

Land Drilling Practices for Protection of the Environment

API RECOMMENDED PRACTICE 52
SECOND EDITION, JULY 1, 1995

REAFFIRMED, SEPTEMBER 2010



AMERICAN PETROLEUM INSTITUTE

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Exploration and Production Department

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FOREWORD

API Recommended Practice 52, First Edition, was issued in February 1976.

This recommended practice was prepared by the Subcommittee on Land Drilling Practices for Protection of the Environment and is under administration of the American Petroleum Institute Exploration and Production Department's Executive Committee on Drilling and Production Practices.

It is intended that this voluntary recommended practice serves as a guide to promote protection of the environment in land drilling operations. Users of this publication are reminded that constantly developing technology, specific company requirements and policy, and specialized or limited operations do not permit coverage of all possible operations, practices, or alternatives. This recommended practice does not present all possible practices for protecting the environment in land drilling operations. Alternative operating procedures and/or equipment are available and routinely used to meet or exceed recommended practices or performance levels set forth herein. Recommendations presented in this publication are not intended to inhibit developing technology and improved equipment or operating procedures. This publication, or portions thereof, cannot be substituted for qualified technical/operational analysis and judgement to fit a specific situation.

There may be federal, state, or local statutes, rules, or regulations requiring land drilling operations to be conducted in a certain manner. Organizations or individuals using this recommended practice are cautioned that requirements of federal, state, or local environmental laws and regulations are constantly evolving and should be reviewed to determine whether or not the practices recommended herein are consistent with current laws and regulations. Land drilling operations must comply with the applicable requirements of federal, state, or local regulations.

Suggested revisions to this recommended practice are invited and should be submitted in writing to the director of the Exploration and Production Department, American Petroleum Institute, 700 North Pearl Street, Suite 1840, Dallas, Texas 75201-2845.

Land Drilling Practices for Protection of the Environment

0 Introduction

Land drilling operations are being conducted with full regard for preservation of the environment in such diverse conditions as metropolitan sites, wilderness areas, barren deserts, wildlife refuges, and arctic locations. Recommendations presented in this publication are based on such wide ranging and extensive industry experience.

The importance of planning prior to construction and initiation of land drilling operations cannot be overemphasized. Section 4 of this standard is devoted solely to planning and Sections 5 through 8 discuss implementation of the plan and ensuing operations.

Although the discussion of several subjects in Section 4, "Planning," and later discussion in the implementation portion appears to be somewhat redundant, this redundancy is necessary to provide adequate coverage of the subject matter.

1 Scope

This standard provides information on environmentally sound practices for land drilling operations. Operational coverage begins with the initial planning of the drilling project and ends with decommissioning of the drill site. Facilities within the scope of this standard include the drill site and roads required to be built and used for access to the drill site.

This document is intended to address environmental considerations and not safety or operational issues. However, there are items discussed, i.e., formation pressure control, for which there are mutual environmental, safety, and operational considerations. Similarly, this standard does not address obligations that may be required by the landowner and lease agreement.

2 References

2.1 STANDARDS

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. All standards are subject to revision, and users are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

API

Environmental Guidance Document: Onshore Solid Waste Management in Exploration and Production Operations

- Bul E1 *Bulletin on the Generic Hazardous Chemical Category List and Inventory for the Oil and Gas Exploration and Production Industry (Superfund Amendments and Reauthorization Act of 1986, Emergency Planning and Community Right-to-Know Act)*
- Bul E3 *Well Abandonment and Inactive Well Practices for U.S. Exploration and Production Operations, Environmental Guidance Document*
- Bul E4 *Environmental Guidance Document: Release Reporting for the Oil and Gas Exploration and Production Industry as Required by the CWA, CERCLA and SARA Title III*
- RP 49 *Recommended Practices for Drilling and Drill Stem Testing of Wells Containing Hydrogen Sulfide*
- RP 53 *Recommended Practices for Blowout Prevention Equipment Systems for Drilling Wells*
- RP 59 *Recommended Practices for Well Control Operations*

2.2 OTHER REFERENCES

*National Register of Historic Places*¹

2.3 U. S. ENVIRONMENTAL LAWS

There are numerous federal environmental laws that may be applicable to land drilling operations. These laws should be carefully studied to determine their impact and applicability to specific operations. The following are some of the major laws that apply.

2.3.1 Clean Air Act (CAA)

The CAA, first enacted in 1970 and amended several times since then, has several features that can lead to significant regulation.

Under the CAA, EPA has established national ambient air quality standards for several air pollutants: sulfur oxides, nitrogen oxides, ozone, carbon monoxide, particulate matter, and lead. On an ambient standard-by-standard basis, every area of the United States is classified as attainment or nonattainment. This classification determines, in part, what

¹Available from Preservation Press, 1785 Massachusetts Avenue, N.W., Washington, D.C.

additional controls on emission sources are required and the timetable for implementation.

EPA is also authorized, under the CAA, to set new source performance standards (NSPS) for certain categories of stationary sources and separate standards for listed hazardous air pollutants (HAPs). These requirements often take the form of technology standards but may take the form of performance standards or work practice standards.

Overall, EPA assumes the authority for regulating new sources, whereas states assume the authority for regulating existing sources. In addition, state standards are often applicable only to nonattainment areas, whereas federal standards are generally applicable in both attainment and nonattainment areas.

Standards aside, the CAA also imposes permitting requirements. Depending on an emission source's nature, emission profile, size, and geographic location, a new source (or major modification) may require a preconstruction review permit. Irrespective of preconstruction review permits, existing sources also generally require operating permits, which are intended to be the vehicle for all applicable source requirements.

The temporary addition on the well site of mobile emission sources, such as drilling rigs or well servicing equipment, should be considered in accordance with relevant permitting requirements, as these activities may trigger state or federal permit requirements.

2.3.2 Clean Water Act (CWA)

The CWA was enacted in 1972 with a goal to restore the surface waters for protection of fish and wildlife and for recreation by the elimination of pollutant discharges from point sources into "Waters of the United States". These "Waters" are very broadly defined and include any conveyance, including dry stream channels, that lead to waterways, including the oceans. The CWA created the National Pollutant Discharge Elimination System (NPDES) permitting program (or state equivalent) for all point source and nonpoint source discharges, including storm water. The discharge permit program regulates discharges of 297 chemical substances through receiving water quality limits and application of best available technology (BAT), best conventional pollutant control technology (BCT), best practical control technology (BPT), and new source performance standards (NSPS). Permits for on-shore discharges are issued by the states (which have been delegated primacy from the EPA), the EPA, or both.

The CWA also established regulations covering the response to an oil spill which could reach navigable waters (includes "Waters of the United States"), adjoining shoreline, or the exclusive economic zone. Spill prevention, control, and countermeasure (SPCC) plans are required for any facility (including temporary fuel storage facilities) storing 42,000 gallons or more of oil in underground tanks or with more

than 1,320 gallons of aboveground storage capacity or with a single tank of more than 660 gallons of storage capacity. The SPCC plan must be written to address the specific location and state the most likely course of the runoff. The plan must be written within six (6) months of beginning an operation, be certified by a registered professional engineer as to its technical feasibility, and be implemented within 1 year. A copy of the plan should remain at the facility or on location, if manned at least 8 hours per day, or at the nearest field office if unmanned. The plan should be available for on-site review during normal working hours. The plan must be reviewed at least once every 3 years and be recertified if significant changes to the plan are required.

Any spill of a reportable quantity (RQ) of oil or hazardous chemicals listed in the CWA regulations requires immediate reporting to the National Response Center at (800) 424-8802 by the person in charge of the facility. An RQ of oil is one which creates a sheen on navigable waters, adjoining shoreline, or the exclusive economic zone, or which causes a violation of applicable water quality standards. Refer to API Bulletin E4, *Environmental Guidance Document: Release Reporting for the Oil and Gas Exploration Industry as Required by the CWA, CERCLA, and SARA Title III*, for additional information.

The U. S. Army Corps of Engineers regulates the dredging and filling of navigable waters. In order to discharge dredged material into these waters, operators must first obtain a permit from the Corps of Engineers.

2.3.3 Safe Drinking Water Act (SDWA)

The SDWA, enacted in 1974, regulates the nation's sources of drinking water. The legislation outlines primary and secondary drinking water standards by establishing maximum contaminant levels (MCLs) which cover mainly metals and organics. To protect the nation's groundwater supply, the underground injection control (UIC) program was developed. This program classified underground aquifers with waters containing less than 10,000 ppm total dissolved solids (TDS) as underground sources of drinking water (USDW). All injection of fluids must be permitted, and a new UIC permit will not be issued until the applicant can demonstrate the injection operation will not endanger an USDW. The oil and gas industry injection wells are regulated as Class II wells in the program. States that have been delegated primacy for this program by the EPA are responsible for the issuance of permits. The EPA is responsible for issuing permits for injection activities in nonprimacy states and on most Indian lands.

Class II injection wells can be used for enhanced oil recovery projects or to dispose of nonhazardous exploration and production (E&P) wastes and must not endanger an USDW. These wells must be protected from surface water entering the wellbore and must maintain mechanical integrity and be

tested periodically. Injection of hazardous waste is regulated under the Resource Conservation and Recovery Act.

2.3.4 Resource Conservation and Recovery Act (RCRA)

RCRA was enacted in 1976 to address the management of wastes (including hazardous waste) and this legislation developed the concept of "cradle-to-grave" responsibility. Hazardous waste, which is regulated under Subtitle C of RCRA, may be solid, liquid, or contained gas and be regulated either because it is "characteristically" hazardous or is one of more than 400 listed wastes. The characteristics of ignitability, reactivity, corrosivity, or toxicity cause a waste to be regulated as hazardous. Toxicity is generally determined by an acid solubility test termed the toxicity characteristic leaching procedure (TCLP). The TCLP requires analysis for a list of 39 chemical substances, composed of 8 metals, 6 pesticides, and 25 organic substances. The regulations covering hazardous wastes can be onerous and contain elements that can result in significant environmental liability. At present, over 4,000 chemicals are specifically named as prohibited from land disposal ("land ban"). States may be delegated the responsibility of preparing programs to manage hazardous wastes.

EPA, in a 1988 regulatory determination, decided that oil and gas exploration and production wastes were high volume and low toxicity wastes which should continue to be exempt under Subtitle C. These wastes include produced water, drilling fluids, drill cuttings, rigwash, drilling fluids and drill cuttings from offshore operations when disposed onshore, well completion/treatment/stimulation fluids, basic sediment and water and other tank bottoms, accumulated materials from separators and fluid treating vessels and production impoundments, pit sludges, workover wastes, glycol compounds from gas dehydration units, gas plant sweetening wastes, cooling tower blowdown, spent filters/media, backwash from exempt waste streams, packing fluids, produced sand, pipe scale, hydrocarbon-bearing soil, pigging wastes, constituents removed from produced water before injection or other disposal, liquid hydrocarbons removed from production streams but not from oil refining, waste crude oil from exploration and producing operations, ejected blowdown materials, gases from production streams, and volatilized light organics from exempt wastes. It should be noted that not all wastes generated by exploration and production (E&P) operations are exempt under Subtitle C. Care must be taken to avoid commingling nonexempt wastes, such as paint wastes, cleaning solvents, and batteries, with exempt wastes, as the resultant mixture will be considered nonexempt and regulated under Subtitle C.

2.3.5 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

CERCLA, which has become known as "Superfund," established a program to identify and remediate sites from

which hazardous substances are, or could be, released into the environment. It identifies over 700 substances as "hazardous" and creates a process to provide funding to investigate and cleanup sites. The EPA has initiated investigation and cleanup action at over 2000 sites and has sought to find the potentially responsible parties (PRPs) to finance and/or finish the cleanup of these sites.

CERCLA also requires notification of the National Response Center in the event of a release of a reportable quantity (RQ) of a hazardous substance. Refer to API Bulletin E4, *Environmental Guidance Document: Release Reporting for the Oil and Gas Exploration and Production Industry as Required by the CWA, CERCLA, and SARA Title III*, for additional information.

CERCLA does contain an exclusion for petroleum and petroleum fractions from the definition of hazardous substance. This exclusion does not apply to petroleum products which have been contaminated as a result of their use. The CERCLA definition of hazardous substance includes RCRA wastes and excludes drilling fluids, produced waters, and other wastes associated with the exploration, development, and production of crude oil or natural gas (E&P wastes). EPA has not always treated E&P wastes as excluded from the definition of hazardous substances. Legal counsel should be consulted if clarification of this issue is needed.

CERCLA provides EPA with broad authority to require PRPs to remediate sites and to pay for the agency's work on sites. It establishes strict liability for remediation without regard to degree of responsibility. EPA can also impose "joint and several" liability, with each liable party potentially responsible for the entire cleanup. Past and present generators, transporters, storage owners, and operators can be considered PRPs.

2.3.6 Emergency Planning and Community Right-to-Know Act (EPCRA)

The Superfund Amendment and Reauthorization Act of 1986 (SARA) reauthorized and extended the Superfund law which was established under CERCLA. SARA's Title III, known as the Emergency Planning and Community Right-to-Know Act (EPCRA), is a separate statute that addresses the concern for potential release of toxic chemicals into surrounding communities.

EPCRA is also known as the Pollution Prevention Act (PPA) and has three major sections, §302-4, §311-312, and §313.

Under §302-4, facilities producing, using, or storing listed extremely hazardous substances (EHSs) above the threshold planning quantity (TPQ) designated in the regulations, must provide emergency planning notification to the State Emergency Response Commission (SERC) and Local Emergency Planning Committee (LEPC) and identify

a facility representative. Releases over the reportable quantity (RQ) of those substances must be reported unless an exception applies. Simultaneous CERCLA reporting may also be required. Refer to API Bulletin E4, *Environmental Guidance Document: Release Reporting for the Oil and Gas Exploration and Production Industry as Required by the CWA, CERCLA, and SARA Title III*, for additional information.

Under §311-312, if threshold amounts of chemicals are present for which a material safety data sheet (MSDS) is required under OSHA's Hazard Communication Standard, facilities must submit information on location and inventory amounts. Reporting is required at least annually or when threshold amounts of new materials come on-site, etc. Refer to API Bulletin E1, *Bulletin on the Generic Hazardous Chemical Category List and Inventory for the Oil and Gas Exploration and Production Industry (Superfund Amendment and Reauthorization Act of 1986, Emergency Planning and Community Right-to-Know Act)*, to help simplify compliance with §311-312. Also, refer to API Bulletin E4.

Under §313 Toxic Release Inventory (TRI) reporting, releases to air, land, water, and certain waste disposal and recycling information must be reported annually for listed substances that meet the threshold criteria. E&P Standard Industrial Classification (SIC) codes are not yet covered under §313, but are under active consideration by EPA for inclusion for reporting. The Pollution Prevention Act (PPA) adds additional data elements for reporting on §313 TRI forms.

States may impose additional or different reporting requirements.

2.3.7 National Historic Preservation Act (NHPA)

The NHPA was established to preserve, restore, and maintain cultural resources of the U.S. The *National Register of Historic Places* identifies property which, for historic reasons, has been declared a treasure and future construction on or around the site must not disturb it. The National Park Service administers this program. Exploration and production operations must take into account listed and potential historical sites when planning future work.

2.3.8 Endangered Species Act

The Fish and Wildlife Service of the U.S. Department of Interior and the National Marine Fisheries Service of the U.S. Department of Commerce are responsible for identifying threatened and endangered plant and animal species, the protection of critical habitats for those species, and preparing recovery plans for listed species. The Endangered Species Act requires all federal agencies to consider the impact of any of their actions (including the granting of approvals, rights-of-way, or permits of any type) on threatened and endangered species. This act also prohibits "incidental take" of endangered species on either public or private lands without a permit.

2.3.9 Hazardous Materials Transportation Act (HMTA)

The HMTA is the authority for the regulation of all shipments of regulated materials by highway (i.e., public access roads and highways), rail, air, or water. Regulated materials or wastes shipped as a result of exploration and production operations are typically subject to either U.S. Department of Transportation (DOT) or U.S. Coast Guard (USCG) regulations.

2.3.10 National Environmental Policy Act (NEPA)

All federal agencies rely on requirements of NEPA for consideration of projects on federal land, identification of public concerns and issues, identification of undesired environmental impacts, identification of alternatives to proposed projects, and identification of mitigation requirements to be used if the project is approved.

2.3.11 Oil Pollution Act of 1990 (OPA '90)

OPA '90 mandated amendments to the existing oil pollution prevention regulations (40 CFR Part 112 and as discussed in 2.3.2) that were originally established by the CWA.

OPA '90 grants the EPA Regional Administrator broad-based authority. It also requires operators of facilities meeting certain criteria to develop and submit a response plan that has been designed to handle routine and worst case discharges of oil or hazardous substances. This plan must include verification of response capability.

There is no specific exclusion for drilling activities. The condition of the site and proximity to navigable waters, wetlands, or other critical habitats should be reviewed. This assessment may indicate that a spill response plan should be filed with the appropriate agency.

2.3.12 Other Laws and Regulations

Environmental laws and regulations may vary with each city, county, and state. Applicable regulations are also issued by Bureau of Land Management (BLM), U.S. Forest Service, National Park Service, and others. The operator and all pertinent contractors should be familiar with the provisions of applicable local laws and regulations prior to the beginning operations. The operator should advise contractors of permit requirements or other restrictions that may impact or limit their operations.

3 Acronyms and Abbreviations

3.1 The following acronyms and abbreviations are used in this recommended practice:

API	American Petroleum Institute
BAT	Best Available Technology
BCT	Best Conventional pollutant control Technology
BPT	Best Practical control Technology
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
CFR	Code of Federal Regulations
CWA	Clean Water Act
DOT	Department of Transportation
E&P	Exploration and Production
EHS	Extremely Hazardous Substance
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act (Title III of SARA, commonly called "Right-to-Know" or SARA Title III)
HMTA	Hazardous Materials Transportation Act
IC	Internal Combustion
LEPC	Local Emergency Planning Committee
MSDS	Material Safety Data Sheets
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standard
OPA	Oil Pollution Act
PPA	Pollution Prevention Act
PRP	Potentially Responsible Party
RCRA	Resource Conservation and Recovery Act
RP	Recommended Practice(s)
RQ	Reportable Quantity
SARA	Superfund Amendments and Reauthorization Act of 1986 (refer to EPCRA)
SDWA	Safe Drinking Water Act
SERC	State Emergency Response Commission
SIC	Standard Industrial Classification
SPCC	Spill Prevention Control and Countermeasure
Superfund	Refer to CERCLA
TCLP	Toxic Characteristic Leaching Procedure (40 CFR 261, Appendix II)
TDS	Total Dissolved Solids
UIC	Underground Injection Control
USCG	United States Coast Guard
USDW	Underground Source of Drinking Water
VOC	Volatile Organic Compound

4 Planning

4.1 INTERACTIVE COMMUNICATIONS AND PLANNING

4.1.1 Communications Between Operator and Surface Owner or Tenant

Early in the planning phase of the well, a team consisting of the well planners and those who will be involved in the actual drilling of the well should visit the proposed site. The site inspection should include a discussion with the land owner or tenant regarding the existence of such items as underground pipelines, buried utilities (electrical or telephone cables or sewer or water lines), old mine shafts, archaeological sites, cemeteries, areas of potential flooding, known endangered animals or plants, or the presence of wetlands that can impact planning and site construction. Special requirements by the surface owner or tenant should be reviewed and considered for incorporation into the drilling plan.

4.1.2 Operator, Contractor, and Service Company Communications

The coordination of environmental protection procedures for the location should include, early in the planning stage of the program, full agreement on responsibilities of the various service companies involved. This early involvement and planning can help assure that key environmental aspects of the drilling plan are not overlooked. Early discussions during planning will help identify special procedures that may need to be developed and provide time to secure required equipment or special permits without delaying the drilling schedule.

Prior to the beginning of projects that may involve hazardous materials, on-site meetings should be planned between the operator's supervisory personnel and the contractors. Well site personnel may need to receive special environmental training. The operator may need to provide training that is specific and unique to a particular project. As an example, special handling procedures for well testing or wellbore monitoring during trips should be explained and responsibility for specific tasks should be assigned.

Reviews of audits for environmental compliance may be scheduled to provide an added degree of assurance that necessary steps are being achieved to safeguard the environment. The use of environmental audits can serve to provide both an increased awareness of special regulations necessary to protect the environment as well as to provide oversight for regulatory compliance.

4.1.3 Internal Communications

Responsibility for maintaining discharge, disposal, and transportation records should be clearly explained to assure proper compliance. Required permits should be reviewed and the consequences of failing to properly report data should be explained. Plans should be made to assure that Material Safety Data Sheets (MSDS) accompany all applicable chemicals brought onto the location. These MSDS should be retained in an identified place, accessible to all on-site personnel. Such information should be communicated to all on-site personnel.

4.2 SITE ASSESSMENT AND CONSTRUCTION PLANNING

The drilling site and rights-of-way should be selected to minimize environmental impacts while allowing economical attainment of the geological objectives. An early visit to the site may make the planning process more efficient and identify areas of concern. The following represent some of the criteria that may be considered as part of the site assessment, selection, and construction processes. Additional procedures may be required by regulatory agencies or landowners when construction could impact environmentally sensitive areas.

4.2.1 Public Safety

The well site should be located to minimize impact on buildings, roadways, and public access areas, taking into consideration the gases and liquids which are expected to be encountered. For wells where toxic gas is anticipated, radius of exposure analysis prior to site selection may be necessary. Refer to API Recommended Practice 49, *Recommended Practices for Drilling and Drill Stem Testing of Wells Containing Hydrogen Sulfide*, for additional information.

4.2.2 Size

The disturbed area should be minimized to the extent possible while still providing an adequate work area for all operations. Flexibility in site shape and size may be necessary in environmentally sensitive areas.

4.2.3 Topography

The existing topography should be utilized to minimize alteration requirements. Contours and gradients should be considered in selecting locations for the access road, reserve pit, trailer houses, and other equipment, so long as safety is not compromised.

4.2.4 Soil

Areas that will support equipment and traffic with the least alteration should be used. Hydric soils (wetlands) and

areas of instability or potential erosion should be avoided. Plans should be made to stockpile topsoil for site reclamation whenever possible. The type of soil, bedrock, and groundwater depth can have a profound effect on the waste handling plan. If explosives are used in construction of the location, permitting may be required.

4.2.5 Surface Water

Protection of surface waters (ponds, creeks, wetlands, etc.) should be considered. Anticipated flow of rainwater or snowmelt should be diverted from the location by contour, grading, berms, or trenching. The sensitivity of regional water issues may influence requirements to isolate equipment through the use of barriers, dikes, ditches, or boarded locations. An SPCC plan may be required. The need for such a plan should be evaluated early in the planning process.

4.2.6 Groundwater

The location and usability of all aquifers should be determined so that positive protective measures may be taken. Excavations such as the conductor, rathole, mousehole, cellar, and the reserve pit may require special planning. Surface casing should be set deep enough to protect usable quality groundwater in accordance with applicable regulations.

4.2.7 Wildlife

Impacts to wildlife should be minimized. Obvious and potential habitat areas should be avoided. A wildlife study or review may be necessary to facilitate site selection and scheduling in or near areas inhabited or frequented by threatened or endangered species. Netting or other methods may be required by regulations to prevent the loss of wildlife in pits or tanks.

4.2.8 Livestock

Depending on the types of animals present, fences, cattle guards, and other appropriate means should be used to isolate livestock, in concurrence with the landowner or tenant.

4.2.9 Vegetation

The site should be chosen to minimize disturbance to vegetation. An area review or study may be necessary to identify threatened, endangered, or wetland species, or their habitat.

4.2.10 Cultural and Historical Resources

A review with the surface owner and the state historic preservation office or appropriate agency should be made to determine areas of concern. Sensitive areas may require an archaeological survey.

4.2.11 Weather

Temperature, rainfall, wind velocity and direction, and frost conditions are all factors that should be considered. Preparing for these conditions will minimize problems with equipment, procedures, and personnel.

4.2.12 Operational Plans

The final site disposition or the use of certain materials or equipment may influence site selection. The use of some sites for production operations or testing and the anticipated use of oil base or other products may influence site selection.

4.2.13 Potential Hazards

Potential hazards such as power lines, buried gas lines, offset wells, or avalanche areas may influence site selection and construction.

4.2.14 Restoration

Site restoration requirements, including regulatory agency or land owner requirements, should be considered as part of the initial site assessment.

4.2.15 Dust Suppression

Dust suppression plans for access roads and location, if required, should be developed in accordance with applicable local or other environmental regulations.

4.2.16 Noise Suppression

Noise suppression plans for access roads and location, if required, should be developed in accordance with applicable local or other environmental regulations.

4.2.17 Storage Areas

Areas for storage of fuel, lubricants, chemicals, solid waste, produced oil, and waste oil should be designed to protect wildlife, prevent water and soil contamination, and minimize possible fire and explosion hazards. A covered area or covered containers should be provided for storage of hazardous wastes.

4.2.18 Sanitation Systems

Location of sanitation systems should be planned and, if necessary, permitted in accordance with applicable local or other regulations.

4.3 DRILLING FLUIDS AND SOLIDS CONTROL PLANNING

In planning the drilling fluid system, consideration should be given to pit design, solids removal equipment, and drilling

fluid additives with the goal of minimizing and managing waste volumes and the use of toxic additives, taking into account the economic considerations that are involved.

In some cases, expenditures to substitute less toxic drilling fluid additives or provide more efficient solids removal may be justified by the minimization of drilling fluid waste disposal costs.

4.3.1 Reserve Pit Design

The first step in designing the reserve pit is to estimate the volume of drilling fluid waste that will be generated as well as other anticipated waste volumes such as rig water and rainwater. Reserve pits should be designed to fully contain the anticipated liquid volume and to prevent seepage. They should be designed so that they minimize any risk to usable groundwater and are not in direct communication with surface water. Reserve pits should be located to minimize the influx of storm water.

Reserve pit liners should be used if required by the regulatory agency or if soil conditions or regional experience indicate a reasonable potential that the pit will be prone to leakage to surface waters or groundwaters. Liners should be made of a material that will withstand normal operating conditions and meet appropriate regulatory requirements.

4.3.2 Solids Removal Equipment

Solids removal equipment, when properly selected and used, can significantly reduce the drilling fluid waste volume. The equipment should be capable of treating at least the volume of drilling fluid being pumped while drilling. Solids removal equipment is designed to remove progressively smaller particle sizes as the drilling fluid is processed. Many variations of equipment installation and operation can be used to maximize liquid recovery for recycling and solids removal efficiency.

4.3.3 Drilling Fluid Additives

In many cases, alternative drilling fluid products can be selected that achieve the desired results with less potential to impact the environment. Drilling fluids and wastes containing high chlorides, oil and grease, or additives containing heavy metals should be handled with special precautions. When possible, bulk drilling fluid or additives should be provided in reusable containers to reduce solid waste generation from empty sacks.

4.4 WATER MANAGEMENT PLANNING

Two potential wastes associated with drilling a well are rig wash and collected storm waters. The volume of rain that falls within the location boundaries can often exceed both the rig and drilling fluid waste volume. These wastes add to the contents of the reserve pit. Efforts to reduce volumes and

reuse these wastes can have a major impact on the overall waste management effort and help to lower drilling costs.

4.4.1 Rig Wash Water

Rig wash water can be a significant portion of the waste. To reduce waste volume, the rig can be cleaned effectively with high-pressure, low-volume washers. The frequency of rig washing can be minimized through the use of drip pans, drilling fluid buckets, drilling fluid saver valves, and drill string floats. An effective method to reduce waste is to recycle rig wash water by using it in the drilling fluid system.

4.4.2 Storm Water

Storm water includes rainfall and snowmelt. Storm water collection can be limited by using as small a location as possible in which rainwater must be retained. The immediate area around the rig structure can be isolated by a berm from the rest of the location. Uncontaminated storm water, outside the immediate rig area, can be discharged as runoff on most locations. State and/or federal storm water runoff regulations should be reviewed for applicability. The location perimeter may need to be ditched and/or bermed to prevent rain draining onto the location.

New construction for site location or road access may require a storm water discharge permit and storm water pollution prevention plan. State regulations should be consulted to determine if the state has primacy for the well site area, and, if so, what the applicable regulations are. In areas where EPA has primacy, it will be necessary to file a Notice of Intent to be covered by the General Permit at least two days prior to commencing construction.

4.5 WASTE MANAGEMENT PLANNING

Waste lubricants, solvents, used oil filters, rig refuse, batteries, and other wastes from drilling and completion operations may be classified as hazardous waste and require special manifesting, collection, recycling, and disposal practices. The list of approved waste sites and handlers should be determined. API *Environmental Guidance Document: Onshore Solid Waste Management in Exploration and Production Operations* provides guidance by defining environmentally sound operating and waste management practices.

5 Drilling Site and Right-Of-Way Preparation

5.1 INTRODUCTION

As noted in Section 4, "Planning," effective communication is essential to a successful project. It is important to recognize that the emphasis is now changing from the development and planning phase of a drilling plan to the implementation phase of the plan. This transition should include an on-site review and discussion of the planned objectives and procedures to be accomplished. Although plans should have been discussed with the land owner or tenant, keeping them informed of progress or plan changes during site construction facilitates good relations.

ognize that the emphasis is now changing from the development and planning phase of a drilling plan to the implementation phase of the plan. This transition should include an on-site review and discussion of the planned objectives and procedures to be accomplished. Although plans should have been discussed with the land owner or tenant, keeping them informed of progress or plan changes during site construction facilitates good relations.

5.2 SITE CONSTRUCTION

The site construction should implement those procedures identified in Section 4, "Planning," which apply to the particular site and rights-of-way. Field supervisors should verify that the drilling site does not have buried pipelines, covered mine shafts, or any other condition or potential hazards that may have been missed during the planning stage.

- a. Copies of all federal, state, or other relevant permits and applicable contingency plans should be kept on-site.
- b. Topsoil should be stockpiled for restoration.
- c. Trees, undergrowth, and other such combustible material should be cleared from the site. Flare pits and lines should be located at a safe distance from this material.
- d. If a water well is drilled to supply water, the well should be constructed and equipped to minimize the possibility of groundwater contamination. The water well should not be deeper than the surface casing if there is a reasonable chance that abnormal pressure could be encountered while drilling. Water well construction and monitoring as well as drinking water testing, if applicable, should be in accordance with SDWA requirements.
- e. Ditching around the rig and drilling fluid pits should be directed to the cellar or a contingency pit so that spilled drilling fluid can be returned to the drilling fluid system or reserve pit and rig water can be recycled. Oil traps may be installed in ditches. Emergency drainage should be directed to the contingency or reserve pit.
- f. Chemical, fuel, lubricant, and waste storage areas should be constructed to prevent contamination of soil or groundwater. Ditching for these areas should be separate from that around other rig equipment and should not drain into the cellar or reserve pit. A covered area or covered container should be provided for storage of hazardous wastes.
- g. Clearance from overhead utility lines should be verified for all anticipated load heights.
- h. Reserve pits should be designed to meet applicable regulatory standards. An impermeable liner may be considered depending on the type of drilling fluid to be used or if soil conditions indicate that the pit will be prone to leakage. If groundwater exists near the surface, special precautions may need to be taken that preclude the use of a reserve pit. When salt zones are expected or if oil base drilling fluid is planned to be used, a separate pit system will aid in isolating the drilling fluid from other waste fluids.

5.3 MOVE IN AND RIG UP

5.3.1 Equipment Preparation Prior to Moving

Before moving equipment to the location, all machinery should be inspected and plugged, drained, or otherwise secured to ensure that fluids cannot leak during transport. When moving in, truckers should place drawworks, engines, and other equipment in a level position on the drilling location to ensure that no fluids will leak while waiting to set the equipment in place. Liquids such as excess fuels, paints, and thinners should be returned to the vendor or secured to ensure that no leaks can occur during transport.

5.3.2 Site Inspection

Once all equipment is in place, the drill site should be inspected to ensure the following items have been achieved:

- a. Any fuel or oil leaks have been corrected.
- b. Ditching and diking has been performed in accordance with the objectives of the drilling plan.
- c. Water well(s) has been properly constructed to prevent groundwater contamination.
- d. Equipment used to pump water from ponds or streams has been located or equipped to prevent any oil or fuel leaks from reaching the water source.
- e. Drip pans should be installed, as necessary, to prevent contamination of the site.
- f. Drilling fluid cleaning equipment is working properly and discharge has been directed to the reserve pit, a suitable waste container, or other areas of disposal.
- g. Equipment provided for conservation of drilling fluid, such as mud buckets, drip pans, or mud-saver valves, has been properly installed and all drilling fluid lines and tanks have been checked for leaks.
- h. Drilling fluid additives have been neatly stored and are easily accessible to the drilling fluid mixing hopper. All chemicals should have proper labeling and material safety data sheets (MSDS) made available to the drilling crew representative when drilling fluid material(s) is delivered to location.

5.3.3 Special Considerations—Air Drilling Operations

In air drilling operations, the following items should be considered:

- a. Pits of adequate size should be appropriately constructed or installed to receive and retain drill cuttings discharged through the blooey line. Particle discharge from the blooey line should be dampened by treatment with a liquid sprinkler or scrubbers at the blooey line discharge.
- b. Blooey line flares should be situated to minimize danger to surrounding surface vegetation or structures. A pilot light

or other means of igniting a flare should be installed at the blooey line discharge.

- c. Foam drilling fluids should be placed in earthen surface pits or tanks and stored to evaporate or otherwise be disposed.

5.3.4 Pressure Control Equipment

When pressure control equipment has been installed, the following items should be considered:

- a. If accumulator lines are flushed with hydraulic oil prior to connecting to the blowout preventers, the oil should be collected and properly disposed or recycled.
- b. Any oil leaks in the hydraulic lines, accumulator pumps, or oil reserve tank should be corrected.
- c. Choke lines, mud-gas separators, and degassers should be installed in accordance with the drilling plan.
- d. If a trip tank is provided, it should be installed so that drilling fluid leaks are prevented.
- e. All pressure equipment should be tested in accordance with the drilling plan and applicable regulations.
- f. If the drilling plan requires toxic gas detection equipment, it should be installed and tested prior to reaching the suspect formation (refer to API Recommended Practice 49, *Recommended Practices for Drilling and Drill Stem Testing of Wells Containing Hydrogen Sulfide*, or applicable regulations for additional guidance).
- g. All pressure control equipment should be in accordance with any applicable regulations and the drilling plan. The operator's representative and contractor's representative should both inspect equipment and confirm appropriate availability and proper hookup.

5.3.5 Sanitation Equipment

Sanitation systems should be installed to prevent raw sewage from trailers and other facilities from reaching surface or subsurface water. A suitable septic system or sewage treatment unit may be installed for trailer houses and bunk houses. Portable chemical toilets or other suitable latrines may be provided and maintained in clean sanitary condition for use by personnel at the drilling site.

5.3.6 Location Housekeeping

Following rig up, all miscellaneous equipment such as boards, pipe, and scrap iron should be neatly stored. A trash trailer, dumpster, or other collection container should be placed on location for the collection of refuse. Garbage and trash disposal should always comply with applicable regulatory requirements. Burning trash is not an acceptable disposal option. Any method of garbage storage should minimize attraction of flies, rats, and other pests. Trash and garbage should not be commingled with drilling wastes.

6 Drilling Operations

6.1 POLLUTION PREVENTION HIERARCHY

Pollution prevention on a land drilling rig includes equipment and practices that eliminate or reduce the amount or toxicity of wastes. Solids removal equipment, substitution of toxic materials with nontoxic materials, and equipment and procedures to prevent loss of control of formation pressures are examples of pollution prevention.

API *Environmental Guidance Document: Onshore Solid Waste Management in Exploration and Production Operations* includes specific suggestions that can be applied to reduce the environmental impact from drilling operations.

Pollution prevention methods should be selected by considering the applicable management practices in the following order of priority:

- Source Reduction
- Recycling
- Treatment
- Disposal

6.1.1 Source Reduction

Source reduction is the preferred practice because of the emphasis on reducing either the amount or toxicity of the waste. Selection of materials, processes, and chemicals that generate little or no toxicity and minimize waste volume will reduce environmental impact and disposal costs. For example, steam or high pressure rig washing equipment reduces the volume of waste water generated during rig cleaning operations.

6.1.2 Recycling

Recycling is the beneficial reuse of a material created from a previous operation or process. Recycling reduces the amount of wastes that must be disposed. As an example, water used for cleaning may be used for addition to the drilling fluid system. Also, used oil can be collected in segregated containers to be recycled.

6.1.3 Treatment

Treatment of wastes can reduce the volume or produce a material suitable for recycling. An example is the treatment of a reserve pit to flocculate solids and reclaim liquids.

6.1.4 Disposal

Disposal is the last option in the hierarchy of waste management. Disposal methods should comply with applicable regulations and minimize impacts on the environment and human health as well as future liability.

6.2 REVIEW OF DRILLING PLAN PRIOR TO SPUD

A pre-spud meeting should be held to discuss the roles, responsibilities, and plans required to drill the well. It should be attended by all the key people involved with the planning and implementation of the drilling program. Environmental and regulatory issues should be an important part of the program and the discussion.

Some specific areas to cover are as follows:

- a. Permits should be reviewed, including compliance procedures that must be followed.
- b. Regulations, company policy, and lease requirements regarding waste handling and disposal should be discussed.
- c. The waste management and pollution prevention plans should be discussed to stress the importance of reducing the amount and toxicity of all types of waste for purposes of protecting the environment and reducing waste disposal costs. The list of waste sites and handlers should be discussed.
- d. Specific rules for traffic control including speed limits, parking areas, safety issues, materials handling, foul-weather procedures, and steps to protect the vegetation along the rights-of-way should be discussed.
- e. Emergency response and spill procedures should be discussed.

Actual conditions encountered during the drilling of a well may differ from those anticipated in the drilling plan. These conditions often require that new or revised procedures be developed. The impact of the revised or new procedures on efficient protection of the environment can best be evaluated through consultation between the on-site personnel and planners. A discussion of the alternative procedures helps ensure that consequences to the environment are not overlooked.

6.3 DRILLING FLUID SYSTEM

Steps should be taken to minimize the loss of drilling fluid. Drilling fluid lines should have sufficient slope to maximize drilling fluid and cuttings transport and should be of sufficient size for the volume of fluid pumped. Washout ports may be used at strategic points.

Drilling fluid processing equipment should be maintained in good condition to minimize waste volumes. Generally, solids-laden drilling fluid should not be allowed to bypass the shale shaker screens since the solids may plug and prevent proper operation of any hydrocyclones.

Used oil should never be disposed of in the drilling fluid system, rig ditches, or reserve pit.

Drilling fluid materials inventories should be maintained to provide ample materials to increase drilling fluid density in an emergency situation. Mixing equipment should be ca-

pable of efficient, even delivery and mixing of drilling fluid weighting material.

All drilling fluid, but especially oil-based drilling fluids, should be returned to the supplier or saved for reuse, if possible. Special effort should be made when using oil-based or saline drilling fluid to prevent loss of fluid by the use of drain pans for the drill pipe, drip pans under the floor, vacuum cleaners, and skimmers. The drilling fluid system should be checked for leaks and repaired if necessary before introduction of any oil-based drilling fluid. All pump seals should be inspected and repaired, if needed. The delivery of oil-based drilling fluid should be discussed to emphasize the steps necessary to unload without spillage.

All drilling fluid chemicals transported to the lease should be transported in accordance with applicable DOT regulations and inventoried as to chemical composition, amount, and potential hazard. The chemical inventory should be accompanied by appropriate MSDS. A determination should be made as to whether special handling is required for any chemicals. In addition, SARA Title III requirements for reporting and emergency planning may be applicable. [Refer to API Bulletin E1, *Bulletin on the Generic Hazardous Chemical Category List and Inventory for the Oil and Gas Exploration and Production Industry (Superfund Amendments and Reauthorization Act of 1986, Emergency Planning and Community Right-to-Know Act)*, for more information.] All chemical containers should be appropriately labeled.

6.4 FORMATION PRESSURE CONTROL

The control of formation pressures is an important factor involved in the protection of the environment. The on-site personnel should be trained on how to perform their respective duties regarding pressure control. Pressure control equipment should be installed, tested, and maintained in proper working condition. Periodic drills can help maintain awareness of the need and procedures for early detection of pressure control problems (refer to API Recommended Practice 53, *Recommended Practices for Blowout Prevention Equipment Systems for Drilling Wells*, and API Recommended Practice 59, *Recommended Practices for Well Control Operations*).

6.5 HAZARDOUS WASTES

Paint solvents, some pipe dopes, pipe thread cleaning solvents, and batteries are examples of materials that may be classified as hazardous waste and may require special collection, storage, manifesting, recycling, and disposal practices. (Refer to API *Environmental Guidance Document: Onshore Solid Waste Management in Exploration and Production Operations* for more information.) These wastes should not be commingled with nonhazardous wastes, since to do so may cause the entire mixture to be classified as haz-

ardous. Hazardous waste should be stored in a covered area or in covered containers.

6.6 LOCATION AND RIGHT-OF-WAY MAINTENANCE

Proper maintenance of the location and right-of-way is important to maintain access and to prevent and control erosion. There should be monitoring of drainage and erosion control structures. They should be repaired as required to ensure the intended function.

When performing scraping and leveling operations, care should be exercised to avoid disrupting ditches, shoulders, and creating berms with the bladed material that could result in directing water across roads or locations.

The use of dust control materials should be evaluated prior to their utilization. The materials should not present a hazard to health, vegetation, wildlife, groundwater, or surface water.

6.7 DRILL STRING

Thread cleaning procedures should be developed to minimize the risk of spillage or drippage of solvents. Used solvents should be disposed of in accordance with federal, state, and local regulations.

Selection of environmentally safe pipe lubricants should be considered. Pipe lubricants containing lead should be avoided. Instruction in the drilling program should include guidelines on proper application of lubricants.

Partially used pipe lubricants should be resealed and marked for use at the next convenient opportunity. Empty containers should be stored and disposed of in accordance with applicable regulations.

7 Completion, Testing, and Plugging and Abandonment Operations

7.1 GENERAL

The original completion, testing, and abandonment operations are generally considered to be part of the drilling program. Environmentally sound operational practices and advanced planning can minimize the potential impact of these operations on the environment.

7.2 COMPLETION OPERATIONS

7.2.1 Logging

Generally, no environmental impact results from logging operations, except for situations in which a logging tool containing radioactive materials is lost in a well. In such cases, the appropriate regulatory authority should be contacted by the operator or the wireline company.

7.2.2 Completion Fluids and Chemicals

All chemicals transported to the lease for completion purposes should be transported in accordance with applicable DOT regulations and inventoried as to chemical composition, amount, and potential hazard. The chemical inventory should be accompanied by appropriate MSDS. A determination should be made as to whether special handling is required for any chemicals. In addition, SARA Title III requirements for reporting and emergency planning may be applicable. [Refer to API Bulletin E1, *Bulletin on the Generic Hazardous Chemical Category List and Inventory for the Oil and Gas Exploration and Production Industry (Superfund Amendments and Reauthorization Act of 1986, Emergency Planning and Community Right-to-Know Act)*, for more information.] All chemical containers should be appropriately labeled.

Evaluation and selection of the methods and container types used for transporting completion chemicals to the lease should be determined in advance. Completion chemicals should be stored in an appropriate area. Where feasible, the use of non-reusable containers (i.e., drums) should be minimized.

Chemical wastes should not be disposed on the ground, to surface waters, in drilling fluids, or in completion fluids. All excess chemicals should be returned to the chemical vendor in the original container.

7.2.3 Production Casing and Tubing

Thread cleaning procedures should be developed to minimize the risk of spillage or drippage of solvents. Used solvents should be recycled or disposed of in accordance with federal, state, and local regulations.

Selection of environmentally safe pipe lubricants should be considered. Pipe lubricants containing lead should be avoided. Instruction in the completion program should include guidelines on proper application of lubricants.

Partially used pipe lubricants should be resealed and marked for use at the next convenient opportunity. Empty containers should be stored and disposed of in accordance with applicable regulations.

7.2.4 Cementing

Excess cement slurries and rinsate from cement mixing tanks should be collected for appropriate disposal in accordance with federal, state, and local regulations.

7.2.5 Perforating

Appropriate tankage should be available to handle all potential surge needs. Wellhead control equipment should be in place and fully functional during perforating operations, especially when perforating underbalanced.

7.2.6 Acidizing

The amount and type of acid required for each acid job should be determined before the chemical is transported to the lease. Applicable MSDS information and emergency response procedures should be reviewed with all personnel involved in the acid job.

If necessary, adequate storage for spent acid and well fluids should be in place prior to initiation of the acid job. Storage of spent acid (acid returns) on the well site should be limited and disposed of as soon as possible.

A plan to treat and dispose of the spent acids, well fluids, and solids should be determined before conducting the acid job. Spent acid or well fluids cannot be disposed of to the surface or lease facilities. Such fluids may be retained in the reserve pit or either tanks or lined pits if soil or groundwater will not be adversely impacted.

7.2.7 Fracturing Stimulation

Methods for mixing fracturing fluids and subsequent high pressure injection should be reviewed by all involved personnel. Potential environmental impact of accidental discharges should be reviewed. Emergency response plans for handling any accidental discharges should be reviewed with all involved personnel.

All unused chemicals and fluids should be removed from the location by the service company upon completion of the job. Fluids should not be disposed of to the surface or lease facilities.

7.2.8 Completion Fluid Filtration

Precautions should be taken to ensure against leaks and accidental discharges of the completion fluids during filtration. Filter cartridge and filter media disposal should be part of the waste management plan. Prior to disposal, filter cartridges and used filter media should be stored in a secure area.

7.3 TESTING

Depending on the test requirements, special equipment may be required to ensure environmentally-sound practices.

The produced fluid may be separated on-site (test separator) or piped to a separation facility. Appropriate fluid storage should be provided for oil and produced water. Fluid should be removed from temporary facilities as soon as practical.

Flares should be installed downwind from the rig and other facilities and at a safe distance from all equipment. The surrounding environment should be considered when installing flares to protect vegetation, livestock, and wildlife.

7.4 PLUGGING AND ABANDONMENT

Plugging and abandonment of subsurface zones should be accomplished according to applicable state and federal regulations. All permits should be properly filed with the appropriate agencies. API Bulletin E3, *Well Abandonment and Inactive Well Practices for U.S. Exploration and Production Operations, Environmental Guidance Document*, provides additional guidance on well plugging practices.

8 Decommissioning

8.1 CHEMICAL AND WASTE DISPOSAL

8.1.1 Removal or disposal of all materials from the drilling location is the joint responsibility of the operator, drilling contractor, and service personnel. The operator has final accountability for the condition of the decommissioned site. The materials to be removed include chemical products, construction materials, pallets, and other waste.

8.1.2 All chemical drums or sacks should be properly labeled as to the contents including any safety or transportation warning labels. Unused chemicals should be returned to the supplier or moved to another location. Regulations pertaining to transportation and disposal may apply. The responsibility for compliance rests with the operator.

8.1.3 Partially used chemicals should be maintained in their original containers and should be wrapped or lids secured to prevent spillage. These may be transported to the next drilling location.

8.1.4 Empty drums should be disposed or recycled in a manner approved by local, state, and federal regulations. These drums may be returned to the vendor or sent to cooerage companies that clean and recycle the drums.

8.1.5 Used drilling fluids and cuttings should be reclaimed or disposed in a manner approved by local, state, and federal regulations. Drilling fluids may be transported and reused at other locations. If considered a regulated hazardous material, the fluids must be transported in accordance with applicable DOT requirements.

8.1.6 Reserve pit fluids and solids should be reclaimed and the pit closed within the time allotted by regulatory agencies. Disposal methods are regulated by the state or EPA region, and all disposal should be in accordance with the regulations in effect at the location. Landowner concurrence may be necessary for on-site land disposal. A pit sampling protocol may be required for sampling the pit liquids and solids (sludge).

8.1.7 Several methods are available by which the drilling fluids can be disposed. These include annular injection, naturally or facilitated evaporation, burial, landspreading, or permitted discharge. The solids remaining after dewatering the pit will include drilling fluid solids and drill cuttings. Some possible disposal methods are burial or trenching, landspreading, landfarming, bioremediation, solidification, slurification for injection, and off-site disposal at an approved facility.

8.1.8 Upon termination of completion operations, blow-down and flare pits should be back filled with soil retained from their excavation. Dewatering the blowdown and flare pits may be necessary prior to back filling operations.

8.1.9 Trash and debris should be removed from the location and properly disposed.

8.1.10 The location, size, use, and contents of all pits should be documented in the operator's well records.

8.2 CONTAMINATED SOIL

Any soil contaminated by operations should be remediated as necessary. Inspection of the site is recommended to assess contamination. Remediation methods and acceptance criteria vary depending on the local, state, and federal regulations in effect at the location. The type, location, and extent of contamination and remediation should be documented and maintained in the well records.

8.3 LOCATION RESTORATION

8.3.1 The site should be restored to a condition that satisfies lease obligations and regulatory requirements. Ditches, dikes, and containment walls should be leveled. The land should be contoured to minimize erosion in the event of heavy rainfall. Topsoil, whether stockpiled at the site or hauled to the location, should be spread as part of the final contouring. A productive topsoil is necessary for replanting.

8.3.2 Reseeding and replanting of the location should be done with plants and grasses native to the area. Soil amendments to encourage establishment of vegetation should be calculated based upon soil testing results. Erosion mitigation is a primary objective of reseeded.

8.3.3 Upon completion of the location restoration, a program of soil sampling, visual inspection, and record keeping may need to be established. Long-term maintenance, recontouring, and replanting may be included in the program and performed as necessary to complete the site restoration.

8.3.4 If a water supply well is used and abandoned, it should be plugged in accordance with applicable regulations.

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