	Facility charges per truck load.
ND	Energy Equity Company - George Tank #1	Injection	Produced water	\$65/load	NA	NA	NA	Facility charges per truck load.
ND	Energy Equity Company - Heckert	Injection	Produced water	\$65/load	NA	NA	NA	Facility charges per truck load.
ND	Energy Equity Company - North Dickinson	Injection	Produced water	\$65/load	NA	NA	NA	Facility charges per truck load.
ND	Indian Hills Disposal Inc. - Indian Hill Landfill	Burial (landfill)	Contam. soils	\$35-\$80/ton	\$100/hr	\$35/hr	NA	Disposal fee varies according to hydrocarbon content. Treatment involves composting. In general, generator conducts lab analyses.
			OBMs and cuttings	\$35-\$80/ton				
			Produced water	\$35-\$80/ton				
			Tank bottoms	\$35-\$80/ton				
			WBMs and cuttings	\$35-\$80/ton				
ND	Missouri Basin Well Service, Inc. - H.T. Knudtson	Injection	Pit water	\$1/bbl	\$85/hr	\$85	NA	NA
		Injection	Produced water	\$0.50/bbl				
ND	Missouri Basin Well Service, Inc. - Zenith-Newton Unit	Injection	Pit water	\$1/bbl	\$85/hr	\$85	NA	NA
			Produced water	\$0.50/bbl				
ND	Prairie Disposal Inc. - Krenz Landfill	Burial (landfill)	Contam. soils	\$15-\$30/ton	NA	NA	NA	Disposal fees depend on the amount of treatment involved. Higher end reflects treatment through composting and windrose.
			OBMs and cuttings	\$15-\$30/ton				



**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			Tank bottoms	\$15-\$30/ton				
			WBMs and cuttings	\$15-\$30/ton				
ND	Ward-Williston Company - Carpentier	Injection	Pit water	\$0.70/bbl	\$85/hr	NA	NA	NA
			Produced water	\$0.70/bbl				
ND	Ward-Williston Company - Martin-Williams	Injection	Pit water	\$0.70/bbl	\$85/hr	NA	NA	NA
			Produced water	\$0.70/bbl				
ND	Ward-Williston Company - Montgomery	Injection	Pit water	\$0.70/bbl	\$85/hr	NA	NA	NA
			Produced water	\$0.70/bbl				
ND	Ward-Williston Company - Pan Am	Injection	Pit water	\$0.70/bbl	\$85/hr	NA	NA	NA
			Produced water	\$0.70/bbl				
ND	Ward-Williston Company - Theodore	Injection	Pit water	\$0.70/bbl	\$85/hr	NA	NA	NA
			Produced water	\$0.70/bbl				
NE	Clean Harbors Environmental Services - Kimball Facility	Thermal treatment	Contam. soils	\$0.19/lb (\$0.14-\$0.40/lb)	NA	NA	NA	Incoming waste stream must be pre-approved. Facility utilizes a 45,000-ton/yr fluidized bed incinerator. The TOU is capable of maximum destruction efficiencies of hazardous waste and able to handle an extremely wide variety of feeds. Delisted ash from TOU operations will be placed in an onsite monofill built to RCRA Subtitle C standards. Facility provides rolloff service, which triggers staging, rental, and roundtrip fees. Trucking service can be provided and fees are distance-driven. For example, a Denver to Dear Trail trip is priced at \$1,000.
			OBMs and cuttings	\$0.19/lb (\$0.14-\$0.40/lb)				
			Tank bottoms	\$0.19/lb (\$0.14-\$0.40/lb)				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			WBMs and cuttings	\$0.19/lb (\$0.14–\$0.40/lb)				
NM	Basin Disposal Inc.	Injection	Produced water	\$0.88/bbl	NA	NA	NA	This is a UIC Class II facility.
NM	C & C Landfarm Inc.	Land application	Contam. soils	\$14/yd <sup>3</sup>	NA	NA	NA	Dirt is “reclaimed” on a quarterly basis.
NM	Chaparral Service Inc.	Injection	Produced water	\$0.40/bbl	\$75–\$80/hr	NA	NA	The transportation fees range between \$75/hr (transporter) and \$80/hr (vacuum).
NM	Chaparral Service Inc.	Transportation	Tank bottoms		\$75–\$80/hr	NA	NA	The transportation fees range between \$75/hr (transporter) and \$80/hr (vacuum). Recovered oil is sold.
NM	Contract Environmental Services Inc.	Land application	Contam. soils	\$17/yd <sup>3</sup>	NA	NA	NA	Waste spread in landfill cell, evenly distributed, disked, and sun-dried. Disposal fee of \$17/yd <sup>3</sup> charged for waste streams that are light in hydrocarbons. Otherwise, the charge is \$34/yd <sup>3</sup> .
			OBMs and cuttings	\$17–\$34/yd <sup>3</sup>				
			Tank bottoms	\$34/yd <sup>3</sup>				
			WBMs and cuttings	\$17/yd <sup>3</sup>				
NM	Controlled Recovery Inc.	Burial (landfill)	Contam. soils	\$18/yd <sup>3</sup>	\$95/hr	\$70/hr	NA	The choice of disposal method (landspreading or landfill) is made by each generator. Depending on the liquid state of the waste stream, dewatering may be required. For recycling of tank bottoms, facility operates a centrifuge to facilitate reclamation.
		Land application	Contam. soils	\$25/yd <sup>3</sup>				
		Burial (landfill)	OBMs and cuttings	\$18/yd <sup>3</sup>				
		Land application	OBMs and cuttings	\$25/yd <sup>3</sup>				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
		Burial (landfill)	Produced water	\$18/yd <sup>3</sup>				
		Land application	Produced water	\$25/yd <sup>3</sup>				
		Recycling	Tank bottoms	\$5/bbl				
		Burial (landfill)	WBMs and cuttings	\$18/yd <sup>3</sup>				
		Land application	WBMs and cuttings	\$25/yd <sup>3</sup>				
NM	Environmental Plus	Land application	Contam. soils	\$14–\$22/yd <sup>3</sup>	\$72/hr	NA		Land farm operation involves spreading and irrigation. Facility only takes possession, not ownership. The transportation fee is for a truck, a licensed driver, and two-way communication, and includes fuel. Facility conducts field surveys.
NM	Envirotech Inc.	Land application	OBMs and cuttings	\$18/bbl–\$18/yd <sup>3</sup>	\$82/hr	NA	NA	Wetter waste streams incur a higher disposal fee, since they need to be run through a blending facility.
			Produced water	\$18/bbl				
			Tank bottoms	\$18/bbl–\$18/yd <sup>3</sup>				
			WBMs and cuttings	\$18/bbl–\$18/yd <sup>3</sup>				
			WBMs and cuttings	\$18/yd <sup>3</sup>				
NM	Gandy Marley Inc.	Land application	Contam. soils	\$14/yd <sup>3</sup>	NA	NA	NA	Transportation pricing is based on bids per yd <sup>3</sup> or bbl.
		Burial (landfill)	OBMs and cuttings	\$16/yd <sup>3</sup>				
		Injection	Produced water	\$0.60/bbl				
		Recycling	Tank bottoms	\$3.75/bbl				
		Burial (landfill)	WBMs and cuttings	\$16/yd <sup>3</sup>				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
NM	Goo Yea Corp. - Goo Yea Landfarm Inc.	Land application	Contam. soils	\$18/yd <sup>3</sup>	\$80/hr	NA	NA	NA
NM	Goo Yea Corp. - Rhino Oilfield Disposal Inc.	Land application	Contam. soils	\$18/yd <sup>3</sup>	\$80/hr	NA	NA	NA
NM	Jay Dan Landfarm LLC	Land application	Contam. soils	\$14/yd <sup>3</sup>	NA	NA	NA	
NM	JFJ Landfarm Inc.	Bioremediation	Contam. soils	\$20/yd <sup>3</sup>	\$65–\$175/hr	NA	\$0	Facility bioremediates and manages muds and cuttings through centrifuging, dewatering, recycling, and offering resultant water for reuse (e.g., in frac jobs). Wastes are blended with soils, then a compost/organism is added. Transportation means include a regular vacuum (\$65), a dump truck (\$75/hr), and a king vacuum (\$175/hr). Testing is undertaken to exclude high Cl-laden wastes.
		Bioremediation	OBMs and cuttings	\$20/yd <sup>3</sup>				
		Land application	OBMs and cuttings	\$20/yd <sup>3</sup>				
		Bioremediation	Tank bottoms	\$20/yd <sup>3</sup>				
		Bioremediation	WBMs and cuttings	\$20/yd <sup>3</sup>				
NM	Jim’s Water Service of New Mexico	Transportation	Produced water	NA	\$1–\$3/bbl	NA	NA	Offers water hauling services only. Trucking fees increase with distance.
NM	Lea Land Inc.	Burial (landfill)	Contam. soils	\$14–\$42/ton	NA	NA	NA	Facility does not accept anything with free liquids. Facility is equipped with liner and leachate systems. Transportation fees vary with distance. Fuel surcharges apply. Generators fill out a waste profile document identifying the history of the waste stream.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			OBMs and cuttings	\$14-\$42/ton				
			WBMs and cuttings	\$14-\$42/ton				
NM	Loco Hills Landfarm LLC	Land application	Contam. soils	\$10/yd <sup>3</sup>	NA	NA	NA	NA
NM	Loco Hills Water Disposal	Evaporation	Produced water	\$0.60/bbl	NA	NA	NA	NA
NM	O K Hot Oil Service Inc.	Injection	Produced water	\$0.50/bbl	\$75/hr	NA	NA	NA
NM	Saunders Landfarm LLC	Land application	Contam. soils	\$10-\$12/yd <sup>3</sup>	NA	NA	NA	Facility does not accept salty waste streams.
NM	Sundance Services Inc.	Burial (landfill)	Contam. soils	\$18/yd <sup>3</sup>	NA	NA	NA	For produced water treatment, oil is skimmed off prior to evaporation.
		Burial (landfill)	OBMs and cuttings	\$18/yd <sup>3</sup>				
		Burial (landfill)	Tank bottoms	\$18/yd <sup>3</sup>				
		Burial (landfill)	WBMs and cuttings	\$18/yd <sup>3</sup>				
		Evaporation	Produced water	\$0.40/bbl				
NM	T-N-T Environmental Inc.	Land application	Contam. soils	\$12/bbl	NA	NA	\$0	Produced water is evaporated in a pond.
		Land application	OBMs and cuttings	\$12/bbl				
		Evaporation	Produced water	\$0.78/bbl				
		Land application	WBMs and cuttings	\$12/bbl				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
OH	American Landfill Inc.	Burial (landfill)	Contam. soils	\$15-\$50/ton	NA	NA	NA	Incoming waste stream must be unregulated. In addition to disposal fee, county taxes accrue. Liquid wastes undergo mixing with dry agents before being land-filled. Disposal fees for solids are \$15/ton and \$18/drum. Disposal fees for liquids are \$22/drum and \$50/ton. NORM analytes are sent to the Ohio Department of Health and Ohio Environmental Protection Agency for disposal approval.
			NORM	\$15-\$50/ton				
			OBMs and cuttings	\$15-\$50/ton				
			Produced water	\$15-\$50/ton				
			Tank bottoms	\$15-\$50/ton				
			WBMs and cuttings	\$15-\$50/ton				
OH	Countywide Landfill and Landfill Gas Processing Plant	Burial (landfill)	WBMs and cuttings	\$16-\$65/ton	NA	NA	NA	Incoming waste stream must meet federal hazardous waste exemption. Disposal fees for solid waste and liquid wastes are \$16/ton and \$65/ton. In addition to the disposal fee, county taxes accrue. Liquid wastes undergo solidification and mixing with dry wastes before being land-filled.
			NORM	\$16-\$65/ton				
			Contam. soils	\$16-\$65/ton				
			OBMs and cuttings	\$16-\$65/ton				
			Produced water	\$16-\$65/ton				
			Tank bottoms	\$16-\$65/ton				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
OH	Waste Management Inc. - Coshocton Landfill	Burial (landfill)	Contam. soils	\$18/ton	NA	\$0.40/gal	NA	Incoming waste has to meet waste acceptance standards in accordance with all applicable regulatory requirements. In addition to disposal costs, county fees of up to \$6.75/ton may accrue. Fees for rolloff containers and dump trucks vary with distances and volumes.
			NORM	\$18/ton				
			OBMs and cuttings	\$18/ton				
			Tank bottoms	\$18/ton				
			WBMs and cuttings	\$18/ton				
OH	Waste Management Inc. - Mahoning Landfill	Burial (landfill)	Contam. soils	\$18/ton	NA	\$0.40/gal	NA	Incoming waste has to meet waste acceptance standards in accordance with all applicable regulatory requirements. In addition to disposal costs, county fees of up to \$6.75/ton may accrue. Fees for rolloff containers and dump trucks vary with distances and volumes.
			NORM	\$18/ton				
			OBMs and cuttings	\$18/ton				
			Tank bottoms	\$18/ton				
			WBMs and cuttings	\$18/ton				
OH	Waste Management Inc. - Suburban Landfill	Burial (landfill)	Contam. soils	\$18/ton	NA	\$0.40/gal	NA	Incoming waste has to meet waste acceptance standards in accordance with all applicable regulatory requirements. In addition to disposal costs, county fees of up to \$6.75/ton may accrue. Fees for rolloff containers and dump trucks vary with distances and volumes.
			NORM	\$18/ton				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			OBMs and cuttings	\$18/ton				
			Tank bottoms	\$18/ton				
			WBMs and cuttings	\$18/ton				
OK	DRD Waste Treatment Solutions	Recycling	Contam. soils	\$8-\$45/yd <sup>3</sup>	\$90/hr	NA	NA	Waste stream is fully reclaimed/recycled. The facility charges a fee of \$8/yd <sup>3</sup> for soil contaminated with Cl, and \$45/yd <sup>3</sup> for soil contaminated with hydrocarbons. Facility provides initial laboratory analyses. Final analytical conducted in EPA-certified laboratory.
			OBMs and cuttings	\$16/bbl				
			Produced water	\$25/load				
			Tank bottoms	\$5/bbl				
			WBMs and cuttings	\$75/load				
OK	Femco (Webb Dozer)	Burial (pit)	Produced water	\$0.35/bbl	\$75/hr	NA	NA	The disposal company is listed as FEMCO in the phonebook, but as Webb Dozer on the inventory list provided by the Oklahoma Corporation Commission. The fee is \$125/load. A load equals roughly 100 bbl.
			WBMs and cuttings	\$1.25/bbl				
OK	Fugo Services - Blizzard	Injection	Produced water	\$0.40/bbl	\$85/hr	NA	NA	Fuel surcharge applied.
OK	Fugo Services - Buckner	Injection	Produced water	\$0.40/bbl	\$85/hr	NA	NA	Fuel surcharge applied.
OK	Fugo Services - Mackey	Injection	Produced water	\$0.40/bbl	\$85/hr	NA	NA	Fuel surcharge applied.
OK	Fugo Services - Nichols	Injection	Produced water	\$0.40/bbl	\$85/hr	NA	NA	Fuel surcharge applied.



**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
OK	Fugo Services - Quinton	Injection	Produced water	\$0.40/bbl	\$85/hr	NA	NA	Fuel surcharge applied.
OK	Hamm & Phillips Service Company	Burial (pit)	Pit water	\$1.50/bbl	NA	NA	NA	Sister company can provide trucking service. Charge for semisolids of \$75 is levied per Bobtail load (roughly 14 yd <sup>3</sup> ).
			WBMs and cuttings	\$1.50/bbl				
OK	Nichols Water Service Inc. - A.R. Turner	Injection	Produced water	\$0.30/bbl	\$75/hr	NA	NA	NA
OK	Nichols Water Service Inc. - Nichols 1	Injection	Produced water	\$0.30/bbl	\$75/hr	NA	NA	NA
OK	Nichols Water Service Inc. - Nichols 2	Injection	Produced water	\$0.30/bbl	\$70/hr	NA	NA	NA
OK	Nichols Water Service Inc. - Nichols 3	Injection	Produced water	\$0.30/bbl	\$75/hr	NA	NA	NA
OK	O'Daniel	Burial (pit)	WBMs and cuttings	\$1/bbl	NA	NA	NA	NA
OK	Safe Earth Inc.	Injection	Produced water	\$0.60-\$0.65/bbl	NA	NA	NA	Quote in parentheses reflects fee estimates for Bobtail and truck.
		Burial (pit)	WBMs and cuttings	\$1.20/bbl (\$100-\$150/load)				
OK	Scott J. Inc. Oilfield Mud Disposal	Burial (pit)	Contam. soils	\$10/yd <sup>3</sup>	NA	NA	NA	Facility operates two lined lagoons (one 8 acres, the other 10 acres). Water is evaporated, and the remainder is covered with soil. High end of charge reflects high Cl waste streams.
			WBMs and cuttings	\$1-\$2/bbl				
OK	T & S Mud Disposal	Burial (pit)	Contam. soils	\$1/bbl	NA	NA	\$0	Facility is an open, lined pit. It manages salt-contaminants. Soils or oil-based muds and cuttings.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
		Injection	Produced water	\$0.35/bbl				
		Burial (pit)	WBMs and cuttings	\$1/bbl				
OK	Trout Disposal	Injection	Produced water	\$0.60/bbl	NA	NA	\$0	NA
OK	Trout Disposal	Burial (pit)	WBMs and cuttings	\$1/bbl	NA	NA	\$0	NA
PA	Castle Environmental Inc.	Discharge (POTW)	Produced water	\$0.025–\$0.050/gal	\$85/hr	NA	NA	The facility operates a nonhazardous wastewater processing facility. Treatment involves chemical precipitation and filtration. For the resultant water from the process, the facility holds an Industrial Discharge Permit (Wastewater Discharge Permit #1-06-A) issued for the discharge of industrial waste for treatment at the New Castle Sanitation Authority's Wastewater Treatment Plant. The facility can provide vacuum truck services, pickup, and transportation.
PA	Hart Resource Technologies	Discharge (NPDES)	Produced water	\$0.0525/gal	NA	NA	NA	Treatment involves chemical precipitation and removal of oils and heavy metals. Surface water discharge occurs under NPDES permit issued by the state.
PA	Moshannon Valley Sewer Authority	Discharge (POTW)	Produced water	\$0.015/gal	NA	NA	NA	Facility receives mainly gas field frac water and, on an intermittent basis, brines that are not strong.
PA	Pennsylvania Brine Treatment	Discharge (NPDES)	Produced water	\$ 0.055/gal	NA	NA	NA	Facility uses chemical precipitation and generates nonhazardous residual sludge that is land-filled offsite at a PADEP-permitted facility. The treated water is then discharged to surface waters under an NPDES permit. Trucking service will be arranged by request. Charges by volume vary with distance.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
PA	Tunnelton Liquids Co	Discharge (NPDES)	Pit water	\$0.045/gal	NA	NA	NA	Facility uses an innovative process to treat pit water (containing some oil-based muds and cuttings). It combines acid mine drainage from an abandoned coal mine with the produced water. Sulfates in the mine drainage help remove contaminants from the produced water. Following several treatment steps, the treated wastewater is discharged to a river under the authority of an NPDES permit. Any solids are sent to a landfill. Tank bottoms are heated and oil is reclaimed.
		Discharge (NPDES)	Produced water	\$0.045/gal				
TX	Basic Energy Services - Duval	Burial (pit)	WBMs and cuttings	\$1-\$2/bbl	\$73.50/hr	NA	NA	Disposal fee range captures \$2.50/bbl for water-based muds, and \$7.50/yd <sup>3</sup> for shell cuttings. Transportation fee is further subject to insurance and a fuel surcharge of 14%.
TX	Basic Energy Services – Jackson	Land application	WBMs and cuttings	\$2.50/bbl–\$7.50/yd <sup>3</sup>	\$73.50/hr	NA	NA	Disposal fee range captures \$2.50/bbl for water-based muds, and \$7.50/yd <sup>3</sup> for shell cuttings. Transportation fee is further subject to insurance and a fuel surcharge of 14%.
TX	Basic Energy Services - Jefferson	Land application	WBMs and cuttings	\$2.50/bbl–\$7.50/yd <sup>3</sup>	\$73.50/hr	NA	NA	Disposal fee range captures \$2.50/bbl for water-based muds, and \$7.50/yd <sup>3</sup> for shell cuttings. Transportation fee is further subject to insurance and a fuel surcharge of 14%.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
TX	CCS Energy Services LLC - Kiva (Direct)	Cavern	Contam. soils	\$6-\$15/bbl	\$55-75/hr	\$150/job	\$0	<p>The Texas disposal facility is a disposal cavern. Displaced brine out of a cavern is injected into a permitted saltwater disposal well. The disposal fees are different, depending on the type of waste and the delivery point of the waste. The farther away the transfer station is from the plant, the higher the fee—transportation is the main reason for this. CCS occasionally provides trucking services from the well site to its facilities. It does not provide trucking from its plant to the landfills because the landfill company takes title to these solids as they leave the gate at their plant. CCS does, however, provide trucking from its dock facility in Texas to its cavern disposal site. Two types of trucks are utilized—vacuum trucks for liquids and end dumps for solids. The cost of trucking varies widely, depending entirely upon the distance the truck must travel. Typically, trucks charge by the hour; \$55 to \$75 is typical. There are times when CCS offers the trucking service as part of a turnkey fee, which is added to the waste price and presented to the generator as one lump sum \$/bbl fee. CCS only does this when the distance to be traveled is short. It should be noted that the majority of the business (+/- 70%) is generated from offshore or near offshore operations. CCS uses its fleet of USCG-approved hopper barges (~ 6,500 bbl each) to transport this waste from its transfer stations to its treatment/disposal facilities. Many times</p>

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			Contam. soils	\$6-\$15/bbl				<p>CCS rents the barge(s) to the generator who places the barge(s) at the rig. CCS either rents these barges on a \$/day rate (\$300/day-\$500/day) or add it in to their \$/bbl fee. When CCS rents out barges, it may either use its tugs or let the generator use its tugs for transportation to its facilities. The cleaning fees for trucks, boats, cuttings boxes, and others vary widely. Simple truck washouts may be \$150, while large dirty boat tanks may be \$10,000 +. Boxes and containers are usually charged by the bbl of wash water used or added to the cost of mud disposal. Typically, no lab fees are charged to the generator unless there is a specific reason to conduct a more in-depth analysis. Each of CCS's facilities is required to have its own lab. Every shipment of E&amp;P waste must be analyzed for a few parameters (these will vary slightly from state to state)—typical analyses are NORM, EC, Cl, H<sub>2</sub>S, temperature, and pH. Many other fees can be charged depending on the job being performed (e.g., crane time, labor, other equipment time, and others).</p>
			OBMs and cuttings	\$6-\$15/bbl				
			Produced water	\$0.50-\$3/bbl				
			Tank bottoms	\$6-\$15/bbl				
			WBMs and cuttings	\$6-\$15/bbl				
TX	CCS Energy Services LLC - Moss Bluff	Cavern	Contam. soils	\$6-\$15/bbl	\$55-\$75/hr	\$150/job	\$0	Same as CCS —Kiva.
			OBMs and cuttings	\$6-\$15/bbl				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
	(Direct)		Produced water	\$0.50-\$3/bbl				
			Tank bottoms	\$6-\$15/bbl				
			WBMs and cuttings	\$6-\$15/bbl				
TX	Clean Harbors Environmental Services - Deer Park LP	Thermal treatment	Contam. soils	\$0.55/lb	NA	NA	NA	Fee assumes a solid waste stream. Incineration becomes the disposal avenue when the waste stream is hydrocarbon-laden. Transportation fee is based on load miles. Generator conducts independent analyses.
			OBMs and cuttings	\$0.45/lb				
			Produced water	\$0.02-\$0.20/lb				
			Tank bottoms	\$0.45/lb				
			WBMs and cuttings	\$0.45/lb				
TX	Coastal Caverns Inc.	Cavern	Contam. soils	\$2-\$7/bbl	NA	NA	NA	Some materials may require preconditioning or further slurrification. Contaminated soils incur a fee at the higher end of the range.
			OBMs and cuttings	\$2-\$7/bbl				
			Produced water	\$0.30-\$0.40/bbl				
			Tank bottoms	\$2-\$7/bbl				
			WBMs and cuttings	\$2-\$7/bbl				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
TX	Eco Mud Disposal - Alice Facility	Treatment	Contam. soils	\$25-\$30/yd <sup>3</sup>	NA	NA	NA	Trucks hauling liquid waste unload into three holding tanks. Dry material is stacked for treatment on dump pads. When processing, the material is conveyed to the mixing pugmill where it is blended with dry chemicals for stabilization and solidification. After the material has been processed, it is hauled by a front-end loader to one of three temporary holding areas where it is allowed to fully cure before being disposed of onsite. A record of each load received is kept by manifest in the office. The company charges for tank washing \$48/hr.
			OBMs and cuttings	\$9/bbl				
			Produced water	\$5/bbl				
			Tank bottoms	\$12/bbl				
			WBMs and cuttings	\$3/bbl				
TX	J. Moss Investments Inc. - Bustamante Facility	Burial (pit)	OBMs and cuttings	\$30/yd <sup>3</sup>	NA	NA	NA	Trucking services provided by sister company. Fees vary by loads. In the alternative, fees are assessed on an hourly basis (\$60 h + fuel surcharge).
			WBMs and cuttings	\$7/bbl				
TX	Karon Smith	Burial (pit)	WBMs and cuttings	\$2/bbl	NA	NA	NA	NA
TX	Key Energy Services, Inc. - Amando, Webb County School Land, Mckendrick, and Barker	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
TX	Key Energy Services, Inc. - Bettie Unit, Porter/Holland, and Sebesta Earl	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Bloes, and Thornton/Henry	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - BrowNAlma, and Jeter-Farmer	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Burns and Hanselman Unit 1	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Carthage Loop, Deberry, Panola County Disposal, Reed, and Singleton Fee	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Case	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Cashburn	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.



**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
TX	Key Energy Services, Inc. - Cooper	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Dasani	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Early	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Freestone County (2)	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Gangl Unit	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Gayle (2)	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Gutierrez (2), Leonard, Medina/ Lozano, Villareal (3), and Ramirez, Maria	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flow-back. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
TX	Key Energy Services, Inc. - Hunt/William, and Brushy Creek Gas Unit	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Hutson	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Joaquin	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Kinder/George	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Kristina	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Live Oak County	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	
TX	Key Energy Services, Inc. - Mckeown and Meisenheimer	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Moser (2)	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
TX	Key Energy Services, Inc. - Nichols Unit	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Peterson, T.M.	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - South Texas Disposal Inc.	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Standifer	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Teeters	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Vick and Lisa	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Washington County, Clay Creek East Unit, and Linda	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.
TX	Key Energy Services, Inc. - Youngblood	Injection	Produced water	\$0.75/bbl	\$65/hr	NA	NA	Facility manages produced water and also some flowback. The water goes into a saltwater disposal well. Any solids go to a licensed disposal facility.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
TX	Lotus LLC	Cavern	NORM	\$150–\$300/bbl	NA	\$150/hr	\$110–\$150/test	Media are slurrified prior to injection. Transportation fee accrues by the hour (vacuum truck) or by the mile (other trucks).
TX	Mo-Vac Service Co. Inc. - Andrews	Injection	Produced water	\$0.50/bbl	\$69/hr	NA	NA	Transportation fee is currently subject to a 16% fuel surcharge. Lab work is outsourced and paid by the generator. The facility conducts testing for Cl, since it is subject to a ceiling of maximum Cl of 3,000 mg/L
TX	Mo-Vac Service Co. Inc. – Ganaway Facility	Burial (pit)	WBMs and cuttings	\$3/bbl	\$69/hr	NA	NA	Transportation fee is currently subject to a 16% fuel surcharge. Lab work is outsourced and paid by the generator. The facility conducts testing for Cl, since it is subject to a ceiling of maximum Cl of 3,000 mg/L.
TX	Newpark Environmental Services - Big Hill (Direct)	Injection (solids)	NORM	\$150–\$300/bbl	NA	NA	\$0	Disposal process involves slurrification and injection. Newpark leases barges. It takes custody at the transfer station. Lab analysis is conducted for pH and Cl.
TX	Newpark Environmental Services - Farnett (Direct)	Injection (solids)	Contam. soils	\$5–\$10/bbl	NA	NA	\$0	Disposal process involves slurrification and injection. Fees for contaminated soils, oil-based muds and cuttings, and tank bottoms will be at the higher end of the range. Disposal fees may be higher than the range indicated. The range given here excludes a transfer-related increment. Newpark leases barges. It takes custody at the transfer station. Lab analysis is conducted for pH and Cl.
			OBMs and cuttings	\$5–\$10/bbl				
			Produced water	\$5–\$10/bbl				
			Tank bottoms	\$5–\$10/bbl				
			WBMs and cuttings	\$5–\$10/bbl				
TX	Newpark	Injection	Contam. soils	\$5.50–\$10.50/bbl	NA	NA	\$0	Same as Newpark—Farnett.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
	Environmental Services - Galveston (Transfer)	(solids)	OBMs and cuttings	\$5.50–\$10.50/bbl				
			Produced water	\$5.50–\$10.50/bbl				
			Tank bottoms	\$5.50–\$10.50/bbl				
			WBMs and cuttings	\$5.50–\$10.50/bbl				
TX	Newpark Environmental Services - Ingleside (Transfer)	Injection (solids)	Contam. soils	\$5.50–\$10.50/bbl	NA	NA	\$0	Same as Newpark—Fannett.
			OBMs and cuttings	\$5.50–\$10.50/bbl				
			Produced water	\$5.50–\$10.50/bbl				
			Tank bottoms	\$5.50–\$10.50/bbl				
			WBMs and cuttings	\$5.50–\$10.50/bbl				
TX	Newpark Environmental Services - Permian Basin - Andrews (Direct)	Cavern	Contam. soils	\$5–\$10/bbl	NA	NA	\$0	Same as Newpark—Fannett.
			OBMs and cuttings	\$5–\$10/bbl				
			Produced water	\$5–\$10/bbl				
			Tank bottoms	\$5–\$10/bbl				
			WBMs and cuttings	\$5–\$10/bbl				
TX	Newpark Environmental Services - Permian Basin - Big Spring (Direct)	Cavern	Contam. soils	\$5–\$10/bbl	NA	NA	\$0	Same as Newpark—Fannett.
			OBMs and cuttings	\$5–\$10/bbl				
			Produced water	\$5–\$10/bbl				
			Tank bottoms	\$5–\$10/bbl				
			WBMs and cuttings	\$5–\$10/bbl				
TX	Newpark Environmental Services -	Cavern	Contam. soils	\$5–\$10/bbl	NA	NA	\$0	Same as Newpark—Fannett.
			OBMs and cuttings	\$5–\$10/bbl				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
	Permian Basin - Fort Stockton (Direct)		Produced water	\$5-\$10/bbl				
			Tank bottoms	\$5-\$10/bbl				
			WBMs and cuttings	\$5-\$10/bbl				
TX	Newpark Environmental Services - Permian Basin - Plains (Direct)	Cavern	Contam. soils	\$5-\$10/bbl	NA	NA	\$0	Same as Newpark—Fannett.
			OBM's and cuttings	\$5-\$10/bbl				
			Produced water	\$5-\$10/bbl				
			Tank bottoms	\$5-\$10/bbl				
			WBMs and cuttings	\$5-\$10/bbl				
TX	Newpark Environmental Services - Port Arthur (Transfer)	Injection (solids)	Contam. soils	\$5-\$10/bbl	NA	NA	\$0	The Port Arthur treatment facility is authorized to receive nonhazardous oil and gas wastes. Pits are authorized for temporary storage of processed solids generated onsite from the treatment of nonhazardous oil field waste. Other pits are authorized to receive wash water from washout of containers used to transport waste material to the facility.
			OBM's and cuttings	\$5-\$10/bbl				
			Produced water	\$5-\$10/bbl				
			Tank bottoms	\$5-\$10/bbl				
			WBMs and cuttings	\$5-\$10/bbl				
TX	S & D Services – Floyd	Injection	Produced water	\$0.40-\$4/bbl	NA	NA	NA	Fee depends on how “dirty” the water is in each case.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
TX	Taylor Disposal Operating Inc. - Caverns 1 & 2	Cavern	Contam. soils	\$6/bbl	\$75/hr	\$100/hr	NA	Materials are injected in a slurry form. Disposal fee is a flat rate. Washout operations average 30 minutes (\$50). Cavern disposal is not used for brine. Taylor operates regular Class II saltwater injection wells in Texas, where fees average \$0.70/bbl.
			OBMs and cuttings	\$6/bbl				
			Tank bottoms	\$6/bbl				
			WBMs and cuttings	\$6/bbl				
TX	Taylor Disposal Operating Inc. - Butler	Injection	Produced water	\$0.70/bbl	\$75/hr	\$100/hr	NA	Washout operations average 30 minutes (\$50).

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
TX	US Liquids of Louisiana LP - Galveston (Transfer)	Burial (landfill)	Contam. soils	\$14/bbl	NA	NA	NA	<p>Wastes are dried and disked. Then solids are placed in a landfill. USLL does not own or operate its own trucking service to pick up wastes from a well site and transport them to the disposal site. However, USLL does have a list of approved trucking companies for each of its operating locations to provide the operator if needed. The following are transportation-related fees: \$95 for trucking/transportation; \$75 for Bobcat with operator; \$225 for crane with operator; \$75 for forklift with operator; and \$175 for track hoe with operator. Other handling charges include \$75 for container handling (dump and rinse 25 bbl or less); \$45 for container rehandling (25 bbl or less); \$150 for drum handling; \$100 truck washout without wash water; \$300 for gauging/waste volume verification; \$3,125 for barge cleaning (open top shale, 1,500 bbl or less); and \$3,750 (open top shale, 1,500 to 3,000 bbl). Third-party equipment triggers cost plus 15%. USLL does perform analyses on incoming waste, but does not charge for this service. USLL checks the following on all loads: pH, EC (soluble salts), NORM screening, oil and grease content, mud weight, and percentage of solids.</p>
			OBM's and cuttings	\$12.75/bbl				
			Tank bottoms	\$14/bbl				
			WBM's and cuttings	\$10.75/bbl				
TX	US Liquids of	Burial (landfill)	Contam. soils	\$7.71/bbl	NA	NA	NA	Same as USLL—Galveston.



**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
	Louisiana LP - Rincon (Direct)		Non-injectable dirt water	\$3.25–\$9.25/bbl				
			OBMs and cuttings	\$7.71–\$9.25/bbl				
			Tank bottoms	\$10.50/bbl				
			WBMs and cuttings	\$3.25/bbl				
TX	US Liquids of Louisiana LP - Zapata (Direct)	Burial (landfill)	Contam. soils	\$6.67/bbl	NA	NA	NA	Same as USLL—Galveston.
			Non-injectable dirt water	\$3.25–\$9.25/bbl				
			OBMs and cuttings	\$6.67–\$8.50/bbl				
			Tank bottoms	\$10.50/bbl				
			WBMs and cuttings	\$2.61/bbl				
TX	Wasson Solid Waste Disposal System LLC	Cavern	Contam. soils	\$3.50/bbl	NA	NA	NA	NA
			OBMs and cuttings	\$3.50/bbl				
			Tank bottoms	\$3.50/bbl				
			WBMs and cuttings	\$3.50/bbl				
TX	Wasson Solid Waste Disposal System LLC - RCC District 8A/Yoakum County	Injection	Produced water	\$0.50/bbl	NA	NA	NA	NA

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
UT	A-1 Tank Rental and Brine Svs. Inc.	Land application	Contam. soils	\$7.50/yd <sup>3</sup>	NA	NA	NA	Solids are mixed with soils and placed at locations that do not have storm water runoffs. Facility offers two types of trucks. The Bobtail is available for \$80/hr, the 130-bbl capacity truck is available for \$95/hr. Produced water is force evaporated in a pond that has a polyethylene liner. The facility offers two types of trucks. The Bobtail is available for \$80/hr, the 130-bbl capacity truck is available for \$95/hr.
		Land application	OBMs and cuttings	\$7.50/yd <sup>3</sup>				
		Evaporation	Produced water	\$1/bbl				
		Land application	Tank bottoms	\$7.50/yd <sup>3</sup>				
		Land application	WBMs and cuttings	\$7.50/yd <sup>3</sup>				
UT	Brennan Bottom Disposal	Burial (pit)	Contam. soils	\$8/bbl	NA	NA		Wastes go into a concrete pit. The water is taken off and goes into a water-cleaning system. Remaining dirt is used for future pond embankment. Produced water is unloaded into pits. The oil on top is removed by vacuum truck.
			OBMs and cuttings	\$8/bbl				
			Produced water	\$0.87/bbl				
			Tank bottoms	\$5/bbl				
			WBMs and cuttings	\$8/bbl				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
UT	Clean Harbors Environmental Services - Aragonite Facility	Thermal treatment	Contam. soils	\$0.17–\$0.20/lb	NA	NA		Nonhazardous, non-RCRA muds, cuttings, contaminated soils, and tank bottoms are usually landfilled (at sister facility Grassy Mountain). However, certain hydrocarbon soils are incinerated. Waste streams must be preapproved. Trucking fees vary by distance.
UT	Clean Harbors Environmental Services - Grassy Mountain Landfill	Burial (landfill)	Contam. soils	\$68–\$80/drum	NA	NA		Rates decrease with a higher number of drums. Bulk rates are \$30/ton to \$50/ton. Waste streams must be preapproved. Trucking fees vary by distance. Incoming waste stream must be preapproved. NORM requires special authorization. Trucking service can be provided and fees are distance-driven.
			NORM	\$135/ton				
			OBMs and cuttings	\$68–\$80/drum				
			Tank bottoms	\$68–\$80/drum				
			WBMs and cuttings	\$68–\$80/drum				
UT	LaPoint Recycle and Storage	Land application	Contam. soils	\$100/ton	\$100/hr	NA	NA	Cost estimates represent the minimum. Major waste streams are muds and cuttings and tank bottoms. Water is evaporated, then the remaining materials are mixed with dirt and remediated.
			OBMs and cuttings	\$100/ton				
			Produced water	\$100/ton				
			Tank bottoms	\$100/ton				
			WBMs and cuttings	\$100/ton				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
UT	MC & MC Disposal	Land application	OBMs and cuttings	\$4/bbl	\$80/hr	NA	NA	Treatment prior to actual land farming involves bacteria and blending with dirt. Major waste streams are muds and cuttings and produced water. Aeration process uses a sprinkler.
		Evaporation	Produced water	\$0.50–\$0.75/bbl				
		Land application	Tank bottoms	\$4/bbl				
WBMs and cuttings	\$4/bbl							
UT	Montezuma Well Service	Evaporation	Produced water	\$1.23/bbl	\$62/hr	NA	NA	Facility handles produced water only. Predecessor used to manage muds and cuttings and soils. Disposal fee is \$98 per load (80-bbl tank).
UT	Nick's Disposal Pit LLC	Burial (pit)	Contam. soils	\$36/yd <sup>3</sup>	NA	NA	NA	This small-scale facility handles spill-contaminated soils. The pit is tar-lined.
UT	R.N. Industries	Evaporation	Produced water	\$0.85/bbl	\$100/hr	NA		Facility can conduct laboratory analyses. This depends on the generator.
			Tank bottoms	\$0.85/bbl				
			WBMs and cuttings	\$0.85/bbl				
WV	Allied Waste Management Inc. - Sycamore Landfill	Burial (landfill)	Contam. soils	\$28.75/ton	NA	NA		The State of West Virginia requires analytical characterization of special wastes and approval of disposal by the WVDEP. WVDEP requires that waste streams destined for landfills must be more than 10% solid. Otherwise, wastewater treatment presents the appropriate option. Facility stipulates that the waste stream must not contain any free liquid and pass the paint filter test. Facility conducts profiling for state approval and internal company approval. For large bulk jobs, the rate may drop to \$23.75/ton. Costs include tipping and other fees.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			OBMs and cuttings	\$28.75/ton				
			Tank bottoms	\$28.75/ton				
			WBMs and cuttings	\$28.75/ton				
WV	Base Petroleum	Injection	Produced water	\$1/bbl	NA	NA	NA	Trucking/pickup services need to be contracted with a third party. Sampling conducted.
WV	Danny Web Construction	Injection	Produced water	\$1/bbl	NA	NA	NA	Facility offers trucking services through a contractor either on a per-hour basis or consolidated-bid basis (one price in multi-year jobs). Sampling conducted.
WV	Waste Management Inc. - Meadowfill Landfill	Burial (landfill)	Contam. soils	\$38-\$75/ton	NA	NA	NA	The State of West Virginia requires analytical characterization of special wastes and approval of disposal by the WVDEP. WVDEP requires that waste streams destined for landfills must be more than 10% solid. Otherwise, wastewater treatment presents the appropriate option. Facility does not accept waste streams with free liquids. Ryan Environmental provides the solidification capability for the landfill. Disposal fees are \$38 for a waste stream containing 20% or more solids, and \$75 for waste streams containing less than 20% of solids and necessitating solidification. The facility does not offer trucking service but contracts with a third company to provide dump trucks and rolloff containers. Quotes are distance- and case-specific. NORM is accepted on a case-by-case basis.
			NORM	\$38-\$75/ton				
			OBMs and cuttings	\$38-\$75/ton				

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			Produced water	\$38-\$75/ton				
			Tank bottoms	\$38-\$75/ton				
			WBMs and cuttings	\$38-\$75/ton				
WV	Waste Management Inc. - Northwestern Landfill	Burial (landfill)	Contam. soils	\$30-\$60/ton	NA	NA	NA	The State of West Virginia requires analytical characterization of special wastes and approval of disposal by the WVDEP. WV requires that waste streams destined for landfills must be more than 10% solid. Otherwise, wastewater treatment presents the appropriate option. The facility runs a solidification pit and uses kiln dust. Fees are \$30 for "solid" waste streams and \$60 for waste streams requiring solidification. Facility has a hauling division and uses contractors. Fees are job-specific. NORM is accepted on a case-by-case basis.
			NORM	\$30-\$60/ton				
			OBMs and cuttings	\$30-\$60/ton				
			Produced water	\$30-\$60/ton				
			Tank bottoms	\$30-\$60/ton				
			WBMs and cuttings	\$30-\$60/ton				
WY	Anticline Disposal LLC	Evaporation	Pit water	\$3.50/bbl	NA	NA	NA	Facility is in the process of building a plant for reuse.
			Produced water	\$3.50/bbl				
WY	High Plains Resources Inc. - Parkman Reservoir	Burial (pit)	OBMs and cuttings	\$17/bbl	NA	NA	NA	Recovered product processed for resale. The lower end of the fee is for methane production water, the higher end is for compressor oil production water.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			Produced water	\$1.75-\$4/bbl				
			Tank bottoms	\$17/bbl				
			WBMs and cuttings	\$17/bbl				
WY	Jim's Water Service - McBeth Pits	Burial (pit)	OBMs and cuttings	\$2-\$8/bbl	NA	NA	NA	Facility uses gravity separation and open pit evaporation. Linings are ensuring minimal exfiltration. Trucking service incurs a varying per-barrel fee. Facility is considering moving from open pits to injection.
			Produced water	\$1.50/bbl				
			WBMs and cuttings	\$2-\$8/bbl				
WY	Joe Scott Enterprises LLC - Reed Fee 22-20	Injection	Produced water	\$3/bbl	NA	NA	NA	This is a commercial UIC Class I well.
WY	Mel's Water Service	Injection	Produced water	\$2/bbl	\$85/hr	NA	NA	The facility is a commercial UIC Class I well.
WY	Newpark Environmental Services	Bioremediation	Contam. soils	\$50-\$120/yd <sup>3</sup>	NA	NA	NA	Bioremediation involves composting.
			OBMs and cuttings	\$50-\$120/yd <sup>3</sup>				
WY	Newpark Environmental Services	Discharge (NPDES)	Produced water	\$2.50-\$3.50/bbl	NA	NA	NA	Water treatment module involves reverse osmosis.
WY	Oilfield Disposal Services Inc.	Evaporation	Produced water	\$2.05/bbl	\$66/hr	NA	NA	Transportation costs are charged by the hour or by the mile, depending on the distance. The hourly charge is for an 80-bbl truck.
WY	Piney Company	Evaporation	Contam. soils	\$8.50/bbl	NA	NA	NA	Technology is spray evaporation. Fees range considerably on a case-by-case basis. It depends on the "heaviness" of the waste stream. The figure indicated represents the very minimum.

**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
			OBMs and cuttings	\$8.50/bbl				
			Produced water	\$2.05/bbl				
			WBMs and cuttings	\$8.50/bbl				
WY	R&G Inc.	Evaporation	Contam. soils	\$8.50/bbl	NA	NA	NA	Technology is spray evaporation. Fees range considerably on a case-by-case basis. It depends on the “heaviness” of the waste stream. The figure indicated represents the very minimum.
			OBMs and cuttings	\$8.50/bbl				
			Produced water	\$2.05/bbl				
			WBMs and cuttings	\$8.50/bbl				
WY	Samson Resources - Wamsutter	Evaporation	Produced water	\$2.02/bbl	NA	NA	NA	Treatment involves freeze-thaw. Produced water is air-sprayed in the winter. Ice pads form, and heavier brine collects at the bottom. The brine is injected. After melting, the freshwater is tested and land-applied.
WY	Sweetwater County Solid Waste Disposal District #1	Land application	Contam. soils	\$55/ton	NA	NA	NA	Cheaper rate applies in-county. Facility uses evaporation ponds for production water.
			OBMs and cuttings	\$55/ton				
			Produced water	\$2.50–\$3/bbl				
			Tank bottoms	\$55/ton				
			WBMs and cuttings	\$55/ton				



**TABLE A.1**

State	Disposal Company and Facility Name	Disposal Method	Type of Waste	Disposal Cost	Transportation Cost	Cost for Cleaning Containers	Cost for Laboratory Analysis	Comments
WY	Waste Inc.	Evaporation	Contam. soils	\$8.50/bbl	NA	NA	NA	Technology is spray evaporation. Fees range considerably on a case-by-case basis. It depends on the "heaviness" of the waste stream. The figure indicated represents the very minimum.
			OBMs and cuttings	\$8.50/bbl				
			Produced water	\$2.05/bbl				
			WBMs and cuttings	\$8.50/bbl				
WY	Yellow Creek Production and Water Disposal LLC - Carpentre	Injection	Produced water	\$3/bbl	NA	NA	NA	This is a commercial UIC Class I well.

<sup>a</sup> Abbreviations: Cl = chlorides; CCS = CCS Energy Services LLC; E&P = exploration and production; EC = electrical conductivity; EPA = U.S. Environmental Protection Agency; H<sub>2</sub>S = hydrogen sulfide; NA = not applicable; NORM = naturally occurring radioactive material; NPDES = National Pollutant Discharge Elimination System; OBM = oil-based materials; PADEP = Pennsylvania Department of Environmental Protection; POTW = publicly owned treatment works; PSC = PSC Industrial Outsourcing, Inc.; RCRA = Resource Conservation and Recovery Act; TCLP = toxicity characteristic leaching procedure; TDS = ?; TOU = thermal oxidation unit; UIC = underground injection control; USCG = United States Coast Guard; USLL = US Liquids of Louisiana LP; WBM = water-based material; WVDEP = West Virginia Department of Environmental Protection.







## **Environmental Science Division**

Argonne National Laboratory  
9700 South Cass Avenue, Bldg. 900  
Argonne, IL 60439-4832

[www.anl.gov](http://www.anl.gov)



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