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RECOMMENDED MANAGEMENT PRACTICES FOR OPERATION AND CLOSURE OF SHALLOW INJECTION WELLS AT DOE FACILITIES

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Executive Summary

The Safe Drinking Water Act established the Underground Injection Control (UIC) program to ensure that underground injection of wastes does not endanger an underground source of drinking water. Under UIC regulations, an injection well is a hole in the ground, deeper than it is wide, that receives wastes or other fluid substances. Types of injection wells range from deep cased wells to shallow sumps, drywells, and drainfields. The report describes the five classes of UIC wells and summarizes relevant regulations for each class of wells and for the UIC program.

The main focus of the report is Class IV and V shallow injection wells. Class IV wells are prohibited and should be closed when they are identified. Class V wells are generally authorized by rule, but EPA or a delegated state may require a permit for a Class V well. In the absence of detailed Federal regulations on operation and closure of shallow injection wells, a DOE well operator must rely on other guidance and information. This report provides recommendations on sound operating and closure practices for shallow injection wells. In addition to recommendations contained in the text, the report contains, as appendices, copies of several relevant EPA documents that provide additional information on well operation and closure.

Another appendix contains information on the UIC programs in 21 states in which there are DOE facilities discharging to injection wells. The appendix includes the name of the responsible regulatory agency and contact person, a summary of differences between the state's regulations and Federal regulations, and any closure guidelines for Class IV and V wells.

Chapter 1 - Background

Purpose and Organization of Report

This document is intended to assist U.S. Department of Energy (DOE) personnel comply with the UIC program and understand what practices are included in the term "injection well". DOE has operated, and currently operates, injection wells at many of its facilities. Preliminary information on the types and numbers of injection wells found at specific DOE sites is available from EH-232. Chapter 2 includes a summary of the Federal UIC regulations; the full text of the Federal UIC regulations is found in 40 CFR Parts 144-148. Appendix A includes descriptions of selected state UIC regulations that differ from the Federal regulations.

Because there are currently no Federal regulations for Class V wells, both DOE facility representatives and regulators may be uncertain about what constitutes acceptable practices for operating Class V wells and for closing Class IV or V wells. Chapter 3 provides a compilation of recommended operating practices for Class V wells and recommended closure practices for Class IV and V wells. This information was compiled through communication with UIC program staff from states and EPA regions. Copies of various documents that provide general background information on injection well operation and closure are included as Appendices B-E. The information presented in this report can be of assistance to DOE facility personnel in preparation of site-wide best management plans (BMPs) or protocols for proper management of injection wells.

What Is An Injection Well?

Under the Environmental Protection Agency's (EPA's) Underground Injection Control (UIC) program rules, an injection well is defined as, "a 'well' into which 'fluids' are being injected." A well is defined as, "a bored, drilled or driven shaft, or dug hole, whose depth is greater than the largest surface dimension." A fluid is defined as, "any material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state." In other words, an injection well is a hole in the ground, which is deeper than it is wide and that receives wastes (other than solid wastes[1]) or other fluid substances. At this time, there is uncertainty about whether activities like the Waste Isolation Pilot Plant, which would emplace containerized liquids into the ground through a deep narrow shaft, are considered to be injection wells.

There are several types of injection wells, which are described below. A traditional injection well is a relatively deep, cased well drilled for use as an injection well, or converted to injection from some other use. A drain field or leach field is a means of distributing liquid in the subsurface soils. Typically a drain field or leach field consists of several horizontal pipes

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[1]The term "solid waste" is used here to describe wastes that are physically solids. Under the Resource Conservation and Recovery Act (RCRA), "solid waste" has a different legal definition that includes liquids, semisolids, and gaseous materials.

radiating in different directions from a distribution point. The liquid flows out through holes in the pipes and soaks into the soil. A drywell is a vertical hole filled with rocks. The hole may be cased with pipe or may be open. Water flows into the rocks and slowly percolates out the bottom of the drywell into the soil. A sump is a hole in the ground which typically is not filled with rocks. Liquids enter the sump and percolate into the soil.

Under the UIC program, drain fields, leach fields, drywells, and sumps are considered to be injection wells even though traditionally they have not been thought of as wells. Drain fields and leach fields have a linear dimension (although it is oriented horizontally) that is longer than the diameter or width of the structure.

Classes of Injection Wells

The UIC regulations set up five classes of injection wells. Each of the well classes is briefly described below.

Class I Wells

Class I wells are used for disposal of hazardous or non-hazardous wastes below the lowest usable aquifer or underground source of drinking water (USDW). It is believed that the wastes can be safely disposed at these depths if the wastes can be isolated from any USDW.

The Federal regulations contain detailed requirements for siting, constructing, operating, monitoring, and closing Class I wells to ensure that contaminants are unable to migrate into a USDW. There are over 500 Class I wells in 22 states, particularly in the Gulf Coast states.

Class II Wells

Class II wells are used for injection of oil and gas industry wastes, injection of fluids for enhanced oil recovery, or underground storage of liquid hydrocarbons. As oil and gas are recovered from wells, a substantial quantity of salt water, known as produced water, is frequently brought to the surface. About 30% of the produced water generated in the United States is disposed of through Class II injection wells. Figure 1 shows a cross-section of a typical Class II well. This is very similar to a Class I well, except that in a Class I well, cement replaces the drilling mud all the way to the top of the well.

As an oil field becomes depleted, less oil can be recovered from it. To maximize oil production, produced water, steam, or other gases are injected into the oil fields to flush more of the remaining oil from the field. The materials injected for this enhanced oil recovery process are injected through Class II wells. In some cases, Class II wells are used to store crude oil, liquified petroleum gas, and other liquid hydrocarbons in underground rock formations.

The Federal regulations for Class II wells contain detailed requirements for construction, monitoring, operations, and closure. There are approximately 170,000 Class II wells in 31 states.

Class III Wells

Class III wells are those used for mineral extraction. There are two primary mining processes that use Class III wells. In solution mining, water or steam is pumped into an injection well where it dissolves the mineral being sought, typically salt or sulfur. The liquified mineral solution is then pumped to the surface.

The in situ leaching procedure is commonly used to extract uranium, gold, and copper. Under this type of mining, water with particular properties is injected into a mineral-bearing formation where it gradually leaches out the mineral from its native ore. The concentrated solution is then pumped to the surface.

The Federal regulations for Class III wells contain detailed requirements for construction, monitoring, operations, and closure. There are approximately 21,000 Class III wells in 16 states, primarily in the south-central and southwestern states. Figure 2 shows a cross-section of two types of Class III wells.

Class IV Wells

Class IV wells are those in which hazardous or radioactive wastes are injected into or above a USDW. Class IV wells are considered to be a threat to USDWs and are prohibited. If a Class IV well is identified, it must be closed and may possibly be subject to remediation.

Class V Wells

The final class of injection wells is not a specific type of well but a catch-all for all injection wells not falling into one of the other classes. Class V wells include drywells, sumps, drain fields, drainage wells, and septic systems, among others. Figures 3 - 5 show cross-section drawings of a drywell, stormwater drainage well, and a septic system, respectively. Class V wells have been widely used in many parts of the country, but they have not typically been subject to extensive permitting requirements.

Because of the diversity of Class V wells, the EPA has sub-divided the class into seven main categories composed of 30 individual well subclasses. The subclasses are shown in Table 1. About 83% of all Class V wells belong to two categories -- drainage wells (57%) and sewage related wells (26%). Current EPA inventories have identified about 170,000 Class V wells, although it is probable that many more Class V wells have not yet been identified or reported to regulators.

Under Federal UIC regulations, all Class I, II, or III wells must be permitted by the EPA or a

delegated state, but Class V wells are authorized by rule and generally are not required to obtain permits until such time as Class V regulations become applicable. Under certain circumstances, EPA may require a permit, and states which have been authorized to administer the UIC program may do so under state authority. Owners or operators of Class V wells must submit an inventory of their Class V wells to EPA or a delegated state agency.

Figure 6 shows the relationship between USDWs and the different classes of injection wells. Class IV wells are not shown in Figure 6, but they would be comparable to the Class V wells.

Statutory Basis for the UIC Program

The Safe Drinking Water Act of 1974 (SDWA) established the UIC Program to protect USDWs from contamination through injection of wastes. The SDWA contains provisions that allow EPA to delegate authority for administration and enforcement of the UIC program to the states. Many states have received UIC program delegation. In those states that have not received UIC program delegation, the regional EPA office administers and enforces the program.

The Resource Conservation and Recovery Act (RCRA) requires EPA to evaluate the safety of injecting hazardous wastes into deep injection wells and to prohibit injection of certain wastes if necessary. RCRA also includes a prohibition on injection of hazardous waste into or above a USDW (Class IV well), but provides an exception to this prohibition for response actions or corrective actions conducted under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). In order to qualify for the CERCLA exemption, the injected water must be treated ground water that was withdrawn from the same aquifer to which it is being returned, and the response or corrective action must be sufficient to protect human health and the environment.

Figure 1 - Cross-section of a Typical Class II Well
(from EPA, 1989)

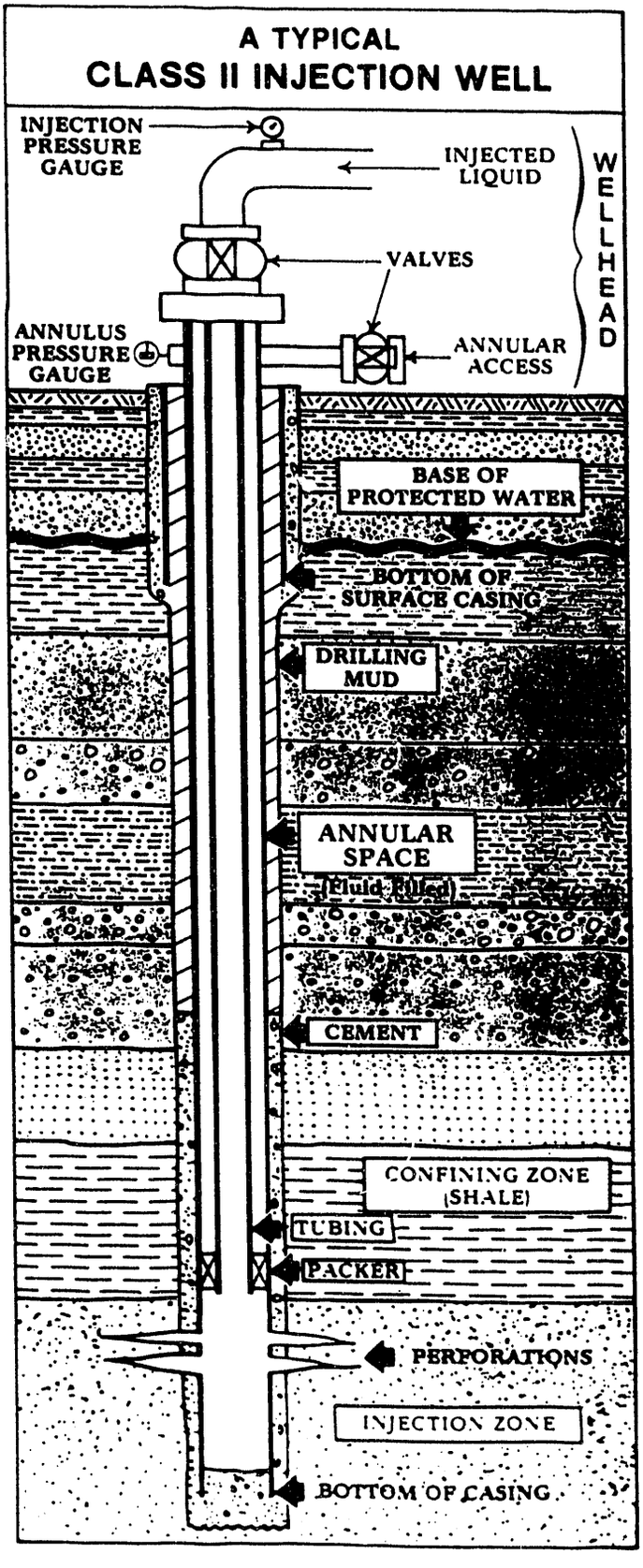
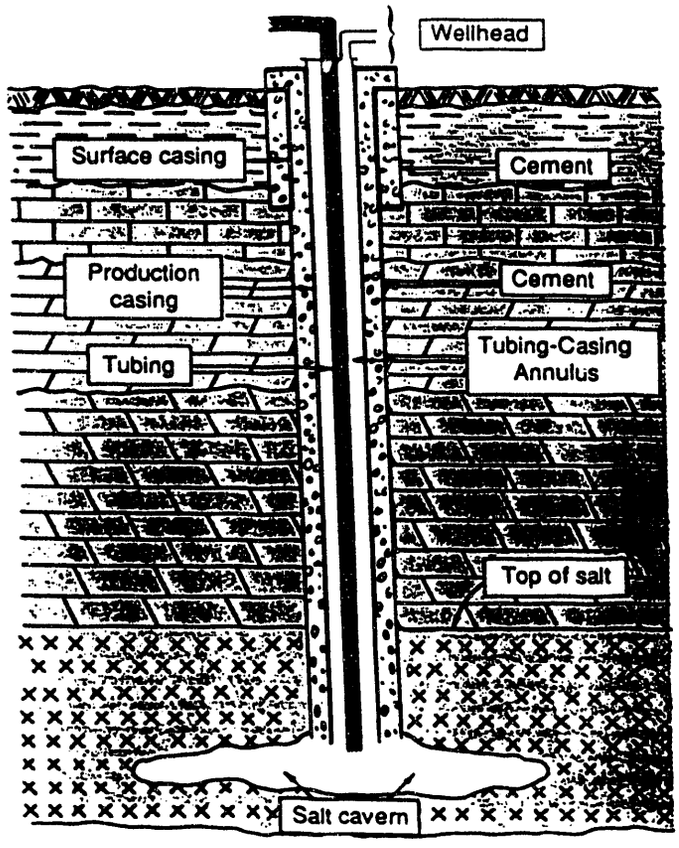


Figure 2 - Cross-sections of Two Types of Class III Wells (from EPA, 1989)

Typical Salt Solution Well Completion



Typical In Situ Leaching Well Completion

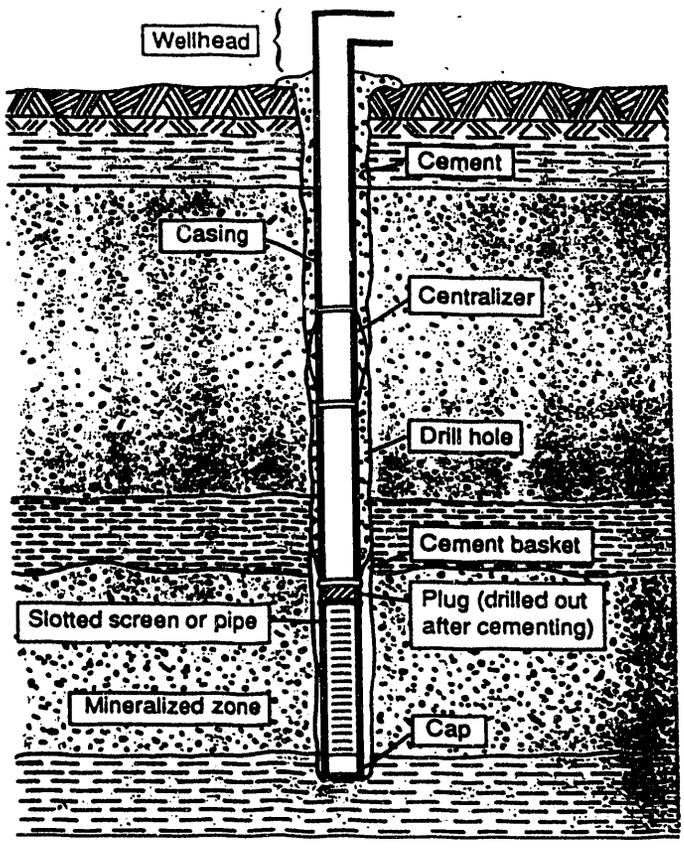


Figure 3 - Cross-section of a Drywell (Class V)
(from UIPC, 1990)

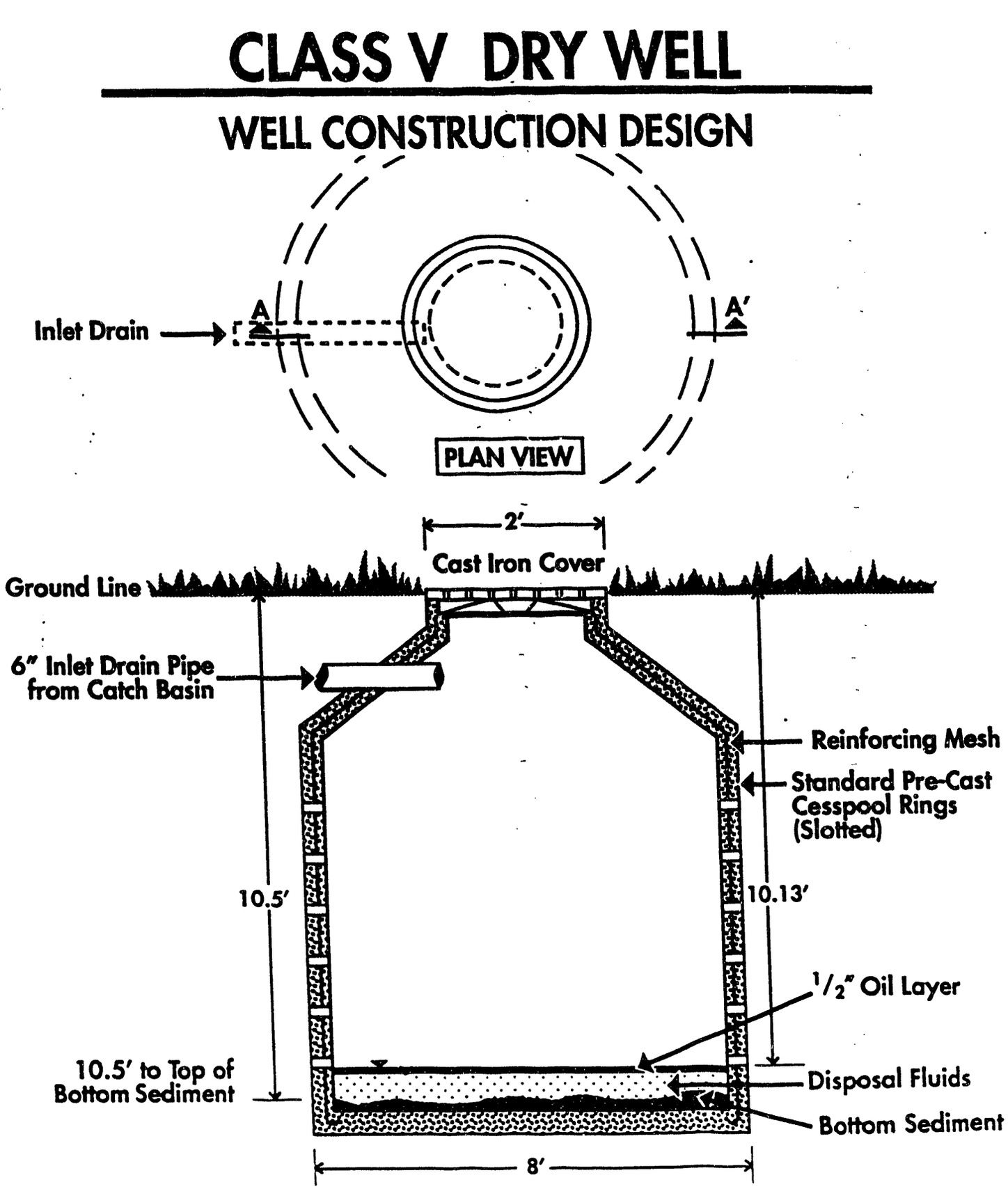


Figure 4 - Cross-section of a Stormwater Drainage Well (Class V)
(from UIPC, 1990)

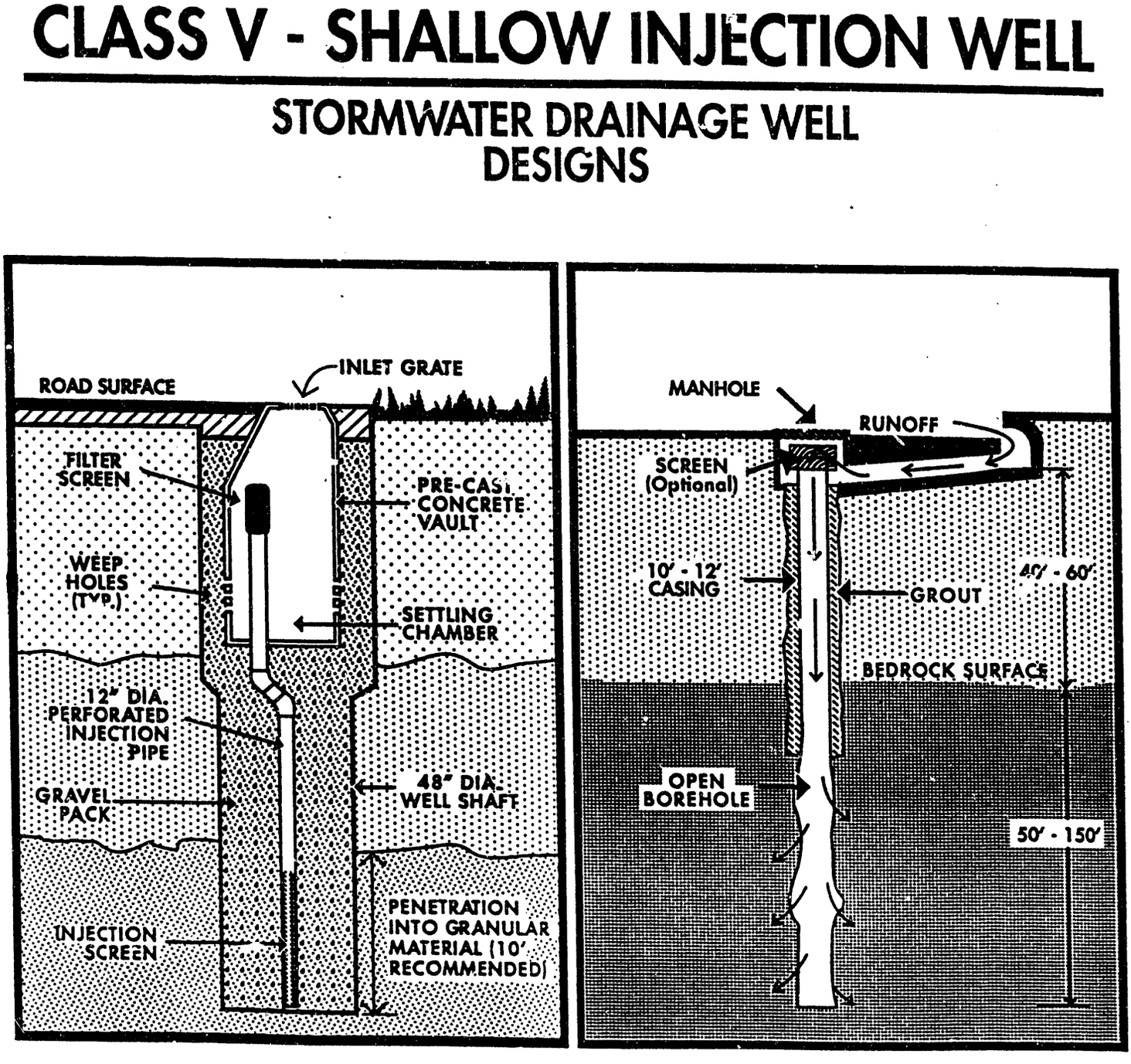


Figure 5 - Cross-section of a Septic System (Class V)
(from UIPC, 1990)

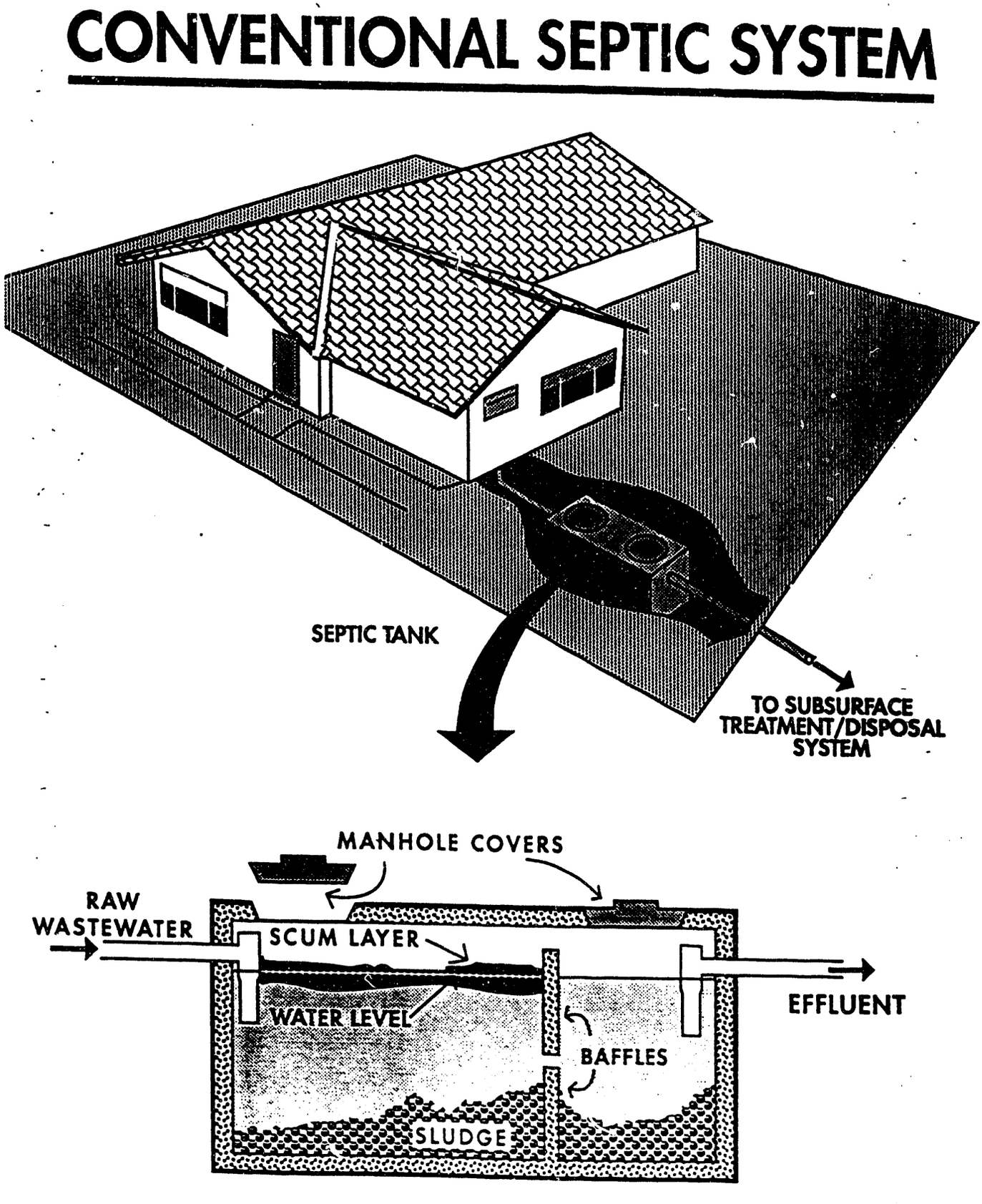


Figure 6 - Injection Wells and Aquifers
(from EPA, 1989)

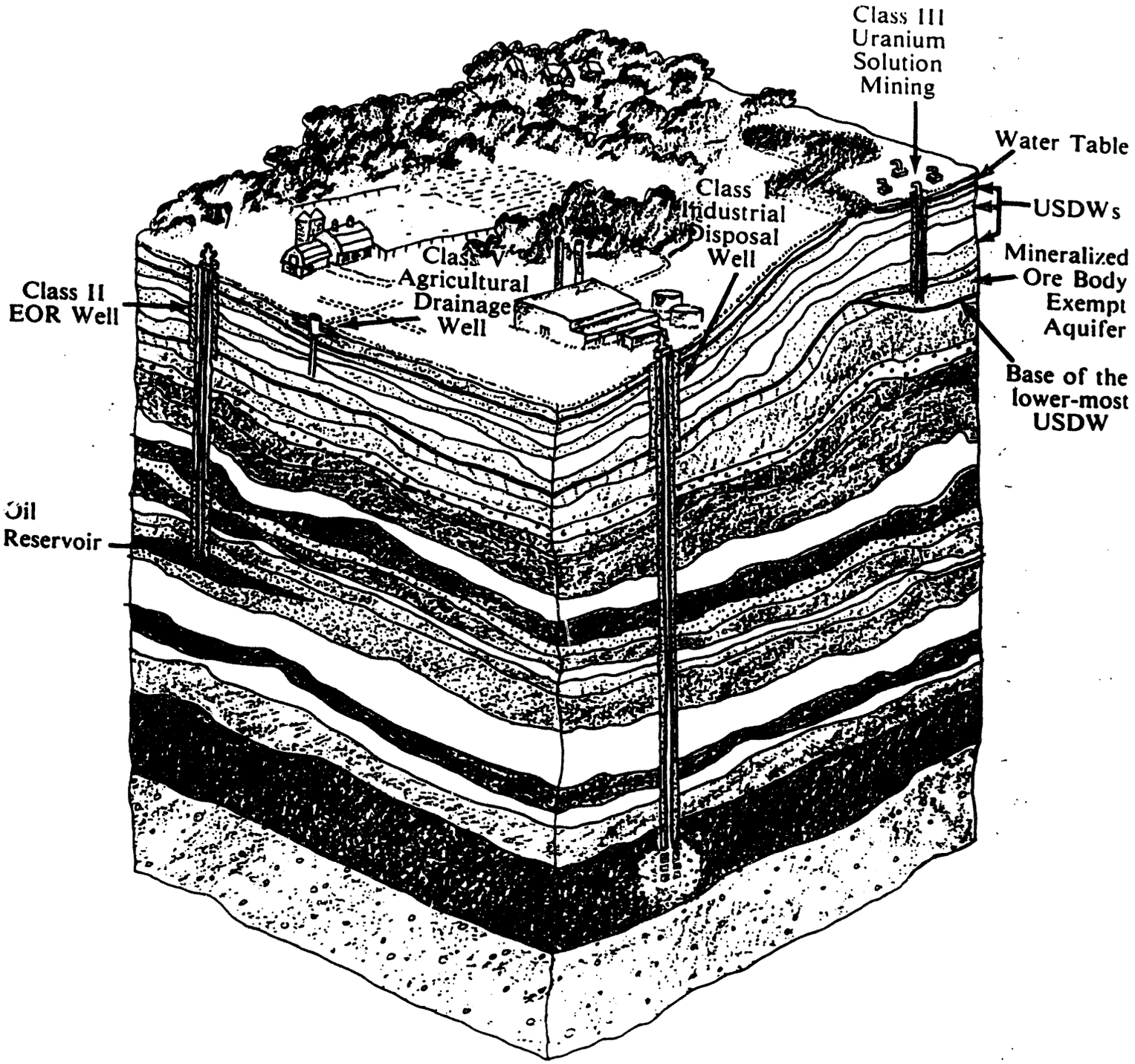


Table 1 - Class V Injection Well Subclasses (from EPA, 1989)

Name of Well Type and Description	Ground Water Contamination Potential	Potential Contaminants	EPA Well Code
DRAINAGE WELLS (a.k.a. DRY WELLS) Agricultural Drainage Wells — receive irrigation tailwaters, other field drainage, animal yard, feedlot, or dairy runoff, etc.	High	Pesticides, nutrients, pathogens, metals transported by sediments, salts.	5F1
Storm Water Drainage Wells — receive storm water runoff from paved areas, including parking lots, streets, residential subdivisions, building roofs, highways, etc.	Moderate	Heavy metals (Cu, Pb, Zn) organics, high levels of coliform bacteria. Contaminants from streets, roofs, landscaped areas, Herbicides, Pesticides.	5D2
Improved Sinkholes — receive storm water runoff from developments located in karst topographic areas.	High-Moderate	Variable: pesticides, nutrients, coliform bacteria.	5D3
Industrial Drainage Wells — wells located in industrial areas which primarily receive storm water runoff but are susceptible to spills, leaks, or other chemical discharge.	High-Moderate	Usually organic solvents, acids, pesticides, and various other industrial waste constituents. Similar to storm drainage wells but usually higher concentrations.	5D4
Special Drainage Wells — used for disposing water from sources other than direct precipitation. Four types were reported: landslide control drainage wells (Montana), potable water tank overflow drainage wells (Idaho), swimming pool drainage wells (Florida), and lake level control drainage wells (Florida)	Moderate-Low	Chlorinated and treated water, pH imbalance, algaecides, fungicides, muriatic acid.	5G30
GEOTHERMAL REINJECTION WELLS Electric Power Reinjection Wells — reinject geothermal fluids used to generate electric power — deep wells.	Moderate	pH imbalance, minerals and metals in solution. (As, Bo, Se), sulfates.	5A5
Direct Heat Reinjection Wells — reinject geothermal fluids used to provide heat for large buildings or developments — deep wells.	Moderate	Hot geothermal brines with TDS between 2,000 to 325,000 mg/l. Co_2, $CaSO_4$, Sr and Ba, As.	5A6
Heat Pump/Air Conditioning Return Flow Wells — reinject groundwater used to heat or cool a building in a heat pump system — shallow wells.	Low	Potable water with temperatures ranging from 90° to 110° F., may have scale or corrosion inhibitors.	5A7
Groundwater Aquaculture Return Flow Wells — reinject groundwater or geothermal fluids used to support aquaculture. Non-geothermal aquaculture disposal wells are also included in this category (e.g. Marine aquariums in Hawaii use relatively cool sea water).	Moderate	Used geothermal waters which may be highly mineralized & include traces of arsenic, boron, fluoride, dissolved & suspended solids, animal detritus, perished animals and bacteria.	5A8
DOMESTIC WASTEWATER DISPOSAL WELLS Untreated Sewage Waste Disposal Wells — receive raw sewage wastes from pumping trucks or other vehicles which collect such wastes from single or multiple sources. (No treatment)	High	Soluble organic & inorganic compounds including household chemicals. Raw sewage with 99.9% water and .03% suspended solid. May contain pathogenic bacteria & viruses, nitrates, ammonia.	5W9
Cesspools — including multiple dwelling, community, or regional cesspools, or other devices that receive wastes and which must have an open bottom and sometimes have perforated sides. Must serve greater than 20 persons per day if receiving solely sanitary wastes. (Settling of solids)	High	Soluble organic & inorganic compounds including household chemicals. Raw sewage with 99.9% water and .03% suspended solid. May contain pathogenic bacteria & viruses, nitrates, ammonia.	5W10
Septic Systems (Undifferentiated Disposal Method) — used to inject the waste or effluent from a multiple dwelling, business establishment, community, or regional business establishment septic tank. Must serve greater than 20 persons per day if receiving solely sanitary wastes. (Primary Treatment)	High-Low	Varies with type of system: fluids typically 99.9% water (by weight) and .03% suspended solids: major constituents include nitrates, chlorides, sulfates, sodium, calcium, and fecal coliform.	5W11
Septic Systems (Well Disposal Method) — examples of wells include actual wells, seepage pits, cavitettes, etc. The largest surface dimension is less than or equal to the depth dimension. Must serve greater than 20 pesons per day if receiving solely sanitary wastes. (Less treatment per square area than 5W32)	High-Low	Varies with type of system: fluids typically 99.9% water (by weight) and .03% suspended solids: major constituents include nitrates, chlorides, sulfates, sodium, calcium, and fecal coliform.	5W31
Septic System (Drainfield Disposal Method) — examples of drainfields include drain or tile lines, and trenches. Must serve more than 20 persons per day if receiving solely sanitary wastes. (More treatment per square area than 5W31)	High-Low	Varies with type of system: fluids typically 99.9% water (by weight) and .03% suspended solids: major constituents include nitrates, chlorides, sulfates, sodium, calcium, and fecal coliform.	5W32
Domestic Wastewater Treatment Plant Effluent Disposal Wells — dispose of treated sewage or domestic effluent from small package plants up to large municipal treatment plants. (Secondary or further treatment)	High-Low	Lower levels of organics and bacteria than other septic systems and cesspools.	5W12
MINERAL AND FOSSIL FUEL RECOVERY RELATED WELLS Mining, Sand, or Other Backfill Wells — used to inject a mixture of water and sand, mill tailings, and other solids into mined out portions of subsurface mines whether what is injected is a radioactive waste or not. Also includes special wells used to control mine fires and acid mine drainage wells.	Moderate	Acidic waters	5X13
Solution Mining Wells — used for in-situ solution mining in conventional mines, such as stopes leaching.	Moderate-Low	2.4% sulfuric acid, pH less than 2 for copper & ferric cyanide solution for gold or silver.	5X14
In-situ Fossil Fuel Recovery Wells — used for in-situ recovery of coal, lignite, oil shale, and tar sands.	Moderate	Steam, air, solvents, igniting agents.	5X15
Saline Brine Return Flow Wells — used to reinject spent brine into the same formation from which it was withdrawn after extraction of halogens or their salts.	Low	Variable	5X16

Table 1 (continued)

Name of Well Type and Description	Ground Water Contamination Potential	Potential Contaminants	EPA Well Code
INDUSTRIAL/COMMERCIAL/UTILITY DISPOSAL WELLS			
Cooling Water Return Flow Wells — used to inject water which was used in a cooling process, both open and closed loop processes.	Low-Moderate	Anti-sealing additives, thermal pollution, potential for industrial spills reaching ground water.	5A19
Industrial Process Water and Water Disposal Wells — used to dispose of a wide variety of wastes and wastewaters from industrial, commercial, or utility processes. Industries include refineries, chemical plants, smelters, pharmaceutical plants, laundromats and dry cleaners, tanneries, carwashes, laboratories, etc. *Industry and waste stream must be specified* (e.g. Petroleum Storage Facility—storage tank condensation water; Electric Power Generation Plant—mixed waste stream of laboratory drainage, fireside water, and boiler blowdown; Car Wash-Mixed waste stream of detergent, oil and grease, and paved area washdown; Electroplating Industry—spent solvent wastes; etc.).	High	Potentially any fluid disposed by various industries, suspended solids, alkalinity, sulfate volatile organic compounds.	5W20
Automobile Service Station Disposal Well — repair bay drains connected to a disposal well. Suspected of disposal of dangerous or toxic wastes.	High	Heavy metals, solvents, cleaners, used oil and fluids, detergents, organic compounds.	5X28
RECHARGE WELLS			
Aquifer Recharge Wells — used to recharge depleted aquifers and may inject fluids from a variety of sources such as lakes, streams, domestic wastewater treatment plants, other aquifers, etc.	High-Low	Variable: water is generally of good quality	5R2
Saline Water Intrusion Barrier Wells — used to inject water into fresh water aquifers to prevent intrusion of salt water into fresh water aquifers.	Low	Varies: advanced treated sewage, surface urban and agricultural runoff, and imported surface waters.	5B22
Subsidence Control Wells — used to inject fluids into a non-oil or gas producing zone to reduce or eliminate subsidence associated with overdraft of fresh water and not used for the purpose of oil or natural gas production.	Low	No specific type of injected fluid noted, similar to aquifer recharge wells.	5S23
MISCELLANEOUS WELLS			
Radioactive Waste Disposal Wells — all radioactive waste disposal wells other than Class IV wells.	Unknown	Low-level radioactive wastes.	5N24
Experimental Technology Wells — wells used in experimental or unproven technologies such as pilot scale in-situ solution mining wells in previously unmined areas.	Low-Moderate	Varies depending on project.	5X25
Aquifer Remediation Related Wells — wells used to prevent, control, or remediate aquifer pollution, including but not limited to Sueprfund sites.	Unknown	Nutrients used in Biodegradation of organics, oil/grease, phenols, toluene.	5X26
Abandoned Drinking Water Wells — used for disposal of waste.	Moderate	Potentially any kind of fluid, particularly brackish or saline water, hazardous chemcials and sewage.	5X29
Other Wells — any other unspecified Class V wells: *Well type/purpose and injected fluids must be specified.*	Unknown	Variable	5X27

Chapter 2 - Overview of Federal Requirements for the UIC Program

The SDWA directs EPA to develop regulations for the protection of underground sources of drinking water from contamination by the subsurface injection or emplacement of fluids through wells. EPA promulgated these regulations under 40 CFR Part 124 and 40 CFR Parts 144 through 148. The regulations specify permitting requirements, minimum standards and technical requirements for the proper siting, construction, operation, monitoring, and plugging and abandonment of injection wells. The next several sections of this chapter provide a brief summary of the key requirements of the Federal UIC regulations. Many states have their own UIC requirements that are summarized in Appendix A.

Order DOE 5400.5, Radiation Protection of the Public and the Environment, contains requirements for disposal of liquid wastes containing radionuclides. The final section of this chapter summarizes the portions of Order DOE 5400.5 relevant to disposal of such wastes to ground water.

40 CFR Part 144 - Underground Injection Control Program

This Part contains permitting and program requirements for the UIC program, along with definitions. Injection wells are divided into five classes, as discussed previously in Chapter 1. Injection of fluids into injection wells must be authorized by rule (i.e., blanket coverage without making application or receiving a permit) or by permit. Discharges into Class IV wells are prohibited.

Authorization by Rule

Owners or operators of all injection wells authorized by rule must submit inventory information no later than one year after the date of approval or effective date of the UIC program for the state unless the facility has interim status under RCRA. All states considered in this study have had UIC programs in effect since the mid-1980s. Therefore, inventory information should already have been submitted for all wells intended to be authorized by rule. At minimum, inventory information shall include:

- facility name and location;
- name and address of legal contact;
- ownership of facility;
- nature and type of injection wells; and
- operating status of injection wells.

Requirements for Class I, II, and III wells, authorized by rule, include 24-hour reporting of any

noncompliance which may endanger human health or the environment, preparation of a plugging and abandonment plan, casing and cementing specifications, operating specifications, monitoring specifications, and reporting specifications. EPA may require the owner or operator of an injection well authorized by rule to apply for a permit on a case-by-case basis for the following reasons:

- the injection well is not in compliance with any of the regulatory requirements;
- the injection well is no longer within the category of wells and types of well operations authorized by the rule;
- the protection of an USDW requires that the injection operation be regulated by requirements that are not contained in the rule; or
- the period of coverage for authorization by rule has expired.

Authorization by Permit

All underground injection operations not authorized by rule must apply for a permit. Under the provisions of 40 CFR 144.31, the application shall include, among other items:

- facility name and mailing address, location, and standard industrial classification (SIC) codes;
- name, address, telephone number, and ownership status of the operator;
- all relevant environmental permitting information, including permits obtained under the SDWA, RCRA, the Clean Water Act, and the Clean Air Act;
- topographic map; and
- description of the nature of the business.

Area permits may be obtained for wells that:

- do not inject hazardous waste;
- are operated by a single operator; and
- are located within the same well field, facility site, or similar unit in the same state.

Emergency permits may be obtained if they are necessary to prevent imminent and substantial endangerment to the health of persons or a substantial and irretrievable loss of oil or gas resources.

Class II and Class III permits are to be reviewed by regulators at least once every five years to determine whether they should be modified. Permits for Class I wells are effective for a fixed term not to exceed 10 years. In cases where EPA or a delegated state requires a permit for a Class V well, the permit is effective for a fixed term not to exceed 10 years.

40 CFR Part 145 - State UIC Program Requirements

The SDWA provides for states to be delegated authority to administer the UIC program. Approval of a particular program is based on a finding that the program meets the minimum standards and technical requirements contained in 40 CFR Part 145. States whose programs have been approved by EPA are known as primacy states. These states have primary enforcement responsibility for the regulation of injection wells in their states.

In those instances where a state has opted not to submit a program for approval, or where the submitted program does not meet the minimum standards and technical requirements, the program is promulgated and administered by EPA. States with Federally-administered programs are known as direct implementation states. Figure 7 shows the UIC Class V program status of the states considered in this study.

40 CFR Part 146 - Underground Injection Control Program: Criteria and Standards

40 CFR Part 146 contains technical criteria and standards for Class I, II, III, and V wells. The criteria and standards are detailed for Class I, II, and III wells, but are very limited for Class V wells. No criteria and standards have been promulgated for Class IV wells.

Well Construction Requirements for Class I, Class II, and Class III Wells

Construction requirements for Class I and new Class II wells require proper siting, casing, and cementing of wells to prevent movement of fluids into or between USDWs. New Class III wells must be similarly cased and cemented. This requirement is waived for new wells in existing projects where substantial evidence exists that no contamination of an USDW would result. In addition, specific technical requirements include geophysical logging and other appropriate testing during drilling and construction.

Operating Requirements for Class I, Class II and Class III Wells

Class I and Class III wells must be operated so that injection pressure does not initiate new fractures or propagate existing fractures in the injection zones. Class II wells must be operated so that injection pressure does not initiate new fractures or propagate existing fractures in the confining zones adjacent to USDWs. Injection pressure must not cause movement of injection

or formation fluids into USDWs.

Injection between the outermost casing protecting USDWs and the well bore is prohibited for Class I, Class II, and Class III wells. For Class I injection wells, the annulus between the tubing and the long casing string must be filled with a fluid and pressurized, subject to approval by regulatory authorities. A packer (device used to seal off the bore of the well at a specific depth) must be placed immediately above the injection zone, unless an alternative to a packer has been approved by the regulatory agency.

Monitoring Requirements for Class I, Class II, and Class III Wells

Monitoring requirements for Class I, Class II, and Class III wells must include sufficiently frequent analyses of injected fluids to yield representative data. In addition, monitoring must be conducted for injection pressures, flow rates, and injected volumes. For Class I injection wells, monitoring the pressure on the annulus between the tubing and the long string of casing is also required. Mechanical integrity must be demonstrated for these wells at least once every five years.

Monitoring programs for Class I wells should include monitoring well data within the area of review, an area surrounding the well. For Class II wells, monitoring results must be retained until the next permit review. Class III well monitoring requirements include monitoring of fluid in the injection zone and any associated monitoring wells. Class II hydrocarbon storage and enhanced recovery wells and Class III wells may be monitored on a field or project basis. Manifold monitoring is acceptable for Class II wells, provided the wells are operated with a common manifold and the owner/operator demonstrates that manifold monitoring is comparable to individual well monitoring.

Reporting Requirements for Class I, Class II, and Class III Wells

Quarterly reporting of the physical and chemical characteristics of the injectate and monthly reporting of the injection pressure, flow rate and volume, and annular pressure are required for Class I wells. Annual reporting is required for Class II wells. Quarterly reporting is required for Class III wells.

Requirements for Class IV and Class V Wells

Construction, operation, and maintenance of Class IV injection wells is generally prohibited; however, using Class IV wells to reinject treated contaminated ground water under an approved ground-water remediation project is allowed (40 CFR 144.13).

Class V wells are authorized by rule unless the owner or operator is required by EPA to obtain a permit on a case-by-case basis. Owners or operators of any Class V well are required to notify and submit inventory information to the regulatory agency within one year of the effective date of the applicable UIC program.

40 CFR Part 147 - State Underground Injection Control Programs

This Part lists the UIC programs in each state, including the responsible regulatory agency, the enabling legislation, the citations for the applicable regulations, and the program's effective date.

40 CFR Part 148 - Hazardous Waste Injection Restrictions

40 CFR Part 148 identifies hazardous wastes that may not be disposed into a Class I hazardous waste injection well. Wastes otherwise prohibited under Part 148 may be injected if:

- the operator has obtained an extension of the effective date of any prohibition;
- an exemption has been granted;
- the waste is generated by a conditionally exempt small quantity generator; or
- the wastes are hazardous only because they exhibit hazardous characteristics and:
  - the wastes no longer exhibit any prohibited hazardous waste characteristic at the point of injection; and
  - are disposed into a non-hazardous injection well or a hazardous injection well that receives only non-prohibited hazardous wastes.

State UIC Requirements

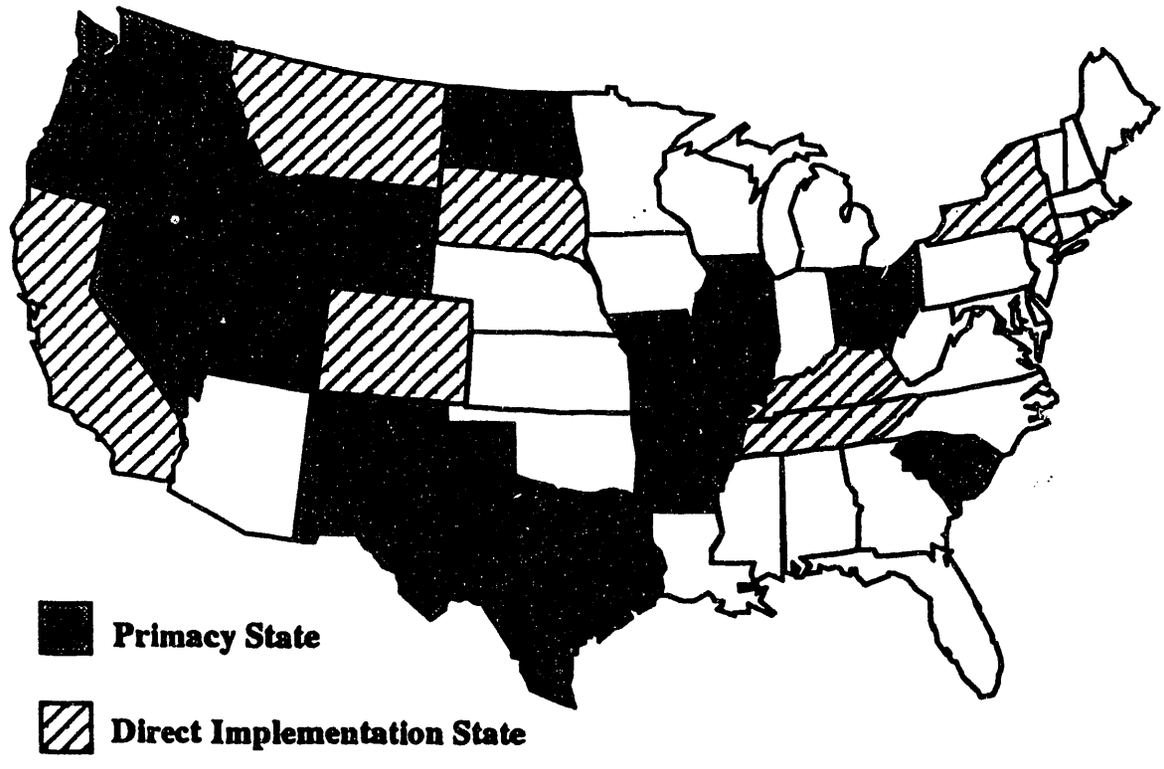
DOE facilities in 21 states operate, may operate, or have operated shallow injection wells. Many of these states have adopted state regulations or policies for Class IV and V wells. For each state with regulations or policies, Appendix A lists:

- the responsible agency and contact person;
- a summary of differences between the state's regulations and Federal regulations; and
- closure guidelines for Class IV and V wells.

Order DOE 5400.5

Order DOE 5400.5, *Radiation Protection of the Public and the Environment*, contains requirements for disposal of liquid wastes containing radionuclides to ground water. The use of soil columns -- described in the Order as trenches, cribs, ponds, or drain fields -- for disposal of radionuclide-bearing wastes must be discontinued at the earliest practicable time. It should be noted that although trenches, cribs, and ponds release contaminants to ground water, they

Figure 7 - Class V Primacy Status of States with DOE Facilities Using UIC Wells



Chapter 3 - Recommendations for Site-Specific Management Practices for Class V Wells

As stated in Order DOE 5400.1, *General Environmental Protection Program*, DOE's policy is to conduct its operations in an environmentally safe and sound manner. DOE is committed to good environmental management practices to minimize risks to the environment and public health, and to anticipate and address potential environmental problems before they pose a threat to the quality of the environment or to the public. As evidence of its environmental protection philosophy, DOE's draft Ground-Water Protection Policy (November 6, 1992) emphasizes prevention of future ground-water contamination and encourages efforts to identify and properly manage potential contamination sources.

Since there are no specific Federal regulations for operating or closing Class V injection wells, it is necessary for each DOE well operator[2] to establish appropriate practices that identify Class V wells and ensure that they are operated and closed in a manner consistent with the Department's ground-water protection goals. To assist in establishing site-wide BMPs, this chapter presents a variety of recommended operating and closure practices based on information gathered through communication with states, industrial groups, and EPA regional offices. In addition to the general information presented in the chapter, more detailed information is provided in Appendices C-G. Additional descriptions of each information source are also given. DOE well operators should consider the information presented in this report when preparing site-wide BMPs. In addition, operators should use professional judgement to incorporate any other available technical information into site-wide plans and protocols.

Although there are no specific Federal regulations for operating or closing Class V wells, there may be relevant state regulations. It is possible that some DOE facilities are operating Class V wells that have not been reported to appropriate regulatory agencies. It is also possible that some DOE facilities are unknowingly operating Class V wells. In either case, the facility may be operating the wells in a manner that would be unacceptable to the regulatory agency. **It is strongly recommended that DOE well operators maintain regular communication with state or Federal regulators. Operators should inform regulators as to the types of wells being operated and should determine the operating and closure practices that must be followed.**

Recommended Operating Practices

The Federal regulations contain no specific operating requirements for Class V wells, but 40 CFR 144.12 (a) prohibits operation of an injection well in a manner that causes a violation of a primary drinking water regulation or adversely affects human health. Consequently, DOE well

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[2] Throughout this chapter, reference is made to DOE well "operator". It is understood that ultimately, the DOE facility managers (both government and contractor) bear the responsibility for all activities at the facility. This report does not attempt to assign specific responsibilities to different individuals. The term "operator" is used to designate any person responsible for operation or management of an injection well at a DOE facility.

operators should ensure that Class V wells are operated in a manner that does not endanger a USDW. There are several components to a site-wide BMP for injection wells that should be followed. These components include:

- identification of injection wells;
- characterization of injectate quality;
- techniques for pollution prevention;
- waste treatment practices;
- spill control practices; and
- monitoring and recordkeeping practices.

Each component is discussed below.

Identification of Injection Wells

Chapters 1 and 2 explain what disposal practices fall under the definition of Class IV and V injection wells. A DOE well operator should conduct a site inventory to identify all potential active and inactive shallow injection wells. Only active injection wells are discussed under the operating practices section of this chapter; closure of inactive wells is discussed in a later section. A site inventory can rely on DOE documents such as Environmental Audit reports and Tiger Team reports, and on the personal knowledge of current or former site employees. If there is uncertainty about whether a particular disposal practice is considered to be an injection well, the operator should seek an opinion from the regulatory agency.

Any shallow injection wells identified through the inventory should be reported to the relevant regulatory agency. If any Class IV wells are identified, no additional materials should be injected through them, and closure should be initiated, as described later in this chapter. If the DOE facility is located in a primacy state, the state may require permits or specific BMPs for Class V wells. The state may also prohibit certain types of Class V wells.

Characterization of Injectate Quality

A DOE well operator must know what material is entering the injection well. Knowledge of injectate characteristics for each well is crucial to preventing endangerment of ground water. This can be accomplished to some extent through process knowledge, but should be supplemented, where necessary, by chemical monitoring.

In order to determine injectate characteristics, each well and its associated systems should be isolated. For example, a storm water drainage well may have been constructed to accept

wastewater through subsurface piping. In order to determine injectate sources and characteristics, the operator should make every effort to locate inlets to the system (floor drains, sink drains, process discharge lines, etc.) so that potential contaminants may be identified. With this knowledge, the operator will be able to isolate potentially harmful contaminants and take appropriate measures to protect the environment. The operator should define the characteristics of each isolated waste stream and take action to mitigate and control discharge of contaminants which may endanger ground water.

The DOE well operator should document waste stream characteristics and sources for each injection well and implement procedures to identify any new waste streams prior to their injection. The operator should also take appropriate measures to ensure that unauthorized waste streams are not disposed of through injection wells.

Techniques for Pollution Prevention

The DOE complex recognizes the advantages of pollution prevention. Pollution prevention is preferable and more cost-effective than cleaning up contaminated ground water. DOE announced its Policy on Waste Minimization and Pollution Prevention on August 20, 1992. Also Chapter 3 of Order DOE 5400.1 contains requirements for site-wide waste minimization and pollution prevention planning. A draft revised Order, DOE 5400.1A, is currently being developed to broaden the requirements for pollution prevention planning to apply to all media, including ground water.

Underground injection operating practices can be improved through pollution prevention. While there are some process-specific pollution prevention techniques, other methods are more generic and are based on: a) excluding any pollutants that are external to the waste stream from the well; or b) removing any undesirable components of the waste stream through process changes prior to injection. Recommended pollution prevention-based management practices for Class V well operations that should be considered by DOE well operators are presented below:

Exclusion of External Sources of Pollutants

- Isolate and separate potential contaminant sources, such as product drums, batteries, and waste handling areas, from storm water drainage wells and associated drainage areas.

- Properly segregate and dispose of hazardous wastes in accordance with RCRA requirements.

- Pave areas where frequent spills occur and construct containment devices such as berms, barriers, and channels to prevent accidental spills to storm water drainage wells.

- Cover storage areas to isolate materials from precipitation or collect storm water

from outdoor storage areas for alternate disposal.

- Conduct regularly scheduled internal inspection and maintenance to identify potential leaks and spills from storage and equipment failure, and take necessary corrective action to avoid releases which may affect the environment.

- Implement a waste reduction and minimization program and recycle whenever possible.

- Provide specific direction for employees regarding substances which may not be disposed through sink drains.

Process Changes to Eliminate Undesirable Contaminants

- Plug unnecessary floor drains and other uncontrolled inlets to the injection system.

- Replace potentially harmful products with alternative products whenever possible.

- Limit or restrict water treatment additives, such as scale inhibitors and biocides, to systems connected to Class V injection wells.

- Eliminate plumbing cross connections (e.g. floor drains unexpectedly leading to drainage wells).

- Utilize recirculating solvent baths.

- Install holding tanks to replace discharges to Class V wells where necessary.

A good source of information on pollution prevention and waste minimization practices specific to injection wells is a series of twelve BMPs for protection of ground water prepared by EPA (1992). Many of the BMPs are relevant to processes or activities found at DOE sites. The EPA BMPs are included as Appendix B. Another source of extensive information on pollution prevention plans and BMPs for industrial activities is EPA's recent document on storm water management (EPA, 1992a). Copies of this document were distributed by EH-23 in November 1992.

Waste Treatment Practices

Although pollution prevention is usually the preferred choice, there are situations in which certain pollutants of concern cannot be eliminated from the waste stream through pollution prevention. In these situations, the DOE well operator can either stop discharging to the injection well or provide treatment prior to discharge. EPA has published extensive information on technologies for treatment of industrial and domestic wastewater as part of the National

Pollutant Discharge Elimination System (NPDES) program. Technologies range from gravity settling of solids and separation of oil and water to complex biological or physical/chemical processes for removing toxic organic chemicals. Selection of the appropriate technologies should be based on the untreated waste stream characteristics and the desired water quality of the injectate before entering the well, along with other considerations such as climate, energy requirements, and cost.

Class V wells are used as part of the sewage treatment and disposal process at some DOE facilities without access to centralized sewage treatment. DOE well operators should ensure that sewage is treated to meet state or local standards before discharging it into the Class V well. Any non-domestic wastewater that is discharged into such Class V wells should be pretreated to acceptable standards or should be removed from the sewage disposal system.

Spill Response Practices

Spills are experienced occasionally at all facilities. A DOE facility can minimize the frequency and severity of spills by implementing a site-wide training program on spill prevention and response. Such a training program would cover all types of spills and would not be limited to those potentially entering injection wells.

Spills should be cleaned up using dry absorbents, whenever possible. Emergency spill kits should be kept in storage areas, loading areas, and other locations with a potential for releases. Often simple measures, using commonly available materials, can be employed on an emergency basis to prevent a spill from entering a surface water body or an injection well. A rag can be shoved in a hole in a pipe to stop or slow down a leak. A barrier of sticks and dirt can keep a waste material from leaving the spill site. These temporary solutions should be followed by more thorough clean up procedures as soon as possible.

Monitoring and Recordkeeping Practices

It is important to have an accurate record of the type and amount of wastes that have been discharged to an injection well. The DOE well operator should sample the injectate on a regular basis for parameters that are appropriate to the type of wastes either known to be or likely to be discharged to the well. In some cases, monitoring wells should be installed to ensure that the injectate does not migrate outside of the injection zone. Generally, the requirement to install monitoring wells will be dictated by the regulatory agency.

The well operator should maintain complete and current files containing site and facility plans, well records, waste disposal manifests and contracts, permits, and other relevant information. The files should be segregated and clearly labeled so that they may be quickly and easily referenced.

Recommended Closure Practices

There are no Federal regulations specifying detailed closure practices for Class IV and V wells, but Federal regulations do contain broad authority allowing EPA, when it administers the UIC program in a state, to require a well owner or operator to submit information to determine whether a well may be endangering a USDW (40 CFR 144.27 (a)). If there is any indication that the injection well may cause a violation of primary drinking water regulations or adversely affect human health, EPA or a delegated state may take whatever actions are necessary to prevent the violation or adverse health effect, including well closure (40 CFR 144.12 (c) and (d)).

Under 40 CFR 144.23 (b), in states in which EPA administers the UIC program, Class IV well operators are required to plug or close each Class IV well and notify EPA before abandoning the well. Upon completion of well closure, the operator must submit certification by an independent registered professional engineer that the facility has been closed (40 CFR 144.13 (b) and 144.14 (c)(9)).

Any injection well that has ceased operation for two years must be plugged and abandoned unless the operator can demonstrate that the temporarily abandoned well will not endanger any USDW (40 CFR 144.52 (a)(6)). Inactive abandoned wells at DOE facilities should be sealed or plugged.

States may have additional closure requirements. Specific state requirements are referenced in Appendix A of this report. **It is strongly recommended that all DOE injection well operators who face closure of Class IV or V wells establish clear communication with the appropriate regulatory agency to make certain that the agency's requirements are understood.** Many past waste disposal practices are no longer appropriate or legal. Regulators generally appreciate cooperation from the regulated community. It is important to note that continuation of known illegal waste disposal practices may lead to criminal charges.

The closure process consists of several steps:

- identification of wells needing closure;
- monitoring and disposal of accumulated substances;
- filling and sealing of well; and
- remediation, if necessary.

Identification of Wells Needing Closure

Earlier in this chapter, DOE well operators were advised to conduct a site-wide inventory of all active and inactive shallow injection wells. It should be relatively simple to identify all active injection wells, but will probably be more difficult to identify the location and contents of inactive wells that ceased activity many years ago. For inactive wells, the DOE well operators should consult old reports, blueprints and drawings, and speak with current or former employees who have knowledge of past disposal practices.

Upon completion of a shallow well inventory, the DOE well operator should determine which wells must be closed. All Class IV wells (in essence, Class V wells that receive hazardous materials) must be closed, except for those eligible wells involved with a CERCLA cleanup (see Chapter 1). As an attempt to identify which subclasses of Class V wells are most likely to receive hazardous wastes, EPA sponsored a study that examined the types of wastes that the wells received and the potential for those wastes to be hazardous (ICF and EEI, 1989). This report concluded that most Class V subclasses probably are not injecting hazardous wastes because the wastes:

- are exempted from regulation as hazardous wastes;
- are not listed wastes;
- are generally relatively clean and are therefore not likely to be characteristic hazardous wastes; and
- are generated and handled so that they are not likely to be mixed with or derived from a hazardous waste.

Five subclasses of wells may be receiving hazardous wastes:

- agricultural drainage wells;
- industrial drainage wells;
- abandoned drinking water wells;
- radioactive waste disposal wells (not because of the radioactive component itself, but because the radioactive component may be mixed with hazardous wastes); and
- experimental technology wells.

Two other subclasses of Class V wells are very likely to be receiving hazardous wastes:

- industrial process water and waste disposal wells; and

- automobile service station wells.

Of the listed subclasses, DOE facilities are likely to have all types except the agricultural drainage wells. If a DOE well operator identifies any wells in these subclasses, he or she should carefully evaluate them for closure.

There is another much larger group of wells that usually receive only non-hazardous materials, but have received hazardous materials accidentally or intentionally, one time or occasionally. For example, a maintenance person may dump some cleaning products in a toilet that goes to a septic system and drain field, or antifreeze may enter a stormwater drainage well at the edge of a parking lot. There is no consensus among regulators on how to treat these wells. Some regulators consider such wells to be Class IV wells from the moment they receive one drop of hazardous materials, while other regulators pragmatically handle these wells as Class V wells that are temporarily out of compliance. EPA has not developed policy guidance on this subject. Until guidance is available, it is recommended that DOE well operators work with their regulatory agencies to determine a case-by-case course of action.

Some other Class V wells should also be closed. Class V wells that may result in a violation of primary drinking water regulations or may adversely affect public health can be required to be closed, at the discretion of the regulatory agency (40 CFR 144.12 (c) and (d)). If a DOE well operator suspects that an injection well violates regulations or causes a health threat, he or she should institute changes to operating practices or close that well, regardless of whether the regulatory agency requires it.

As mentioned above, 40 CFR 144.27 (a) allows EPA to require a well owner or operator to submit information to determine whether a well may be endangering a USDW. EPA Region V has prepared a draft set of guidelines for conducting site assessments at Class IV and V wells that cites this regulation as the basis for requiring site assessments (EPA, 1992b). This document, which is included as Appendix C, recommends that site assessments be conducted at all Class IV wells and at any Class V wells suspected of causing a violation of drinking water regulations or an adverse health effect. The draft guidelines outline three levels of site assessments with increasingly detailed evaluations. Initially, an operator conducts a Level 1 site assessment, and depending on what is discovered, he or she may conduct Level 2 or 3 site assessments.

Monitoring and Disposal of Accumulated Substances

Once a well is designated for closure, any additional discharge of wastes into that well should be prohibited. If the waste stream continues to be generated, it must be routed to another disposal alternative, such as a sanitary sewer or a holding tank for offsite disposal.

DOE well operators should take samples for laboratory analysis of the liquid and sludge that accumulates in the plumbing leading to the injection well, including sumps, drains, and catch basins, and from the surrounding soils. Analytical parameters should be chosen using

knowledge of former injectate characteristics. Bacterial action may lead to the presence of degradation products; this should be considered when laboratory analytical parameters are chosen. Appendix D contains information on selecting sampling locations and chemical parameters for analysis.

EPA Region IX prepared guidelines on closing shallow injection wells (EPA, 1992c). This document, included as Appendix D, covers the entire closure process, but emphasizes sampling aspects. It serves as a good reference for selection of sampling equipment, sample location, quality assurance/quality control, sample collection, and analytical methods.

Any waste material in the attached plumbing and any contaminated soil should be removed and disposed of in accordance with state and Federal requirements. Due to the nature of DOE's operations, some of the waste materials may be contaminated with radionuclides. Such material should be handled in accordance with DOE requirements for managing residual radioactive materials, including those contained in Order 5400.5 and Order 5820.2A, and in associated monitoring and survey guidance.

Filling and Sealing of Well

Following sampling of an injection well and removal of any contaminated solids, sludges, and soils, DOE well operators should disconnect and clean any drain lines leading to the well. The drain lines should be removed or filled with concrete, cement, or grout. If the injection well is a drywell, sump, or drain field, it should be backfilled with clean fill dirt, sand, or gravel. If the well is a more traditional small-diameter, cased well, the well should be backfilled to near the surface and capped with a plug of concrete, cement, or grout. In either case, the DOE well operator should determine if there are any state or local requirements for filling wells.

When a DOE well operator has completed removal of contaminated materials and filled and sealed the well, he or she should submit to the regulatory agency a certification by an independent registered professional engineer that closure has been completed (40 CFR 144.13 (b) and 144.14 (c)(9)). In addition to the certification, it is recommended that the DOE well operator submit a report containing at least the following information:

- reason for closure of the well and the steps followed during closure;
- site plan showing location of well and sample locations;
- analytical results of fluid, sludge, and soil samples; and
- site assessment of the extent of contamination.

Remediation

The regulatory agency with UIC primacy in a state will determine whether further environmental

remediation is required. The decision to require remediation is generally based on the analytical results and the site assessment submitted in the closure report, which indicate the extent of contamination. At some DOE sites, remediation of shallow injection wells may occur as part of site-wide restoration programs, whether it is required by the regulatory agency or not.

There are numerous remediation methods available. The choice of appropriate remediation method depends upon specific site characteristics such as subsurface conditions and the nature of contamination. DOE well operators should evaluate remediation methods and make a recommendation to the regulatory agency. The regulatory agency will review DOE's recommendations and either approve DOE's recommended methods or require alternatives. The DOE complex has extensive expertise in environmental remediation; therefore the subject will not be discussed further in this document.

Closure Plan Guidance for Service Station Wells

In September 1991, EPA undertook its first major national enforcement effort against Class V well operators. EPA issued Administrative Consent Orders to ten major oil companies (EPA, 1991) requiring them to close automobile service station disposal wells (subclass 5X28 as shown in Table 1) at their stations by the end of 1993. DOE well operators should determine if there are any 5X28 wells as part of their vehicle maintenance facilities, and if so, initiate closure. An information copy of the 5X28 well identification protocol and closure plan requirements from the EPA orders is included as Appendix E.

Following issuance of the EPA Administrative Consent Orders, the American Petroleum Institute (API) released a report on recommended practices for handling water discharges from automotive service facilities located at petroleum marketing operations (API, 1992). The API document provided background information on closing floor drains, drywells, cesspools, and septic systems that are subject to potential contamination, and on alternative methods for cleaning service bay floors. The API closure plan information appears to be compatible with the EPA Orders.

Conclusions

This report provides background information on the UIC program, reviews state and Federal UIC regulatory requirements, and presents a variety of operating and closure practices for shallow injection wells. With the exception of the few Federal regulatory requirements discussed in this chapter, all other practices are recommended, not mandatory. The DOE well operator must use his or her judgement to select the most applicable and relevant requirements from the suite of practices described here and elsewhere. These should become part of a site-wide plan that guides injection well operations and closure. Any injection well plan should seek to prevent future ground-water contamination and, where technically and economically practicable, restore contaminated ground water to a level commensurate with its current or potential future uses. The plan should not be developed and implemented in a vacuum; concurrence from the regulatory agency is prudent and will avoid future misunderstandings.

REFERENCES

API, 1992, *Handling Water Discharges from Automotive Service Facilities Located at Petroleum Marketing Operations*, American Petroleum Institute Recommended Practice 1633, Washington, DC, January.

EPA, 1989, *Injection Wells - An Introduction to Their Use, Operation and Regulation*, U. S. Environmental Protection Agency, Washington, DC, April.

EPA, 1991, *Administrative Consent Orders under the Authority of the Safe Drinking Water Act* [against ten major oil companies], UIC NAO 91-01 - 91-10, U.S. Environmental Protection Agency, Washington, DC, September.

EPA, 1992, *Best Management Practices for Protecting Ground Water*, U.S. Environmental Protection Agency document EPA 570/9-91-036 (contains sections 036A - 036L), Washington, DC, January.

EPA, 1992a, *Storm Water Management for Industrial Activities - Developing Pollution Prevention Plans and Best Management Practices*, U.S. Environmental Protection Agency document EPA 832-R-92-006, September.

EPA, 1992b, *EPA - Region 9 Guidelines for Closure of Shallow Disposal Wells*, U.S. Environmental Protection Agency, Region IX, San Francisco, CA.

EPA, 1992c, (draft) *Region 5 Guidelines on Conducting Site Assessments at Class IV and V Injection Well Facilities*, U.S. Environmental Protection Agency, Region V, Chicago, IL, April.

ICF and EEI, 1989, *Class V Well Comparison with RCRA Regulations*, prepared for U.S. Environmental Protection Agency, UIC Branch by ICF Incorporated and Engineering Enterprises Incorporated, September.

UIPC, 1990, *An Introduction to the Underground Injection Control Program*, Underground Injection Practices Council, Oklahoma City, OK.

APPENDIX A

SUMMARY OF KEY DIFFERENCES IN STATE UIC REGULATIONS FOR STATES WITH DOE FACILITIES DISCHARGING TO INJECTION WELLS

Appendix A

Summary of Key Differences among UIC Programs for States with DOE Facilities Operating Injection Wells

June 1993

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Introduction

In addition to the Federal requirements for the Underground Injection Control (UIC) program, many states have adopted state regulations or policies for UIC Class V activities. This appendix provides an overview of the way in which state Class V regulations differ from the Federal Class V regulations for the 21 states in which there are DOE facilities that operate, have operated, or are likely to operate injection wells. The appendix also provides the name, address, and phone number of the state regulatory agencies that have Class V well authority. If the state has any special procedures for operating or closing wells, the procedures are reviewed as well.

The information was compiled through inquiries with state and United States Environmental Protection Agency (EPA) regulators. This information is as complete and up to date as possible, but DOE injection well operators should independently contact the state or EPA regulatory agency to ensure that all requirements are known.

The states are discussed in alphabetical order.

ARKANSAS

Responsible Agency for Class V UIC Program

Arkansas Department of Pollution Control and Ecology (ADPCE)
P.O. Box 8913
Little Rock, AR 72219-8913
Contact Person: Gerald L. Delavan
(501) 562-7444

Summary of differences between State Class V UIC regulations and Federal guidelines

The State of Arkansas has not yet developed its own Class V regulations. Federal regulations for Class V wells are forthcoming. Once those regulations are promulgated, if the state determines that additional Class V regulations are warranted, the state will draft additional guidelines.

Closure guidelines for Class IV and V wells

To date, no Class IV wells have been identified in the State of Arkansas by regulatory officials, thus no closures of Class IV wells have been performed. Based on shallow well inventories, ADPCE has identified only a few Class V wells in operation, mostly septic systems. Each Class V well identified is physically inspected for its potential effect on shallow ground-water supplies. If the effect appears minimal, the operator is allowed to continue operation of the present system; if there is a potential for impact or the substances being injected are inappropriate, the system is closed according to guidelines selected for that system. To date, no formal Class V shallow injection well closure requirements have been developed by the State of Arkansas. In each specific instance in which a Class V well needed to be closed, the closure was handled on a case-by-case basis.

Presumably, once Federal Class V well guidelines are in place, the State of Arkansas will adopt those regulations by reference. Until that time, no specific closure guidelines will be enforced.

CALIFORNIA

Responsible Agencies for Class V Program

1) EPA, Region IX
75 Hawthorn Street
San Francisco, CA 94105
Contact Person: Clarence E. Tenley
(415) 744-1835

Explanation: The State of California has not obtained primacy for the Class V UIC program; therefore, the Class V UIC program is administered through the EPA, Region IX office.

2) Nine California Regional Water Quality Control Boards

Explanation: The operation and closure of all Class V wells, with respect to their potential to pollute ground water, must conform to Regional Water Quality Control Plans which are adopted and implemented by the state's nine California Regional Water Quality Control Boards. Each Regional Water Board covers a unique hydrologic drainage basin in California. The following is an intermediate contact person for all of the Regional Water Boards:

3) Division of Water Quality
State Water Resources Control Board
P.O. Box 944213
Sacramento, CA 94244-2130
Contact Person: Ken Harris
(916) 657-0876

4) State Department of Conservation
Division of Oil and Gas, and Geothermal Resources (DOGGR)
1416 Ninth Street, Room 1310
Sacramento, CA 95814
Contact Person: Michael Stettner
(916) 445-9686

Explanation: The operation and closure of Class II wells and geothermal wells, a subclass of Class V wells, is regulated by the DOGGR. The EPA has assigned responsibility for administering the geothermal injection program to the DOGGR through a Memorandum of Agreement.

Summary of differences between State Class V UIC regulations and Federal Class V guidelines

Although the Class V program is administered by EPA, there are some state regulations that apply.

Section 13260.3 of the California Water Code - Any person operating or planning to construct an injection well, or any activity which could affect the quality of the waters of the state, is required to file a waste discharge report with the Regional Water Board. However, two other agencies have equivalent permitting authority. The DOGGR will issue the appropriate permit for geothermal injection wells. EPA issues the appropriate permit for any Class V well covered by its program. To ensure compliance, both agencies should involve the Regional Water Boards in their permitting process.

The Regional Water Boards prescribe waste discharge requirements to protect the following beneficial uses of ground water: 1) Municipal; 2) Agricultural; 3) Industrial Process Supply; 4) Industrial Service

Supply; 5) Wildlife Habitat; and 6) Water Contact Recreation. For potential and existing underground sources of drinking water, water quality standards are typically set at or below state drinking water standards. These are typically at least as strict as the maximum contaminant levels (MCLs).

It is also state policy to prevent any unreasonable degradation of ground water. This policy is not Federally mandated (Resolution Number 68-16 of the Water Resources Control Board).

Closure guidelines for Class IV and V wells

As a minimum, all abandoned or permanently inactive wells in California must be destroyed in accordance with Section 13700 et seq. of the California Water Code. Other inactive wells must be maintained for future use as specified in Section 24400 of the California Health and Safety Code. With the exception of geothermal wells covered by (c) below, wells are broadly defined in Section 13710, 13711, and 13712 of the California Water Code to include most artificial excavations. Minimum standards for the destruction of wells are specified in the California Department of Water Resources (DWR) Bulletins 74-81 and 74-90 (available by calling (916) 653-1097). Several special requirements are noteworthy:

a. Local agencies may mandate requirements exceeding the DWR standards on how wells must be destroyed.

b. Individual Regional Water Boards may impose special requirements on some types of underground injection wells to protect water quality.

c. Requirements for abandoning Class V geothermal wells are specified in Section 3746 et. seq. of the California Public Resources Code and administered by DOGGR.

d. Decommissioning of wells involving the injection of hazardous substances, especially Class I and IV wells, and wells at sites where hazardous substances may be a public health concern, especially state Superfund sites, is under the jurisdiction of the California Department of Toxic Substances Control (DTSC). Specific guidelines are currently being developed by the DTSC for decommissioning these and other wells.

Class V geothermal wells must conform to Section 3746 et. seq. of the California Public Resources Code of Regulations.

COLORADO

Responsible Agencies for Class V UIC Program

1) EPA Region VIII
One Denver Place, Suite 500
999 18th Street
Denver, CO 80202-2413
Contact Person: Thomas Pike
(303) 293-1544

Explanation: The State of Colorado has not obtained primacy of the Class V UIC program; therefore, the Class V UIC program is administered through the EPA Region VIII office.

2) Colorado Department of Health
WQCD-GWPS-B2
4300 Cherry Creek Dr. South
Denver, CO 80222-1530
Contact Person: George Moravec
(303) 692-3584

Explanation: This department handles wastewater treatment, stormwater runoff, surface impoundment discharge to ground water, and experimental technologies.

3) Colorado Department of Natural Resources
Oil and Gas Conservation Commission
1580 Logan Street, Suite 380
Denver, CO 80203
Contact Person: Dennis Bicknell
(303) 894-2100

Explanation: This agency handles Class II UIC issues.

Summary of differences between State Class V UIC regulations and Federal Class V guidelines

There are no differences between state and Federal guidelines for Class V wells in the State of Colorado.

Closure guidelines for Class IV and V wells

Colorado is in the process of promulgating rules and regulations that address specific activities to protect ground water. Some state agencies with statutory authority over an activity may require a permit to construct a well and/or a UIC well permit/certificate from EPA before a certificate of operation for a well/activity will be issued. These agencies may have specific requirements for plugging and abandonment of wells to protect ground-water quality or water rights. Requirements vary among state agencies according to the activity. Rules and regulations for some activities are currently in effect and others will become effective in 1993 or when funding becomes available for implementation.

IDAHO

Responsible Agency for Class V UIC Program

Idaho Department of Water Resources (IDWR)
1301 North Orchard
Boise, ID 83706-2237
Contact Person: Mark Slifka
(208) 327-7900

Summary of differences between State Class V UIC regulations and Federal Class V UIC guidelines

(References below are to the Idaho Department of Water Resources regulations entitled "Rules for Construction and Use of Injection Wells" - newly adopted in April 1993.)

2.4 - Definition of deep well. Any injection well deeper than 18 feet is considered a deep well, including Class V wells. Shallow wells are those less than 18 feet deep.

3.2 - Authorizations, prohibitions, and exemptions.

1) and 2) Classes I - IV injection wells are not authorized.

3) Deep Class V wells may be authorized by permit.

5) Shallow Class V wells are authorized by rule without a permit if the required inventory information is submitted, and use of the well does not result in contamination of a USDW.

4.1 - Inventory information. All owners or operators of shallow Class V wells must submit information to the Director. The type of information required is listed in this regulation.

4.2 - Permit requirements. The Director may authorize operation of a Class V well through a permit that specifies the terms and conditions of acceptable operation. If operation of a shallow Class V well is causing contamination of a USDW, injection must cease immediately.

5.2 - Application information required. This regulation outlines the information that must be submitted with the permit application for deep Class V wells.

7.2 - Permit conditions and requirements. All permits must contain conditions to insure that USDWs will be protected from waste and contamination.

1) Deep injection wells must be constructed by a licensed well driller. Injection wells must be constructed to prevent entry into the well of fluids other than those specified in the permit.

2) Owners or operators must develop approved procedures to detect construction or operational failure and must have a contingency plan to deal with well failure. State inspectors have the right of entry and inspection at injection well sites. Injection facilities must be operated and maintained to achieve compliance with all terms and conditions of the permit. Injection of any contaminant into a USDW that may cause a health hazard is prohibited.

3) This subsection contains requirements for abandoning injection wells.

7.3 - Duration of approved permits. Permits for Class V(e) wells requiring permits and for Class V(c)

wells may be in effect for no more than 10 years.

8.2 - Standards for the quality of fluid discharged. This regulation contains numerical limits which must be met before the fluids can be injected into the well. Chemical and radiochemical constituents must not exceed MCLs. Additional restrictions are placed on biological, physical, visual, and olfactory characteristics. The injected fluids may not cause a violation of NPDWRs or affect human health.

8.3 - Criteria for location and use. Injection wells must be separated from water supply wells. This regulation gives guidelines on the necessary separation distance. This requirement may be waived if the quality of injected fluids is high enough.

9.1 - Monitoring.

1) The Director of IDWR may require monitoring of injection pressure, flow rate and volume, analysis of the quality of injected fluids, ground-water monitoring, and a demonstration of mechanical integrity.

2) Monitoring frequency must be specified in the permit.

3) All monitoring must be done by a certified laboratory and must follow approved methods.

4) All field instruments must be tested and maintained to ensure accuracy.

9.2 - Record keeping. Records of all monitoring activities must be maintained for 5 years.

9.3 - Reporting.

1) Monitoring results must be reported to the Director.

2) The Director must be notified within 5 days after the discovery of violation of the terms and conditions of the permit. If the injection activity endangers human health or the environment, the activity must be stopped and reported immediately.

13 - Exemption from drinking water sources designation. The Director may exempt an aquifer or portion thereof if it is not currently a USDW and will not in the future be utilized as a USDW.

Closure guidelines for Class IV and V wells

(References below are to a section of the same IDWR regulation as stated above)

7.2 (3) - Conditions of permanent and temporary abandonment.

a) Notice of abandonment must be provided to the Director not less than ten working days prior to commencement of abandonment.

b) The method of abandonment must be approved by the Director.

c) Notice of completion of abandonment must be submitted to the Director within 30 days of completion.

d) Deep Class V wells must be plugged in such a manner as to prevent movement of fluids into or between drinking water sources.

ILLINOIS

Responsible Agencies for Class V UIC Program

1) Illinois EPA
Bureau of Land Pollution Control
2200 Churchill Road
Springfield, IL 62706
Contact Person: Ron Steward
(217) 524-3279

Explanation: This agency is responsible for handling most Class V issues.

2) Illinois Department of Public Health
525 West Jefferson
3rd Floor
Springfield, IL 62761
Contact Person: Jerry Dalsin
(217) 782-5830

Explanation: This agency is responsible for the regulations pertaining to proper closure of wells.

3) EPA Region V
230 S. Dearborn Street
Chicago, IL 60604
Contact Person: John Taylor
(312) 886-1501

Explanation: The State of Illinois is in the process of relinquishing primacy of the Class V UIC program. When that occurs, the Class V program will be administered by EPA Region V.

Summary of differences between State Class V UIC regulations and Federal Class V guidelines

The State of Illinois has no Class V regulations. However, when a Class V well is identified by state officials, the Illinois EPA investigates to determine if the well is a threat to USDWs. If the well is determined to be a Class IV well, the Illinois EPA requires the owner and operator to cease utilization of the injection well and requires closure to conform to appropriate regulations.

Closure guidelines for Class IV and V wells

State closure requirements for Class V wells are found in Title 77 of the Illinois Administrative Code, Section 920, Illinois Well Construction Code. Implementation is carried out by the Illinois Department of Health.

The State of Illinois requires that closure of Class IV wells be conducted under RCRA rules.

KENTUCKY

Responsible Agencies for Class V UIC Program

1) EPA Region IV
Water Supply Branch
345 Courtland Street, NE
Atlanta, GA 30365
Contact Person: Nancy Marsh
(404) 347-3866

Explanation: The State of Kentucky has not obtained primacy of the Class V UIC program; therefore, that program is administered through EPA Region IV.

2) Kentucky Division of Water/Ground Water Branch
14 Reilly Road
Frankfort, KY 40601
Contact Person: Kay Harker
(502) 564-3410

Explanation: This department is the state agency that handles general Class V issues.

3) Kentucky Cabinet for Human Resources
Department of Health Services
275 East Main
Frankfort, KY 40602
Contact Person: Ken Wade
(502) 564-4935

Explanation: This department handles on-site sewage disposal issues.

4) Kentucky Division of Water/NPDES Program
14 Reilly Road
Frankfort, KY 40601
Contact Person: Clyde Baldwin
(502) 564-3410
Explanation: This department handles stormwater runoff to sinkholes.

Summary of differences between State Class V regulations and Federal Class V guidelines

Although the EPA administers the Class V UIC program, some sections of the state law apply.

Kentucky Revised Statutes (KRS) Chapter 224.70-110 - General prohibition against water pollution. This section states that no person may, directly or indirectly, throw, drain, run or otherwise discharge into any of the waters of the commonwealth in contravention of any of the rules, regulations, permits, or orders of the Natural Resources and Environmental Protection Cabinet.

KRS 224.70-120 - Permit to discharge pollutants into waters. This section describes the permit fees for the eight categories of entities which discharge pollutants. Fees range from $3,200 for major industry to $1,000 for non-process industry.

In the State of Kentucky, stormwater runoff to sinkholes is currently regulated as an NPDES permit.

MISSOURI

Responsible Agencies for Class V UIC Program

1) Missouri Department of Natural Resources (MDNR)
Division of Geology and Land Survey
P.O. Box 250
Rolla, MO 65401
Contact Person: Bruce Netzler
(314) 368-2171

Explanation: With a few exceptions, this department has overall responsibility for Class V UIC.

2) Missouri Department of Health
1730 East Elm Street
Jefferson City, MO 65102
Contact Person: Roger Gibson
(314) 751-6216

Explanation: This department has responsibility for Class V septic tanks: a) if septic tanks are part of a unit in the Missouri motel licensing program or, b) if septic tanks are malfunctioning and a complaint is received by the Health Department.

3) Missouri Department of Natural Resources
Division of Geology and Land Survey, UIC/Oil and Gas Unit
P.O. Box 250
Rolla, MO 65401
Contact Person: Evan Kifer
(314) 368-2167

Explanation: The Oil and Gas Unit of the MDNR has responsibility over Class II wells.

Summary of differences between State Class V UIC regulations and Federal Class V UIC guidelines

Missouri has adopted all Federal UIC regulations after they have been enacted.

A recent amendment to the Missouri Water Well Drillers Act has surpassed Federal requirements in addressing heat pumps (5A7) and abandoned drinking water wells (5X29).

(References below are to sections of Title 10 - Department of Natural Resources "10 CSR 20-6 Permits")

.070 - Installers of heat pump systems have to be licensed and all systems are registered with the State of Missouri.

.080 - Heat pump regulations are currently being developed to address construction standards and coolants used in heat pump systems.

(References below are to sections of the Revised Statutes of Missouri 1991 - Water Well Drillers, Regulations)

256.615 - Any drinking water wells abandoned after August 28, 1991 are required to be plugged by the landowner according to the regulations developed pursuant to section 256.600 to 256.640. Additionally, old wells that are determined to present a threat to ground water must be plugged.

256.628 - A public water supplier who adds customers to its service must notify those previously serviced by a well of their responsibility to plug wells if they are no longer using them.

Closure guidelines for Class IV and V wells

Closure requirements for Class IV and Class V wells are generally determined on a case-by-case basis. Missouri water well regulations address closure requirements for abandoned water wells. These regulations will also be applied to heat pump return wells and other types of drilled injection wells.

MONTANA

Responsible Agencies for Class V UIC Program

1) EPA Region VIII
One Denver Place, Suite 500
999 18th Street
Denver, CO 80202-2413
Contact Person: Thomas Pike
(303) 293-1544

Explanation: The State of Montana has not obtained primacy of the Class V UIC program; therefore, that program is administered through the EPA Region VIII office.

2) Montana Department of Health and Environmental Sciences (MDHES)
Water Quality Division, Subdivision Section
P.O. Box 200901
Helena, MT 59620-0901
Contact Person: Pat Risa
(406) 444-4633

Explanation: This department is responsible for the state's septic systems.

3) Montana Water Quality Board
Water Quality Bureau
P.O. Box 200901
Helena, MT 59620-0901
Contact Person: Tim Byron
(406) 444-2406

Explanation: This department handles the state's water quality issues.

Summary of differences between State Class V regulations and Federal Class V guidelines

There are no specific state Class V UIC regulations or permitting system, but the following regulations are relevant.

Administrative Rules of Montana (ARM) 16.20.1011 - Nondegradation. Any ground water whose existing quality is higher than the established ground-water quality standards for its classification must be maintained at that high quality, unless it has been affirmatively demonstrated to the board that a change is justifiable as a result of necessary economic or social development and will not preclude present or anticipated use of such waters.

ARM 16.20.1012 - Exclusions from permit requirements. The State of Montana has a permit system for discharges to ground water; however, discharges regulated under the Federal UIC program are exempted from these permit requirements.

Closure guidelines for Class IV and V wells

It is Region VIII's policy to close all 5X28 and some high risk 5W20 shallow injection wells unless the facility owners apply for a UIC permit. Listed below are the owners' alternatives:

1) Plug the drain and operate as a 100% dry shop.

2) Recycle the injectate and close the drain to the septic system.

3) Connect to the municipal sewer and discontinue use of the septic system.

4) Send the waste to a holding tank. (A popular method in Region VIII is to disconnect the drainfields from the septic tank, plug the outlet of the septic tank, and use the septic tank as a holding tank.)

5) Submit an analysis of the injectate with a UIC permit application if the operator feels the injectate will meet EPA drinking water standards. If the injectate meets drinking water standards, the facility is granted a permit. As part of the permit agreement, the facility's injectate must be sampled quarterly.

After inventory information from the facility owner has been received, EPA requires that one of the above mentioned alternatives be in place within five months of receipt of the closure letter.

NEVADA

Responsible Agencies for Class V UIC Program

1) Nevada Department of Conservation and Natural Resources
Division of Environmental Protection (NDEP)
333 West Nye Lane
Capital Complex
Carson City, NV 89710
Contact Person: Marcia Greybeck
(702) 687-5870

Explanation: The NDEP has overall responsibility for UIC, including Class V.

2) NDEP
1515 East Tropicana, Suite 395
Las Vegas, NV 89119
Contact Person: Dean Mireau
(702) 486-7010

Explanation: This office covers the Nevada Test Site and Tonopah Test Range only.

Summary of differences between State Class V UIC regulations and Federal Class V guidelines

Nevada Revised Statutes

NRS 445.221 - Injection of fluids into wells or discharge of pollutants without a permit is prohibited. Except as authorized by a permit issued by NDEP pursuant to the appropriate provisions of NRS 445.131 to 445.354, inclusive, and regulations adopted by the state environmental commission, it is unlawful for any person to:

a) discharge from any point source any pollutant into any waters of the state or any treatment works;

b) inject fluids through a well into any waters of the state;

c) discharge from a point source a pollutant or inject fluids through a well that could be carried into the waters of the state by any means; or

d) allow a pollutant discharge from a point source or fluids injected through a well to remain in a place where the pollutant or fluids could be carried into the waters of the state by any means.

Nevada Administrative Code

445.4249 - An application for a permit to inject fluid must satisfy the director that the underground injection will not endanger any source of drinking water. Owners and/or operators of all existing and new injection wells must submit a permit application to the state.

Closure guidelines for Class IV and V wells

Any Class V well used to dispose of hazardous substances is prohibited and will be referred to the Nevada Division of Environmental Protection, Bureau of Chemical Hazards Management, Site Assessment/Corrective Action Branch. The site will be treated as a RCRA closure which would require, at a minimum, a preliminary site assessment including identification of substances disposed and testing of soils and affected waters. The well will not be returned to Class V status until cleanup is complete. This may necessitate obtaining another permit and relocation of the Class V well if required for operations (i.e. salt water disposal, vehicle washdown area, etc.).

NEW MEXICO

Responsible Agencies for Class V UIC Program

1) New Mexico Environmental Department (NMED)
Ground Water Protection and Remediation Bureau
Ground Water Section
1190 St. Francis Drive
Santa Fe, NM 87502
Contact Person: Richard Ohrbom
(505) 827-0219

Explanation: This department handles all Class V wells except those within the oil and gas production industry.

2) Energy, Minerals, and Natural Resources Department
Oil Conservation Division
Land Office Building
310 Old Santa Fe, NM 87501
Contact Person: William LaMay, Director
(505) 827-5800

Explanation: This division handles all Class V wells which are within the oil and gas production industry.

Summary of differences between State Class V UIC regulations and Federal Class V UIC guidelines

The State of New Mexico's regulations for Class V injection wells follow the guidelines set by the EPA. The state has one set of injection well regulations that are applied to all well classes. The NMED will not approve any Class V waste disposal wells unless effluent is within New Mexico WQCC regulatory standards.

Approved discharge plans serve as permits.

WQCC 82-5-101 - Discharge plan and other requirements.

a) No effluent disposal well or in situ extraction well may be approved which allows for movement of fluids into ground water having 10,000 mg/l or less of TDS except for fluid movement approved pursuant to Section 82-5-103 (designated aquifers), or pursuant to a temporary designation as provided in Section 82-5-101.C.2 (methods used for ground-water remediation).

b) Operation of an effluent disposal well or in situ extraction well must be pursuant to an approved discharge plan according to the schedules in this section.

WQCC 82-5-200-210 - These regulations provide the technical criteria and performance standards for effluent disposal wells and in situ extraction wells, including area of review, corrective action, mechanical integrity, construction requirements, operating requirements, monitoring requirements, reporting requirements, and plugging and abandonment.

Closure guidelines for Class IV and V wells

Closure requirements include the removal or neutralization of any material associated with the Class V wells such that no leachate will be produced after the site closes that may reach ground water or, in the case of 5X14 wells, the wells have to be plugged to ensure that no contaminants can migrate down to ground water after cessation of 5X14 operations.

Proper plugging and abandonment is required for any monitoring wells, recovery wells and 5X26 wells associated with ground-water remediation.

WQCC 82-5-209 - Plugging and abandonment.

a) The discharger must submit, as part of the discharge plan, a plan for plugging and abandonment of an effluent disposal well or an in situ extraction well. If requested, a revised or updated abandonment plan must be submitted for approval prior to closure.

b) Prior to abandonment of a well used in an effluent disposal or in situ extraction operation, the well must be plugged in a manner which will not allow the movement of fluids through the well bore out of the injection zone or between other zones of ground water. Cement plugs must be used unless a comparable method has been approved by the director for the plugging of in situ extraction wells at that site.

c) Prior to placement of the plugs, the well must be in a state of static equilibrium with the mud weight equalized top to bottom, either by circulating the mud in the well at least once or by a comparable method approved by the director.

d) Placement of the plugs must be accomplished by one of the following: the balance method; the dump bailer method; the two-plug method; or an equivalent method with the approval of the director.

e) The following must be considered by the NMED in determining the adequacy of a plugging and abandonment plan: the type and number of plugs to be used; the placement of each plug, including the elevation of the top and bottom; the type, grade and quantity of cementing slurry to be used; the method of placement of the plugs; the procedure to be used to plug and abandon the well; and such other factors that may affect the adequacy of the plan.

f) The discharger must retain all records concerning the nature and composition of injected fluids until five years after completion of any plugging and abandonment procedure.

NEW YORK

Responsible Agencies for Class V UIC Program

1) EPA Region II
26 Federal Plaza
New York, NY 10278
Contact Person: Susan Osofsky
(212) 264-1547

Explanation: The State of New York has not obtained primacy of the Class V UIC program; therefore, that program is administered through the EPA Region II office.

2) New York Department of Environmental Conservation (NYDEC)
Division of Water
Bureau of Wastewater Facilities Design
50 Wolf Road
Albany, NY 12233-3505
Contact Person: Paul J. Kolakowski, P.E.
(518) 457-1157

Explanation: Ground-water discharges from Industry/Municipal Operators are regulated by the Bureau of Wastewater Facilities Design

3) Bureau of Community Sanitation
NYS Health Department
Room 404
2 University Place
Albany, New York 12203-3313
Contact Person: Richard Svenson
(518) 458-6706

Explanation: Household septic and systems for individual homes are regulated by the Health Department

Summary of differences between State Class V UIC regulations and Federal Class V UIC guidelines

Although EPA administers the Class V program, some state regulations apply.

NYSC 6-X-703-6 - Ground-water effluent standards and limitation for discharges. a) This section of the state regulations identifies the existence of ground-water effluent limitations [Table 3 (e)] that apply to a discharge point source or outlet or any other discharge within the meaning of the Environmental Conservation Law that will or may enter unsaturated or saturated zones. The ground-water effluent standard is the maximum allowable concentration.
b) In addition to the chemical characteristics, coliform or pathogenic organisms must not be discharged in amounts sufficient to render fresh ground water detrimental to public health, safety or welfare.

The Federal UIC program is based on industrial activities associated with the production of wastewater. The State of New York takes into account the source of wastewater; therefore, water quality effluent standards are applied.

New York Water Pollution Control and Enforcement Laws, 17-0701 - Permit for disposal system

required. This section states that until a written SPDES permit has been granted by the commissioner, or by a designated representative, it is unlawful for any person to make or cause to make or use any outlet or point source for the discharge of sewage, industrial waste or other wastes or the effluent therefrom, into the waters of this state.

NORTH DAKOTA

Responsible Agency for Class V UIC Program

North Dakota State Department of Health and Consolidated Laboratories
Environmental Health Section, Division of Water Quality
1200 Missouri Avenue, PO Box 5520
Bismarck, ND 58502-5520
Contact Person: Gary Bracht
(701) 221-5213

Summary of differences between State Class V regulations and Federal guidelines

There are no differences between state and Federal guidelines for Class V wells in the State of North Dakota.

Closure guidelines for Class IV and V Wells

If a Class IV well is identified in the state, the well is plugged. Based on site specific conditions, such as depth to ground water, type of contaminant, receptors, geology, or lithology of the area, remediation of the soil and ground water may be required at the site. Prior to remedial activities, a site investigation will be required. This authority requiring remediation comes from 61-28 of the Century Code which is "Control, Prevention and Abatement of Pollution of Waters of the State of North Dakota."

OHIO

Responsible Agency for Class V UIC Program

Ohio EPA
Division of Drinking and Ground Waters
P.O. Box 1049
1800 Watermark Drive
Columbus, Ohio 43266-0149
Contact Person: Mary Lou Hodnett
(614) 644-2905

Summary of differences between State Class V UIC regulations and Federal guidelines

Ohio Class V rules are similar to existing Federal guidelines. The State of Ohio grants exemptions from formal permitting of Class V Aquifer Remediation wells designed to remediate contaminated sites providing there will be no additional threat to USDWs. The UIC Unit of the Ohio EPA reviews a workplan prior to exempting these wells from the permitting process. The workplan must include, at a minimum, the following information:

a) A description of the nature of the spill/release (material/substance spilled, estimated volume, material properties, etc.);

b) A hydrogeologic site description (including ground-water flow direction);

c) A detailed description of proposed remediation action, i.e.
- Injection well installation/construction
- Pump and treat
- In situ bioremediation
- Air stripping, carbon adsorption, etc.;

e) A complete analysis of fluids to be injected;

f) The volume and rate of fluid to be injected; and

g) The results of any ground-water monitoring.

If a permitting exemption is granted, monthly operating reports must be submitted which must include at a minimum:

a) An analysis of the injectate;

b) The rate and volume of the injected fluids;

c) A description of well maintenance and rehabilitation procedures; and

d) The results of ground-water monitoring at the site.

Ohio EPA grants exemptions with the understanding that injected fluids will not exceed Primary Drinking Water Standards, Maximum Contaminant Levels (MCLs) or Health Advisory Limits (HAs) and that injection activities will not cause further spread of contamination.

Ohio EPA has developed fact sheets, guidelines and guidance to assist Class V operators in meeting regulatory requirements and protection of ground water including:

a) Class V Injection Well Fact Sheet;

b) Ohio EPA, UIC Program, Class V Well Inventory Reporting Form;

c) 5X28 Best Management Practices (1/18/91);

d) Information Summary of BMPs for Class V Injection Wells; and

e) 5X26 Aquifer Remediation Projects.

Closure guidelines for Class IV and V wells

Closure of Class IV wells generally is referred to Ohio EPA's Division of Hazardous Waste Management, and the wells must be closed according to RCRA rules with input from the UIC program.

Ohio EPA requires that any Class V well owner or operator submit a plan for plugging and abandonment for approval prior to closure. This assures that wells will be closed in a manner protective of USDWs.

OREGON

Responsible Agency for Class V UIC Program

Oregon Department of Environmental Quality (ODEQ)
811 SW 6th Avenue
Portland, OR 97204
Contact Person: Rene C. Dulay
(503) 229-5374

Summary of differences between State Class V UIC regulations and Federal guidelines

OAR 340-44-015 1) and 2) - The State of Oregon has a general requirement for a Water Pollution Control Facilities permit to construct and operate any waste disposal well, except for the following types of waste disposal wells which, though regulated, do not require a permit:

a) cesspool and seepage pits of less than 5,000 gallons per day capacity;

b) stormwater drains from residential or commercial areas, which are not affected by toxic or industrial wastes; and

c) sewage drain holes serving less than 20 persons per day.

3) - Other waste disposal wells may be exempted from permit requirements on a case-by-case basis, including:

a) all cesspools and seepage pits constructed before January 1, 1982, and which dispose of only domestic waste;

b) all sewage drain holes which were constructed before January 1, 1980, and which dispose of only domestic waste;

c) geothermal reinjection wells which return uncontaminated water to the same or an equivalent quality aquifer; and

d) reinjection of air conditioning water or heat pump transfer water to the same aquifer or one of equivalent quality.

4) - The following types of wells are prohibited:

a) wells used to dispose of hazardous waste into, above, or below a USDW;

b) wells used to dispose of other industrial or municipal wastewater into or below a USDW; and

c) wells used for underground injection activities that allow movement of fluids into a USDW if the fluids will cause a violation of NPDWRs.

5) - The use of sewage drain holes is prohibited unless the disposal well is outside the boundaries of an incorporated city, sanitary district or county service district and municipal sewer service is not available to the property; or unless the ODEQ grants a waiver.

OAR 340-44-017 1) - Without first obtaining a Waste Disposal Well Repair Permit from the Director

or his representative, no person may repair or attempt to repair a plugged or otherwise failing sewage drain hole.

OAR 340-44-030 - Permits may not be issued for construction, maintenance or use of waste disposal wells where any other treatment or disposal method which affords better protection of public health or water resources is reasonably available or possible.

Inventory requirements. The State of Oregon Class V UIC regulations do not require submission of inventory information.

OAR 340-44-035 - Permits must contain conditions relating to their location, construction or use and a time limited for authorized use.

OAR 340-44-040 - Upon abandonment or discontinuance of use, waste disposal wells must be plugged and sealed.

OAR 340-44-050 1) - Waste disposal wells for storm drainage will only be used in those areas where there is an adequate confinement barrier or filtration medium between the well and a USDW, and where construction of surface-discharging storm sewers is not practical.

2) - New storm drainage disposal wells must be as shallow as possible but may not exceed a depth of 100 feet.

3) - Storm drainage wells may not be located closer than 500 feet to a domestic water well.

4) - Use of a waste disposal well for agriculture drainage is prohibited.

5) - Use of a waste disposal well for surface drainage in areas where toxic chemicals or petroleum products are stored or handled is prohibited, unless there is containment around the product area which will prevent spillage or leakage from entering the well.

6) - Any owner or operator of a waste disposal well for storm drainage must have available a means of temporarily plugging or blocking the well in the event of an accident or spill.

7) - Any parking lot which is drained by waste disposal wells must be kept clean of petroleum products and other organic or chemical wastes as much as practicable to minimize the degree of contamination of the storm water drainage.

Closure guidelines for Class IV and V wells

Closure requirements for Class IV wells should conform with RCRA rules which the Oregon Department of Environmental Quality is implementing.

OAR 340-44-040 - Abandonment and Plugging of Waste Disposal Wells.

1) A waste disposal well, upon abandonment or discontinuance of use, must immediately be rendered completely inoperable by plugging and sealing the hole to prevent the well from being a channel allowing the vertical movement of water and a possible source of contamination of the ground-water supply.

2) All portions of the well which are surrounded by "solid wall" formation must be plugged and filled with cement grout or concrete.

3) The top portion of the well must be effectively sealed with cement grout or concrete to a depth of at least 18 feet below the surface of the ground or, wherever this method of sealing is not practical, effective sealing must be accomplished in a manner approved in writing by the Director or his authorized representative.

SOUTH CAROLINA

Responsible Agency for Class V UIC Program

South Carolina Department of Health and Environmental Control (SCDHEC)
Ground Water Protection Division
Underground Injection Control Program
2600 Bull Street
Columbia, SC 29201
Contact Person: Robert Devlin
(803) 734-5324

Summary of differences between State Class V UIC Regulations and Federal Class V guidelines

UIC Regulations, 48-1-R61-87.11(E) - Class V wells are subdivided into Class V-A and Class V-B wells. The Class V-B well classification applies to all injection wells used to return to the supply aquifer the water which has passed through a non-contact system and includes, but is not limited to heat pump return flow wells and cooling water return flow wells. Class V-A well classification applies to all injection wells not included in Class I, II, III, IV, and V-B wells.

Class V-A Wells

48-1-R61-87.5 - Protection of underground sources of drinking water. The movement of fluids containing wastes or contaminants into underground sources of drinking water as a result of injection is prohibited if the presence of the waste or contaminant:

a) may cause a violation of any drinking water standard under R61-58.5; or

b) may otherwise adversely affect the health of persons.

48-1-R61-87.11(E.2) - No person may construct, use or operate a well of this class for injection:

a) except as authorized by a permit issued by the SCDHEC as provided by these regulations; or

b) in violation of R61-87.5.

48-1-R61-87.13 - Permit requirements. A permit must be obtained from the SCDHEC prior to constructing, operating or using any Class V-A well for injection.

Class V-A permits must contain the following:

a) A description of the activities conducted by the applicant which require a permit;

b) name, mailing address, and location of the facility for which the application is submitted;

c) the owner's and (if different than the owner) operator's name, address, telephone number, ownership status, and status of Federal, state, private, public, or other entity;

d) a brief description of the nature of the business; and

e) proposed operating data as follows:

- average and maximum daily rate and volume of fluid to be injected;
- average and maximum injection pressure; and
- source and an analysis of the chemical, physical, biological and radiological characteristics of the injected fluid.

Class V-B Wells

48-1-R61-87.11(F) - This class is authorized by rule and does not require a permit; however, no person may construct, use or operate a well of this class for injection in violation of R61-87.5.

Reporting requirements: All Class V-B well owners or operators must submit the following information to the SCDHEC no later than thirty days after beginning injection for new wells of this class:

a) facility name and location description including direction and distance from two nearby map reference points;

b) name and mailing address of facility owner;

c) name and mailing address of facility operator;

d) nature and type of injection facility and well(s) including drawings of the surface and subsurface construction details of the well(s); and

e) operating status of the injection facility and wells(s).

Closure guidelines for Class IV and V wells

Class V wells in operation prior to the effective date of the stated regulations must be permitted or abandoned by the owner in a manner specified by the SCDHEC. All Class IV wells must be abandoned by the owner in a manner specified by the SCDHEC. As part of abandonment, the Department may require the owner to:

a) Install monitoring wells in the injection zone and adjacent zones as necessary to detect the dispersion and migration of injection fluids within and from the injection zones.

b) Monitor the fluid levels and water quality in the injection and monitoring wells at specified intervals.

c) Submit the results of the monitoring at such frequencies and in such form as specified.

SOUTH DAKOTA

Responsible Agencies for Class V UIC Program

1) EPA Region VIII
One Denver Place, Suite 500
999 18th Street
Denver, CO 80202-2313
Contact Person: Thomas Pike
(303) 293-1544

Explanation: The State of South Dakota has not obtained primacy of the Class V UIC program; therefore, that program is administered by the EPA Region VIII.

2) Division of Environmental Quality
Department of Environment and Natural Resources
Joe Foss Building
523 East Capital Avenue
Pierre, SD 57501-3181
Contact Person: Jeanne Goodman
(605) 773-5047

Explanation: This department handles the state's water quality issues.

Summary of differences between Class V State regulations and Federal Class V guidelines

Although the EPA Region VIII administers the Class V UIC program, state regulations also apply.

74:03:15:02 - Classification of ground water.

> (a) The existing and future beneficial uses of ground water must be maintained and protected. Waters for which the ambient water quality is better than the minimum levels prescribed must be maintained and protected at the better water quality.
>
> (b) Ground water which has an ambient concentration of 10,000 mg/L or less total dissolved solids is classified as having the beneficial use of drinking water supplies, suitable for human consumption.
>
> (c) If the ambient concentration of any water contaminant in the ground water is in conformance with the standards in 74:03:15:03, degradation of the ground water to the limit of the standards may be permitted as specified in chapter 74:03:16 for necessary economic or social development upon approval of a water quality variance permit.
>
> (d) No water quality standards may be violated and no designated beneficial uses may be impaired by the granting of a water quality variance permit allowing degradation of ground-water quality. If the ground-water quality does not meet the standards in 74:03:15:03 as a result of natural causes or conditions, no degradation of the ground water beyond the ambient concentration may be allowed.

74:03:15:03 - Standards for ground water. Within this section are listed the standards which must be met unless otherwise provided by chapters 74:03:15 and 74:03:16.

74:03:16:02 - Applicant for ground-water discharge plans. The owner and operator of a new discharge facility, unless exempted, as well as existing facilities that discharge waste or pollutants that may move directly or indirectly into ground water must apply to the secretary for an approved ground-water discharge plan.

74:03:16:05 - Class V UIC wells permitted by the EPA do not need separate state-approved discharge plans but are required to comply with state regulations.

74:03:16:06 - Application requirements for ground-water discharge plan approval. This section lists the sixteen required elements to be included in the discharge plan.

TENNESSEE

Responsible Agencies for Class V UIC Program

1) EPA Region IV
Water Supply Branch
345 Courtland Street, NE
Atlanta, GA 30365
Contact Person: Nancy Marsh
(404) 257-3866

Explanation: The State of Tennessee has not obtained primacy of the Class V UIC program; therefore, that program is administered through the EPA Region IV office. Region IV has given the state some authority to handle Class V issues.

2) Tennessee Department of Environment and Conservation
Division of Water Supply
401 Church Street
Nashville, TN 37243
Contact Person: Robin Bell
(615) 532-0191

Explanation: Although Tennessee does not have primacy over Class V wells, Class V issues are first handled through this department. If the issue cannot be resolved through this department according to the state regulations, the case is then directed to Region IV.

Summary of differences between State Class V UIC regulations and Federal Class V guidelines

Although the EPA administers the Class V program, some state regulations also apply.

Classification of injection wells. The State of Tennessee does not classify septic systems or agriculture drainage wells as Class V wells.

1200-4-6-.14(1.a) - The use of any well to dispose of water carrying human waste, household or business waste, raw sewage or effluent from any septic tank or other sewer system of any kind is prohibited.

1200-4-6-.14(1.b) - The use of any Class V well in such a manner as to present a hazard to any existing or future use of ground water classified pursuant to rule 1200-4-6-.05(1) is prohibited.

1200-4-6-.14(2.a) - Construction and operation of a Class V well is authorized provided the use of any Class V injection well does not present a hazard to any existing or future use of ground water classified pursuant to rule 1200-4-6-.05(1).

1200-4-6-.14(2.b) - It is a requirement that the owner or operator of a Class V well supply the following:

a) Facility name and location, including a plot plan showing location of well(s);

b) Name and address of legal contact;

c) Ownership of facility;

d) Nature and type of injection wells, including installed dimensions of wells and construction materials;

e) Operating status of injection wells, including history of injection;

f) Volume of injected fluid;

g) Nature of injected fluid to include physical, chemical, biological or radiological characteristics;

h) Description of injection well, including monitoring wells(s); and

i) Plans for the construction of any new well, or modification of any existing Class V injection well which have been approved by the Department of Environmental Conservation.

1200-4-6-.14(4) - No authorization by permit or rule will be allowed where a Class V well causes or allows a violation of the water quality criteria in rule 1200-4-6-.05 or results in the pollution of any ground or surface water.

1200-4-6-.14-(5) - If at any time the Department learns that an existing Class V system may cause a violation of these regulations, the Department must:

a) require the injector to apply for an individual permit;

b) order the injector to take such actions including, where required, closure of the injection well as may be necessary to prevent the violation; or

c) take enforcement action.

1200-4-6-.14(6) - Notwithstanding any other provision of this section, the Department may take emergency action upon receipt of information that a contaminant from a Class V injection system is likely to enter a public water system and present an imminent and substantial endangerment to human health.

1200-4-6-.14(7) - Construction Standards for Class V Wells are as follows:

a) The variety of Class V wells and their uses dictate a variety of construction designs consistent with those uses and preclude specific construction standards. However, a well must be designed and constructed for its intended use, in accordance with good engineering practices. The design and construction must be approved by the Department of Environment and Conservation.

b) Class V wells must be constructed so that their intended use does not violate the water quality standards.

1200-4-6-.14(8) - Operating Requirements for Class V Wells are as follows:

a) All Class V injection wells must be operated in such a manner that they do not present a hazard to ground water classified pursuant to rule 1200-4-6-.05(1).

b) Use of a pretreatment system may be necessary to insure that the water discharged meets the applicable water quality standards.

c) Initial and/or periodic testing may be required for Class V injection wells.

d) Upon completion of the well, the owner or operator must certify to the Department that the well has been completed in accordance with the approved construction plan and must submit any other additional information required.

1200-4-6-.14(9) - Monitoring Requirements are as follows:

a) The Department may require monitoring of Class V injection wells, the nature of which will be determined by the type of well, nature of the injected fluid and water quality of the receiving aquifer.

b) The Department must determine the extent and frequency of monitoring based on the type of injection well and the nature of the injected fluid.

1200-4-6-.14(10) - Reporting requirements for Class V wells will be determined by the type of injection well and nature of injected fluid.

Closure guidelines for Class IV and V wells

1200-4-6-.14(11) - State Class V plugging and abandonment standards are as follows:

a) The Department will order that a Class V injection well be plugged and abandoned when the use of the system is determined to be a hazard to the ground-water resource.

b) Prior to abandoning a Class V injection well, the well must be plugged with cement in a manner which will not allow movement of fluids between formations containing ground water classified pursuant to rule 1200-4-6-.05(1). The proposed plugging method and type of cement must be approved by the Department. Placement of the cement plug must be accomplished by any recognized method which is acceptable to the Department.

c) The owner or operator must notify the Department of his intentions to abandon the system when a Class V injection well is no longer used or is usable for its intended purpose.

d) The owner of any Class V injection well must apply for a Plugging and Abandonment Permit when the well is no longer used or usable for its intended purpose or any other purpose approved by the Department. The application must include justification for abandonment, the approved plugging and abandonment plan and any proposed modification to the original plugging plan as approved by the Department.

TEXAS

Responsible Agencies for Class V UIC Program

1) Underground Injection Control
Railroad Commission of Texas
P.O. Drawer 12967, Capital Station
Austin, TX 78711-2967
Contact Person: Richard Ginn
(512) 463-6796

Explanation: The Railroad Commission covers all UIC activities related to the production of oil and gas.

2) Texas Water Commission (TWC)
Ground Water Section
P.O. Box 13087 Capital Station
Austin, TX 78711
Contact Person: Steve Musick
(512) 371-6329

Explanation: The TWC covers all Class V UIC activities other than anything related to the production of oil and gas.

Summary of differences in State Class V UIC regulations and Federal Class V guidelines

Rules of the Texas Water Commission

331.3 - With the exception of the injection of waste into subsurfaces via a single family residential cesspool, septic system, or other device that receives waste which has an open bottom or perforated sides, the construction of an injection well, the conversion of a well into an injection well, and the use or operation of an injection well is prohibited unless authorized by an injection well permit, order or rule of the commission.

331.4- Mechanical Integrity. Injection may be prohibited for Class V wells which lack mechanical integrity. A demonstration of mechanical integrity may be required at any time if there is reason to believe mechanical integrity is lacking.

331.5 - No permit or authorization by rule may be allowed where an injection well causes or allows the movement of fluid that would result in the pollution of a USDW.

331.9 - Class V wells injecting contaminated water are authorized by rule subject to post-construction registration.

331.9 - Class V wells involving a waste, treated waste, or treated contaminated water require staff approval before construction.

331.9 - Underground Injection of domestic wastewater of 1000 gallons or greater per day requires a UIC permit prior to construction.

331.132 - Construction standards for Class V wells.

a) All Class V wells must be completed in accordance with the following specifications unless

otherwise authorized by the Commission.

b) A form for the construction of all new Class V wells must be completed.

c) The annular space between the borehole and the casing must be filled from ground level to a depth of not less than ten feet below the land surface or well head with cement slurry. In areas of shallow, unconfined ground-water aquifers, the cement need not be placed below the static water level. In areas of shallow, confined ground-water aquifers having artesian head, the cement need not be placed below the top of the water-bearing strata.

d) In all wells where plastic casing is used, a concrete slab or sealing block must be placed above the cement slurry around the well at the ground surface.

e) In wells where steel casing is used, a slab or block will be required above the cement slurry except when a pitless adapter is used.

f) All wells, especially those that are gravel packed, must be completed so that aquifers or zones containing waters that are known to differ significantly in chemical quality are not allowed to commingle through the borehole-casing annulus or the gravel pack and cause quality degradation of any aquifer zone.

g) The well casing must be capped or completed in a manner that will prevent pollutants from entering the well.

h) When undesirable water is encountered in a Class V well, the undesirable water must be sealed off and confined to the zone(s) of origin.

Closure guidelines for Class IV and V wells

Class IV wells are prohibited, and proper closure according to appropriate regulations is required. Because these wells involve hazardous waste, in most cases they are subject to RCRA requirements. These requirements are complex and depend on the status of the facility at the time of closure.

331.133 Closure Standards.

a) It is the responsibility of the landowner or person having the well drilled, deepened, or otherwise altered, to plug or have plugged, according to standards set forth in these rules. a Class V well which is to be abandoned.

b) Closure must be accomplished by removing all of the removable casing and the entire well filled to land surface with cement.

c) In lieu of the procedure in subsection (b) of this section, and if the use of a Class V well that does not contain undesirable water is to be permanently discontinued, the well may be filled with fine sand, clay, or heavy mud followed by a cement plug extending from land surface to a depth of not less than ten feet.

d) In lieu of the procedure in subsection (b) of this section, and if the use of a Class V well that does contain undesirable water is to be permanently discontinued, either the zone(s) containing undesirable water, or the fresh water zone(s) must be isolated with cement plugs and the remainder of the well bore filled with sand, clay, or heavy mud to form a base for a cement plug extending from land surface to a depth of not less than ten feet.

Class V well closures are reviewed on a case-by-case basis for cleanup and closure procedures. In general, any contaminant source should be removed, any contaminated ground water should be remediated to pre-contamination background concentrations if feasible, and the well plugged, from total depth to the surface, with cement or an approved substitute.

UTAH

Responsible Agency for Class V UIC Program

Department of Environmental Quality (UDEQ)
Division of Water Quality
P.O. Box 144870
Salt Lake City, Utah 84114-4870
Contact Person: Fred Pehrson
(801) 538-6146

Explanation: This department regulates all state Class V wells with the exception of Class V septic systems of less than 5000 gallons, which are handled by local health departments.

Summary of differences between State Class V UIC regulations and Federal Class V UIC guidelines

The State of Utah's UIC regulations are equivalent to the Federal requirements. The state requirements can be found in the Administrative Rules for the UIC Program, R317-7, Utah Administrative Code.

The state currently has no general Class V permit form. Each case is considered on a site-specific basis.

Closure guidelines for Class IV and V wells

Closure of 5X28 and 5W20 injection wells. These wells are ordered closed as they are identified. If injectate exceeds MCLs, ground water is considered endangered and ground-water assessments are required. If contamination is found to be impacting USDW's, remediation strategies must be implemented.

WASHINGTON

Responsible Agency for Class V UIC Program

Washington Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600
Contact Person: Bert Bowlen
(206) 438-7066

Summary of differences between State Class V UIC regulations and Federal Class V UIC guidelines

WAC 173.218.020 - Policy. The disposal of waste fluids from industrial, commercial, or municipal sources into wells will not be authorized by the department, except that existing operations are authorized providing these operations satisfy the necessary standards and requirements.

WAC 173.218.040 - Authorization required. No fluid may be injected through wells except as authorized pursuant to this chapter.

WAC 173.218.090 - Class V injection wells.

1) all new Class V injection wells that inject industrial, municipal, or commercial waste fluid into or above a USDW are prohibited.

2) Owners of all existing Class V wells that inject industrial, municipal, or commercial waste fluids into a USDW must apply to the Department for approval to operate.

3) Owners of all other Class V wells must notify the Department of the location of their wells.

WAC 173.218.100 - Permit terms and conditions.

1) Permits must specify conditions that reflect all known, available, and reasonable methods of prevention, control, and treatment, and fulfill Federal UIC requirements. Any conditions necessary to preserve and protect a USDW must be included.

2) Any injection well that allows the movement of fluid into a USDW that results in a violation of a national primary drinking water standard or may otherwise adversely affect the beneficial use of a USDW is prohibited.

Closure guidelines for Class IV and V wells

Currently, there are no state closure regulations; however, department guidance for Class V closure is administered on a case-by-case basis. If a Class IV well is to be closed, it is handled under state RCRA requirements which are more stringent than the Federal RCRA requirements for remediation. For example, Washington has ground-water quality standards which must be met.

Remediations are covered under the Model Toxics Control Act (MTCA). This Act includes ground-water quality standards that parallel the Ground Water Quality Standards, Chapter 173-200 WAC. These ground-water quality standards apply primarily to discharges including stormwater which affect ground water.

WYOMING

Responsible Agency for Class V UIC Program

Water Quality Division
Wyoming Department of Environmental Quality
122 West 25th Street
Cheyenne, WY 82002
Contact Person: Robert Lucht
(307) 777-7781

Summary of differences between State Class V UIC regulations and Federal guidelines

The State of Wyoming regulates 5X25, 5X15 and 5X14 wells as Class III wells and not Class V wells. In addition, 5N24 wells are regulated as Class I wells.

The State of Wyoming does not have "Authorization by Rule." Within W.S. 35-11-301(a), it is stated that no person, except when authorized by permit, may discharge waste to waters of the state. All injections require either a UIC permit or a permit to construct under Chapter III of the Wyoming Water Quality Rules and Regulations.

The regulation of septic tanks with less than 2000 gallons per day capacity and no industrial component may be delegated to counties. Specific delegations vary among the counties.

Closure guidelines for Class IV and V wells

For wastes disposed of at levels significantly above MCL's, the Wyoming Department of Environmental Quality requires site investigations including installation of monitoring wells and extensive analyses. If ground-water contamination is detected, remediation, including source removal, may be required.

The state requires periodic monitoring of effluent.

As of November, 1992, approximately one half of the state's 5X28 wells had been plugged.

APPENDIX B

EPA'S BEST MANAGEMENT PRACTICES FOR PROTECTING GROUND WATER

United States
Environmental Protection
Agency

Office of Water (WH 550G)

EPA 570/9-91-036
January 1992

EPA

Best Management Practices For Protecting Ground Water

SUMMARY OF CLASS V WELL BMP FACT SHEETS

Fact Sheet	Facility and Well Type
Fact Sheet No. 1	Automotive Service Stations Using Shallow Waste Disposal Wells
Fact Sheet No. 2	Facilities Using Shallow Industrial Waste Disposal Wells
Fact Sheet No. 2A	Additional BMPs for Dry Cleaners Using Shallow Industrial Waste Disposal Wells
Fact Sheet No. 2B	Additional BMPs for Photographic Processing Establishments Using Shallow Industrial Waste Disposal Wells
Fact Sheet No. 2C	Additional BMPs for Furniture Strippers Using Shallow Industrial Waste Disposal Wells
Fact Sheet No. 2D	Additional BMPs for Electroplaters Using Shallow Industrial Waste Disposal Wells
Fact Sheet No. 2E	Additional BMPs for Printed Circuit Board Manufacturers Using Shallow Industrial Waste Disposal Wells
Fact Sheet No. 2F	Additional BMPs for Printing Shops Using Shallow Industrial Waste Disposal Wells
Fact Sheet No. 2G	Additional BMPs for Fabricated Metal Industry Facilities Using Shallow Industrial Waste Disposal Wells
Fact Sheet No. 2H	Additional BMPs for Medical Services Facilities Using Shallow Industrial Waste Disposal Wells
Fact Sheet No. 2I	Additional BMPs for Lawn Care Establishments Using Shallow Industrial Waste Disposal Wells
Fact Sheet No. 3	Carwashes Using Shallow Industrial Waste Disposal Wells

Note: These BMPs are adapted from a May 1991 EPA report titled, "Class V Well BMP Guidance - Phase I and Phase II," and have been modified in response to comments by EPA Regions. For a copy of the EPA report, please contact the Underground Injection Control Branch of the Office of Ground Water and Drinking Water, U S EPA.

For further information contact:

United States
Environmental Protection
Agency

Office of Water (WH 550G)

EPA 570/9-91-036A
January 1992

EPA

Best Management Practices For Protecting Ground Water

Automotive Service Stations Using Shallow Waste Disposal Wells

(Class V Well BMP Fact Sheet Number 1)

EPA recognizes that certain industrial waste disposal practices using drainage wells may pose unacceptable risks to Underground Sources of Drinking Water. These operations allow the discharge of various wastes to a drainage system neither designed for nor capable of treating them. Accordingly, BMPs for Service Station Disposal Wells focus on well closure and alternative disposal methods. We have also included BMPs for waste minimization to help facilities reduce waste disposal costs, regardless of the disposal method they use. In addition local, county, and State regulations may prohibit use of these wells. Note: these practices are recommendations only. For more information, contact the person named below.

Well Closure (if so directed)

- Submit closure plan if so directed; temporarily plug well with cement or plumbers plug until plan is approved
- After sampling well contents, clean pipes and drains leading to well if so directed, using, for example, plastic pigs
- Remove liquid and sludge from well if so directed; dispose of in compliance with federal, State, and local laws
- Fill well voids with clean inert material; seal pipes and well sides with cement or concrete; plug and cap well opening; seal cap and floor
- Remove and dispose of visibly contaminated soil in compliance with federal, State, and local laws
- After removing visibly contaminated soil, collect and analyze soil and fluid samples; send results to Chief of the appropriate State or Region Section
- For bay drain(s) connected to a septic system, continue to use septic system (after closing bay drains) only if allowed and only for domestic waste

Alternative Disposal

- If floor drain(s) are required, connect drain(s)/disposal system(s) to sanitary sewer if allowed by appropriate federal, State and local regulations
- If floor drain(s) are required, connect drain(s) to holding tank; periodically pump out tank and have licensed hauler transport wastes to an approved treatment or disposal facility
- Use waste exchange services to reuse and recycle as much waste as practical
- Apply for a permit to continue injecting if so directed

United States
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Office of Water (WH 550G)

EPA 570/9-91-036B
January 1992

EPA

Best Management Practices For Protecting Ground Water

Facilities Using Shallow Industrial Waste Disposal Wells

(Class V Well BMP Fact Sheet Number 2)

EPA recognizes that certain industrial waste disposal practices using drainage wells may pose unacceptable risks to Underground Sources of Drinking Water. These operations allow the discharge of various wastes to a drainage system neither designed for nor capable of treating them. Accordingly, BMPs for Industrial Disposal Wells focus on well closure and alternative disposal methods. We have also included BMPs for waste minimization to help facilities reduce waste disposal costs, regardless of the disposal method they use. See Fact Sheets 2A - 2I for BMPs for Industrial Disposal Wells used by specific industries. In addition local, county, and State regulations may prohibit use of these wells. Note: these practices are recommendations only. For more information, contact the person named below.

Well Closure (if so directed)

- Submit closure plan if so directed; temporarily plug well with cement or plumbers plug until plan is approved
- After sampling well contents, clean pipes and drains leading to well if so directed, using, for example, plastic pigs
- Remove liquid and sludge from well if so directed; dispose of in compliance with federal, State, and local laws
- Fill well with clean inert material, seal pipes and well sides with cement or concrete, and plug and cap well opening; seal cap and floor
- Remove and dispose of visibly contaminated soil in compliance with federal, State, and local laws
- After removing visibly contaminated soil collect and analyze soil and fluid samples; send results to the Chief of the appropriate State or Region Section

Alternative Disposal

- If floor drain(s) are required, connect drain(s)/disposal system(s) to sanitary sewer if allowed by appropriate federal, State and local regulations
- If floor drain(s) are required, connect drain(s) to holding tank; periodically pump out tank and have licensed hauler transport wastes to an approved treatment or disposal facility
- Use waste exchange services and recycle as much waste as practical
- Apply for a permit to continue injecting if so directed

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Office of Water (WH 550G)

EPA 570/9-91-036C
January 1992

EPA

Best Management Practices For Protecting Ground Water

For Dry Cleaners Using Shallow Industrial Waste Disposal Wells

(Class V Well BMP Fact Sheet Number 2A)

EPA recognizes that certain industrial waste disposal practices using drainage wells may pose unacceptable risks to Underground Sources of Drinking Water. These operations allow the discharge of various wastes to a drainage system neither designed for nor capable of treating them. Accordingly, BMPs for Industrial Disposal Wells focus on well closure and alternative disposal methods. We have also included BMPs for waste minimization to help facilities reduce waste disposal costs, regardless of the disposal method they use. In addition local, county, and State regulations may prohibit use of these wells. Note: these practices are recommendations only. For more information, contact the person named below.

The BMPs listed below apply to dry cleaners. Fact Sheet Number 2 in this series lists BMPs that are applicable to Industrial Disposal Wells in general (including those used by dry cleaners), particularly for closure and alternative disposal.

Waste Minimization

- Use equipment with built-in distillation units or add such units to existing equipment to extend the life of solvents and reduce still waste volume
- Add carbon adsorption units, refrigeration/condensation units, or azeotropic conditioning for solvent recovery (azeotropic conditioning entails adding a substance to a mixture to facilitate distillation and separation of individual components of the mixture)
- Add prewashing where possible to remove some dust and oils (this increases solvent and filter cartridge life)
- Properly operate distillation units to minimize solvent content of still bottoms
- Heat used filter cartridges in a closed container to vaporize and capture excess solvent
- Open button traps and lint gaskets only long enough to clean
- Inspect and repair gaskets, seals, hoses, and couplings to minimize solvent, vapor, and liquid loss

United States
Environmental Protection
Agency

Office of Water (WH 550G)

EPA 570/9-91-036D
January 1992

EPA

Best Management Practices For Protecting Ground Water

For Photographic Processing Establishments Using Shallow Industrial Waste Disposal Wells

(Class V Well BMP Fact Sheet Number 2B)

EPA recognizes that certain industrial waste disposal practices using drainage wells may pose unacceptable risks to Underground Sources of Drinking Water. These operations allow the discharge of various wastes to a drainage system neither designed for nor capable of treating them. Accordingly, BMPs for Industrial Disposal Wells focus on well closure and alternative disposal methods. We have also included BMPs for waste minimization to help facilities reduce waste disposal costs, regardless of the disposal method they use. In addition local, county, and State regulations may prohibit use of these wells. Note: these practices are recommendations only. For more information, contact the person named below.

The BMPs listed below apply to photographic processing establishments. Fact Sheet Number 2 in this series lists BMPs that are applicable to Industrial Disposal Wells (including those used by photographic processing establishments), particularly for closure and alternative disposal.

Waste Minimization

- Use as little water as possible (e.g., install water demand valves to control water use)
- Use timers to turn off continuous washers when film is not being processed to reduce wastewater volume
- Install a washless processing system
- Use film with less or no silver; or use silver fixers which allow silver to be filtered out of developing solutions
- Replace ferricyanide bleach with ferric EDTA (ethylenediaminetetraacetic) complex (Note: mixing EDTA complex from scratch may be dangerous) or regenerate spent ferri-cyanide bleach using ozone oxidation, electrolysis, persulfate salts, liquid bromine, ion exchange, or highly concentrated bleach-fix replenishment
- Use a closed-cycle system to enhance recovery of silver
- Configure chemical recovery cartridges in series to maximize silver recovery
- Recover silver by using metallic replacement, electrolytic recovery, chemical precipitation, ion exchange, reverse osmosis, and/or evaporation

United States
Environmental Protection
Agency

Office of Water (WH 55LG)

EPA 570/9-91-036E
January 1992

EPA

Best Management Practices For Protecting Ground Water

For Furniture Strippers Using Shallow Industrial Waste Disposal Wells

(Class V Well BMP Fact Sheet Number 2C)

EPA recognizes that certain industrial waste disposal practices using drainage wells may pose unacceptable risks to Underground Sources of Drinking Water. These operations allow the discharge of various wastes to a drainage system neither designed for nor capable of treating them. Accordingly, BMPs for Industrial Disposal wells focus on well closure and alternative disposal methods. We have also included BMPs for waste minimization to help facilities reduce waste disposal costs, regardless of the disposal method they use. In addition local, county, and State regulations may prohibit use of these wells. Note: these practices are recommendations only. For more information, contact the person named below.

The BMPs listed below apply to furniture strippers. Fact Sheet 2 in this series lists BMPs that are applicable to Industrial Disposal Wells in general (including those used by furniture strippers), particularly for closure and alternative disposal. In addition the Agency believes that wastes from furniture strippers pose significant risks to ground water when injected. Industrial Disposal Wells at these facilities will probably be closed.

Waste Minimization

- Use complete hand stripping in place of chemical stripping where practical
- Remove loose paint and stain by hand before chemical stripping
- Spray stripping chemicals on furniture in sealed chambers and filter excess and runoff, or use a recirculating flow system which screens the stripping fluid as it is recycled
- Have a licensed recycling service periodically collect used hot and cold tank liquids and provide new or replenished stripping fluids

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Note: These BMPs are adapted from a May 1991 EPA report titled, "Class V Well BMP Guidance - Phase I and Phase II," and have been modified in response to comments by EPA Regions. For a copy of the EPA report, please contact the Underground Injection Control Branch of the Office of Ground Water and Drinking Water, U.S. EPA.

For further information contact:

United States
Environmental Protection
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Office of Water (WH 550G)

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EPA

Best Management Practices For Protecting Ground Water

For Electroplaters Using Shallow Industrial Waste Disposal Wells

(Class V Well BMP Fact Sheet Number 2D)

EPA recognizes that certain industrial waste disposal practices using drainage wells may pose unacceptable risks to Underground Sources of Drinking Water. These operations allow the discharge of various wastes to a drainage system neither designed for nor capable of treating them. Accordingly, BMPs for Industrial Disposal Wells focus on well closure and alternative disposal methods. We have also included BMPs for waste minimization to help facilities reduce waste disposal costs, regardless of the disposal method they use. In addition local, county, and State regulations may prohibit use of these wells. Note: these practices are recommendations only. For more information, contact the person named below.

The BMPs listed below apply to the electroplating industry. Fact Sheet Number 2 in this series lists BMPs that are applicable to Industrial Disposal Wells in general (including those used by electroplaters), particularly for closure and alternative disposal. In addition the Agency believes that wastes from Electroplaters pose significant risks to ground water when injected. Industrial Disposal Wells at these facilities will probably be closed.

Waste Minimization

- Use deionized water in place of tap water to facilitate recycling and minimize the generation of sludges
- Extend plating bath life and recover metals and additives through treatment
  - For example, use electrolytic dummying to remove excess copper
  - Other methods include high surface area electrowinning/electrorefining, ion exchange, ion transfer, evaporators, and reverse osmosis
- Convert process baths to non-cyanide plating baths where technically feasible
- Substitute trisodium phosphate or ammonia for cyanide cleaners where technically feasible
- Replace hexavalent chromium solutions with trivalent chromium solutions where technically feasible
- Use sulfuric acid and hydrogen peroxide in place of chromic acid where technically feasible
- Withdraw parts from plating baths slowly to minimize "drag-out"

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Best Management Practices For Protecting Ground Water

For Printed Circuit Board Manufacturers Using Shallow Industrial Waste Disposal Wells

(Class V Well BMP Fact Sheet Number 2E)

EPA recognizes that certain industrial waste disposal practices using drainage wells may pose unacceptable risks to Underground Sources of Drinking Water. These operations allow the discharge of various wastes to a drainage system neither designed for nor capable of treating them. Accordingly, BMPs for Industrial Disposal Wells focus on well closure and alternative disposal methods. We have also included BMPs for waste minimization to help facilities reduce waste disposal costs, regardless of the disposal method they use. In addition local, county, and State regulations may prohibit use of these wells. Note: these practices are recommendations only. For more information, contact the person named below.

The BMPs listed below apply to printed circuit board manufacturers. Fact Sheet Number 2 in this series lists BMPs that are applicable to Industrial Disposal Wells in general (including those used by printed circuit board manufacturers), particularly for closure and alternative disposal.

Waste Minimization

- Substitute aqueous processable resists for solvent processable resists where feasible
- Replace chemical board production with computer-driven mechanical etching processes for low-volume board production, such as for prototypes
- Replace chromic-sulfuric acid etchants with ferric chloride or ammonium persulfate where possible
- Use thinner copper foil to clad laminated boards, where feasible
- Decant and filter photoresist stripper to extend stripper life
- Extend plating bath life and recover metals and additives through treatment
  - — For example, use electrolytic dummying to remove excess copper
  - — Other methods include high surface area electrowinning/electrorefining, ion exchange, ion transfer, evaporators, and reverse osmosis
- Recycle spent chromic acid using an electrolytic diaphragm cell or other method

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Best Management Practices For Protecting Ground Water

For Printed Circuit Board Manufacturers Using Shallow Industrial Waste Disposal Wells

(Class V Well BMP Fact Sheet Number 2E)

EPA recognizes that certain industrial waste disposal practices using drainage wells may pose unacceptable risks to Underground Sources of Drinking Water. These operations allow the discharge of various wastes to a drainage system neither designed for nor capable of treating them. Accordingly, BMPs for Industrial Disposal Wells focus on well closure and alternative disposal methods. We have also included BMPs for waste minimization to help facilities reduce waste disposal costs, regardless of the disposal method they use. In addition local, county, and State regulations may prohibit use of these wells. Note: these practices are recommendations only. For more information, contact the person named below.

The BMPs listed below apply to printed circuit board manufacturers. Fact Sheet Number 2 in this series lists BMPs that are applicable to Industrial Disposal Wells in general (including those used by printed circuit board manufacturers), particularly for closure and alternative disposal.

Waste Minimization

- Substitute aqueous processable resists for solvent processable resists where feasible
- Replace chemical board production with computer-driven mechanical etching processes for low-volume board production, such as for prototypes
- Replace chromic-sulfuric acid etchants with ferric chloride or ammonium persulfate where possible
- Use thinner copper foil to clad laminated boards, where feasible
- Decant and filter photoresist stripper to extend stripper life
- Extend plating bath life and recover metals and additives through treatment
  - — For example, use electrolytic dummying to remove excess copper
  - — Other methods include high surface area electrowinning/electrorefining, ion exchange, ion transfer, evaporators, and reverse osmosis
- Recycle spent chromic acid using an electrolytic diaphragm cell or other method

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Best Management Practices For Protecting Ground Water

For Print Shops Using Shallow Industrial Waste Disposal Wells

(Class V Well BMP Fact Sheet Number 2F)

EPA recognizes that certain industrial waste disposal practices using drainage wells may pose unacceptable risks to Underground Sources of Drinking Water. These operations allow the discharge of various wastes to a drainage system neither designed for nor capable of treating them. Accordingly, BMPs for Industrial Disposal Wells focus on well closure and alternative disposal methods. We have also included BMPs for waste minimization to help facilities reduce waste disposal costs, regardless of the disposal method they use. In addition local, county, and State regulations may prohibit use of these wells. Note: these practices are recommendations only. For more information, contact the person named below.

The BMPs listed below apply to print shops. Fact Sheet Number 2 in this series lists BMPs that are applicable to Industrial Disposal Wells in general (including those used by print shops), particularly for closure and alternative disposal.

Waste Minimization

- Use photomechanical, electrostatic, and surface plate processes rather than metal etching and plating since the former generate smaller amounts of hazardous waste
- Use electronic imaging for editing and print only final versions on paper to reduce chemical (and paper) use
- Use water-based or soy-based inks, where possible, to minimize petroleum concentrations in waste water
- Install automatic web splicers and web break detectors
- Install automatic blanket cleaners
- Use automatic ink levelers
- Standardize ink sequence and ink rotation to the greatest extent practicable
- Use aerosol spray in place of solvents to clean out ink fountains at the end of print runs to prevent drying and clogging
- Use countercurrent washing where appropriate

Note: These BMPs are adapted from a May 1991 EPA report titled, "Class V Well BMP Guidance - Phase I and Phase II," and have been modified in response to comments by EPA Regions. For a copy of the EPA report, please contact the Underground Injection Control Branch of the Office of Ground Water and Drinking Water, U.S. EPA.

For further information contact:

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Best Management Practices For Protecting Ground Water For Fabricated Metal Industry Facilities Using Shallow Industrial Waste Disposal Wells (Class V Well BMP Fact Sheet Number 2G)

EPA recognizes that certain industrial waste disposal practices using drainage wells may pose unacceptable risks to Underground Sources of Drinking Water. These operations allow the discharge of various wastes to a drainage system neither designed for nor capable of treating them. Accordingly, BMPs for Industrial Disposal Wells focus on well closure and alternative disposal methods. We have also included BMPs for waste minimization to help facilities reduce waste disposal costs, regardless of the disposal method they use. In addition local, county, and State regulations may prohibit use of these wells. Note: these practices are recommedations only. For more information, contact the person named below.

The BMPs listed below apply to fabricated metal industry facilities. Fact Sheet Number 2 in this series lists BMPs that are applicable to Industrial Disposal Wells in general (including those used by fabricated metal industry facilities), particularly for closure and alternative disposal.

Waste Minimization

- Standardize metalworking fluids to the greatest extent possible
- Use high-quality metalworking fluid to minimize amount needed
- Recycle metalworking fluids through filtering, skimming, coalescing, or other methods
- Use deionized water in place of tap water to facilitate recycling
- Extend bath life and recover metals and additives through treatment
  - — For example, use electrolytic dummying to remove excess copper
  - — Other methods include high surface area electrowinning/electrorefining, ion exchange, ion transfer, evaporators, and reverse osmosis
- Rotate electroplating barrels over bath after immersion to allow them to drain
- Replace barrel plating with rack plating where possible to minimize "drag-out"

Note: These BMPs are adapted from a May 1991 EPA report titled, "Class V Well BMP Guidance - Phase I and Phase II," and have been modified in response to comments by EPA Regions. For a copy of the EPA report, please contact the Underground Injection Control Branch of the Office of Ground Water and Drinking Water, U.S. EPA.

For further information contact:

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Best Management Practices For Protecting Ground Water

For Medical Services Facilities Using Shallow Industrial Waste Disposal Wells

(Class V Well BMP Fact Sheet Number 2H)

EPA recognizes that certain industrial waste disposal practices using drainage wells may pose unacceptable risks to Underground Sources of Drinking Water. These operations allow the discharge of various wastes to a drainage system neither designed for nor capable of treating them. Accordingly, BMPs for Industrial Disposal Wells focus on well closure and alternative disposal methods. We have also included BMPs for waste minimization to help facilities reduce waste disposal costs, regardless of the disposal method they use. In addition local, county, and State regulations may prohibit use of these wells. Note: these practices are recommendations only. For more information, contact the person named below.

The BMPs listed below apply to medical services facilities. Fact Sheet Number 2 in this series lists BMPs that are applicable to Industrial Disposal Wells in general (including those used by medical services facilities), particularly for closure and alternative disposal.

Waste Minimization

- Install water demand zone valves to control water use
- Use reverse osmosis water supply equipment, where technically feasible, to minimize cleaning requirements for dialysis machines
- Use a closed-cycle system to enhance recovery of silver
- Renew photoprocessing chemicals using replenisher concentrates and regenerators
- Recycle developer using, for example, an ion exchange system or an electrodialysis system
- Recover silver from photographic equipment using metallic replacement, electrolytic recovery, chemical precipitation, ion exchange, reverse osmosis, and/or evaporation
- Replace instruments containing mercury with electronic instruments
- Segregate and properly label radioactive wastes
- Use less hazardous isotypes where possible: for example, use iridium-192 or cesium-137 needles in place of radium-226 needles

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Best Management Practices For Protecting Ground Water

For Lawn Care Establishments Using Shallow Industrial Waste Disposal Wells

(Class V Well BMP Fact Sheet Number 2I)

EPA recognizes that certain industrial waste disposal practices using drainage wells may pose unacceptable risks to Underground Sources of Drinking Water. These operations allow the discharge of various wastes to a drainage system neither designed for nor capable of treating them. Accordingly, BMPs for Industrial Disposal Wells focus on well closure and alternative disposal methods. We have also included BMPs for waste minimization to help facilities reduce waste disposal costs, regardless of the disposal method they use. In addition local, county, and State regulations may prohibit use of these wells. Note: these practices are recommendations only. For more information, contact the person named below.

The BMPs listed below apply to lawn care establishments. Fact Sheet Number 2 in this series lists BMPs that are applicable to Industrial Disposal Wells in general (including those used by lawn care establishments), particularly for closure and disposal alternative.

Waste Minimization

- Pave high-spill areas and add containment such as channels or barriers
- Collect contaminated rinse waters, truck washdown water, spills, and floor drainage
- Recycle collected fluids by pumping them back into trucks and/or application equipment and re-using them for pesticide and fertilizer applications where appropriate

Note: These BMPs are adapted from a May 1991 EPA report titled, "Class V Well BMP Guidance - Phase I and Phase II," and have been modified in response to comments by EPA Regions. For a copy of the EPA report, please contact the Underground Injection Control Branch of the Office of Ground Water and Drinking Water, U.S. EPA.

For further information contact:

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Best Management Practices For Protecting Ground Water
Carwashes Using Shallow Industrial Waste Disposal Wells
(Class V Well BMP Fact Sheet Number 3)

EPA recognizes that drainage well disposal practices may pose a threat of contamination to Underground Sources of Drinking Water. These wells, while necessary, may need additional attention to minimize their impact on ground water resources. For more information, contact the person named below.

BMPs

- Discharge to sewer systems or to holding tanks where practical and where in compliance with State and local regulations
- Capture and recycle as much waste water as possible using filters, oil/water separators with recyclable absorbents that absorb hydrocarbons but do not react with water, reclamation systems, and other appropriate technologies; some carwashes currently recycle 100 percent of captured waste water
- Inspect treatment equipment, tanks, and chemical containers regularly for leaks
- Use biodegradable soaps and chemicals instead of solvent-based solutions
- Calibrate treatment and application equipment regularly
- Process pit dirt to separate solids, contaminants, and wastewater
- Dry pit dirt in order to reduce waste shipped to special liquid waste landfills
- Hire a licensed transporter to dispose of pit dirt and wastewater treatment residuals
- Comply with federal, State, and local solid and liquid waste disposal regulations
- Apply for a permit to continue injecting if so directed

Note: These BMPs are adapted from a May 1991 EPA report titled, "Class V Well BMP Guidance - Phase I and Phase II," and have been modified in response to comments by EPA Regions. For a copy of the EPA report, please contact the Underground Injection Control Branch of the Office of Ground Water and Drinking Water, U.S. EPA.

For further information contact:

APPENDIX C

DRAFT REGION 5 GUIDELINES ON CONDUCTING SITE ASSESSMENTS AT CLASS IV AND V INJECTION WELL FACILITIES

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REGION 5 GUIDELINES ON CONDUCTING SITE ASSESSMENTS AT CLASS IV AND V INJECTION WELL FACILITIES

Part I. Introduction

All Class IV and most Class V wells present the possibility of endangering human health and the environment because they inject fluids directly into underground sources of drinking water (USDWs). Region 5 believes it is necessary to fully assess the potential for this endangerment at some point either before, during, or after closing Class IV or Class V injection wells. Although Class IV wells are banned, the implementation of the Toxicity Characteristic (TC) Rule, published in the Federal Register on March 29, 1990, has caused some Class V wells to be reclassified as Class IV wells. This, along with the recent national shallow-injection well initiative, has focused attention on the issue of closure of those Class V wells which may cause a violation of primary drinking water regulations. Closure, in many cases, is not just ceasing injection into the well, it also may include conducting a site assessment and, if necessary, performing remediation at the site. The goal of conducting site assessment is to determine if contamination of ground water has occurred, and if so, to determine the extent of that contamination. The question that should be answered at the end of a site assessment is whether the injection well should be closed, and if contamination has occurred, whether site remediation should be performed.

The two subcategories of Class V wells that cause the most concern over the possibility of endangering human health and the environment are service station disposal wells (5X28) and industrial waste disposal wells (5W20). Automobile service station wells are a potential hazard because of the presence of hydrocarbons and solvents in the service bay area. Contaminants from spills, washing off automobiles, or disposal of wastes can get into the groundwater via the well at these sites. It is difficult to assess the amount of environmental damage or human health risk that can occur from a 5X28 well due to the variability of the wastestream. Data collected by United States Environmental Protection Agency (USEPA) headquarters of sample analyses taken from 5X28 wastestreams show that up to 36 organic and inorganic contaminants that are listed on the National Primary Drinking Water Standards and/or exhibit a characteristic of toxicity have been injected through a 5X28 well.

For 5W20 wells, the total universe of constituents possibly disposed of via this well type can be quite large. However, the wastestream is usually generated through a consistent industrial process, so the variability of constituents injected into a single well should be less than that for 5X28 wells. Although the variability of constituents may be less, the potential for environmental harm is not lessened. For this reason, 5W20 wells should also be tested to determine the toxicity of the waste being injected in order to evaluate the potential harm that the injection operation may pose to human health and the environment.

As stated above, the TC Rule has caused some Class V wells to be reclassified as Class IV. In addition, chemical sampling and analysis of Class V wells as part of site assessment has shown many wells previously thought to be Class V to be, in actuality, Class IV wells. For example, a preliminary study conducted on 70 5X28 wells nationwide showed that 37% of the sites had sludges that would be characterized as hazardous under the TC Rule and 17% of the

sites had liquid that was characterized as hazardous. The data collected to date at Class V wells sampled in Region 5 show similar results. Of the 14 5X28 wells in the Region that were sampled, 21% had hazardous waste or sludge present; likewise, 14% of the 21 5W20 wells were similarly hazardous. Moreover, when comparing the data from these wells to the maximum contaminant levels (MCLs), 64% of the 5X28 and 47% of the 5W20 wells had levels of constituents that exceeded the National Primary Drinking Water standards.

The seriousness of such injection activities may be illustrated using a sample calculation of contaminant transport in a typical aquifer. The derivation of this calculation is elaborated upon in Attachment A. The example chosen is one for a 3.5 mg/l concentration of benzene, a human carcinogen known to cause a higher than normal incidence of leukemia, which was measured in the injectate at a 5X28 well in New York State. Assuming a uniform groundwater flow of 0.002 cm/sec for a typical glacial till aquifer, a concentration of benzene of 0.5 milligrams per liter (mg/l) will be found in the groundwater 0.4 miles down-gradient from the well after one year of injection. This level is still 100 times greater than the health-based MCL for benzene and meets the definition of hazardous waste under the TC Rule. If a water supply well were located within 0.4 miles down gradient of this 5X28 well, there exists the real potential for producing hazardous levels of benzene in the drinking water after only one year of well operation, assuming the generic hydraulic parameters chosen in Attachment A are representative of this site.

This document presents the authorities for the Region to request that a site assessment be performed at Class IV and Class V facilities which may be injecting fluids at concentrations that violate primary drinking water standards and outlines Region 5's guidelines when conducting Class IV and V site assessments. The second part of this document discusses the different levels of site assessment that may be required at a site and the data requirements for each level. Special emphasis is placed on sampling procedures and protocols due to the complexity and wide range of difficulties that may be encountered in conducting a sampling program.

Part II. Statutory and Regulatory Basis

A. Class IV Wells

The operation of Class IV wells is prohibited under UIC regulations at 40 CFR 144.13(a). In addition, 40 CFR 144.13(b) requires the owner or operator of a Class IV well to comply with Section 144.23 regarding closure of Class IV wells. Section 144.23 provides that for EPA administered programs, the owner or operator of a Class IV well shall plug or otherwise close the well in a manner acceptable to the Regional Administrator. By stating that the well can be otherwise closed in a manner acceptable to the Regional Administrator, Section 144.23 provides discretionary authority for the Regional Administrator to require actions beyond plugging a well where a Class IV operation has occurred. In addition, under 40 CFR 144.23(b)(2) the owner or operator must submit to the Regional Administrator for approval a plan for plugging or otherwise closing the well. The preamble to the Part 144 regulations promulgated in 1984 elaborates on the discretionary authority available to the Regional Administrator:

> Often, the Agency will want to impose groundwater monitoring requirements prior to closing certain wells to determine whether and to what extent the ground water has been contaminated. Section 144.27 will afford this authority to the Regional Administrator...[I]n some circumstances the Agency will want to require aquifer cleanup. Where ...appropriate, [the Regional Administrator] will require it on a case by case basis pursuant to Section 1431 or other authorities of the Safe Drinking Water Act, and may also draw on the authorities of other statutes such as [CERCLA].
> 49 Federal Register 20144, May 11, 1984.

The authority in 40 CFR 144.23 can be read in conjunction with other discretionary authorities available to the Regional Administrator such as the information gathering requirements available under 40 CFR 144.27. This section provides that, for EPA administered programs, the Regional Administrator may require rule-authorized wells (such as Class V or Class IV wells existing at the outset of the UIC program (6/24/84)) to submit information deemed necessary to determine whether the well may be endangering a USDW in violation of 40 CFR 144.12; including chemical analysis, groundwater monitoring and reporting. Failure to submit in a timely fashion any such information requested would result in the loss of authorization of the well in question.

Another discretionary authority is the emergency authority in Section 1431 of the SDWA which provides that upon receipt of information that a contaminant which is present in or is likely to enter a USDW may present an imminent and substantial endangerment to the health of persons, the Administrator (and by delegation the Regional Administrators) may take such actions as deemed necessary to protect the health of persons. This may be done by an administrative order or judicial injunctive relief. The administrative order may be enforced in district court and violations thereof are subject to penalties of $5000 per day of violation. In order to determine whether there is cause for invoking this authority, such as a determination that contaminants which may cause a violation of a primary drinking water regulation are entering the groundwater, it is necessary to perform a site assessment which includes sampling and analysis of the wastestream being injected into the ground.

This emergency authority is reiterated in Underground Injection Control regulations at 40 CFR 144.12(e) which prohibits the abandonment of any injection activity in a manner that allows the movement of any contaminant into a USDW if such contamination may cause a violation of a primary drinking water regulation or adversely affect the health of persons. While Class IV wells are not specifically mentioned, the authority as it relates to Class V wells may be employed with respect to former Class V wells.

B. Class V Wells

Much of the above discussion regarding Class IV wells, such as the discretionary authority available to the Regional Administrator and the emergency authority in Section 1431, also applies to Class V wells and will not be reiterated here.

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In addition to the emergency authority found in Section 1431 and the availability of Section 144.27 to seek information as to the dangers of the injection activity, the enforcement sanctions available in Section 1423 also may be employed for violations of 144.12(a).

Further, subsection (c) of 40 CFR 144.12 provides that if a Class V well may cause a violation of primary drinking water regulations, the Director (Regional Administrator in EPA administered programs) may order such actions as necessary to prevent the violation in accordance with SDWA authorities. Subsection (d) provides that if the Class V well may be otherwise adversely affecting the health of persons, the Director may prescribe actions which may be necessary to prevent the adverse effect, including any action authorized under subsection (c). Neither subsection (c) nor (d) is linked to "an imminent and substantial endangerment." Thus, pursuant to Section 1423 of the SDWA, the prescription of actions for violations of 40 CFR 144.12(a) would include the issuance of an administrative order to comply and to pay penalties of up to $10,000 per day. A civil enforcement action seeking injunctive relief and penalties of up to $25,000 per day would also be available, as well as criminal enforcement.

In summary, if it is determined that there are grounds to believe the operation of an injection activity caused contamination of soils or ground water, the Regional Administrator may require a site assessment, which can include monitoring or sampling, to determine the extent of such contamination under 40 CFR 144.27. Failure to comply with the 144.27 request can be subjected to a Section 1423 compliance order with penalties or referred for judicial action.

Once the extent of the contamination has been established via the site assessment, the Regional Administrator can order the owner/operator to revise the closure plan to include restoration of the aquifer or removal of the contaminated soil in addition to proper plugging of the well under 40 CFR 144.12(a) and (c).

The authorities listed above empower the Regional Administrator to require such actions as necessary to prevent the endangerment of human health and the environment. These actions include requiring the operator to perform some measure of site assessment to determine the magnitude and extent of the groundwater contamination. Based on the nature of the activities occurring at 5X28 and 5W20 sites, the construction of the wells, and the probable constituents of the wastestream, Region 5 feels there is adequate cause to request operators of these sites to perform chemical sampling as part of an initial site assessment to determine if contamination of the drinking water aquifers has occurred. The relevance of sampling at 5X28 and 5W20 sites has been borne out by the results of the preliminary nationwide study described above, which showed that 37% of the sites in the study had hazardous constituents being injected via their wells.

Part III. Recommendation

It is Region 5's position that, in order to determine whether injection activities have caused endangerment to human health or the environment, at a

minimum, first level site assessments should be performed by the owner/operator at all Class IV injection well facilities. Further, site assessments may be required at Class V facilities where it has been determined that injection into the well may cause a violation of drinking water regulations or otherwise adversely affect the health of persons. Such determination may be made based on well type or on a case by case basis.

Part IV. Elements of a Site Assessment Plan

Site assessments can vary in scope and level of detail. In this document, site assessments have been subdivided into three levels, each level requiring the acquisition of information that is deemed necessary based on the data gathered at the level preceding it. As stated in the recommendation above, all Class IV and most Class V facilities will be required to conduct a first level site assessment. Based on the results of the first level assessment, it may be determined that the site does not warrant further investigation, however, Region 5 reserves the right to require further investigation in the future should it be deemed necessary. If the results of the first level assessment demonstrate that the injection operation may pose harm to human health or the environment, then a second level assessment is required. Likewise, if the second level assessment continues to show the injection operation may pose harm to human health or the environment, then the operator proceeds to a third level assessment. To determine whether a site should undergo level 2 site assessment, Region 5 is using the criteria that if the sampling results obtained under the first level site assessment show the injectate to be classified as hazardous under the TC Rule, then the site will move up to level 2 site assessment. At sites where the injectate does not exhibit a characteristic of toxicity but does exceed a MCL set under the National Primary Drinking Water Standards, Region 5 may request a level 2 site assessment to be performed. Such requests will be made on a site-by-site basis. Should new concentration limits be set for the constituents currently being tested for, or if new information is received showing the limits currently being employed to be too stringent or too lax, then Region 5 will reassess the criteria currently being used to determine when site assessment will move to the second level.

The determination for when to move from level 2 to level 3 will be made based on an evaluation of the proximity of discharge points from the aquifer in question, the volume and mobility of the waste plume, possible subsurface chemical transformations, and other technical considerations. Such determination must be made on a site-by-site basis, hence no set criteria for when to elevate the site assessment from level 2 to level 3 can be given here.

It should be noted that, upon USEPA approval, well closure can be completed, and may be required, at any time during the site assessment. In other words, site assessments up to level three can be initiated and completed before, during and after well closure. The following is a description of the information to be provided for each level of site assessment, including additional detail regarding sampling and analysis.

A. Level 1 Site Assessment
All site assessments submitted by owners/operators of Class IV or V wells should include the following:

1) A description of the injection activity including accurate facility plans and drawings;

2) Diagrams and construction records detailing the construction of the injection well;

3) A Quality Assurance Project Plan (QAPP) that covers data collection, including wastestream sampling, handling and analysis; and

4) The chemical composition of the injectate. Owners/operators of 5X28 wells should analyze their wastes for either the constituents listed in Attachment C of this document or for the constituents listed under 40 CFR 261.24 as exhibiting a characteristic of toxicity. Owners/operators of 5W20 wells should analyze their waste for constituents exhibiting toxicity as described in the TC Rule under 40 CFR 261.24, unless they demonstrate that other chemical analyses can characterize their wastestream more completely than the TC analyses. A step-by-step description of how to determine the appropriate test method(s) is described below.

Operators should follow the lettered sequence found below when carrying out the sampling and analysis of their shallow injection well waste. Attachment B contains a visual representation of the steps to be followed. Each lettered section below can be treated as a step in the decision-making process necessary to complete a waste characterization. Requirements for a specific well type do not necessarily apply to operators of a differing well type.

a. Determination of the Presence of Listed Wastes

Operators of Class V injection wells should be aware that characterization of their wastestream is not wholly dependent upon comprehensive analyte concentration knowledge. Wastes may be hazardous, not only by individual analyte concentration exceedance, but also by matching a specific description of waste(s) found at 40 CFR §261.30-§261.33. Waste codes (F,K,P,U) found in this section refer to either (1) specific process-generated wastes or (2) listed analytes disposed of on land in a manner for which they were not intended or which do not meet product grade quality standards.

An operator must investigate the possibility that injected waste may meet a definition of hazardous waste as specified in 40 CFR §261-Subpart D. A positive match of waste with the waste codes in this section must be reported to Region 5 UIC staff as soon as it is known. In addition, a positive match may also require some groundwater sampling to determine the nature and extent of the waste contamination. A sampling plan for the site should be approved by Region 5 before sampling is initiated.

b. Operator Knowledge of Characteristically Hazardous Waste

As stated in the March 29, 1990, Federal Register Notice approving the Toxicity Characteristic Leaching Procedure (TCLP) and at 40 CFR 262.11(c)(2), an operator of an injection well may apply knowledge of the waste, the raw materials, and the processes used in its generation to determine if a waste exhibits any characteristic of hazardous waste. Such knowledge must be reported to Region 5 staff as soon as it is known. Any such claim should be supported with relevant documentation, such as Material Safety Data Sheets describing the materials stored or used onsite, a detailed description of the activities or manufacturing processes conducted on site that may contribute to the wastestream, and any management practices employed to prevent wastes from being injected underground.

c. Determining the Sampling Location

The sampling location will vary from site to site depending on well construction and wastestream source and production. The ideal sampling scheme would consist of ground water and soil samples taken at some defined point of compliance, close to the point of injection, in the drainfield or down-gradient from the point of injection. However, designing and implementing this type of sampling program would be time, labor, and cost intensive. For this reason, in a first level site assessment the sampling point may be at the wellhead, oil/water separator, septic tank, or in the dry well, although the operator may elect to conduct a groundwater sampling scheme as described above, if so desired. If the site assessment progresses to level three, then ground water and soil sampling in the drainfield should be conducted.

Sampling at the wellhead is not practical for most 5X28 and 5W20 wells because they do not receive a constant wastestream. For those Class V wells which receive a constant wastestream generated through a uniform, repeated process, sampling should consist of the liquid phase taken at the wellhead or before entering an oil/water separator or septic tank. Sampling a non-constant wastestream at the wellhead is difficult because there is no liquid phase present except during spills or washing down the site. It is also not representative because, if a sample can be obtained, it will consist of the latest spill or washwater, and will not provide a good indicator of the aggregate wastestream. Therefore, we suggest that if the disposal line is connected to an oil/water separator, liquid and sludge samples be taken from the separator. If a separator is not present and the line empties into a septic tank, then liquid and sludge samples should be taken from the tank. Finally, if there is no separator or septic tank present and the waste is going directly into a dry well, then sludge or sediment samples should be taken from the bottom of the well. If there is a liquid phase present in the well, it should also be sampled.

d. Requirements Specific to 5X28 Injection Wells

Operators of 5X28 wells should submit samples of both their waste sludge and waste water to a laboratory for chemical analysis. A list of 38 waste parameters to be tested for and their approved analytical methods is found in Attachment C. Operators may use this list when selecting a laboratory to perform analytical determinations. This list contains constituents common to the 39 found on the TCLP list, the 75 found on the Maximum Contaminant Level (MCL) list for National Primary Drinking Water standards and the most current database of constituents present in 5X28 wells across the country. Operators have the option of testing their waste using either a test method found in Attachment C or the TCLP method. The operator should notify USEPA which method is to be used prior to sampling. In addition, two characteristic tests are on this list: ignitability and corrosivity. The constituents found in either Attachment C or in the TC rule are those most likely to be of environmental concern in 5X28 wells because sampling data shows that they are the most likely constituents to be found in this well type and they can be present in hazardous concentrations. Quality assurance protocols must be observed as specified in paragraph (f) below.

e. Requirements Specific to 5W20 Injection Wells

Operators of 5W20 wells must submit samples of both their waste sludge and waste water to a laboratory for chemical analysis. The universe of possible individual constituents to be found in any given 5W20 well can be very large, considering the diversity of waste types covered within this well classification. Considering this point, if an operator has not conducted the exercise found under Part IV(A)(4)(b) above, or has found the waste to contain any of the constituents listed under the TC rule, then a complete TCLP analysis is required, along with tests of ignitability and corrosion. A partial TCLP analysis may be required, if upon completion of the exercise in paragraph (b) above, the operator can certify that not all constituents listed in the TC Rule may be present in the wastestream. Quality assurance protocols must be observed as specified in paragraph (f) below.

f. Quality Assurance and Quality Control Requirements

The process of analytical determination is reliable only if standard quality assurance and quality control measures are followed. These items should be described in great detail in a quality assurance project plan (QAPP) submitted to Region 5 for Agency approval prior to implementation of the sampling event(s). A complete QAPP would contain comprehensive descriptions of items 1 through 23 below. Attachment D is a suggested format for QAPP preparation. A complete QAPP would contain the 23 items listed below, presented following the 16 element outline found in Attachment D.

1. Sample description,
2. Sample collector,
3. Sample collection method,
4. Sample collection point,
5. Sample preservation technique,
6. Analytical method for parameter detection/quantification,
7. Anticipated quantification limit for each parameter,
8. Sampling schedule,
9. Equipment cleaning blanks,
10. Trip blanks,
11. Sample replicates,
12. Sample chain-of-custody protocol,
13. Equipment calibration,
14. Data reduction,
15. Data validation,
16. Data reporting,
17. Internal quality control,
18. Performance audits,
19. Systems audits,
20. Laboratory preventative maintenance,
21. Data assessment procedures,
22. Laboratory corrective actions, and
23. Quality assurance reports.

In view of the goal of sampling both 5X28 and 5W20 wells as soon as possible, Region 5 is presently requiring, at a minimum, items 1 through 7 above and all applicable quality assurance/quality control documentation from the laboratory selected. However, Region 5 reserves the right to require additional sampling and analyses, along with a QAPP containing all items above, in the format suggested in Attachment D.

g. Reporting Analytical Results

Operators should submit to Region 5 all documentation sent to them by the laboratory as well as all relevant records maintained by the injection facility. This should be done as soon as possible after the operator receives this information in order that USEPA staff can interpret the results in a timely manner.

B. Level 2 Site Assessment

If the information gathered in the level 1 site assessment shows that injection operations may have introduced contaminants into underground sources of drinking water, then it becomes necessary to determine whether the quantity, location, or toxicity of the contamination poses a threat to human health or the environment. Evaluation of the following information, gathered under a level 2 site assessment, is necessary in order to make such a determination. Well testing, such as slug or pump tests, may be considered in order to gather some of the information requested as part of a level 2 site assessment.

1) A topographic map of the site showing the locations and types of any discharge from or recharge to the injection aquifer, such as public or private water wells, rivers, etc., or other injection wells and septic systems, and the location of any samples taken for chemical analysis, within either a 2 mile radius of the well, or the zone through which the contaminant migrated, calculated using known site-specific hydraulic parameters;

2) The average and maximum rate and cumulative volume of waste injected into the subsurface during the duration of well operation; and

3) A description of the local hydrogeology of the site. This should include, but may not be limited to:

   a. The identification of any aquifer(s) receiving injected waste;

   b. A description and quantification of the groundwater quality of any receiving aquifer and all significant zones of saturation above or immediately below the injection zone;

   c. A description of the ground water flow system, including flow velocity, flow direction, vertical component of flow (if any), and interconnection between the injection zone and any significant zones of saturation located above or below the injection zone;

   d. The depth, thickness, permeability, porosity, water level(s), and lateral variations of the injection zone and any significant zones of saturation located above or below the injection zone; and

   e. The method(s) used to determine all information in parts a. through d. above (e.g. field tests, literature).

C. Level 3 Site Assessment

In moving from level 1 to level 2 site assessment, it was determined that the injection of wastes that are either hazardous or that violate national primary drinking water standards has occurred at the site. In order to move from level 2 to level 3, it should first be determined that the waste plume is in proximity to a point of discharge from the aquifer and that the plume may reach that point of discharge. Therefore, once level 3 is reached, it has already been determined that the injection activity has impacted the environment. The dual goals of level 3 site assessment is to determine whether human health is endangered, and to delineate the extent of the impact on the environment. The information gathered during level 3 site assessment can also be used in planning remediation options, if it has been determined that remediation is necessary.

Upon evaluation of the information submitted in the site assessment under Parts IV(A) and IV(B) of this document, the USEPA may request additional information to be submitted as part of a level 3 site assessment. The information should either demonstrate that the waste plume does not threaten human health or help to determine the extent of the threat. Such information may be in the form of a demonstration that the hazardous constituents in the

plume undergo a transformation in the subsurface rendering them non-toxic, or a larger area of review may be searched to demonstrate that the plume will never migrate to a point where it could impact human health. In the event that neither of these options can demonstrate that the waste plume will not threaten human health, it may be necessary for data gathering devices such as a monitoring network be installed at the injection well site.

1) If a groundwater monitoring network is required, the following information should be submitted for approval prior to installation of that network:

   a. The proposed number, location, depth, and construction of detection monitoring wells; and

   b. The techniques, procedures, and analytical equipment to be used for ground water sampling during the assessment, including but not limited to:

      1. Method for measurement of groundwater elevations; and

      2. A quality assurance plan for the installation and operation of a monitoring well network. The plan should conform to the guidelines given in Attachment D.

2) Any additional information may be requested by the Director.

Further information on ground water monitoring can be obtained in RCRA Ground Water Monitoring Technical Enforcement Guidance Document (1986).

The Director may, based on an evaluation of the site, choose to waive any of the elements of a site assessment plan listed above.

ATTACHMENT A
SAMPLE CALCULATION FOR CONTAMINANT TRANSPORT

The governing equations when predicting groundwater contaminant transport can be quite complex, attempting to deal with such elusive variables as contaminant-specific molecular diffusion, physical and chemical isotropy of the medium, and actual direction of groundwater flow. As such, a simplified approach is taken here. The following exercise assumes a one-dimensional particle path, which is directly down the groundwater flow gradient. The aquifer is assumed to have isotropic and homogeneous physical and chemical characteristics. The equation which will predict the velocity of the groundwater flow in the one dimension (x-direction) is

(1) $v_x=(K/n_e)(dh/dl)$ Source: Fetter, 2nd ed., 1988

where v_x=velocity in cm/sec
K=permeability in cm/sec
n_e=effective Darcian porosity (%/100)
dh/dl=groundwater gradient (cm/cm)

The equation which governs the transport of a solute in this one-dimensional flow is

(2) $C/C_o=0.5\times[\text{erfc}\{(L-v_xt)/(2\sqrt{(D_Lt)}\}+\exp\{v_xL/D_L\}\times\text{erfc}\{(L+v_xt)/(2\sqrt{(D_Lt)}]$

where C=[constituent] at time t (mg/l) Source: Fetter, 2nd ed., 1988
C_o=[constituent] at time t_o (mg/l)
L=distance from well (cm)
t= time (sec)
erfc=complimentary error function
exp=exponential function

Since equation (2) takes the form of $C/C_o=0.5\times$ (dispersion term + diffusion term), the relative contribution of each term is important. In most cases, the effect of diffusion is orders of magnitude lower than that of dispersion and may be ignored when making an approximation. Hence, equation (2) reduces to

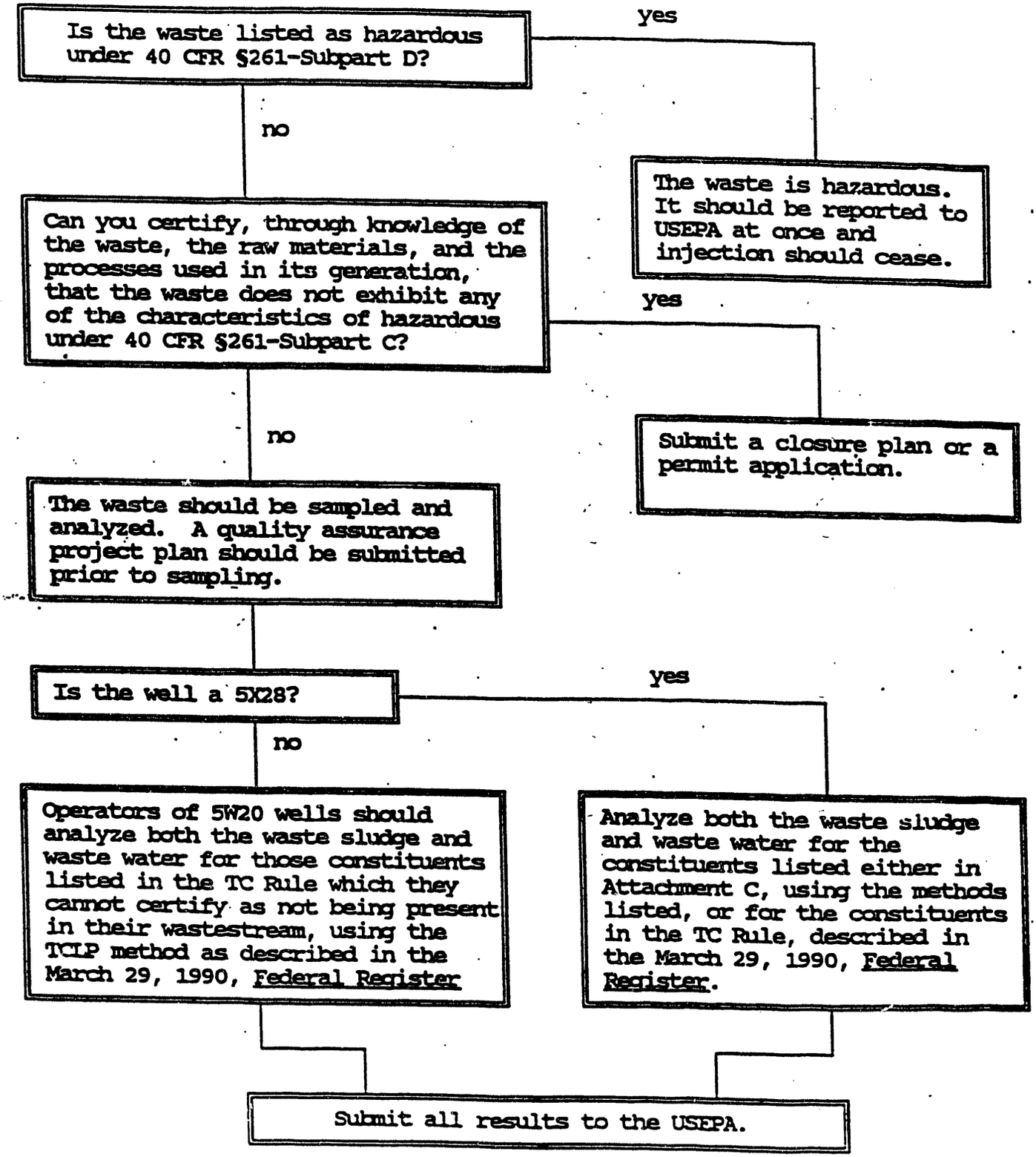
(3) $C/C_o=0.5\times\text{erfc}\{(L-v_xt)/(2\sqrt{(D_Lt)}\}$

By assigning the measured value of 3.5 mg/l benzene to C_o and defining C to be its TC limit of 0.5 mg/l, we can choose a length of time of injection and calculate the distance at which the hazardous plume front will be found in a linear distance from the well, L. This process is simply done by finding the value of the erfc argument in equation (3) which corresponds to $2.0\times C/C_o$ and then solving for L.

After a year of constant injection, with the input parameters of K=0.1 cm/sec, n_e=0.20, dh/dl=0.01, $t=3.15\times10^7$ sec (1 year), the distance that the hazardous waste plume front will travel is 2136 feet, or roughly 0.4 miles from the well. This calculation is performed using the concentration data from a Class 5X28 well in New York State. The parameters assumed for the hydrogeology are from typical glacial till sand lenses found in Region 5, and are approximations only. It should be noted that site specific values for these parameters are crucial to any such attempt at modeling the extent of plume migration. The extent of contaminant transport is also highly dependent upon

such physical factors as topographic relief and water table fluctuations induced by human activity such as water well pumping and aquifer recharge. These factors influence the hydraulic parameters used above. This information, however, is typically not available at many Class V injection well sites.

ATTACHMENT B
SAMPLING FLOW CHART FOR 5W20 AND 5X28 OPERATORS
LEVEL 1 SITE ASSESSMENT



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ATTACHMENT C

LIST OF CONSTITUENTS AND THE APPROPRIATE TEST METHODS FOR CLASS 5X28 WELLS

INORGANICS

CONSTITUENT	PREFERRED METHOD	OTHER METHODS
Arsenic	6010	7060/7061
Barium	6010	7080/7081
Cadmium	6010	7130/7131
Chromium	6010	7190/7191
Lead	6010	7420/7421
Mercury	7470	
Nickel	6010	7520
Selenium	6010	7740/7741
Silver	6010	7760/7761
Ignitability	1010/1020	
Corrosivity	1110	

ORGANICS

CONSTITUENT	PREFERRED METHOD	OTHER METHODS
Benzene	8240	8020
Carbon Tetrachloride	8240	8010
Chlorobenzene	8240	8010/8020
Chloroform	8240	8010
1,4-Dichlorobenzene	8250/8270	8010/8020/8120
1,2-Dichloroethane	8240	8010
1,1-Dichloroethene	8240	8010
trans-1,2-Dichloroethene	8240	8010
1,2-Dichloropropane	8240	8010
2,4-Dinitrotoluene	8250/8270	8090
Ethylbenzene	8240	8020
Hexachloro-1,3-butadiene	8120	
Hexachlorocyclopentadiene	8250/8270	8120
Hexachloroethane	8250/8270	8120
Nitrobenzene	8250/8270	8090
PAHs (Benzo(a)pyrene)	8250/8270	8100
Pentachlorophenol	8250/8270	8040
Phthalates	8060	
Tetrachloroethene	8240	8010
Toluene	8240	8020
1,2,4-Trichlorobenzene	8250/8270	8120
Trichloroethene	8010	
1,1,1-Trichloroethane	8240	8010
1,1,2-Trichloroethane	8240	8010
2,4,6-Trichlorophenol	8040	
Vinyl Chloride	8240	8010
Xylenes	8240	8020

All test methods are taken from "Test Methods for Evaluating Solid Waste Physical/Chemical Methods, SW-846"

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ATTACHMENT D

SUGGESTED FORMAT FOR A QUALITY ASSURANCE PROJECT PLAN (QAPP)

1. Title Page and QAPP Approval
2. Table of Contents
3. Project Description
4. Project Organization and Responsibility
5. Quality Assurance Objectives for Measurement Data in Terms of Precision, Accuracy, Completeness, Representativeness, and Comparability
6. Sampling Procedures
7. Sample Custody
8. Calibration Procedures and Frequency
9. Analytical Procedures
10. Internal Quality Control Checks
11. Data Reduction, Validation and Reporting
12. Performance and System Audits
13. Preventative Maintenance
14. Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completeness
15. Corrective Action
16. Quality Assurance Reports to Management

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APPENDIX D

EPA REGION 9

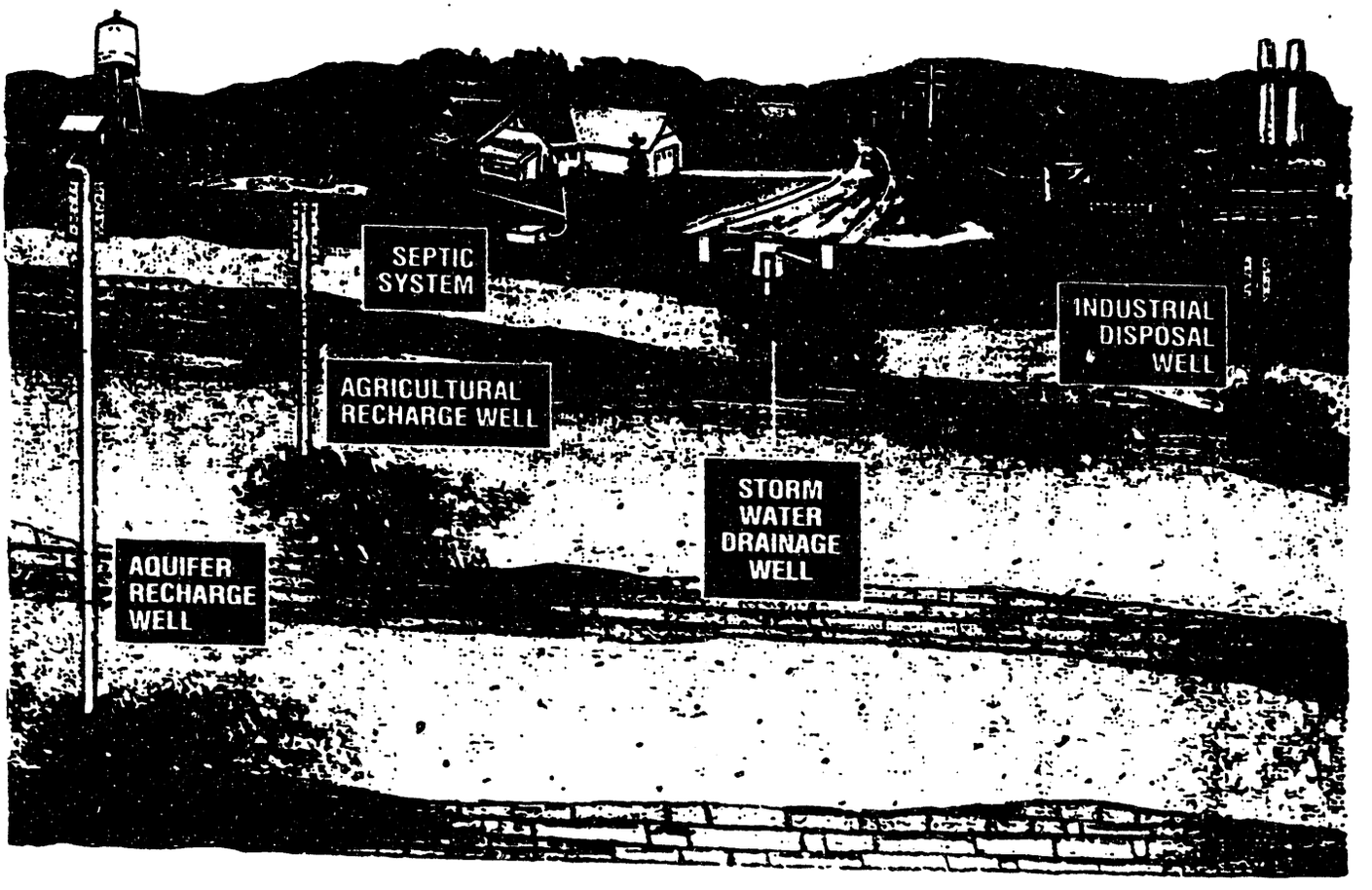
GUIDELINES FOR CLOSURE OF SHALLOW DISPOSAL WELLS

EPA - REGION 9

GUIDELINES FOR CLOSURE

OF

SHALLOW DISPOSAL WELLS



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I. INTRODUCTION

The Safe Drinking Water Act (SDWA) of 1974, as amended, requires the U. S. Environmental Protection Agency (EPA) to establish a program which provides for the safety of the nation's drinking water. The Underground Injection Control (UIC) program was established under the SDWA to prevent contamination of underground sources of drinking water from improper use of disposal wells.

Underground sources of drinking water vary in depth and quality from pristine aquifers a few feet beneath the ground surface to aquifers that are thousands of feet deep containing up to 10,000 parts per million of dissolved solids, usually in the form of salts. Over 50% of the U.S. population relies on these aquifers for drinking water, and the percentage is increasing every year.

Disposal wells covered by the UIC program include bored, driven or drilled shafts or dug holes whose depth is greater than the largest surface dimension, where the principal function of the shaft or hole is the emplacement of fluids. Under certain conditions, sumps, septic tanks, cesspools and drainfields may also be considered disposal wells. For the purposes of the UIC program, a fluid is any material or substance which flows or moves, whether in a semisolid, liquid, sludge, gas or any other form or state. Contaminants introduced into underground sources of drinking water through the use of disposal wells include bacteria and viruses, minerals and nitrates, heavy metals, organic chemicals and pesticides.

Most types of disposal wells are subject to construction, performance and monitoring requirements designed to ensure that no contamination of underground sources of drinking water occurs through their use. Wells that discharge fluids into or above an underground source of drinking water are generally classified as shallow disposal wells and are not always subject to these requirements. The disposal of hazardous fluids into shallow wells (Class IV wells) is prohibited under the SDWA. However, many shallow wells (Class V) accept fluids that are not defined as hazardous, but still have a potential to contaminate underground sources of drinking water. EPA Region IX is requesting closure of such wells.

This guidance is designed to aid in the proper closure of shallow disposal wells. In addition to providing guidelines for the closure of these wells, general information is included concerning sampling equipment, methods and procedures for collecting liquid, sediment and soil samples; required methods of sample analysis; contractor and laboratory requirements; and sample chain of custody requirements.

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It is important to note that this guidance is designed to aid in the closure of wells. The owner or operator of a facility is ultimately responsible for proper closure of the wells and is also responsible for complying with other federal regulations such as RCRA and CERCLA, and with state and local regulations. The owner or operator must ensure that facility practices do not contribute to the contamination of ground water.

II. REQUIREMENTS FOR CONTRACTORS

Activities involving site assessment and well closure require a professional level of expertise. In addition to knowledge regarding the correct procedures and methods used in collecting samples, some investigations may require a knowledge of the mechanisms of contaminant transport; federal, state and local regulations and ordinances relating to waste management; and actions needed to remediate a contaminated site.

To ensure that the contractor has the qualifications - through a combination of education and experience - to perform sampling and site assessment requirements, EPA Region IX requires that:

1. The contractor submit an acceptable sampling plan which addresses:

    a. types of sampling containers and their preparation
    b. sample preservation methods
    c. sampling equipment and method of sample retrieval
    d. familiarity with specified sampling methods
    e. certified lab to which samples will be sent
    f. chain of custody

2. The individual signing any report related to a workplan for closure of a well or a sampling plan must be a professional geologist or a civil engineer registered with the state. This individual shall be responsible for the content, validity and completeness of the report. All reports related to well closure activities shall include the following certification:

    I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, I certify that the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

III. LABORATORY SELECTION

Either state-certified laboratories or those associated with EPA's Contract Lab Program must be used for sample analyses. If the distance to the nearest laboratory is such that hand-delivery is not possible, samples should be express/overnight delivered. All laboratories involved in the analysis of samples must retain their calibration logs for two years, laboratory data logs for three years, and sampling labels or information from the labels for three years. All analytical tests must be performed in accordance with methods acceptable under quality assurance guidelines. A quality assurance plan must be submitted with the sampling plan. For more information regarding laboratory selection, see the reference section of this document.

IV. CLASS IV AND V WELL CLOSURE GUIDELINES

When any Class IV or Class V well threatens to violate a primary drinking water regulation or otherwise causes conditions that may adversely affect public health, EPA Region IX, upon learning of such violation or conditions, will require closure of the well. Closure must then be accomplished in such a manner as to ensure that no movement of fluid containing any contaminant will move into underground sources of drinking water (USDWs). As an element of proper well closure, Region IX may require cleanup of soil and/or groundwater in and around the Class IV or V well.

To meet EPA requirements, well closure should, at a minimum, include the elements of the following guidelines:

1. Provide an acceptable alternative for disposal of waste fluids. The alternative must comply with all regulations such that no violation or future violation of primary drinking water standards will result. EPA requests the use of management practices that reduce the amount of contaminants released into the environment through product changes, improved operating practices, reuse of materials, onsite closed-loop recycling, on and off-site reclamation, and water conservation.

2. Identify the locations of all drains, drain lines, drywells, and cesspools or septic systems at the facility.

3. Contact EPA at least seven (7) days in advance of any site operations relating to closure activities.

4. Take representative samples from the liquid and/or sludge phase present in the drain(s) and the well(s) or septic tank(s) in accordance with the procedures described in "Sampling Methods and Procedures" under "Sample Collection". Have the samples analyzed for volatile organics, metals, total petroleum hydrocarbons and oil and grease in accordance with the methods described under "Sample Analysis" and, if necessary, prepared in accordance with the methods for the Toxicity Characteristic Leaching Procedure (TCLP) in 40 C.F.R. Part 261 Appendix II as amended June 29, 1990. Copies of sampling and analysis results, and results of all quality control samples, must be submitted to EPA.

5. Remove the contents from the drains and drain lines and the well(s) or septic tank(s) and determine appropriate disposal methods based on the results of the sample analyses. The owner/operator is ultimately responsible for proper disposal of all wastes, and should carefully review all arrangements for disposal to ensure compliance with federal, state and local regulatory requirements.

6. Disconnect the drain lines from the well, pressure wash the drains and lines, fill them with grout or cement, and permanently seal them. All waste associated with cleaning the drains and lines should be disposed of in accordance with federal, state, and local regulations.

7. Observe the following closure requirements for septic tanks and wells:

Case A: Septic system accepting industrial and sanitary wastewater into a common septic tank and drainfield or leachfield.

The septic tank should have the contents removed and disposed of appropriately. If a visual inspection of the tank indicates cracks or leaks, the tank and any visibly contaminated soil in the vicinity should be removed and disposed of appropriately. Soil samples should be taken below the bottom of the tank excavation in the manner described in "Sampling Methods and Procedures" under "Sample Collection" and analyzed by a certified analytical laboratory. If the tank does not have any cracks or leaks, soil samples may be taken at either end of the tank at a depth that is at least as deep as the bottom of the tank. The tank may then be used for sanitary waste only, and the drain pipes leading from the restrooms need not be disconnected. Soil samples must also be taken along every twenty feet of drainfield or leachfield and sent to a certified laboratory for analysis. It is recommended that soil samples be taken at other locations where there is a potential for a high degree of contamination (worst-case locations) such as elbows and joints in pipe lines, floor drains and clarifiers. All soil samples should be analyzed according to the methods in "Sampling Methods and Procedures" under "Sample Analysis". In addition, at least two soil samples, taken at the worst-case location around either the tank or drainfield, must be both analyzed for total concentrations and prepared in accordance with the methods for the Toxicity Characteristic Leaching Procedure (TCLP) in 40 C.F.R. Part 261 Appendix II as amended June 29, 1990. See Figures A-1 and A-2 for required and recommended soil sample locations.

Case B: Septic system accepting only industrial wastewater into a septic tank and drainfield or leachfield.

The septic tank should have the contents removed and disposed of appropriately. Any visibly contaminated soil in the vicinity of the tank should be removed and disposed of appropriately. If the tank has cracks it should be removed and disposed of properly. Soil samples should be taken below the bottom of the tank excavation in the manner described in "Sampling Methods and Procedures" under "Sample Collection" and analyzed by a certified analytical laboratory. Soil samples must also be taken along every twenty feet of drainfield or leachfield. It is recommended that soil samples be taken at other suspected worst-case locations such as elbows and joints in pipe lines, floor drains and clarifiers. All soil samples should be analyzed according to the methods in "Sampling Methods and Procedures". In addition, at least two soil samples, taken at the worst-case location around either the tank or drainfield, must be both analyzed for

total concentrations and prepared in accordance with the methods for the Toxicity Characteristic Leaching Procedure (TCLP) in 40 C.F.R. Part 261 Appendix II as amended June 29, 1990. The excavated area should then be backfilled with clean suitable fill material. See Figures B-1 and B-2 for required and recommended soil sample locations.

Case C: Drywells, cesspools or drainage wells accepting industrial and sanitary wastewaters, or only industrial wastewaters.

The drywell, cesspool or drainage well (identified hereafter as "well") should have the contents removed and disposed of appropriately. It is required that the well casing be removed if it is practicable. Any visibly contaminated soil underlying the contents of the well should be removed. Soil samples should be taken in the center of the bottom of the well in the manner described in "Sampling Methods and Procedures" under "Sample Collection" and analyzed by a certified analytical laboratory. If taking samples from the bottom of the well is not feasible, samples should be taken on opposite sides of the well, at a distance not to exceed one foot away from the borehole, and starting at a depth that is equivalent to the depth of the bottom of the well. It is recommended that soil samples be taken at other suspected worst-case locations such as elbows and joints in pipe lines, floor drains and clarifiers. All soil samples should be analyzed according to the methods in "Sampling Methods and Procedures". In addition, at least two soil samples, taken at the worst-case location, must be both analyzed for total concentrations and prepared in accordance with the methods for the Toxicity Characteristic Leaching Procedure (TCLP) in 40 C.F.R. Part 261 Appendix II as amended June 29, 1990. The remaining hole where the well has been removed should then be filled with grout and sealed with asphalt or cement. See Figures C-1 and C-2 for required and recommended soil sample locations.

Case D: Leachfield/filtration gallery accepting sanitary and industrial wastewaters, or only industrial wastewaters.

The practice of disposing sanitary and/or industrial wastewaters directly to a leachfield/filtration gallery without the use of a septic tank is unacceptable. The leachfield should be excavated, and all visibly contaminated soils removed and disposed of appropriately. Soil samples must be taken along every twenty feet of drainfield or leachfield in the manner described in "Sampling Methods and Procedures" under "Sample Collection" and sent to a certified laboratory for analysis. It is recommended that soil samples be taken at other suspected worst-case locations such as elbows and joints in pipe lines, floor drains and clarifiers. All soil samples should be analyzed according to the methods in "Sampling Methods and Procedures". In addition, at least two soil samples, taken at the worst-case locations in the drainfield or leachfield, must be both analyzed for total concentrations and prepared in accordance with the methods for the Toxicity Characteristic Leaching Procedure (TCLP) in 40 C.F.R. Part 261 Appendix II as amended June 29, 1990. The area should be regraded using clean fill. See Figures D-1 and D-2 for required and recommended soil sample locations.

8. Contact state and local agencies and incorporate their requirements into the well closure plans.

9. Submit a report, upon completion of well closure activities, that includes the following items:

- A plot plan showing locations of disposal or drainage well(s), sampling points, buildings and adjacent streets. Indicate the north direction by an arrow.
- Copies of all fluid, sludge and soil samples analysis results, and results of all quality control samples.
- Copies of manifests or other documentation pertaining to proper disposal of all removed liquid, sludge and soil.
- A description of the extent of site contamination. Should site remediation appear necessary, recommendations from a registered geologist or registered civil engineer, with sufficient experience in soils, should be included to address the problem.

10. Include, on all reports submitted to EPA that relate to well closure activities, the certification given in "Requirements for Contractors".

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These guidelines do not constitute a remediation plan. It is the responsibility of the owner or operator to ensure that further site evaluation be conducted if analytical results of the soil samples indicate the presence of contamination.

All submittals are to be sent to:

Underground Injection Control Section
U.S. Environmental Protection Agency
75 Hawthorne Street, W-6-2
San Francisco, CA 94105

Case A: Soil Sample Locations for a Septic System Receiving Both Industrial and Sanitary Wastes

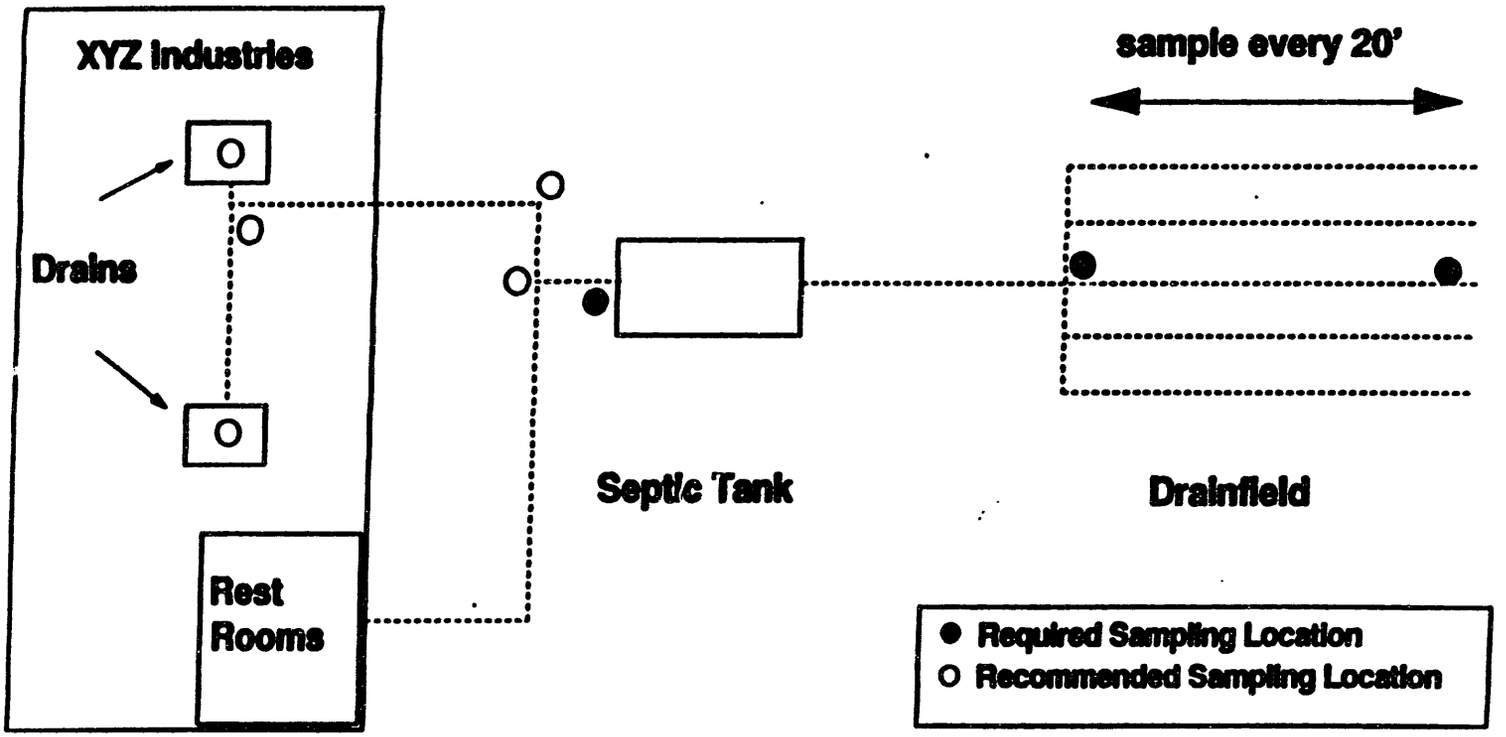

Figure A-1: Plan View

Note: The soil sample locations shown above meet the minimum requirements of the EPA UIC Program. However, the owner and/or operator of the well is also responsible for meeting the requirements of all other applicable federal, state, and local laws, and for adequately assessing the extent of any soil or ground water contamination.

Case A: Soil Sample Locations for a Septic System Receiving Both Industrial and Sanitary Wastes

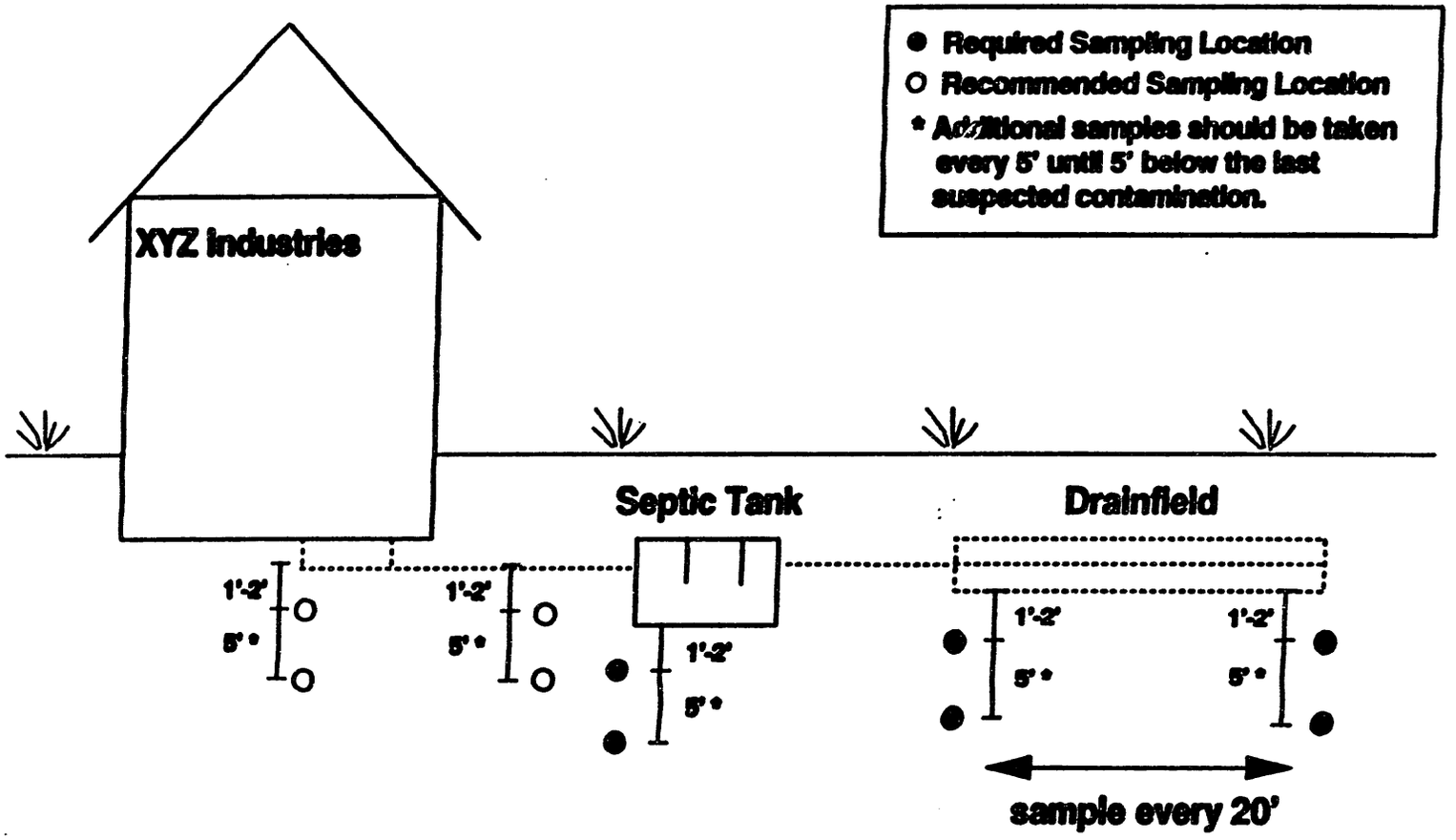

Figure A-2: Side View

Note: The soil sample locations shown above meet the minimum requirements of the EPA UIC Program. However, the owner and/or operator of the well is also responsible for meeting the requirements of all other applicable federal, state, and local laws, and for adequately assessing the extent of any soil or ground water contamination.

Case B: Soil Sample Locations for a Septic System Receiving Only Industrial Wastes

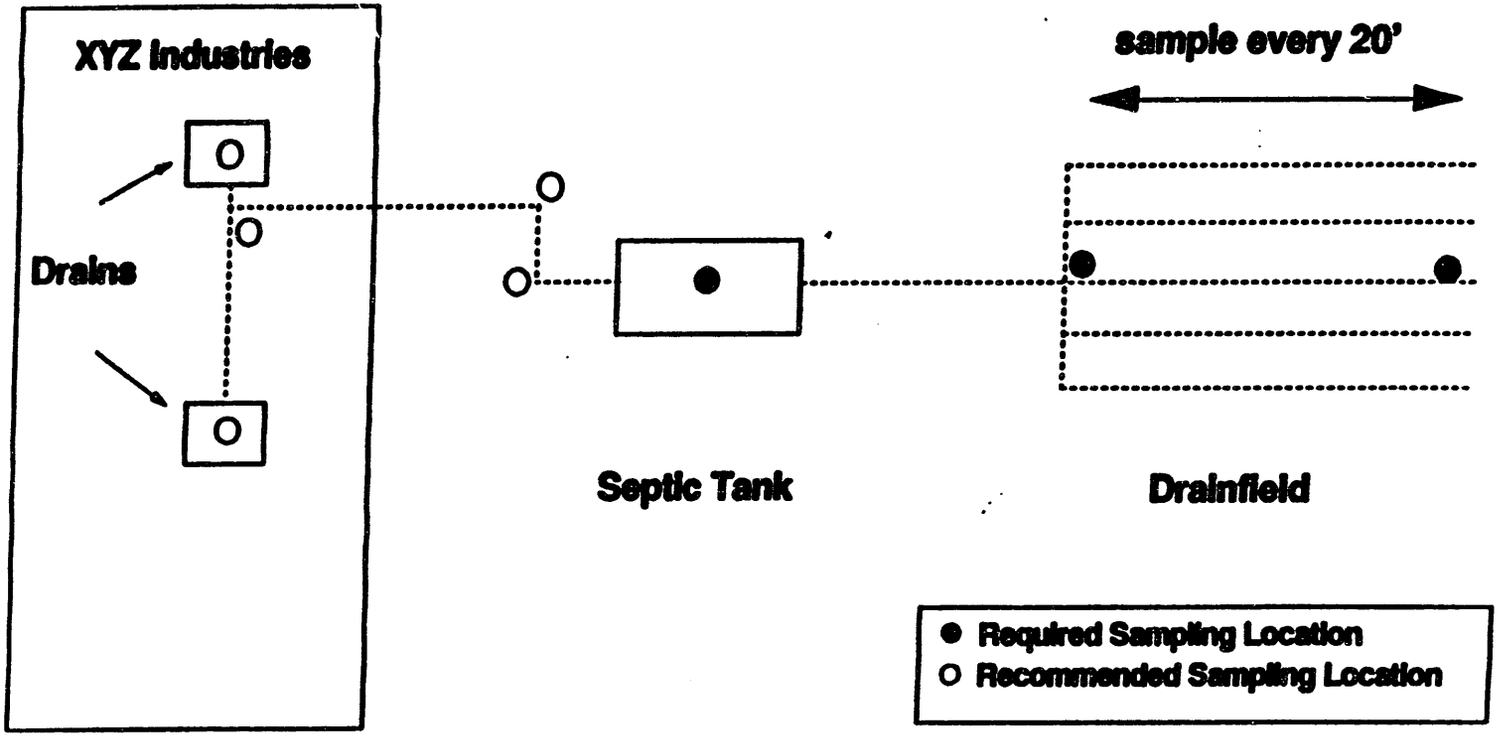

Figure B-1: Plan View

Note: The soil sample locations shown above meet the minimum requirements of the EPA UIC Program. However, the owner and/or operator of the well is also responsible for meeting the requirements of all other applicable federal, state, and local laws, and for adequately assessing the extent of any soil or ground water contamination.

Case B: Soil Sample Locations for a Septic System Receiving Only Industrial Wastes

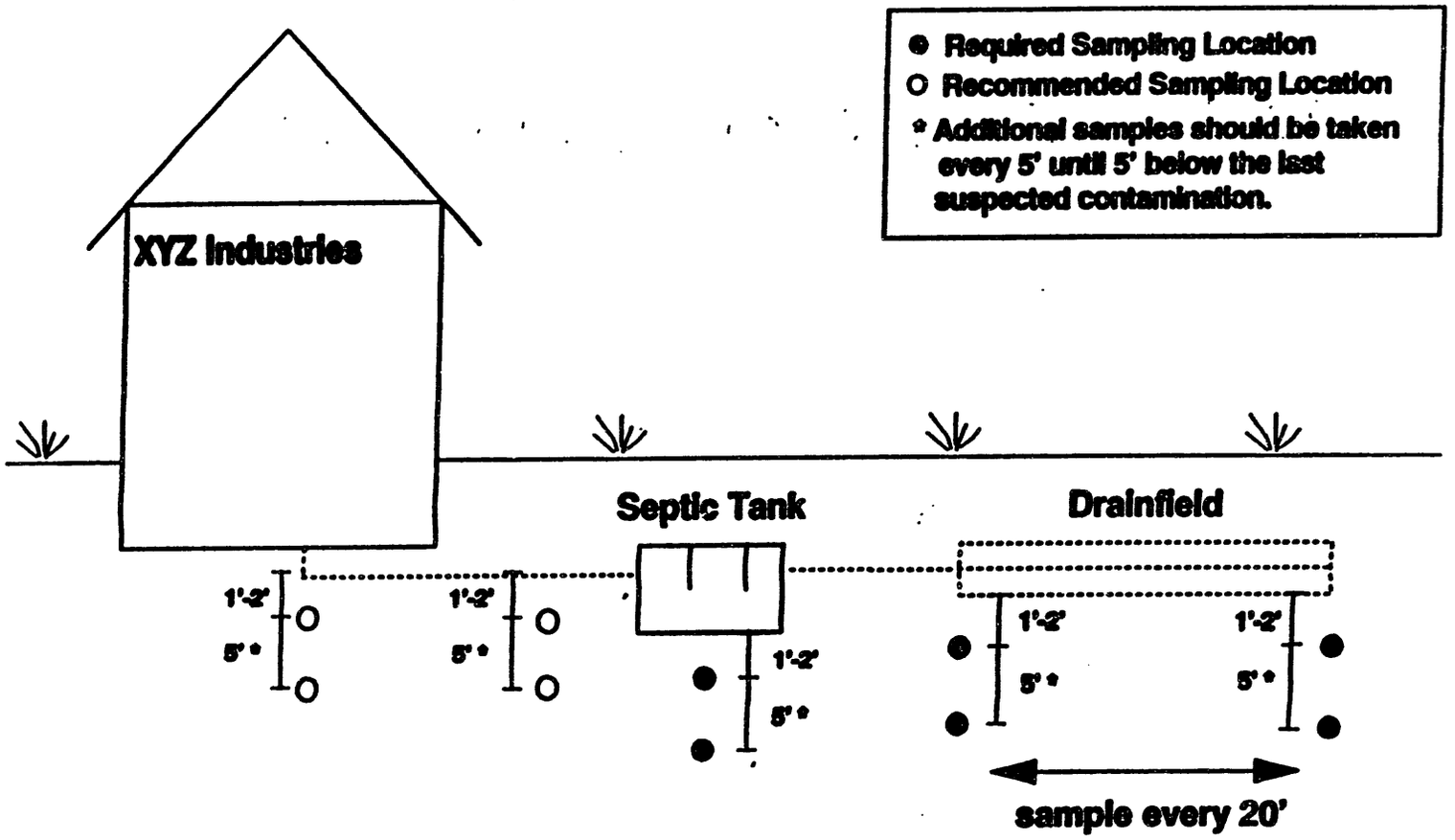

Figure B-2: Side View

Note: The soil sample locations shown above meet the minimum requirements of the EPA UIC Program. However, the owner and/or operator of the well is also responsible for meeting the requirements of all other applicable federal, state, and local laws, and for adequately assessing the extent of any soil or ground water contamination.

Case C: Drywell, Cesspool, or Drainage Well Receiving Both Industrial and Sanitary Wastes or Only Industrial Wastes

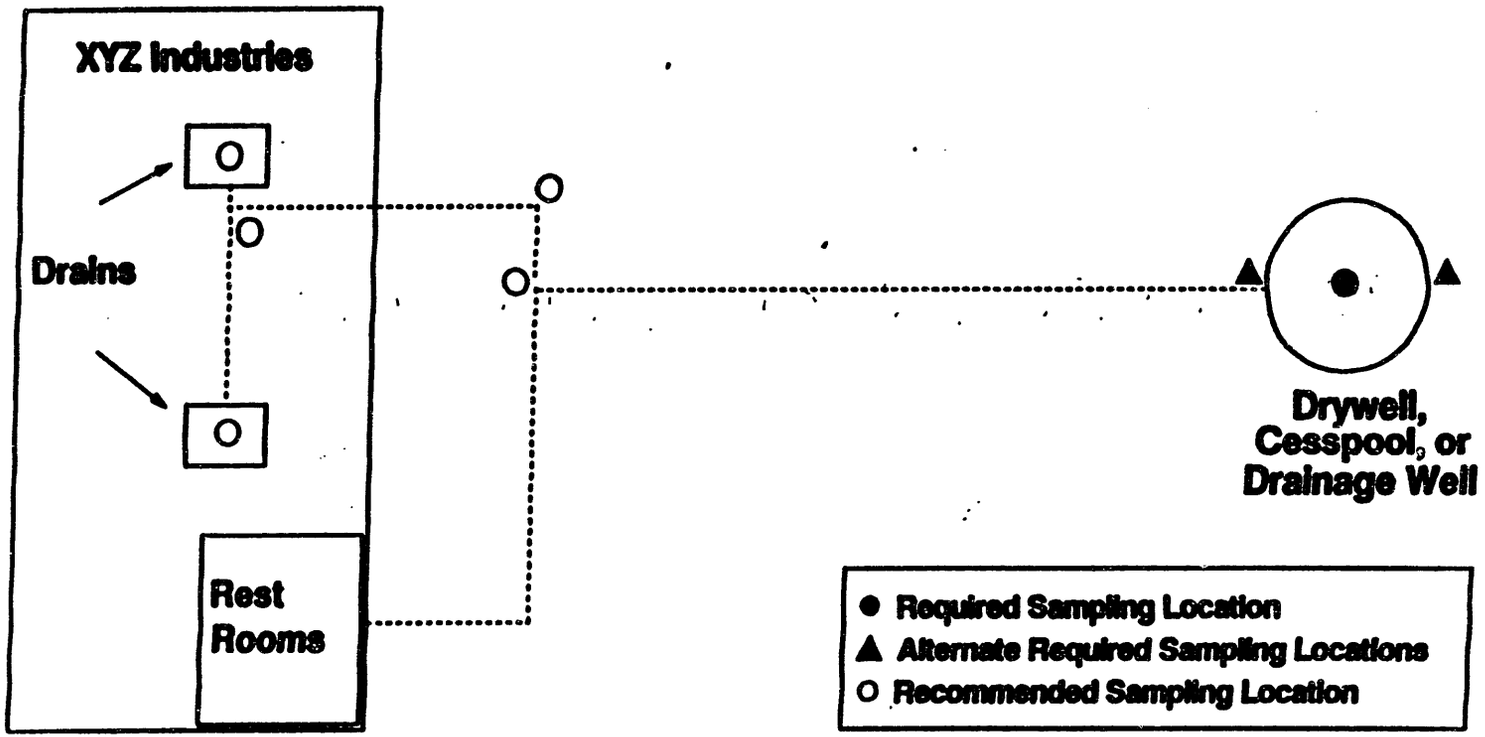

Figure C-1: Plan View

Note: The soil sample locations shown above meet the minimum requirements of the EPA UIC Program. However, the owner and/or operator of the well is also responsible for meeting the requirements of all other applicable federal, state, and local laws, and for adequately assessing the extent of any soil or ground water contamination.

Case C: Drywell, Cesspool, or Drainage Well Receiving Both Industrial and Sanitary Wastes or Only Industrial Wastes

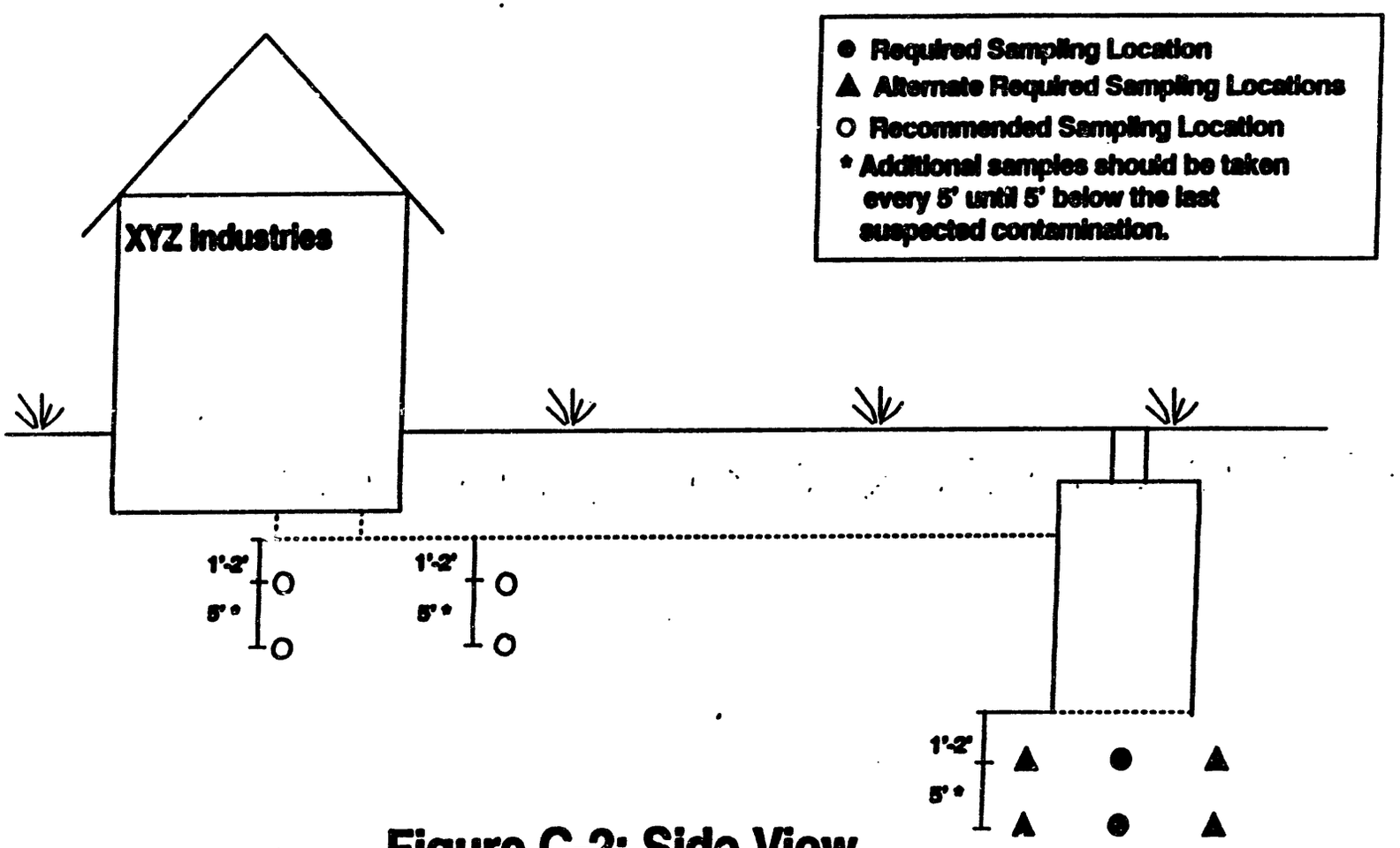

Figure C-2: Side View

Note: The soil sample locations shown above meet the minimum requirements of the EPA UIC Program. However, the owner and/or operator of the well is also responsible for meeting the requirements of all other applicable federal, state, and local laws, and for adequately assessing the extent of any soil or ground water contamination.

Case D: Leachfield/Infiltration Gallery Receiving Both Industrial and Sanitary Wastes or Only Industrial Wastes

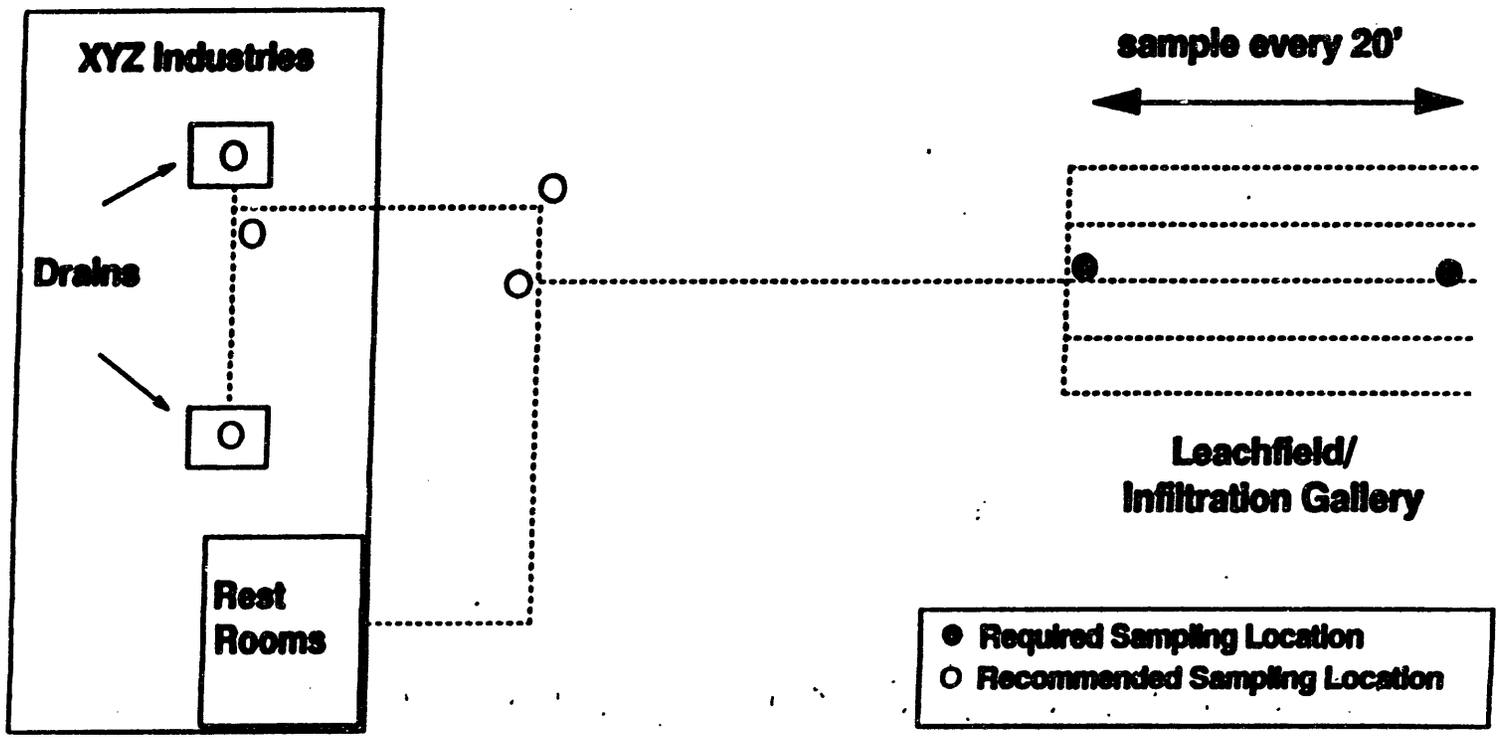

Figure D-1: Plan View

Note: The soil sample locations shown above meet the minimum requirements of the EPA UIC Program. However, the owner and/or operator of the well is also responsible for meeting the requirements of all other applicable federal, state, and local laws, and for adequately assessing the extent of any soil or ground water contamination.

Case D: Leachfield/Infiltration Gallery Receiving Both Industrial and Sanitary Wastes or Only Industrial Wastes

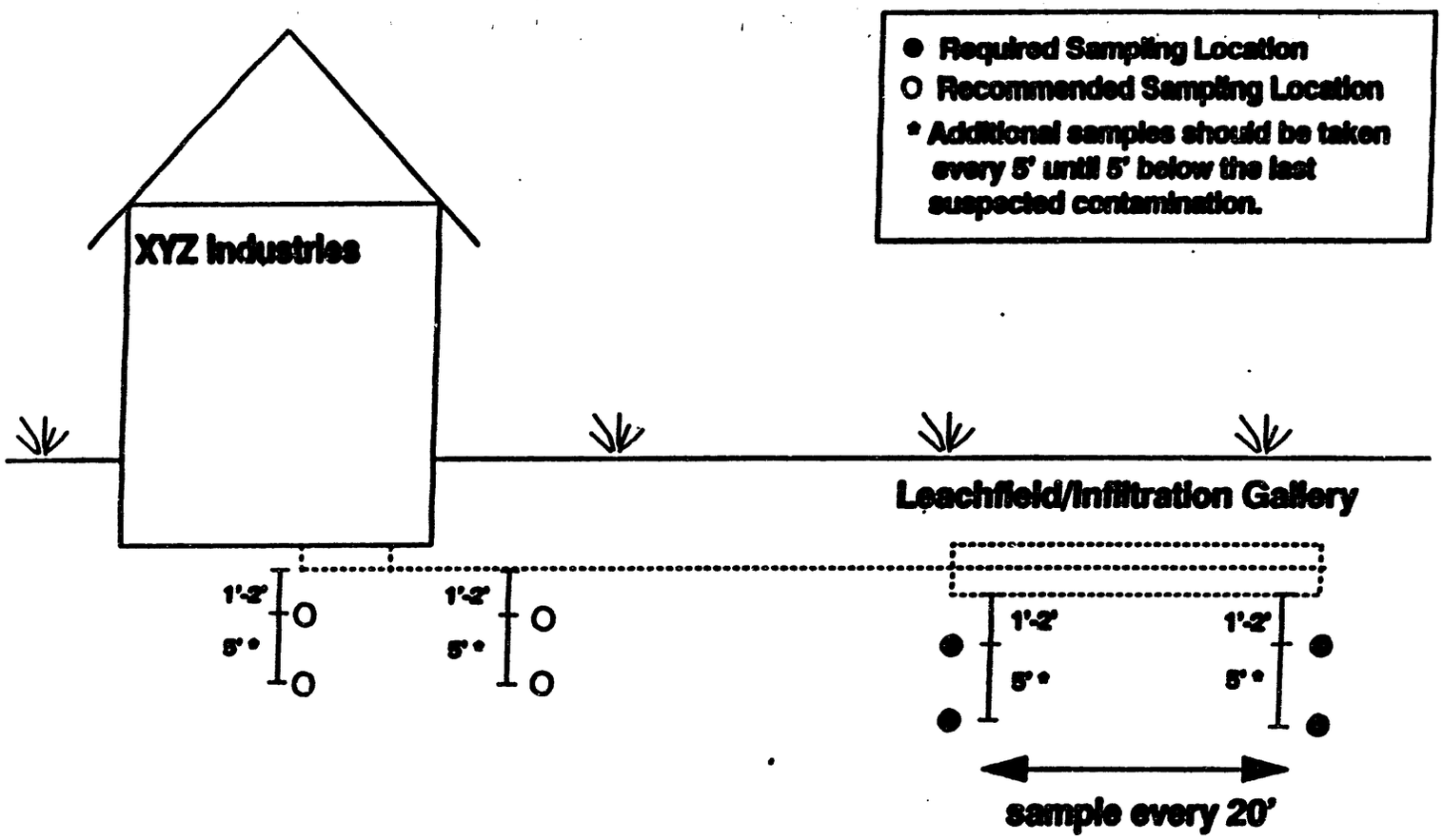

Figure D-2: Side View

Note: The soil sample locations shown above meet the minimum requirements of the EPA UIC Program. However, the owner and/or operator of the well is also responsible for meeting the requirements of all other applicable federal, state, and local laws, and for adequately assessing the extent of any soil or ground water contamination.

V. SAMPLING METHODS AND PROCEDURES

A. Sampling Equipment

Various types of equipment may be used to collect grab samples from shallow well systems. Typical sampling equipment includes pond samplers, weighted bottles, and bailers. The equipment is usually made of stainless steel, glass or Teflon. Other equipment may be used when the situation warrants.

The pond sampler is used when the system is easily accessible and when the sampling point is deeper than arm's length. This sampling device consists of a telescoping aluminum rod to which a stainless steel or nalgene beaker is attached using an adjustable stainless steel C-clamp. The size of the beaker is determined by the volume and number of samples to be collected.

The bailer is useful for sampling from small diameter wells, septic tanks, and other areas where openings are too small to permit use of the pond sampler. A bailer is lowered into the fluid with a rope and retrieved with a sample of the fluid.

Weighted bottles or similar devices may be utilized to sample fluid at a depth below an oil/water interface. Such devices must be lowered below the floating product phase before opening. Fluid from below the interface may then be retrieved.

Often sediment samples from the bottom of a sump are collected using a beaker attached to a pond sampler. A stainless steel lab scoop is generally used to transfer the sediment from the beaker to the required container. Trowels and drive samplers are also used to collect samples.

In addition to the sampling equipment typically used to obtain samples, nalgene bottles for liquid sample transfer; certified organic-free, metal-free water for quality assurance blank samples; and instruments for measurement of fluid pH and temperature are used.

It is important to avoid using equipment or containers that may alter the sample through the introduction of foreign matter. Contaminated sampling equipment can result in leaching or particulate fallout, volatilization or adsorption of the sample.

B. Equipment Decontamination

All sampling equipment must be decontaminated before and after each sampling event. All quality control equipment blank samples must be obtained after equipment has been thoroughly decontaminated, prior to collecting injectate samples. Decontamination procedures should be as follows:

1. Disassemble equipment
2. Wash with non-phosphate detergent (alconox) and tap water
3. Rinse with tap water
4. Rinse with isopropyl alcohol (use a squirt bottle)
5. Rinse with deionized or distilled water (triple)
6. Rinse with certified organic free, metal-free water

C. Quality Assurance/Quality Control

Quality assurance (QA) is the process of assuring that data obtained are technically sound and properly documented. Quality control (QC) procedures are employed to measure the degree to which quality assurance objectives are met.

This document is intended to provide guidelines on some of the minimum requirements necessary to ensure the quality of the data produced by the sampling/analysis activities required by EPA prior to well closure. The regulated facilities are responsible for the quality of the data produced, and are expected to provide data of known, documented, and verifiable quality.

Following is a list of some of the quality control samples which can be employed. In general, at least one replicate sample, and one type of blank must be obtained for every ten field samples. And, if there are less than ten field sampling points, at least one replicate sample and one type of blank must be obtained.

1. Trip Blanks:

Trip blanks are used to detect contamination or cross-contamination which may have occurred during sample handling and transportation. These blanks must be prepared prior to the sampling effort and will accompany sample containers used during sampling and in the transport cooler. The trip blanks consist of certified metal-free, organic-free water and will be analyzed by a certified laboratory at the time the other samples are analyzed.

2. Equipment Blanks:

Quality control (QC) equipment blanks are used to assess the caliber of field decontamination procedures. After the sampling equipment has undergone decontamination procedures, certified metal-free, organic-free water is poured into the sampling equipment and from there into sampling containers. These containers are preserved, documented and analyzed in exactly the same manner as those containers holding samples of waste fluid.

3. Replicate Samples:

Replicate sampling is used to determine consistency in both sampling procedures and analytical methods. In general, replicate samples must be obtained at one out of every ten sampling points, and at least one replicate sample must be obtained if there are less than ten sampling points. To collect these samples, fluid is obtained from a sampling point and split between two identical containers. Both containers undergo the same method of analysis at the laboratory. The laboratory is not informed of the existence of QC samples.

In addition, split samples, spiked samples and field blanks are used for QA/QC purposes. These can be briefly described as follows:

4. Split Samples:

This is a sample that has been divided into two containers for analysis by separate laboratories. A split sample aids in identifying discrepancies in the laboratory's analytical techniques and procedures.

5. Spiked Samples:

This is a sample to which a known quantity of analyte(s) of interest has been added. Spiked samples are for the purpose of checking the accuracy of analytical procedures.

6. Field Blanks:

This is a sample of certified metal-free, organic-free water to which the same quantity of preservative is added as is added to the field samples. This type of sample provides a check on any contamination of chemical preservatives.

D. Sample Analysis

Region IX requires that all samples associated with well closure activities be anayzed for the compounds listed below using the indicated methods. Analysis for semi-volatile organic compounds is only necessary when such compounds are suspected of being in the waste stream.

1. Volatile Organics: EPA Method 8240 (Volatile Organics); EPA Method 8260 (Volatile Organics by Capillary Column); or a combination of EPA Methods 8010 (Halogenated Volatile Organics), 8015 (Nonhalogenated Volatile Organics) and 8020 (Aromatic Volatile Organics).

2. Semi-Volatile Organics: EPA Method 8270 (Semi-volatile Organics) is recommended when the presence of semi-volatile organics is suspected to be in the waste stream.

3. Metals: Appropriate EPA Methods for all metals on the Toxicity Characteristics (TC) list (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver).

4. Total Petroleum Hydrocarbons (TPH) : EPA Methods 5030/8015 and 5030/8020 to analyze for gasoline in liquid or soil, EPA Method 3510/8015 for diesel in liquid, and EPA Method 3540/8015 for diesel in soil.

5. Total Recoverable Petroleum Hydrocarbons (TRPH): EPA Methods 9070A/418.1 for liquid and EPA Methods 9071A/9073 for soil.

Note: Some waste streams may contain additional constituents not covered by these methods. In those cases, additional EPA analytical methods must be employed to determine whether other constituents are present at concentrations which violate the primary drinking water standards or may otherwise adversely affect the health of persons. For literature regarding appropriate methods, see the reference section at the end of this document.

E. Sample Collection - Liquid and Sediment

1. Volatile Organics:

Samples for volatile organics are generally taken first to minimize the disturbance of the fluid and resulting loss of volatiles.

An oil/water interface probe should be utilized to define the base of any free floating product encountered while sampling. If no floating liquid phase is present, a sampling device can be lowered into the fluid - as deeply as possible without disturbing the sediment - and extracted with a representative grab sample of fluid. The fluid can then be transferred to pre-chilled, pre-labeled 40-ml volatile organic analysis (VOA) vials with Teflon septa. The sample should be preserved by adding hydrochloric acid (HCl) to a pH of less than 2. Two 40-ml vials should be obtained for each VOA sample. When analyzing using the Toxicity Characteristic Leaching Procedure (TCLP), collect an additional two liters of sample and place in two one-liter amber glass bottles with Teflon septa. Try to fill the bottles as full as possible so that no head space is remaining. Additional sample volume may be needed to allow for each physical phase to be analyzed separately. Do not add HCl to samples that will be analyzed using the TCLP.

If a separate floating phase is encountered while sampling, a sampling device that collects fluid from beneath the floating phase should be used. This device is operated by gently lowering it in the closed position to a depth below the oil/water interface, carefully opening and filling it with sampling fluid, and then closing and retrieving the sample.

When transferring the sampling fluid from the sampling container to a VOA vial, the fluid must be poured slowly and smoothly to produce a meniscus over the lip of the vial. The screw-top lid with the Teflon septum is then tightened onto the vial, and the vial turned upside down and gently tapped to check for the presence of air bubbles. If air is trapped in the vial, i.e. head space is present, the sample must be retaken. VOA samples should not be taken near any exhaust systems which may cause contamination of the sample.

The samples should be tagged with an identification number, chilled to approximately 4°C in a cooler, and sent to a certified analytical laboratory.

2. Semi-Volatile Organics:

Samples for semi-volatile organics should be collected after those for volatile organics. The method of collection is the same as that described for volatiles. After the fluid is collected, it should be transferred with the aid of a funnel into a pre-labeled, one-liter glass bottle with a Teflon septum. The sample must be tagged and chilled to approximately 4°C for shipping to the analytical laboratory.

3. Metals:

Samples for metals should be taken after those for volatile and semi-volatile organics. The type of metal constituent to be analyzed determines the sampling procedure. Metal samples can be divided into the following categories:

- Dissolved Metals - have a particle size capable of passing through a 0.45 micron membrane filter.
- Suspended Metals - have a particle size which is retained by a 0.45 micron membrane filter.
- Total Metals - the concentration of metals determined on an unfiltered sample following vigorous digestion, or the sum of the concentrations of metals in both the dissolved and suspended fractions.
- Total Recoverable Metals - the concentration of metals in an unfiltered sample following treatment with hot dilute mineral acid.

Dissolved metals:

To evaluate the dissolved metal constituents, the sample must be filtered through a 0.45 micron membrane filter as soon as practicable after collection. Glass or plastic filtering apparatus using plain, non-grid marked membrane filters are recommended to avoid possible contamination. The first 50-100 ml of filtrate should be used to rinse the three-liter filter flask. The rinsate is discarded, and the flask used to collect the required volume of filtrate. Filtrate is then transferred to a one-liter, polyethylene, certified metal-free bottle provided by a lab, and the sample acidified with 1:1 redistilled nitric acid (HNO_3) to a pH of less than 2. Do not add HNO_3 to samples that will be analyzed for mercury or those that will be analyzed using the TCLP.

Suspended metals:

To determine the suspended metal constituents, a representative volume of unpreserved sample must be filtered through a 0.45 micron membrane filter. The volume filtered is recorded and the membrane filter containing the insoluble material is transferred to a container suitable for transport to an analytical laboratory.

Total metals:

Total metal constituents in a sample are determined by acidifying the unfiltered sample

with 1:1 redistilled HNO_3 to a pH of less than 2 at the time of collection.

Total recoverable metals:

Total recoverable metals in a sample are determined by acidifying the entire sample with 5 ml/l concentrated redistilled HNO_3 at the time of collection.

It is generally best to analyze liquids for Total Metals. Often sediment samples from the bottom of a sump are collected using a beaker attached to a pond sampler. A stainless steel lab scoop is generally used to transfer the sediment from the beaker to the required container. Sediment samples should be placed in an 8-oz. wide-mouthed glass jar. The jar should be completely filled so that no headspace is present. After being taped and labeled, the sample should be placed immediately in an ice chest and kept cold (4°C) for delivery to the laboratory. Care should be taken throughout to avoid contamination of both the inside and outside of the jar and its contents.

4. Total Petroleum Hydrocarbons (TPH)

Injection Well Fluids and Sediment: Use collection methods described for sampling for semi-volatile organics. If sampling for TPH as gasoline, the fluid should be transferred to two pre-labeled 40-ml vials with Teflon septa (as described for volatile organics). If sampling for TPH as Diesel, the fluid should be transferred using a funnel to a pre-labeled, one-liter glass bottle with a Teflon septum. Preserve the sample by adding hydrochloric acid (HCl) to a pH of less than 2. The sample must be tagged and chilled to 4°C for shipping to the analytical laboratory.

5. Total Recoverable Petroleum Hydrocarbons (TRPH):

Injection Well Fluids and Sediment: Use the collection methods described for semi-volatile organics. The fluid should be transferred to a one-liter glass bottle with a Teflon septum. The sample must then be preserved, tagged and chilled as above.

F. Sample Collection - Soil

The bore hole can be made with a continuous flight or hollow stem auger, rotary core drill or other drilling method. It is recommended that core sampling equipment avoid the use of drilling fluids since these greatly increase the potential for sample contamination. Soil sampling kits are commercially available that can be used at relatively shallow depths to both drill the bore hole and collect a soil core. These units contain augers, coring tubes and sufficient drill rod extensions to sample up to depths of

twenty-five feet.

The most common procedures for collecting soil samples use a thin-wall steel tube (core barrel), fitted with a brass liner, which is forced into the undisturbed soil at the bottom of the bore hole. This is sometimes referred to as drive sampling. Core barrels are generally from one inch to three inches in diameter and 12 to 24 inches long. When the core barrel is retrieved, friction will usually retain the sample inside the barrel in most unsaturated materials.

Samples should be taken at locations where the potential for a high degree of contamination exists (suspected worst-case locations) such as elbows, joints in pipe lines, clarifiers, floor drains, tanks and wells. Several depth borings should be planned to be sampled for chemical analysis. Sample intervals will vary, but in general should be taken between one and two feet beneath the excavation or the bottom of the septic tank, cesspool, well, pipe line or floor drain surface, and then every five feet to the water table, or until five feet past the last suspected contamination.

Upon retrieval from the borehole, the sample liners should be removed and placed on clean plastic. After each use, sampling equipment must be decontaminated. Sample liners should be separated with a clean steel knife and logged by an on-site geologist, using the Unified Soil Classification System.

After logging, the exposed ends of the liner should be covered. Typically, Teflon sheets and plastic end caps are used and secured with silicone-based tape. Sample labels should be written or attached securely to the end caps and should contain the following information: boring number, sample location, sample number, sample depth, date and time of sampling, name of sampler, and required analytical method. Sealed and labeled samples must be placed in cooled ice chests and shipped to the analytical laboratory.

TABLE I
SAMPLING METHODS
Recommended Sampling Containers, Preservation Techniques, and Holding Times

Analysis Method	Fluid	Sediment and Soil	Preservation	Holding Time
Volatile Organics: -EPA 8240, -EPA 8260, or -EPA 8010, 8015, and 8020	Two 40-ml volatile organic analysis vials fitted with Teflon septa (VOA vials)	One 125-ml wide mouth glass jar with Teflon septum, or brass tube	Chill to 4°C For liquid samples, add HCl to pH<2	14 days
Metals: Appropriate EPA methods for -Arsenic -Barium -Cadmium -Chromium -Lead -Selenium -Silver	One 1-liter polyethylene bottle	One 8-oz. wide mouth glass jar, or brass tube	Chill to 4°C For liquid samples, add HNO_3 to pH<2	180 days
Mercury: Appropriate EPA method	One 1-liter polyethylene bottle	One 8-oz. wide mouth glass jar, or brass tube	Chill to 4°C	28 days
Total Petroleum Hydrocarbons- Gasoline: -EPA 5030/8015 and 5030/8020 (liquid) -EPA 5030/8015 and 5030/8020 Diesel: -EPA 3510/8015 (liquid) -EPA 3540/8015 (soil)	Two 40-ml VOA vials (gasoline) or one 1-liter glass bottle with Teflon septum (diesel)	One 125-ml wide mouth glass jar with Teflon septum, or brass tube	Chill to 4°C For liquid samples, add HCl to pH<2	14 days
Total Recoverable Petroleum Hydrocarbons: -EPA 9070A/418.1 (liquid) -EPA 9071A/9073 (soil)	One 1-liter glass jar with Teflon septum	One 8-oz. wide mouth glass jar with Teflon septum, or brass tube	Chill to 4°C For liquid samples, add HCl to pH<2	14 days

Note:

Additional sample volume may be needed for quality control samples.

TABLE II
TCLP SAMPLING METHODS
Recommended Sampling Containers, Preservation Techniques, and Holding Times

Analysis Method	Fluid	Sediment and Soil	Preservation	Holding Time
Volatile Organics: -Appropriate TCLP methods	Two 40-ml volatile organic analysis vials fitted with Teflon septa (VOA vials) and two 1-liter amber glass bottles with Teflon septa	One 125-ml wide mouth glass jar with Teflon septum, or brass tube	Chill to 4°C	14 days
TCLP metals -Arsenic: 7060 -Barium: 6010 -Cadmium: 6010 -Chromium: 6010 -Lead: 7421 -Selenium: 7740 -Silver: 6010	One 1-liter polyethylene bottle	One 8-oz. wide mouth glass jar, or brass tube	Chill to 4°C	180 days
Mercury: 7470	One 1-liter polyethylene bottle	One 8-oz. wide mouth glass jar, or brass tube	Chill to 4°C	28 days

Notes:

The TCLP cannot be used with analytical methods for total petroleum hydrocarbons (TPH) and total recoverable petroleum hydrocarbons (TRPH).

Additional sample volume may be needed for quality control samples and for each physical phase to be analyzed separately.

G. Common Sampling Errors

The following are common errors made during sampling that lead to inconsistent data results:

- Failure to calibrate instruments
- Lack of equipment maintenance
- Use of inappropriate sample containers
- Lack of QA samples to assure precision of sampling methods and laboratory analysis.
- Sample loss or leakage during shipping or handling due to improper packaging
- Mislabelling
- Poor field records

H. Chain of Custody

The purpose of chain of custody procedures is to be able to trace possession of a sample from the time it is collected until it is potentially introduced as evidence in a legal proceeding.

A sample is in "custody" if:

- It is actually in one's actual physical possession
- It is in one's view
- It was in one's possession and it was secured so that it could not be tampered with.
- It is kept in a secured area with access restricted to authorized personnel only.
- It is placed in a container that is sealed with an official seal that will be broken when the container is opened.

Chain of custody documentation includes, but is not limited to, the entries in the sampler's field notebook, the official seals on the sampling containers and the chain of custody record. The inspector needs to assure that the relationship between the physical sample and the related documentation is clear, complete, and accurate. The sample number, date and time of sampling, location and sample type, preservative used, analysis required, and sampler's initials should appear on all documents.

When transferring the samples, the individual relinquishing and the individual receiving the sample must sign and record the date and time on the chain of custody record.

Every person who takes custody must fill in the appropriate section of the chain of custody record. For a sample of a chain of custody record see Figure E. If the samples are sent by mail, then the package must be registered with return receipt requested.

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

CHAIN OF CUSTODY RECORD

REGION 9
75 Hawthorne Street
San Francisco, California 94105-390

PROJ NO.	PROJECT NAME
SAMPLERS: *(Signature)*	

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CON-TAINERS							REMARKS

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

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USEPA Region 9 Quality Assurance Management Section, October 1989. Preparation of a USEPA Region 9 Sampling and Analysis Plan for Private and State-Lead Superfund Projects (9QA -06-89).

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USEPA, Methods for Chemical Analysis of Water and Wastes, Doc. No. EPA 600/4-79-020.

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USEPA, Methods for the Determination of Organic Compounds in Drinking Water, Doc. No. EPA 600/4-88-039.

USEPA, Region 9 Quality Assurance Management Section, January, 1990, Laboratory Documentation Requirements for Data Validation, Doc. No. 9QA-07-90.

APPENDIX E

EPA'S CLOSURE PLANS FOR 5X28 FACILITIES

FROM NATIONAL ADMINISTRATIVE CONSENT ORDER

AGAINST TEN MAJOR OIL COMPANIES

Closure Plans for 5X28 Facilities

The following closure plans are to be followed in permanent closure of 5X28 wells that ceased discharge prior to March 29, 1991. These are the minimum closure requirements; if State or local requirements are more stringent, they must be followed. An alternate closure plan must be submitted and approved in accordance with the terms of this Order to close an injection well with alternate design, or using other than the following procedures.

Part A. Reconnection of Drains and Options for Alternate Disposal

If sealing a drain (floor and/or sink) permanently is not practical, then one of the following options must be chosen for any drain that may receive industrial or hazardous waste.

Option 1: The drain may be connected to a sanitary sewer which is connected to a POTW, if the discharge is permitted by the POTW. If this option is used, the owner or operator should be aware of the monitoring and reporting requirements under the Clean Water Act, and any local pretreatment requirements.

Option 2: The drain may be connected to a container or storage tank for product recovery/recycling or storage. If this option is used, the owner or operator should be aware of applicable requirements governing: a) hazardous waste storage tanks, b) underground storage tanks that hold petroleum or hazardous substances, c) the limitations on the time hazardous waste can be stored, and d) the requirements for small/large quantity generators including manifesting and transportation of all hazardous wastes in accordance with 40 CFR Parts 262 through 265.

Part B. Closure of Oil/Water Separator and Injection Well(s)

The following generic closure plan must be followed for any oil/water separators and all injection wells (drywells, cesspools and septic systems) unless an alternate closure plan is submitted and approved under the terms of this Order.

Step 1: Six to eight weeks before the planned closure, collect samples from both the liquid and sludge phases of the

oil/water separator and injection well[2], as applicable, in accordance with the procedures described in 40 C.F.R Part 261 Appendix I "Representative Sampling Methods". Have the samples analyzed for ignitability as well as, volatile organics and metals in accordance with the methods for the Toxicity Characteristic Leaching Procedure (TCLP) in 40 C.F.R. Part 261 Appendix II as amended June 29, 1990. If other constituents have been used on-site, e.g. pesticides or herbicides, sample for all constituents used on-site. If opening the well six to eight weeks ahead of closure would unduly disrupt operations, e.g. necessary to dig the service area up to access the well, sampling can be done at the time of closure. Storage of all material on-site must comply with applicable State and local requirements.

Step 2: Drywells and Cesspools

a) **Remove all liquid, sludge, sand, gravel and visibly contaminated soil.**

b) **Collect a grab sample of the visibly clean soil and/or ground water below the base of the last visibly contaminated soil, sample and analyze:**

1) **the soil using SW 846 Method 8240 "Gas Chromatography/Mass Spectrometry for Volatile Organics"; and**

2) **the ground water, if applicable, for all Maximum Contaminant Levels (MCLs) in effect at the time of sampling, in accordance with the sampling and analytical requirements in 40 CFR Part 141.**

Step 3: Septic Systems

a) **Remove all liquid and sludge from the septic tank.**

b) **Conduct a visual inspection to determine the integrity of the septic tank, and:**

1) **if the tank does not have cracks or holes, it may be used for domestic waste.**

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[2] If analytical costs would exceed disposal costs, the owner/operator may opt to treat the liquid and sludge phases in the oil/water separator and/or injection well as a RCRA hazardous waste and dispose at an approved RCRA treatment, storage and disposal facility. Proceed to Step 2a or 3a, as applicable, for the remainder of the closure requirements.

2) if the tank does have cracks or holes, it must be removed, as well as, any visibly contaminated soil adjacent to the tank. Following removal of the visibly contaminated soil, sample and analyze as specified in Part B Step 2b above.

Step 4: If analyses of samples from either phase in the oil/water separator or injection well indicate that the contents are RCRA hazardous waste, then the owner/operator must dispose of the hazardous phase(s) in accordance with the requirements of 40 CFR Part 262, using a licensed hauler operating in accordance with 40 CFR Part 263 and transporting the waste to an approved RCRA treatment, storage or disposal facility authorized under 40 CFR Parts 264 or 265.

Step 5: If the liquid phase of the well is RCRA hazardous, or the soil and/or ground water samples taken in Step 2b or 3b above indicate contamination, EPA reserves the right to require further remediation, depending on site specific circumstances and the levels of constituents found in the samples. Additional remediation is outside the scope of this Order and will be handled on a site specific basis by the EPA or State with UIC program jurisdiction.

Step 6: If the analyses indicate that either phase of the oil/water separator or injection well is non-hazardous the owner/operator may contract for removal of the non-hazardous phase(s) through a reputable waste hauler.

Step 7: If the oil/water separator will not be needed for pretreatment to the POTW, disconnect any lines, and fill the oil/water separator with compacted clean fill, sand or gravel.

Step 8: Filling the Well and Regrading the Site

a) If the drywell or cesspool is no longer needed for other purposes (e.g. domestic waste or storm water runoff from roofs) the well shall be backfilled with clean fill or other material required by State or local regulations, and the area restored to its original condition. If the well must be used, the owner/operator must continue to implement pollution prevention/waste minimization plans to ensure that industrial and hazardous wastes do not enter the system.

b) If the septic tank was removed in Step 3b(2) above, and the facility needs a new unit for management of domestic wastes, a new unit may be installed in compliance with local regulations. If the septic tank had integrity in Step 1b above, it may be operated for solely domestic wastes. The owner/operator must continue to implement pollution prevention/waste minimization plans to ensure

that industrial and hazardous wastes do not enter the septic system.

END

DATE
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10/22/93