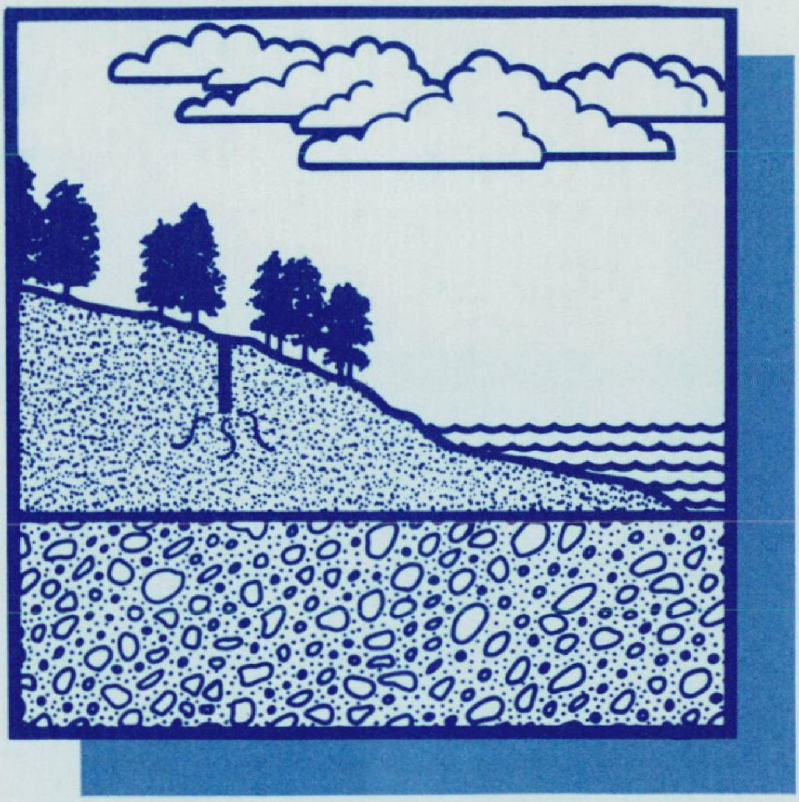
SHALLOW INJECTION WELL PRACTICES

CLASS V WELL FACTS



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF DRINKING WATER

INTRODUCTION

The subsurface environment has been utilized for centuries to dispose of liquid wastes with the philosophy that the waste was out of sight and out of mind. The recent realization that subsurface waste disposal could contaminate ground water prompted the development of an Underground Injection Control (UIC) program as part of the Safe Drinking Water Act (SDWA) of 1974. This program was designed to prevent contamination of Underground Sources of Drinking Water (USDW) by injection wells. A well, as defined in Title 40 of the Code of Federal Regulations is either a dug hole or a bored, drilled or driven shaft whose depth is greater than its largest surface dimension. Injection is defined as the subsurface emplacement of fluids in a well where a fluid is any material that flows or moves whether it is semisolid, liquid, sludge or gas. No injection is authorized without approval from the appropriate regulatory agency. In states with primacy for implementing the UIC program, this would be a state agency. In states that have not received primacy, the regulatory agency is the USEPA. As part of the UIC program, injection wells were divided into five main classes.

INJECTION WELL CLASSIFICATION

Class I: Wells used to inject hazardous wastes or dispose of industrial and municipal fluids beneath the lowermost USDW.

Class II: Wells used to inject fluids associated with the production of oil and natural gas or fluids/compounds used for enhanced hydrocarbon recovery. These wells normally inject below the lowermost USDW except in cases where the USDW is hydrocarbon producing.

Class III: Wells which inject fluids for the extraction of minerals.

Class IV: Wells which dispose of hazardous or radioactive wastes into or above a USDW *(BANNED)*.

Class V: Wells not included in the other classes, generally inject nonhazardous fluid into or above a USDW.

If a well does not fit into one of the first four Classes and meets the definition of an injection well, it is considered a Class V well. It should be noted that not all Class V wells are used for disposal. Examples of Class V practices which are not disposal related include: Aquifer Recharge, Fossil Fuel Recovery and Mineral Recovery.

CLASS V — SIMPLE TO COMPLEX

Class V injection practices recognized by the USEPA include 30 individual types of wells which range in complexity from simple cesspools which are barely deeper than they are wide to sophisticated geothermal reinjection wells which may be thousands of feet deep. Table 1 illustrates the abundance, potential for ground water contamination and potential contaminants for the 30 different types of Class V wells.

As can be seen in Table 1, the Class V injection well category is very large and diverse. Class V injection practices can be divided into two general categories, "high-tech" and "low-tech". "Low-tech" wells generally have simple casing designs and surface equipment and inject into shallow formations by gravity flow or low volume pumps. In contrast, "high-tech" wells typically have multiple casing strings, sophisticated well head equipment to control and measure pressure and inject high volumes of fluid into deep saline formations that are separated from aquifers by an impermeable confining layer.

CLASS V INJECTION SYSTEMS AND YOUR DRINKING WATER

The majority of Class V injection is into or above the USDW. USDW is defined as an aquifer or its portion which supplies any public water system or contains a sufficient quantity of ground water to supply a public water system, contains less than 10,000 mg/L total dissolved solids and is not an exempted aquifer.

Potential for contaminating ground water is quite varied and depends on:

1. Where injection occurs relative to the aquifer.
2. Well construction, design, and operation.
3. Injectate quality.
4. Volumes of waste injected.

Wells injecting below the lowermost USDW have the least potential for contaminating ground water. Class V injection directly into USDW is potentially more harmful to the water quality than discharges above the water table. This is because some contaminants are removed from the waste by attenuation, adsorption and degradation in the unsaturated zone.

Based on inventories conducted by the states, it is estimated that there are hundreds of thousands or more Class V wells in the United States and its Territories and Possessions. There are seven main categories of Class V injection wells which contain the 30 individual well types. Most Class V wells belong to two main categories: drainage wells and sewage related wells.

PUBLIC AWARENESS: THE KEY TO PROTECTING DRINKING WATER

The large number of Class V wells releasing a wide variety of contaminants pose a significant threat to ground water supplies. Almost half of the U.S. population receives their drinking water from underground sources. Therefore, it is imperative that these supplies be adequately protected. The threat to ground water from Class V practices can be significantly reduced by utilizing the best management practices available at the local or regional level. One example of a regional practice would be the optimal application of pesticides and fertilizers to reduce the amount of chemicals that would reach ground water through agricultural drainage wells. An example of a local management practice would be a public awareness program to educate people on the detrimental effects of disposing of household chemicals into a septic system. Household chemicals, when discharged into a septic system, can directly contaminate ground water and can reduce the effectiveness of the septic system to remove other potentially harmful contaminants.

Some types of Class V wells may require stricter regulation than those currently in place. The UIC program addresses only a part of the overall threat to underground sources of drinking water. At the local level, a UIC program integrated with careful planning and the utilization of best management practices available and other ground water protection initiatives can significantly reduce the threat to our drinking water supplies.

For additional information you can contact the USEPA Safe Drinking Water Hot Line: 1-800-426-4791.

☆U.S. GOVERNMENT PRINTING OFFICE: 1994-0-548-816

Table 1
Class V Wells

NAME OF WELL TYPE AND DESCRIPTION	Ground Water Contamination Potential	POTENTIAL CONTAMINANTS	Estimated Number of * Wells	States With High Numbers Of Wells (Reported)
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.	1338	Idaho, Iowa, Texas, NY
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.	90,333	Arizona, NY, Indiana, Florida, Utah, Washington
Improved Sinkholes — receive storm water runoff from developments located in karst topographic areas.	High-Moderate	Variable: pesticides, nutrients, coliform bacteria	479	Michigan, Kentucky, Missouri
Industrial Drainage Wells — wells located in industrial areas which primarily receive storm water runoff but are susceptible to spills, leaks, or other chemical discharges.	High-Moderate	Usually organic solvents, acids, pesticides, and various other industrial waste constituents. Similar to storm drainage wells but usually higher concentrations.	3,799	New York, Washington, Utah
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.	1,555	Florida
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	89	California, Nevada
Direct Heat Reinjection Wells — reinject geothermal fluids used to generate heat for large buildings or developments — deep wells.	Moderate	Hot geothermal brines with TDS between 2,000 to 325,000 mg/l. Co_3, $CaSO_4$, Sr, and Ba, As.	21	Nevada, Oregon
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.	10,006	Texas, Virginia, Florida
Groundwater Aquaculture Return Flow Wells — reinject groundwater or geothermal fluids used to support aquaculture. Non-geothermal aqualculture 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.	25	Hawaii
DOMESTIC WATESWATER 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.	980	Illinois
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.	6,622	Oregon
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.	26,700	Florida, Michigan, California, Puerto Rico
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 persons per day if receiving solely sanitary wastes. (Less treatment per sqaure area that 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.	4,435	Michigan, Maryland, Kentucky
Septic Systems (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.	3,764	Alaska, California, South Carolina
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.	1,099	Florida, Hawaii
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	6,500	Missouri, Pennsylvania, Idaho
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.	2,025	Arizona, New Mexico
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.	66	Wyoming, Colorado
Spent-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	121	Arkansas, Michigan
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.	289	Idaho, Michigan, Florida
Industrial Process Water and Waste 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.	1,938	Ohio, New York, Alaska
Automobile Service Station Disposal Wells — 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.	98	Michigan, New Jersey, Alaska
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 teatment plants, other aquifers, etc.	High-Low	Variable: water is generally of good quality.	3,551	New York, Florida
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.	164	California
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.	4	Wisconsin
MISCELLANEOUS WELLS				
Radioactive Waste Disposal Wells — all radioactive waste disposal wells other than class IV wells.	Unknown	Low-level radioactive wastes.	122	Washington
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	225	Wyoming, Arizona
Aquifer Remediation Related Wells — wells used to prevent, control or remediate aquifer pollution, including but not limited to Superfund sites.	Unknown	Nutrients used in Biodegradation of organics, oil/grease, phenols, toluene.	353	Colorado, Michigan, New Mexico
Abandoned Drinking Water Wells — used for disposal of waste.	Moderate	Potentially any kind of fluid, particularly brackish or saline water, hazardous chemicals and sewage.	3,050	Minnesota, Texas
Other Wells —any other unspecified Class V wells. *Well type/purpose and injected fluids must be specified.*	Unknown	Variable	37	Florida, North Dakota

*Most Concern

*Conservative: could be much greater number

Inventory based on 1987 Class V Report to Congress