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The Class V Underground Injection Control Study

Volume 14

Special Drainage Wells

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SPECIAL DRAINAGE WELLS

The U.S. Environmental Protection Agency (USEPA) conducted a study of Class V underground injection wells to develop background information the Agency can use to evaluate the risk that these wells pose to underground sources of drinking water (USDWs) and to determine whether additional federal regulation is warranted. The final report for this study, which is called the Class V Underground Injection Control (UIC) Study, consists of 23 volumes and five supporting appendices. Volume 1 provides an overview of the study methods, the USEPA UIC Program, and general findings. Volumes 2 through 23 present information summaries for each of the 23 categories of wells that were studied (Volume 21 covers 2 well categories). This volume, which is Volume 14, covers Class V special drainage wells.

1. SUMMARY

Special drainage wells are used throughout the country to inject drainage fluids from sources other than direct precipitation. This is a "catch-all" category, including all drainage wells that are not agricultural, industrial, or storm water drainage wells. The specific types of wells that fit into this category are:

- Pump control valve discharge and potable water tank overflow discharge wells;
- Landslide control wells;
- Swimming pool drainage wells; and
- Dewatering wells.

Pump control valve discharges and potable water tank overflows may be drained to the subsurface on occasion, usually when an emergency overflow or bypass procedure takes place. Landslide control wells are used to dewater the subsurface in landslide-prone areas. Removing ground water from sediments decreases the weight of the sediments and increases the resistance to shearing in the area (USEPA, 1987). Swimming pool drainage wells are used to drain swimming pool water to the subsurface for seasonal maintenance or special repairs. Dewatering wells are used at construction sites to lower the water table and keep foundation excavation pits dry (Rahn, 1997). Dewatering wells may also be used at mining sites, where they are known as "connector wells," to drain water from an upper aquifer into a lower one to facilitate mining activities. In addition, one dewatering well in Colorado is used to dispose of brine captured from springs by drawing saline water from the shallow aquifer that recharges a river and injecting it into a deeper aquifer.

In addition to these four types of wells, USEPA Region 5 staff report the existence of steam trap wells, which inject steam condensate collected from a system of pipelines at one industrial facility in East Chicago, Indiana. Although classified as special drainage wells for the purpose of this study, these steam trap wells are not considered in detail because they only exist at one facility and no specific information about them is available.

Injectate characteristics vary among the types of special drainage wells. The injectate from pump control valve discharge and potable water tank overflows is expected to meet all drinking water standards due to the potable nature of the water. The quality of injectate in landslide control wells depends on the quality of the ground water that is being drained to a deeper level in the subsurface. The limited amount of available data indicates that swimming pool drainage well injectate contains coliforms. In addition, the recommended chemical composition of swimming pool water includes total dissolved solids (TDS) levels above the secondary maximum contaminant level (MCL) for drinking water. Data show that dewatering well injectate typically contains the following constituents above primary MCLs or health advisory levels (HALs): turbidity, nitrogen-total ammonia, arsenic, cadmium, cyanide, lead, molybdenum, nickel, nitrate, and radium 226. Additionally, the following constituents in dewatering well injectate are typically detected above secondary MCLs: iron, manganese, TDS, and sulfate. Measured pH level are also below the lower end of the secondary MCL range.

Because special drainage wells do not tend to be located in areas with specific geologic characteristics (they are typically located wherever the need for a certain type of drainage exists), generalizations about the injection zone characteristics are very limited. In Florida, where swimming pool drainage wells and mine dewatering wells are prevalent, the injection zone is typically karst. Swimming pool water is often injected into aquifers from which the pool water was initially withdrawn, and the injected water quality is usually not significantly degraded from that in the receiving aquifer. In some cases, swimming pool drainage wells inject into saline aquifers. Landslide control wells and dewatering wells inject into deeper aquifers that can accept volumes of fluid from upper aquifers.

No contamination incidents have been reported for pump control valve discharge and potable water tank overflow discharge wells, landslide control wells, or swimming pool drainage wells. A 1984 study expressed concern over water quality received by the Floridan aquifer when dewatering wells were operated at several phosphate mining sites. However, no contamination incidents caused by the use of dewatering wells have been reported.

In general, special drainage wells are not highly vulnerable to spills or illicit discharges. The extent of any potential contamination caused by dewatering or landslide control wells is highly dependent upon the characteristics of the construction or mining site or potential landslide location that is being dewatered. Pump control valves and potable water tanks and swimming pools are not especially vulnerable to spills or illicit discharges.

According to the state and USEPA Regional survey conducted for this study, there are approximately 1,945 documented special drainage wells and more than 3,750 special drainage wells estimated to exist in the U.S. The wells are documented in 13 states, although 97 percent are located in Florida (782) and Indiana (1,102). The trends in constructing and operating special drainage wells indicate that these numbers are likely to decrease in the future. An alternative type of landslide control well may replace the type that injects water deeper into the subsurface. This alternative moves water to the ground surface or to surface water bodies. Swimming pool drainage wells, which are mainly located in Florida, are associated with older pools and are generally no longer constructed. Many of the mine dewatering wells associated with phosphate mining in Florida have been closed.

Special drainage wells are rule authorized in Idaho, Indiana, and Ohio. However, the other states with the majority of special drainage wells are implementing more specific regulatory programs to address these wells. Specifically, individual permits are issued in Alaska, Florida, and Oregon, and general permits for single family swimming pools are issued in Florida. A *de facto* ban on connector wells exists in Florida because old wells are terminated and plugged as they are discovered, and new connector wells are not permitted.

2. INTRODUCTION

The existing UIC regulations define Class V drainage wells as those "used to drain surface fluids, primarily storm runoff, into a subsurface formation" (40 CFR §146.5). In the *1987 Class V UIC Report to Congress*, USEPA characterized special drainage wells as those used to inject drainage fluids from sources other than direct precipitation (USEPA, 1987). As described above, the special drainage well category currently serves as a "catch-all" category, including all drainage wells that are not agricultural, industrial, or storm water drainage wells.

In USEPA's *1987 Class V UIC Report to Congress*, the special drainage well category included lake level control wells used on occasion to drain lakes to prevent their overflow. USEPA maintained this categorization when conducting the survey and other research for this study. However, upon review of the new information collected on lake level control wells, the Agency has decided that these wells are better categorized as storm water drainage wells. Therefore, lake level control wells are addressed in Volume 3 of the Class V Study along with other wells that fit into the storm water drainage category.

3. PREVALENCE OF WELLS

For this study, data on the number of Class V special drainage wells were collected through a survey of state and USEPA Regional UIC Programs. The survey methods are summarized in Section 4 of Volume 1 of the Class V Study. Table 1 lists the numbers of Class V special drainage wells in each state, as determined from this survey, along with descriptions of the wells. The table includes the documented number and estimated number of wells in each state, along with the source and basis for any estimate, when noted by the survey respondents. If a state is not listed in Table 1, it means that the UIC Program responsible for that state indicated in its survey response that it did not have any Class V special drainage wells.

As shown in this table, there are 1,945 special drainage wells inventoried in 13 states (in Ohio, state staff reported no documented wells but estimate they may exist). However, some states believe that the actual number of wells is higher than documented. The total estimated number of special drainage wells in the nation is more than 3,750.

Table 1. Inventory of Special Drainage Wells in the U.S.

State	Documented Number of Wells	Estimated Number of Wells		Description of Wells
		Number	Source of Estimate and Methodology [1]	
USEPA Region 1 -- None				
NH	NR	NR	State experience with underground storage tank installations.	Construction dewatering wells.
USEPA Region 2 -- None				
USEPA Region 3				
WV	5	NR	N/A	Probably are swimming pool drainage wells or water treatment plant backwash wells.
USEPA Region 4				
FL	782	-1,500	Approximately 1,300 swimming pool drainage wells in Dade County; 100-200 phosphate mining connector wells.	Connector wells and swimming pool drainage wells.
USEPA Region 5				
IN	1,102	NR	N/A	Drinking water fountain drainage wells and steam trap wells.
OH	0	1,000	Based on information on state parks' water faucet overflow amounts and ground water-based public water system overflow control wells. Estimate assumes that nearly all special drainage wells in OH are associated with potable drinking water source overflows.	Wells used to drain potable drinking water source overflows.
USEPA Region 6				
NM	1	1	This well is permitted but the facility is not yet operational.	No description provided.
USEPA Region 7 -- None				
USEPA Region 8				
CO	3	NR	N/A	No other information provided. One of the wells is a dewatering well used to dispose of brine captured from springs that discharge into a river.
UT	2	2	N/A	Mine dewatering and ground water elevation control wells.

Table 1. Inventory of Special Drainage Wells in the U.S. (Continued)

State	Documented Number of Wells	Estimated Number of Wells		Description of Wells
		Number	Source of Estimate and Methodology [1]	
USEPA Region 9				
CA	2	2	N/A	No description provided.
HI	6	6	N/A	Potable water tank overflow drainage wells.
NV	2	2	N/A	Construction dewatering wells.
USEPA Region 10				
AK	2	50	Best professional judgement.	Potable water (pump hose) overflow and landslide stabilization wells.
ID	20	20	N/A	Potable water tank overflow wells, wells used to drain irrigation well discharge at pump startup, standpipe/drain overflow wells, wells used to drain surface runoff from a wildlife management area.
OR	10	>50	Best professional judgement.	Landslide control wells.
WA	8	8	N/A	Potable water tank overflow wells and swimming pool drainage wells.
All USEPA Regions				
All States	1,945	>3,750	Total estimated number counts the documented number when the estimate is NR.	

[1] Unless otherwise noted, the best professional judgement is that of the state or USEPA Regional staff completing the survey questionnaire.

N/A Not applicable.

NR Not reported.

Indiana and Florida contain the largest number of special drainage wells, with 1,102 documented in Indiana and 782 in Florida. All but two of the special drainage wells in Indiana are steam trap wells, located at a single facility in East Chicago, Indiana. They are associated with boiler operations and are located throughout the facility. Hot steam is transferred from the power station steam boilers to a pipeline system that distributes the steam throughout the plant. As the steam travels through the system of pipelines, it cools and generates a condensate that travels to the steam traps where it is discharged. In this way, steam is not released from the pipelines. No other steam trap wells have been reported as special drainage wells anywhere else in the country. The other two special drainage wells in Indiana are drinking water fountain drainage wells.

The 782 documented wells in Florida consist of swimming pool drainage wells and a type of mine dewatering well known as connector wells. The majority of the estimated special drainage wells in Florida are thought to be swimming pool drainage wells, with about 1,300 estimated to exist in Dade County. Swimming pool drainage wells are generally not constructed in newer pools (Kowalsky, 1998). The more prevalent industry practice today is to connect swimming pool drains to sewer systems. However, drainage wells do exist in older pools (Deuerling, 1997). Separately, 100 to 200 mine dewatering wells are thought to exist in west-central Florida. The Tampa Department of Environmental Protection believes that most of these mine dewatering wells have been closed.

Although New Hampshire staff did not report the presence of any special drainage wells in the state, it is likely that they actually exist. The New Hampshire Department of Environmental Services described dewatering wells that are frequently used in conjunction with underground storage tank (UST) installations (Pillsbury, 1997). Similarly, Ohio staff have not documented any special drainage wells, but estimate that 1,000 exist in the state. This estimate was calculated using the amount of overflow from state park water faucets and the number of ground water-based public water system overflow control wells in Ohio. The estimate assumes that nearly all special drainage wells in Ohio are associated with potable drinking water source overflows. Idaho and Oregon are the only other states where staff report the presence of more than 10 special drainage wells. Idaho documents 20 wells, which include potable water tank overflow, irrigation well discharge at pump start-up, standpipe drain/overflow, and surface water runoff from a wildlife management area. Oregon documents 10 special drainage wells, which are used for landslide control by the Oregon Department of Transportation.

4. WASTEWATER CHARACTERISTICS AND INJECTION PRACTICES

4.1 Injectate Characteristics

A variety of inorganic and organic constituents may be released into special drainage wells. Sampling results from various studies that address the occurrence of these chemicals are summarized below. This discussion is supported by Attachment A to this volume, which presents complete tables of injectate quality data for some kinds of special drainage wells. This section compares sampling results to applicable standards, including primary (health-based) MCLs, secondary MCLs (which are not health-based, but rather are designed to prevent adverse aesthetic effects, such as taste or odor), and HALs (non-regulatory thresholds designed to prevent adverse health effects).

Steam Trap Wells

As mentioned above, steam trap wells are located at one facility in East Chicago, Indiana. The injectate reportedly contains a 0.4 ppm amine solution that is added to the boiler feedwater as a corrosion inhibitor and the condensate consists of softened water.

Pump Control Valve Discharges and Potable Water Tank Overflow Discharges

No data were obtained on the characteristics of injectate from pump control valve discharges and potable water tank overflow discharges. However, fluids injected in these kinds of special drainage wells are expected to generally meet drinking water standards since they originate from municipal potable water supply storage systems, assuming the water meets drinking water standards. For example, water tank overflow wells in Idaho have been reported to drain waters that comply with drinking water standards (USEPA, 1987).

Landslide Control Wells

Although landslide control wells are known to exist in several western states, no data on the quality of the fluids injected into these wells were obtained.

Swimming Pool Drainage Wells

As part of the requirements for an industrial waste discharge permit, Venetian Pool of Coral Gables, Florida, sampled its swimming pool effluent in July 1993. Table 2 presents the results of this sampling and analysis. None of the detected constituents exceed the MCLs; however, coliforms are present at 2 per 100 milliliters. The microbiology primary MCL states that no more than 5 percent of the total samples taken in a month may test positive for coliform. For water systems that collect fewer than 40 routine samples per month, no more than one sample can test positive for coliform.

According to the National Swimming Pool Foundation, the water drained from swimming pools can contain notable amounts of algae. However, it is more likely to be very similar to drinking water, just with a higher amount of chlorine. Typical chlorine levels are expected to be on the order of 2 ppm (Kowalsky, 1998).

Table 2. Water Quality Data from a Swimming Pool Drainage Well
Venetian Pool, Coral Gables, Florida

	Drinking Water Standards*		Health Advisory Levels**		
Constituent	mg/l	P/S	mg/l	N/C	Class V Well Sample
Trihalomethanes (mg/l)	0.1/0.08[†]	P	-		0.0448
Total Dissolved Solids (mg/l)	500	S	-		446
Total Suspended Solids (mg/l)	-		-		<1.0
Total Residual Cl_2 (mg/l)	4	P	-		2.0
Total Coliform (#/100 ml)	***	P	-		2.0

Source: Cadmus, 1999
* Drinking Water Standards: P= Primary; S= Secondary.
** Health Advisory Levels: N= Noncancer Lifetime; C= Cancer Risk.
*** Used as an indicator that other potentially harmful bacteria may be present. No more than 5.0% of samples may be coliform-positive in a month. For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform positive.
[†] 0.1 is the current MCL, 0.08 is the proposed rule for Disinfectants and Disinfection By-products: Total for all THMs combined cannot exceed the 0.08 level.
-No standards or advisory levels available.

Some general information on the composition of swimming pool drainage can also be found in pool operation and maintenance guidance. Pool manufacturers recommend the following as ideal levels of common pool water constituents (Chlorine Chemistry Council, 1998; Raynor Pools, 1998; Prestige Pools, 1998):

- Chlorine: 1.0 to 3.0 ppm
- Total Bromine: 2.0 to 4.0 ppm
- pH: 7.2 to 7.8
- Total Alkalinity: 80 to 140 ppm
- Calcium Hardness: 200 to 400 ppm
- Total Dissolved Solids: 1,000 to 2,000 ppm.

In addition, the American National Standards Institute (ANSI) and the National Spa and Pool Institute provide suggested operational parameters for pool water along with their standards for public swimming pools. These parameters, which are presented in Table A-1 in Attachment A to this volume, are not part of the standards but are provided as guidelines. Of these parameters recommended by the industry, the TDS level exceeds the secondary MCL.

Although these are the ideal levels for a well-maintained pool, water that is drained from a pool may not have these levels. Constituent concentrations in pool drainage may be higher or lower than these ideal levels, especially if the pool is being drained at the end of the season or because the water is out of balance and the pool must be refilled.

Dewatering Wells

Dewatering wells are used at construction sites to lower the water table and keep foundation excavation pits dry (Rahn, 1997). Dewatering wells may also be used at mining sites, where they are known as connector wells, to drain water from an upper aquifer into a lower one to facilitate mining activities. Because water is simply removed from one aquifer and placed into another without treatment or processing, injectate from construction dewatering wells is the same as the water that was originally removed from the aquifer. As a result, the injectate will be of high quality unless the surrounding water quality is poor (Land, 1998).

In Florida, mine dewatering wells used in association with the phosphate mining industry are known as connector wells (Deuerling, 1997). Connector wells are placed so that they can drain water from a shallow aquifer into a deeper aquifer. Although the wells recharge the lower aquifer, they are discussed in this volume (as opposed to the Class V Study on aquifer recharge wells) because their primary purpose is to dewater soil near the surface in a mining area (Deuerling, 1997). Given the way connector wells are constructed and operated, the injectate quality is determined solely by the water quality of the upper aquifer. In Colorado, a dewatering well operated by the US Bureau of Reclamation injects saline fluids containing CRW-100, which is a Baker Petrolite corrosion inhibitor, into a deeper aquifer.

Kimrey and Fayard (1984) tested 13 connector wells at eight sites in the phosphate mining area of Florida. The samples were analyzed for the presence of 75 constituents. The complete results of these water quality analyses are presented in Tables A-2 and A-3 of Attachment A to this volume. The authors point out that water recharged into the lower aquifer has moved through the natural filter of loose sediments in the upper aquifer, thereby possibly lowering the concentrations of some constituents. The background water quality of the receiving aquifers is unknown.

Tables 3 and 4 present summaries of the water quality data only for those parameters for which there are drinking water MCLs and/or HALs. Table 3 presents data from three connector well sites over a two-day sampling period. Table 4 presents on-day sampling data taken from an additional five sites. All of the samples exceed the primary MCL for turbidity. Several samples were below the lower end of the secondary MCL range for pH (the lowest reading was 4.3). Nitrogen (as total ammonia) is present in one sample above the draft noncancer health advisory for ammonia (see Table 4). This sample also exceeds the secondary MCLs for TDS (residue at 180°C and sum of constituents) and manganese, the proposed primary MCL for sulfate, and the primary MCL for radium-226. Arsenic is present in one sample above the primary MCL and above the cancer HAL in several samples. All of the connector well samples exceed the secondary MCL of 0.3 mg/l for iron. Several samples also exceed the action level of 0.015 mg/l for lead, and two samples exceed the primary MCL for cadmium.

Table 3. Summary of Water Quality Data from Multiple Sampling Events at Connector Wells at Three Sites in Phosphate Mining Area, Polk and Hillsborough Counties, Florida

Constituent	Drinking Water Standards *		Health Advisory Levels **		Lonesome Mine (1)			Big Four Mine (2)			IMC-Kingsford (3)		
	mg/l	P/S	mg/l	N/C	Samples	Range	Median	Samples	Range	Median	Samples	Range	Median
Turbidity (NTU)	0.5-1.0	P	-		5	3.0-19	7.0	4	2.0-70	25	2	2.0-14	8
pH (SU)	6.5-8.5	S	-		5	5.3-6.5	6.2	4	5.7-6.9	6.1	2	6.3-6.6	6.45
Nitrogen, Ammonia Total (mg/l as N)	-		30	N	5	0.040-0.090	0.050	4	0.050-0.150	0.110	2	0.060-0.150	0.105
Nitrogen, Nitrite Total (mg/l as N)	1	P	-		5	0.000-0.010	0.000	4	0.00-1.00	0.005	2	0.00-.040	0.020
Nitrogen, Nitrate Total (mg/l as N)	10	P	--		5	0.00-1.4	1.0	4	0.00-0.03	0.01	2	0.02-1.1	0.56
Solids, Residue at 180°C, Dissolved (mg/l)	500	S	-		5	52-152	105	4	50-187	130	2	111-190	151
Solids, Sum of Constituents, Dissolved (mg/l)	500	S	-		5	46-135	88	4	50-187	130	2	101-179	140
Chloride, Dissolved (mg/l as Cl)	250	S	-		5	8.0-16	10	4	4.4-11	6.5	2	13-14	14
Sulfate, Dissolved (mg/l as SO_4)	500	P	-		5	0.2-7.8	7.2	4	5.0-12	5.2	2	26-38	32
Fluoride, Dissolved (mg/l as F)	4	P	-		5	0.3-0.5	0.3	4	0.4-0.7	0.6	2	0.7-1.0	0.9
Arsenic, Total (mg/l as As)	0.050	P	0.002	C	5	0-0.002	0.001	4	0.001-0.002	0.001	2	0.001	0.001
Barium, Total Recoverable (mg/l as Ba)	2	P	2	N	5	<0.050-0.1	0.1	4	<0.050-0.1	0.1	2	<0.05	<0.05
Cadmium, Total Recoverable (mg/l as Cd)	0.005	P	0.005	N	5	0-0.002	0.001	4	0-0.009	0	2	0-0.001	0.0005
Chromium, Total Recoverable (mg/l as Cr)	0.1	P	0.1	N	5	0.01-0.020	0.010	4	0.010-0.020	0.015	2	0.010-0.020	0.015
Copper, Total Recoverable (mg/l as Cu)	1.3	P	-		5	0.005-0.210	0.026	4	0.005-0.280	0.015	2	0.004-0.016	0.010
Iron, Total Recoverable (mg/l as Fe)	0.300	S	-		5	0.7-2.8	1.4	4	0.780-5.6	1.075	2	0.790-1.6	1.195
Lead, Total Recoverable (mg/l as Pb)	0.015	P	-		5	0.01-0.036	0.018	4	0.002-0.02	0.003	2	0.004-0.006	0.005
Manganese, Total Recoverable (mg/l as Mn)	0.050	S	-		5	0.01	0.01	4	0.01	0.01	2	0.01-0.02	0.015
Silver, Total Recoverable (mg/l as Ag)	0.1	S	0.1	N	5	0	0	4	0	0	2	0	0
Strontium, Dissolved (mg/l as Sr)	-		17	N	4	0-0.1	0.02	4	0-0.07	0.045	2	0.02-0.09	0.055
Selenium, Total (mg/l as Se)	0.05 µg/l	P	-		5	0-0.001	0	4	0	0	2	0-0.001	0.001
Mercury, Total Recoverable (mg/l as Hg)	0.002	P	0.002	N	5	<0.0001-	0.0001	4	<0.0001-	0.0001	2	0.0001-	0.0002
Aldrin, Total	-		0.002	C	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00

Table 3. Summary of Water Quality Data from Multiple Sampling Events at Connector Wells at Three Sites in Phosphate Mining Area, Polk and Hillsborough Counties, Florida (Continued)

Constituent	Drinking Water Standards *		Health Advisory Levels **		Lonesome Mine (1)			Big Four Mine (2)			IMC-Kingsford (3)		
	mg/l	P/S	mg/l	N/C	Samples	Range	Median	Samples	Range	Median	Samples	Range	Median
Lindane, Total	0.0002	P	0.0002	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Chlordane, Total	0.002	P	0.003	C	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Dieldrin, Total	-		0.0002	C	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Endrin, Total	0.002	P	0.002	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Toxaphene, Total	0.003	P	0.003	C	5	0	0	4	0	0	2	0	0
Heptachlor, Total	0.0004	P	0.0008	C	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Heptachlorepoxide, Total	0.0002	P	0.0004	C	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Methoxychlor, Total	0.04	P	0.040	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
PCB, Total	0.0005	P	0.0005	C	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Malathion, Total	-		0.2	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Diazinon, Total	-		0.0006	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Methylparathion, Total	-		0.002	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
2,4,5-T, Total	-		0.07	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Radium 226, Dissolved, Radon Method (pCi/l)	5	P	20	C	5	0.25-1.0	0.85	4	0.34-1.2	0.80	2	2.1-2.6	2.4
Uranium, Dissolved, Extraction	0.02		***		5	0000.06-	0.00025	4	0.00009-	0.00024	2	0.0005-	0.0006

Source: Kimrey and Fayard, 1984.
(1) Sampling events took place at the Lonesome Mine near Fort Lonesome, Florida, on September 4-5, 1980.
(2) Sampling events took place at the Big Four Mine in Hillsborough County, Florida, on August 28-29, 1980.
(3) Sampling events took place at the IMC-Kingsford Mine in Hillsborough and Polk Counties, Florida, on August 25-26.
-No standards or advisory levels available.
* Drinking Water Standards: P= Primary; S= Secondary. ** Health Advisory Levels: N= Noncancer Lifetime; C= Cancer Risk. *** Under review.

Table 4. Summary of Water Quality Data from Multiple Sampling Events at Connector Wells at Five Sites in Phosphate Mining Area, Polk and Hillsborough Counties, Florida

Constituent	Drinking Water Standards *		Health Advisory Levels **		(1)	(2)	(3)	(4)	(5)
	mg/l	P/S	mg/l	N/C					
Turbidity (NTU)	0.5-1.0	P	-		16	20	13	3.0	35
pH (SU)	6.5-8.5	S	-		6.0	6.8	6.4	7.1	4.3
Nitrogen, Ammonia Total (mg/l as N)	-		30	N	0.020	0.020	0.040	0.020	160
Nitrogen, Nitrite Total (mg/l as N)	1	P	-		0.000	0.000	0.000	0.000	0.000
Nitrogen, Nitrate Total (mg/l as N)	10	P	-		9.2	0.32	0.01	0.43	0.08
Solids, Residue at 180 ° C, Dissolved (mg/l)	500	S	-		195	277	286	140	3580
Solids, Sum of Constituents, Dissolved (mg/l)	500	S	-		85	246	281	128	3430
Chloride, Dissolved (mg/l as Cl)	250	S	-		18	11	16	5.0	20
Sulfate, Dissolved (mg/l as SO_4)	500	P	-		3.1	34	18	5.4	2600
Fluoride, Dissolved (mg/l as F)	4	P	-		0.2	0.9	0.7	0.4	1.6
Arsenic, Total (mg/l as As)	0.05	P	0.002	C	0.002	0.02	0.002	0.11	0.002
Barium, Total Recoverable (mg/l as Ba)	2	P	2	N	0.01	<0.05	0.1	<0.05	<0.05
Cadmium, Total Recoverable (mg/l as Cd)	0.005	P	0.005	N	0.002	0.002	0	0	0.008
Chromium, Total Recoverable (mg/l as Cr)	0.1	P	0.1	N	0.01	0.02	0.01	0.02	0.02
Copper, Total Recoverable (mg/l as Cu)	1.3	P	-		0.009	0.097	0.007	0.011	0.015
Iron, Total Recoverable (mg/l as Fe)	0.3	S	-		1	1.2	1.4	0.11	25
Lead, Total Recoverable (mg/l as Pb)	0.015	P	-		0.003	0.01	0.002	0.001	0.008
Manganese, Total Recoverable (mg/l as Mn)	0.05	S	-		0.01	0.04	0.03	0.01	0.71
Silver, Total Recoverable (mg/l as Ag)	0.1	S	0.1	N	0	0	0	0	0
Strontium, Dissolved (mg/l as Sr)	-		17	N	0.07	0.13	0.21	0.13	-
Selenium, Total (mg/l as Se)	0.05	P	-		0	0.001	0	0	0
Mercury, Total Recoverable (mg/l as Hg)	0.002	P	0.002	N	0.0003	0.0007	<0.0001	<0.000 1	0.0002
Aldrin, Total	-		0.0002	C	0.00	0.00	0.00	0.00	0.00
Lindane, Total	0.0002	P	0.0002	N	0.00	0.00	0.00	0.00	0.00
Chlordane, Total	0.002	P	0.003	C	0.00	0.00	0.00	0.00	0.00
Dieldrin, Total	-		0.0002	C	0.00	0.00	0.00	0.00	0.00
Endrin, Total	0.002	P	0.002	N	0.00	0.00	0.00	0.00	0.00

Table 4. Summary of Water Quality Data from Multiple Sampling Events at Connector Wells at Five Sites in Phosphate Mining Area, Polk and Hillsborough Counties, Florida (Continued)

Constituent	Drinking Water Standards *		Health Advisory Levels **		(1)	(2)	(3)	(4)	(5)
	mg/l	P/S	mg/l	N/C					
Toxaphene, Total	0.003	P	0.003	C	0	0	0	0	0
Heptachlor, Total	0.0004	P	0.0008	C	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide, Total	0.0002	P	0.0004	C	0.00	0.00	0.00	0.00	0.00
Methoxychlor, Total	0.04	P	0.04	N	0.00	0.00	0.00	0.00	0.00
PCB, Total	0.0005	P	0.0005	C	0.00	0.00	0.00	0.00	0.00
Malathion, Total	-		0.2	N	0.00	0.00	0.00	0.00	0.00
Diazinon, Total	-		0.0006	N	0.00	0.00	0.00	0.00	0.00
Methylparathion, Total	-		0.002	N	0.00	0.00	0.00	0.00	0.00
2,4,5-T, Total	-		0.07	N	0.00	-	0.00	0.00	0.00
Radium 226, Dissolved, Radon Method (pCi/l)	5	P	20	C	4.8	1.1	.95	.93	8.9
Uranium, Dissolved, Extraction	0.02	P	***		0.0051	0.0014	0.01.3	0.011	0.0016

Source: Kimrey and Fayard, 1984.
(1) Watson Mine. Sampling events took place at Watson Mine on August 20, 1980.
(2) Silver City Mine. Sampling events took place at Silver City Mine on August 20, 1980.
(3) Fort Meade Mine. Sampling events took place at Fort Meade Mine on August 20, 1980.
(4) Nichols Mine. Sampling events took place at Nichols Mine on August 19, 1980.
(5) Phosphoria Mine. Sampling events took place at Phosphoria Mine on August 21, 1980.
* Drinking Water Standards: P= Primary; S= Secondary .
** Health Advisory Levels: N= Noncancer Lifetime; C= Cancer Risk.
*** Under review.
-No standards or advisory levels available.

The Druid Mine Shaft in Colorado received a one-time discharge, via gravity, of treated fluid into the mine shaft (Stewart, 1993). The source of the injection fluid was a solution pond with a near neutral pH, containing trace amounts of cyanide and heavy metals. Table A-4 in Attachment A to this volume presents the chemical analysis of the injectate. Table 5 summarizes these data for those parameters for which there are detected values, drinking water MCLs, and/or HALs. As shown, several inorganics were reported above the MCLs and/or HALs: cadmium, cyanide, manganese, molybdenum, nickel, nitrate, TDS, and sulfate.

Table 5. Summary of Water Quality Data from Druid Mine Shaft

Constituent	Drinking Water Standards *		Health Advisory Levels **		Results mg/l (dissolved basis)
	mg/l	P/S	mg/l	N/C	
Aluminum	0.05 - 0.2	S	-		0.14
Arsenic, total	0.05	P	0.002	C	0.002
Barium, dissolved	2	P	2	N	<.02
Beryllium, dissolved	0.004	P	0.0008	C	<.02
Boron, dissolved	-		0.6	N	0.13
Cadmium, recoverable	0.005	P	0.005	N	0.067
Chromium, total	0.1	P	0.1	N	0.02
Copper, recoverable	1.3	P	-		1.10
Cyanide, total	0.2	P	0.2	N	2.24
Fluoride, dissolved	4	P	-		1.71
Iron, recoverable	0.3	S	-		0.08
Lead, recoverable	0.015	P	-		<.001
Manganese, recoverable	0.05	S	-		0.84
Mercury, recoverable	0.002	P	0.002	N	0.0006
Molybdenum, dissolved	-		0.04	N	0.26
Nickel, dissolved	0.1	P	0.1	N	1.75
Nitrogen, Nitrate	10	P	-		37.8
Nitrogen, Nitrite	1	P	-		0.10
pH	6.5 - 8.5	S	-		8.15
Selenium, recoverable	0.05	P	-		0.006
Silver, recoverable	0.1	S	0.1	N	0.026
Solids, dissolved	500	S	-		4560
Sulfate, total	500/250	P/S	-		2080
Zinc, recoverable	5	S	2	N	1.56

Source: Stewart, 1993

* Drinking Water Standards: P= Primary; S= Secondary

** Health Advisory Levels: N= Noncancer Lifetime; C= Cancer Risk

-No standards or advisory levels available.

4.2 Well Characteristics

No information is available on the design characteristics of steam trap wells or pump control valve discharge and potable water tank overflow discharge wells. The information available for the kinds of special drainage wells is presented below.

Landslide Control Wells

The dewatering process helps to remove ground water that can act as a lubricant in an active or potentially active landslide area. Two types of landslide control wells exist. One type is a configuration of vertical drainage wells placed above horizontal drainage systems (a pipe or trench). The horizontal components receive water from the vertical wells and discharge it to surface outlets. This type of landslide control well is not considered a Class V well because it does not inject or drain fluids to the subsurface (the drained water is released onto the land surface or into surface water bodies).

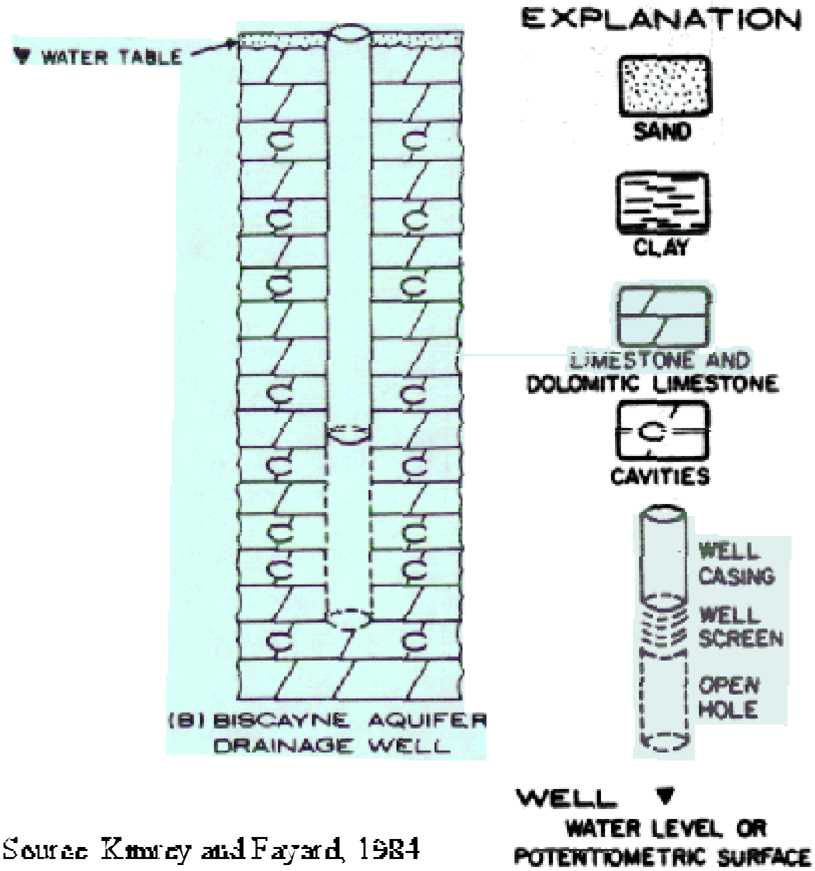
The other method of landslide control employs vertical wells that carry water from the shallow subsurface in the landslide-prone area to a deeper zone. The water drains into deeper, often very porous, sediments through an open borehole. Such wells often range in depth from 200 to 250 feet, and extend approximately 150 feet deep into the underlying formation.

Swimming Pool Drainage Wells

The typical construction of a swimming pool drainage well in Florida is shown in Figure 1. A review of records in Dade County, Florida, in 1984 showed that most swimming pool drainage wells are less than four inches in diameter and range from approximately 20 to approximately 150 feet in depth. The drainage wells typically are cased almost completely, except for a few feet at the bottom of the well. This allows injection to occur in only a relatively thin section of the aquifer.

The standard practice for swimming pool wastewater disposal is discharge into a sanitary sewer through an approved air gap or into an “approved subsurface disposal system” (ANSI, 1991). According to the National Spa and Pool Institute and the National Swimming Pool Foundation, this subsurface system does not include drainage wells, but is more likely to be a storm sewer or sewage line, depending on individual community requirements (DiGiovanni, 1998; Kowalsky, 1998).

Figure 1. Typical Construction of a Swimming Pool Drainage Well in Florida

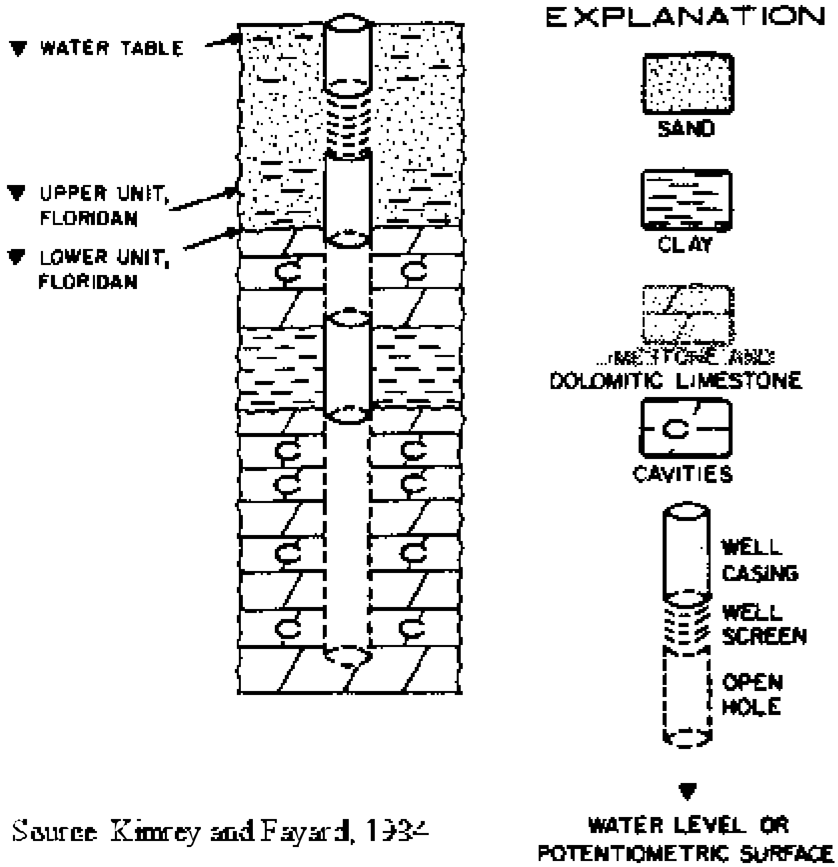


Source: Kimrey and Fayard, 1984

Dewatering Wells

Connector wells, a type of mine dewatering well which drains water from an upper aquifer to a lower one, have been used heavily in phosphate mining operations in Florida. Figure 2 shows the typical construction of such a connector well. A well screen is placed in the clastic sediment of the upper aquifer zone and the bottom of the well casing is seated in competent rock. The depth of the well depends on the depth of the receiving aquifer: the well must be drilled to a zone that has suitable transmissivity to receive the drained water. An effective connector well will be placed where the screened upper zone has adequate yields, where there is a prevailing natural downward gradient, and where there is sufficient transmissivity in the receiving zone (Kimrey and Fayard, 1984). State officials describe connector wells as connecting the surficial aquifer with the upper part of the Floridan aquifer. The wells are typically 2 to 4-inches in and probably have no grouting.

Figure 2. Typical Construction of a Connector Well in Florida

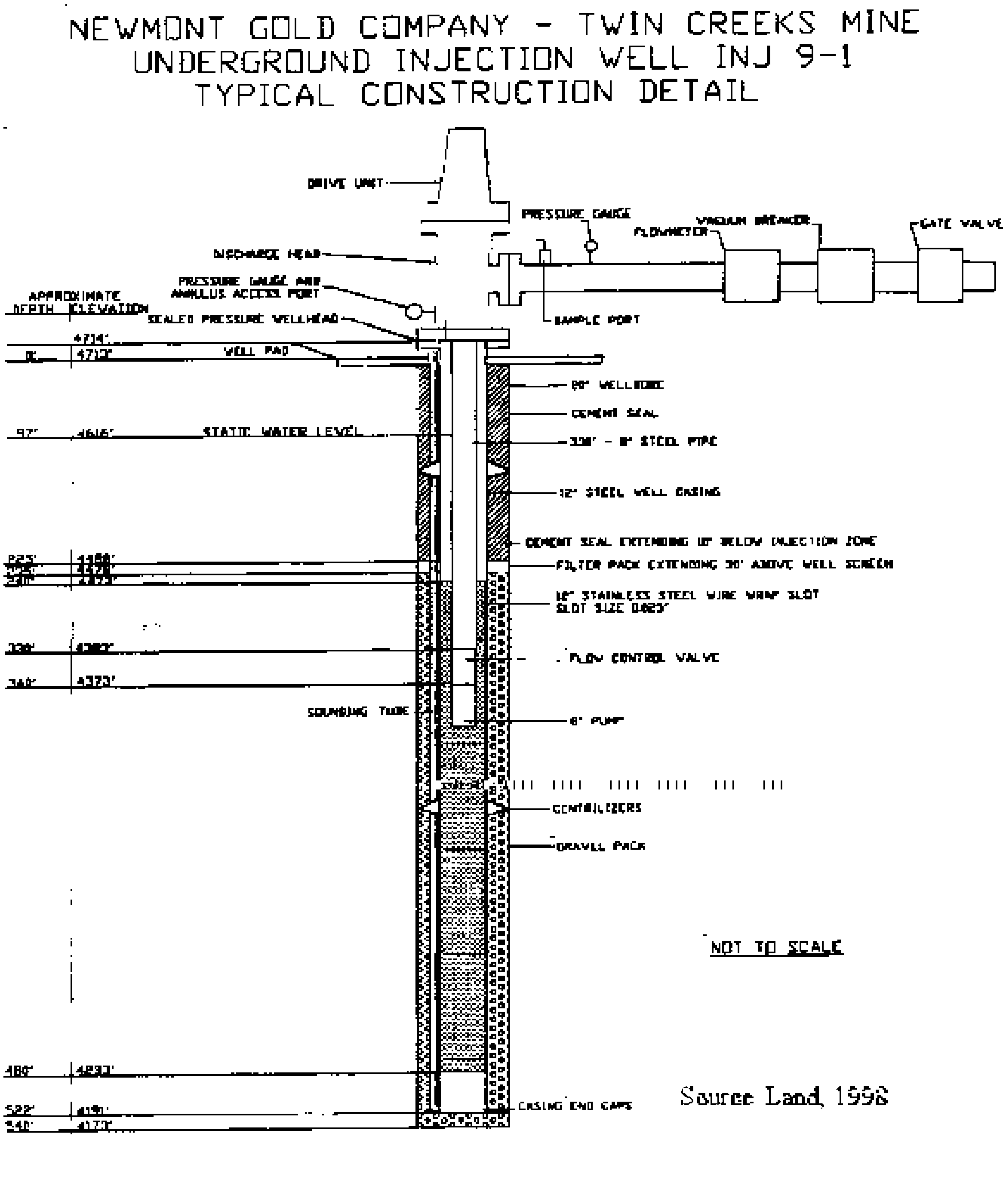


Source Kimrey and Fayard, 1984

As of the mid-1980s, connector wells were found primarily in Florida and used mainly for the dual purpose of facilitating mining by removal of ground water and recharging lower aquifers (Kimrey and Fayard, 1984). However, information gathered for the Class V UIC Study indicates that state officials have attempted to close most of these wells (Cadmus, 1999). The Florida Department of Environmental Protection confirms that as these wells are discovered, they are plugged, and no new wells are permitted (Richtar, 1999). The US Bureau of Reclamation operated a similar type of dewatering well in Bedrock, Colorado. The Paradox Valley Salinity Control Well No. 1 is used for the purpose of disposing of brine captured from springs that discharge into the Delores River. The well draws saline water from the shallow aquiifer that recharges the river and injects it into a deeper aquifer.

As shown in Figure 3, the mine dewatering wells found in Nevada range from 250 to 2,000 feet deep and are cased with steel. The wells are typically completed in alluvium, or sometimes bedrock, and drainage occurs under low pressures. Operators are encouraged to place the screened interval of the well completely below the water table to prevent dissolution of minerals in the vadose zone, which would degrade water quality (Land, 1998).

Figure 3. Typical Construction of a Dewatering Well in Nevada



Construction dewatering wells are similar to the mine dewatering connector wells described above. However, they tend to be more shallow, about 100 to 200 feet in depth, and located in urban areas. Construction dewatering wells are cased with steel, completed in bedrock or alluvium, and drain by gravity or slight pressure. When used for construction, dewatering wells usually function only temporarily. However, some dewatering wells may be permitted for longer periods of use when buildings have deep subsurface structures and dewatering is necessary to prevent structural flooding or structure problems (Land, 1998).

ANSI and the American Society of Civil Engineers (ASCE), in their guidelines on urban subsurface drainage, do not address injection or draining water deeper into the subsurface. In fact, the guidelines recommend that water collected in a drainage system be conveyed to a "safe and adequate outlet, such as a natural outfall or storm drainage facility." A transverse drainage system is recommended for ground water drainage. Such a transverse system is typically situated underneath a road or railroad. It consists of horizontal interceptor drains that collect ground water as it flows through a granular drainage layer. The interceptor drains then carry the water to an outlet following the guidelines described above. The water is not drained into the subsurface (ANSI, 1993a).

The Idarado Mine in Telluride, Colorado is an example of a mine dewatering operation where water was collected from two upper mine levels and then reinjected to the lowest mine level, the Mill Level Tunnel, in hopes of improving the water quality in the San Miguel River Basin. Historically, the two upper mine levels of the Idarado Mine, the Bullion and Penn Tunnels, discharged to Marshall Creek, a tributary of the San Miguel River. By rerouting the upper mine water to the lowest mine level, the water will eventually be discharged into a passive water treatment system before entering the San Miguel River Basin.

The mine water was routed via an 850-foot, high density, polyethylene-lined drill hole which was authorized as a Class V injection well. In contrast with typical underground injection systems, the water from the Penn and Bullion portals does not remain underground, but rather is discharged to the surface (Eddy, 1996).

The Kelley Mine in Butte, Montana also operated a mine dewatering well. Up to 450 gallons per minute of ground water was pumped from the Kelley shaft, metals were then extracted, the ground water treated, and the fluid reinjected into the Parrot and Steward mine shafts (McCarthy, 1996).

4.3 Operational Practices

No information has been obtained on the operational practices of steam trap well, pump control valve discharge and potable water tank overflow discharge wells, or landslide control wells.

New connector wells in Florida must demonstrate that all applicable water quality standards will be met at the point of injection or that fluids are not being injected into a USDW. Other kinds of dewatering wells that are technically not connector wells are used at mines. For example:

- At the Kelley Mine in Butte, Silver Bow County, Montana, 50 to 60 pounds of metal were recovered per 1,000 gallons of mine water drawn from 3,300 feet below the surface of the Kelley Mine (Western, 1992). The principal metals recovered were: aluminum, calcium, magnesium, manganese, iron, and zinc. In October 1996, zinc was the primary metal being extracted. Mine water was directed to the zinc extraction unit where zinc in the water was precipitated with sodium hydrosulfide and then removed from the mine water stream. The arsenic that was contained in the mine water co-precipitated with the zinc. After removal of the hydrosulfide precipitate, the water was reinjected into the Kelley Mine. The precipitated zinc was washed with city water and the decanted wash water was also reinjected. The precipitated zinc was re-dissolved in sulfuric acid, which resulted in a zinc sulfate solution and an elemental sulfur sludge. The arsenic from the mine water remained in this non-leachable state in the sludge and was reinjected to the Kelly Mine. In December 1995, it was estimated that 750,000 gallons of mine water had been processed in such a manner.

- As described in Section 4.1, the Druid Mine Shaft in Colorado received a one-time discharge, via gravity, of treated fluid into the mine shaft. The source of the injection fluid was a solution pond, and the injectate amount was limited to 750,000 gallons. The solution was first treated in batches of 100,000 to 200,000 gallons, and retained in holding ponds until permission to inject was granted. There was not sufficient ground water present at the Druid Mine site to establish a the presence of a true aquifer or a regional water table. There were no construction procedures since the injection well used was an already existing mine shaft and no pressure was utilized (Stewart, 1993).

In Florida, where swimming pool drainage wells are most common, there are no operating requirements. The frequency of swimming pool drainage depends on the climate in which the pool is located. In colder climates, swimming pools are usually drained as part of the winterizing process. Once a year, the water level is lowered by about one half to one third its normal level. Pools in warmer climates generally circulate their water throughout the year and are drained only for special repairs (DiGiovanni, 1998). In Dade County, swimming pool drainage wells are permitted to drain into the freshwater or saline zones of the Biscayne aquifer (Kimrey and Fayard, 1984). The Biscayne aquifer, a USDW, is the only source of drinking water for approximately three million people who live in areas from Homestead, Florida, in Dade County, northward to Boca Raton, in Palm Beach County, Florida (Randazzo and Jones, 1997).

5. POTENTIAL AND DOCUMENTED DAMAGE TO USDWs

5.1 Injectate Constituent Properties

The primary constituent properties of concern when assessing the potential for Class V special drainage wells to adversely affect USDWs are toxicity, persistence, and mobility. The toxicity of a constituent is the potential of that contaminant to cause adverse health effects if consumed by humans. Appendix D to the Class V Study provides information on the health effects associated with contaminants found above drinking water MCLs or HALs in the injectate of special drainage and other Class V wells. As discussed in Section 4.1, coliforms were found to be present in swimming pool drainage wells injectate, and the contaminants that have been observed above MCLs or HALs in dewatering well injectate are turbidity, nitrogen (ammonia), sulfate, radium, arsenic, lead, cadmium, cyanide, molybdenum, nickel, nitrate, TDS, pH, manganese, and iron.

Persistence is the ability of a chemical to remain unchanged in composition, chemical state, and physical state over time. Appendix E to the Class V Study presents published half-lives of common constituents in fluids released in special drainage and other Class V wells. All of the values reported in Appendix E are for ground water. Caution is advised in interpreting these values because ambient conditions have a significant impact on the persistence of both inorganic and organic compounds. Appendix E also provides a discussion of mobility of certain constituents found in the injectate of special drainage and other Class V wells.

The point of injection for most special drainage wells is typically within a permeable, coarse-grained limestone or sand unit (e.g., those in Florida). Therefore, conditions are likely to be present that would allow constituents in special drainage well injectate to be highly mobile.

5.2 Observed Impacts

No incidents of contamination caused by any kind of special drainage well were found during the survey conducted for the Class V Study (Cadmus, 1999). As summarized below, the information collected suggests that swimming pool drainage wells in Florida should pose minimal risk while connector wells associated with the phosphate mining industry in Florida have the potential to endanger USDWs.

Swimming Pool Drainage Wells

Even though swimming pool drainage wells in Florida drain into saline or fresh zones of the Biscayne aquifer, officials in Florida do not consider swimming pool drainage wells to be a threat to USDWs because of their intermittent use (Deuerling, 1997). Moreover, Kimrey and Fayard (1984) suggest that injection of swimming pool water into the Biscayne aquifer in Florida has little effect on the potability of water in the aquifer because the injectate quality is not appreciably different from water that was withdrawn from the aquifer to initially fill the swimming pool. They conclude that as long as injection is restricted to aquifer zones where water chloride concentrations exceed 1,500 mg/l, contamination of the aquifer does not pose a problem.

Dewatering Wells

Kimrey and Fayard (1984) express concern over the quality of water received by the Floridan aquifer when connector wells are used in association with the phosphate mining industry. In this case, highly mineralized water was injected into the USDW and samples from 12 of 13 wells sampled exceeded MCLs for turbidity and total iron concentrations. In addition, seven of the 13 wells injected waters that exceeded the requirements for gross alpha radioactivity levels (Kimrey and Fayard, 1984).

6. BEST MANAGEMENT PRACTICES

The following sections discuss the information that is available on best management practices (BMPs) and alternatives to special drainage wells.

Landslide Control Wells

Large diameter deep drainage wells are being used in Italy to protect urban and other areas from landslides. The system, known as RODREN, is composed of large vertical drainage wells, about 1,200-1,500 millimeters in diameter, located about five to seven meters apart, and connected at their bases by a horizontal pipe about 76 to 100 millimeters in diameter. The vertical wells are waterproofed at the top and closed by steel covers if they are to be used as inspection or structural wells. These wells are also waterproofed at the bottom underneath the point where it is connected to the horizontal well (Bianco and Bruce, 1991). This prevents drainage into the deeper subsurface. The depth of the vertical and horizontal wells varies according to the geological structures in the area. The horizontal discharge pipe is located below the slip surface. The RODREN system has been found to be effective in increasing slope stability, cost effective in comparison to other drainage systems, and adaptable to various types of slope geometry and geology (Bruce, 1992).

Swimming Pool Drainage Wells

In Florida, owners of swimming pools are cautioned not to locate a drainage well near a drinking water supply well (Deuerling, 1997). According to the National Swimming Pool Foundation, swimming pool drainage wells are an obsolete technology. The alternative, which is now used in most pool construction and drainage, is to pump water from a drain in the bottom of the pool to a sewage line or storm sewer. The pump is placed beneath the pool drain. The destination of the water depends on the standards and typical practices of the individual community (Kowalsky, 1998). Contemporary manuals on the construction and operation of swimming pools describe similar practices and do not mention or recommend drainage into the subsurface. One manual suggests placing two main drains, at least 8 to 12 feet apart, at the deepest part of the pool. A concrete or fiberglass plastic grate is placed over the drain. When the construction elevations and placement of the pool allow, the main drains convey water by unrestricted gravity flow to the storm or sewer line. A pump may be necessary if the pool is situated so that gravity drainage is not possible (Gabrielsen, 1987).

Dewatering Wells

If there are contaminated sites near a construction site, dewatering may draw in the contaminated water, thus polluting a previously uncontaminated aquifer. The Nevada UIC Program suggests searching the area for corrective action sites or potential sources of contamination to reduce the chances of this type of incident (Land, 1998). In Florida, the Department of Environmental Protection examines the areas surrounding the wells and assesses the mining materials that are used as well as any pollutants that might be emitted from equipment (e.g., oil and grease). According to state staff, connector well injectate does not usually contain significant levels of contaminants, and the wells are usually located in rural areas away from populations (Richtar, 1999).

The Connecticut Department of Environmental Protection describes BMPs for foundation drainage and dewatering, which is often used in conjunction with construction dewatering to maintain the long-term integrity of a completed foundation. According to the BMP manual, uncontaminated water from foundation drainage and dewatering may be discharged to a storm sewer or stream in accordance with federal, state, or local requirements. However, if contaminated ground water is discovered, proper investigation and remediation is necessary. The presence of contaminated ground water may indicate a ground water contamination problem (Inglese, 1992).

Although ANSI and ASCE do not specifically recommend injection or subsurface drainage into deeper aquifers, they do address water quality with respect to urban subsurface drainage. Available guidelines state that developments in the drainage area of a well can generate pollutants that could be conveyed into the subsurface. If flow rate through the drainage system is increased, pollutants will be transported more quickly. The guidelines recommend reviewing the area periodically after construction of the subsurface drainage system to determine if any nearby changes (e.g., new development and construction) have affected the composition and volume of subsurface flow. The guidelines state that sampling, monitoring, and treatment may be needed if contamination problems are present (ANSI, 1993b).

The ANSI guidelines also recommend routine, thorough inspections to "keep systems clean, soil-tight, structurally intact, and free of debris." The inspection schedule will vary according to various factors, including the climate and geology of the area. ANSI (1993b) recommends that the following elements be included in a thorough inspection:

- Look for accumulated debris, rodents, or other obstacles to flow at inlets and outlets.
- Check the interior of the system for roots, mineral deposits, trash, silt accumulations, or other objects that might impede flow.
- Inspect the ground surface for signs of subsurface drainage leakage.
- Check inlet and outlet areas for evidence of soil erosion, which can impede structural and hydraulic performance.
- Examine visible structures, such as catch basins, headwalls, and culverts, for signs of wear or breakage.
- Check upstream in the drainage system for backups or collections of surface water that indicate reduced inflows.

The guidelines also recommend using electronic and optical aids like television cameras and fiber optic scopes to reveal the presence of cracks, displacements, misalignments, and other interior problems in the system. Finally, it is suggested that an aggressive preventive maintenance program be designed and implemented. This includes regular inspection of structure for signs of structural distress and loss of hydraulic function. Also, cleaning the subsurface drainage system regularly prevents clogging. The standards suggest the use of high-pressure hydraulic drain cleaners or chemical treatment where there is no access for mechanical cleaning. When chemical cleaning is done, the standards recommend that it be accomplished "in an environmentally responsible manner" which includes neutralizing acid solutions that might be used to dissolved iron ocher deposits (ANSI, 1993b).

7. CURRENT REGULATORY REQUIREMENTS

Several federal, state, and local programs exist that either directly manage or regulate Class V special drainage wells. On the federal level, management and regulation of these wells falls primarily under the UIC program authorized by the Safe Drinking Water Act (SDWA). Some states and localities have used these authorities, as well as their own authorities, to extend the controls in their areas to address concerns associated with special drainage wells.

7.1 Federal Programs

Class V wells are regulated under the authority of Part C of SDWA. Congress enacted the SDWA to ensure protection of the quality of drinking water in the United States, and Part C specifically mandates the regulation of underground injection of fluids through wells. USEPA has promulgated a series of UIC regulations under this authority. USEPA directly implements these regulations for Class V wells in 19 states or territories (Alaska, American Samoa, Arizona, California, Colorado, Hawaii, Indiana, Iowa, Kentucky, Michigan, Minnesota, Montana, New York, Pennsylvania, South Dakota, Tennessee, Virginia, Virgin Islands, and Washington, DC). USEPA also directly implements all Class V UIC programs on Tribal lands. In all other states, which are called Primacy States, state agencies implement the Class V UIC program, with primary enforcement responsibility.

Special drainage wells currently are not subject to any specific regulations tailored just for them, but rather are subject to the UIC regulations that exist for all Class V wells. Under 40 CFR 144.12(a), owners or operators of all injection wells, including special drainage wells, are prohibited from engaging in any injection activity that allows the movement of fluids containing any contaminant into USDWs, "if the presence of that contaminant may cause a violation of any primary drinking water regulation . . . or may otherwise adversely affect the health of persons."

Owners or operators of Class V wells are required to submit basic inventory information under 40 CFR 144.26. When the owner or operator submits inventory information and is operating the well such that a USDW is not endangered, the operation of the Class V well is authorized by rule. Moreover, under section 144.27, USEPA may require owners or operators of any Class V well, in USEPA-administered programs, to submit additional information deemed necessary to protect USDWs. Owners or operators who fail to submit the information required under sections 144.26 and 144.27 are prohibited from using their wells.

Sections 144.12(c) and (d) prescribe mandatory and discretionary actions to be taken by the UIC Program Director if a Class V well is not in compliance with section 144.12(a). Specifically, the Director must choose between requiring the injector to apply for an individual permit, ordering such action as closure of the well to prevent endangerment, or taking an enforcement action. Because special drainage wells (like other kinds of Class V wells) are authorized by rule, they do not have to obtain a permit unless required to do so by the UIC Program Director under 40 CFR 144.25. Authorization by rule terminates upon the effective date of a permit issued or upon proper closure of the well.

Separate from the UIC program, the SDWA Amendments of 1996 establish a requirement for source water assessments. USEPA published guidance describing how the states should carry out a source water assessment program within the state's boundaries. The final guidance, entitled *Source Water Assessment and Programs Guidance* (USEPA 816-R-97-009), was released in August 1997.

State staff must conduct source water assessments that are comprised of three steps. First, state staff must delineate the boundaries of the assessment areas in the state from which one or more public drinking water systems receive supplies of drinking water. In delineating these areas, state staff must use "all reasonably available hydrogeologic information on the sources of the supply of drinking water in the state and the water flow, recharge, and discharge and any other reliable information as the state deems necessary to adequately determine such areas." Second, the state staff must identify contaminants of concern, and for those contaminants, they must inventory significant potential sources of contamination in delineated source water protection areas. Class V wells, including special drainage wells, should be considered as part of this source inventory, if present in a given area. Third, the state staff must "determine the susceptibility of the public water systems in the delineated area to such contaminants." State staff should complete all of these steps by May 2003 according to the final guidance.[1]

7.2 State and Local Programs

As presented in Section 3 above, more than more than 95% of documented and more than 70% of the estimated special drainage wells in the nation exist in six states: Alaska, Florida, Idaho, Indiana, Ohio, and Oregon. Attachment B to this volume describes how each of these states currently address special drainage wells.

The statutory and regulatory framework for special drainage injection wells in the six states with the largest numbers of wells fall into two major groups.

- In states in which the UIC Class V program is directly implemented by USEPA, the states do not have regulatory provisions that specifically address special drainage wells. However, Alaska requires individual permits for discharges of domestic wastewater to ground water that are greater than 500 gallons per day (gpd) or do not go through a soil absorption system or receive primary treatment. In Indiana, the other Direct Implementation state with a relatively large number of special drainage wells, USEPA Region 5 authorizes Class V wells by rule, and

[1] May 2003 is the deadline including an 18-month extension.

the USEPA Region has the authority to impose provisions that ensure that wells do not endanger USDWs as described in Section 7.1.

- Primacy states for Class V UIC wells apply a range of requirements to special drainage wells. Florida issues general permits for categories of Class V wells. The only exception is single family swimming pool drainage wells, which Florida includes under general permits. A *de facto* ban on connector wells exists in Florida because old wells are terminated and plugged as they are discovered, and new connector wells are not permitted. Oregon does not specifically address special drainage wells, yet the state regulations require a water pollution control facility permit for construction and operation of a waste disposal well. Idaho and Ohio authorize Class V wells by rule. For special drainage wells, Idaho requires submission of inventory information and use of the well so that it does result in contamination of a drinking water source or cause a violation of water quality standards that would affect a beneficial use. Ohio does not specifically address special drainage wells; however, the state regulations authorize injection activities as long as a drilling and operating permit is obtained when the well is constructed.

ATTACHMENT A
INJECTATE QUALITY DATA FOR SPECIAL DRAINAGE WELLS

Table A-1. Suggested Chemical Operational Parameters for Public and Residential Swimming Pool Waters

Constituent	Minimum	Ideal	Maximum
Free Chlorine (ppm)	1.0	1.0-3.0	3.0
Combined Chlorine (ppm)	None	None	0.2
Bromine (ppm)	2.0	2-4	4.0
pH (SU)	7.2	7.4-7.6	7.8
Total Alkalinity (buffering) (ppm as $CaCO_3$)	60	80-100 (for calcium hypochlorite, lithium hypochlorite, and sodium hypochlorite) 100-120 (for sodium dichlor, trichlor, chlorine gas, and bromine compounds)	180
Total Dissolved Solids (ppm)	300	1000-2000	3000
Calcium Hardness (ppm as $CaCO_3$)	150	200-400	500-1000+
Heavy Metals	None	None	None
Algae	None	None	None
Bacteria	None	None	Dependent upon local code
Cyanuric Acid (ppm)	10	30-50	150
Temperature (°F)	-	78-82	104
Ozone, Low Output Generators Contact Concentration (mg/l)	-	-	0.1

Source: ANSI, 199; ANSI, 1995.

Table A-2. Complete Water Quality Data from Multiple Sampling Events at Connector Wells at Three Sites in Phosphate Mining Area, Polk and Hillsborough Counties, Florida

Constituent	Drinking Water Standards *		Health Advisory Levels **		Lonesome Mine (1)			Big Four Mine (2)			IMC-Kingsford (3)		
	mg/l	P/S	mg/l	N/C	Samples	Range	Median	Samples	Range	Median	Samples	Range	Median
Temperature (°C)	-		-		5	22.5-24.0	23.0	4	23.0-25.0	23.5	0	-	-
Turbidity (NTU)	0.5-1.0	P	-		5	3.0-19	7.0	4	2.0-70	25	2	2.0-14	8
EC (µmhos)	-		-		5	70-282	185	4	103-420	330	2	200-310	255
pH (Std. Units)	6.8-8.5	P	-		5	5.3-6.5	6.2	4	5.7-6.9	6.1	2	6.3-6.6	6.45
Carbon Dioxide, Dissolved (mg/l as CO_2)	-		-		5	59-137	82	4	26-207	65	2	38-44	41
Alkalinity, Field (mg/l as $CaCO_3$)	-		-		5	10-106	61	4	7-121	82	2	39-90	65
Bicarbonate, FET-FLD (mg/l as $HC0_3$)	-		-		5	12-129	74	4	8-147	101	2	48-110	79
Nitrogen, Organic Total (mg/l as N)	-		-		5	0.02-0.17	0.06	4	0.06-0.82	0.13	2	0.09-.16	0.13
Nitrogen, Ammonia Total (mg/l as N)	-		30	N	5	0.040-0.090	0.050	4	0.050-0.150	0.110	2	0.060-0.150	0.105
Nitrogen, Nitrite Total (mg/l as N)	1	P	-		5	0.000-0.010	0.000	4	0.00-1.00	0.005	2	0.00-.040	0.020
Nitrogen, Nitrate Total (mg/l as N)	10	P	-		5	0.00-1.4	1.0	4	0.00-0.03	0.01	2	0.02-1.1	0.56
Nitrogen, Ammonia + Organic Total (mg/l as N)	-		-		5	0.07-0.26	0.12	4	0.11-0.90	0.28	2	0.22-0.24	0.23
Nitrogen, NO_2 + NO_3 Total (mg/l as N)	-		-		5	0.00-1.4	1.0	4	0.01-1.0	0.02	2	0.02-1.1	0.56
Nitrogen, Total (mg/l as N)	-		-		5	0.08-1.7	1.1	4	0.14-1.9	0.29	2	0.26-1.4	0.83
Carbon, Organic Total (mg/l as C)	-		-		5	1.8-32	10	4	3.6-22	11	2	11-13	12
Phosphorus, Ortho, Total (mg/l as P)	-		-		5	0.140-0.930	0.340	4	0.480-6.60	0.900	2	0.090-0.930	0.510
Phosphorus, Total (mg/l as P)	-		-		5	0.540-2.40	1.60	4	0.720-6.60	1.35	2	0.090-1.20	0.645
Hardness (mg/l as $CaCO_3$)	-		-		5	20-120	73	4	95-630	115	2	63-140	102
Hardness, Noncarbonate (mg/l as $CaCO_3$)	-		-		5	6-20	12	4	11-620	16	2	24-48	36
Solids, Residue at 180°C, Dissolved (mg/l)	500	S	-		5	52-152	105	4	50-187	130	2	111-190	151
Solids, Sum of Constituents, Dissolved (mg/l)	500	S	-		5	46-135	88	4	50-187	130	2	101-179	140
Calcium, Dissolved (mg/l as Ca)	-		-		5	5.0-35	24	4	33-120	41	2	16-45	31
Magnesium, Dissolved (mg/l as Mg)	-		-		5	1.9-8.4	2.9	4	2.8-79	3.5	2	5.7-6.2	6.0
Sodium, Dissolved (mg/l as Na)	-		-		5	4.6-7.0	5.5	4	3.2-220	6.5	2	10-14	12

Table A-2. Complete Water Quality Data from Multiple Sampling Events at Connector Wells at Three Sites in Phosphate Mining Area, Polk and Hillsborough Counties, Florida (Continued)

Constituent	Drinking Water Standards *		Health Advisory Levels **		Lonesome Mine (1)			Big Four Mine (2)			IMC-Kingsford (3)		
	mg/l	P/S	mg/l	N/C	Samples	Range	Median	Samples	Range	Median	Samples	Range	Median
Potassium, Dissolved (mg/l as K)	-		-		5	0.2-3.9	0.2	4	0.2-3.0	0.3	2	0.4-0.6	0.5
Chloride, Dissolved (mg/l as Cl)	250	S	-		5	8.0-16	10	4	4.4-11	6.5	2	13-14	14
Sulfate, Dissolved (mg/l as SO_4)	500	P	-		5	0.2-7.8	7.2	4	5.0-12	5.2	2	26-38	32
Fluoride, Dissolved (mg/l as F)	4	P	-		5	0.3-0.5	0.3	4	0.4-0.7	0.6	2	0.7-1.0	0.9
Silica, Dissolved (mg/l as SiO_2)	-		-		5	3.1-7.8	3.6	4	4.2-6.5	6.0	2	4.0-7.6	5.8
Arsenic, Total (mg/l as As)	0.05	P	0.002	C	5	0-0.002	0.001	4	0.001-0.002	0.001	2	0.001	0.001
Barium, Total Recoverable (mg/l as Ba)	2	P	2	N	5	<0.05-0.1	0.1	4	<0.05-0.1	0.1	2	<0.05	<0.05
Cadmium, Total Recoverable (mg/l as Cd)	0.005	P	0.005	N	5	0-0.002	0.001	4	0-0.009	0	2	0-0.001	0.0005
Chromium, Total Recoverable (mg/l as Cr)	0.1	P	0.1	N	5	0.01-0.02	0.01	4	0.01-0.02	0.015	2	0.01-0.02	0.015
Copper, Total Recoverable (mg/l as Cu)	1.3	P	-		5	0.005-0.21	0.026	4	0.005-0.28	0.015	2	0.004-0.016	0.001
Iron, Total Recoverable (mg/l as Fe)	0.3	S	-		5	0.7-2.8	1.4	4	0.78-5.6	1.075	2	0.790-1.600	1.195
Lead, Total Recoverable (mg/l as Pb)	0.015	P	-		5	0.01-0.036	0.018	4	0.002-0.02	0.003	2	0.004-0.006	0.005
Manganese, Total Recoverable (mg/l as Mn)	0.05	S	-		5	0.01	0.01	4	0.01	0.01	2	0.01-0.02	0.015
Silver, Total Recoverable (mg/l as Ag)	0.1	S	0.1	N	5	0	0	4	0	0	2	0	0
Strontium, Dissolved (mg/l as Sr)	-		17	N	4	0-0.1	0.02	4	0-0.07	0.045	2	0.02-0.09	0.055
Selenium, Total (mg/l as Se)	0.05	P	-		5	0-0.01	0	4	0	0	2	0-0.001	0.001
Mercury, Total Recoverable (mg/l as Hg)	0.002	P	0.002	N	5	<0.0001-0.0001	0.0001	4	<0.0001-0.0001	0.0001	2	0.0001-0.0002	0.0002
Perthane, Total (mg/l)	-		-		5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Naphthalenes, Polychlor. Total (mg/l)	-		-		5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Aldrin, Total (mg/l)	-		0.002	C	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Lindane, Total (mg/l)	0.0002	P	0.0002	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Chlordane, Total (mg/l)	0.002	P	0.003	C	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
DDD, Total (mg/l)	-		-		5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
DDE, Total (mg/l)	-		-		5	0.00	0.00	4	0.00	0.00	2	0.00	0.00

Table A-2. Complete Water Quality Data from Multiple Sampling Events at Connector Wells at Three Sites in Phosphate Mining Area, Polk and Hillsborough Counties, Florida (Continued)

Constituent	Drinking Water Standards *		Health Advisory Levels **		Lonesome Mine (1)			Big Four Mine (2)			IMC-Kingsford (3)		
	mg/l	P/S	mg/l	N/C	Samples	Range	Median	Samples	Range	Median	Samples	Range	Median
DDT, Total (mg/l)	-		-		5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Dieldrin, Tota (mg/l)	-		0.0002	C	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Endosulfan, Total (mg/l)	-		-		5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Endrin, Total (mg/l)	0.002	P	0.002 µg/l	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Ethion,Total (mg/l)	-		-		5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Toxaphene, Total (mg/l)	0.003	P	0.003	C	5	0	0	4	0	0	2	0	0
Heptachlor, Total (mg/l)	0.0004	P	0.0008	C	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Heptachlorepoxide, Total (mg/l)	0.0002	P	0.0004	C	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Methoxychlor, Total (mg/l)	0.04	P	0.04	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
PCB, Total (mg/l)	0.0005	P	0.0005	C	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Malathion, Total (mg/l)	-		0.2	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Parathion, Total (mg/l)	-		-		5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Diazinon, Total (mg/l)	-		0.0006	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Methylparathion, Total (mg/l)	-		0.002	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
2,4-D, Total (mg/l)	-		-		5	0.00-0.18	0.00	4	0.00	0.00	2	0.00	0.00
2,4,5-T, Total (mg/l)	-		0.07	N	5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Mirex, Total (mg/l)	-		-		5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Silvex, Total (mg/l)	-		-		5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Total Trithion, (mg/l)	-		-		5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Methyl Trithion, Total (mg/l)	-		-		5	0.00	0.00	4	0.00	0.00	2	0.00	0.00
Cesium 137 Dissolved (pCi/l)	-		-		5	<1.0	<1.0	4	<1.0	<1.0	2	<1.0	<1.0
Strontium 90 Dissolved (pCi/l)	-		-		5	<0.4-<1.5	0.4	4	<0.4	<0.4	2	<0.4-<0.7	0.6
Radium 226, Dissolved, Radon Method (pCi/l)	5	P	20	C	5	0.25-1.0	0.85	4	0.34-1.2	0.80	2	2.1-2.6	2.4
Gross Alpha, Dissolved (mg/l as U-NAT)	-		-		5	0.023- 0. 850	0.024	4	0.053-0.590	0.114	2	0.01-0.038	0.024

Table A-2. Complete Water Quality Data from Multiple Sampling Events at Connector Wells at Three Sites in Phosphate Mining Area, Polk and Hillsborough Counties, Florida (Continued)

Constituent	Drinking Water Standards *		Health Advisory Levels **		Lonesome Mine (1)			Big Four Mine (2)			IMC-Kingsford (3)		
	mg/l	P/S	mg/l	N/C	Samples	Range	Median	Samples	Range	Median	Samples	Range	Median
Gross Beta, Dissolved (PSI/l as CS-137)	-		-		5	2.2-29	7.4	4	4.4-25	10.3	2	4.8-5.4	5.1
Gross Beta, Dissolved (pCi/l as YT-90)	-		-		5	2.1-28	7.2	4	4.4-25	10	2	4.6-5.2	4.9
Uranium, Dissolved, Extraction (mg/l)	0.02		***		5	0.00006-.0012	0.00025	4	0.00009-0.00050	0.00024	2	0.00050-0.00070	.00060

Source: Kimrey and Fayard, 1984.
(1) Sampling events took place at the Lonesome Mine near Fort Lonesome, Florida, on September 4-5, 1980.
(2) Sampling events took place at the Big Four Mine in Hillsborough County, Florida, on August 28-29, 1980.
(3) Sampling events took place at the IMC-Kingsford Mine in Hillsborough and Polk Counties, Florida, on August 25-26.
-No standards or advisory levels available.
* Drinking Water Standards: P= Primary; S= Secondary
** Health Advisory Levels: N= Noncancer Lifetime; C= Cancer Risk
*** Under review.

Table A-3. Complete Water Quality Data from Multiple Sampling Events at Connector Wells at Five Sites in Phosphate Mining Area, Polk and Hillsborough Counties, Florida

Constituent	Drinking Water Standards *		Health Advisory Levels **		(1)	(2)	(3)	(4)	(5)
	mg/l	P/S	mg/l	N/C					
Temperature (° C)	-		-		25.0	24.5	23.0	23.0	25.0
Turbidity (NTU)	0.5-1.0	P	-		16	20	13	3.0	35
EC (µmhos)	-		-		214	421	490	222	4850
pH (Std. Units)	6.8-8.5	P	-		6.0	6.8	6.4	7.1	4.3
Carbon Dioxide, Dissolved (mg/l as CO_2)	-		-		70	51	168	16	0.0
Alkalinity, Field (mg/l as $CaCO_3$)	-		-		36	166	217	100	0
Bicarbonate, FET-FLD (mg/l as $HC0_3$)	-		-		44	202	264	122	0
Nitrogen, Organic Total (mg/l as N)	-		-		0.11	0.12	0.02	0.01	1.0
Nitrogen, Ammonia Total (mg/l as N)	0.006	P	30	N	0.020	0.020	0.040	0.020	160
Nitrogen, Nitrite Total (mg/l as N)	1	P	-		0.000	0.000	0.000	0.000	0.000
Nitrogen, Nitrate Total (mg/l as N)	10	P	-		9.2	0.32	0.01	0.43	0.08
Nitrogen, Ammonia + Organic Total (mg/l as N)	-		-		0.13	0.14	0.06	0.03	161
Nitrogen, NO_2 + NO_3 Total (mg/l as N)	-		-		9.2	0.32	0.01	0.43	0.08
Nitrogen, Total (mg/l as N)	-		-		9.3	0.46	0.07	0.46	161
Carbon, Organic Total (mg/l as C)	-		-		3.1	16	9.2	10	41
Phosphorus, Ortho, Total (mg/l as P)	-		-		0.150	0.300	0.730	0.530	0.270
Phosphorus, Total (mg/l as P)	-		-		2.80	0.610	1.20	0.540	0.320
Hardness (mg/l as $CaCO_3$)	-		-		89	220	270	120	860
Hardness, Noncarbonate (mg/l as $CaCO_3$)	-		-		53	54	53	20	860
Solids, Residue at 180 ° C, Dissolved (mg/l)	500	S	-		195	277	286	140	3580
Solids, Sum of Constituents, Dissolved (mg/l)	500	S	-		85	246	281	128	3430
Calcium, Dissolved (mg/l as Ca)	-		-		24	51	60	40	230
Magnesium, Dissolved (mg/l as Mg)	-		-		7.1	23	29	3.7	70
Sodium, Dissolved (mg/l as Na)	-		-		5.6	7.4	12	4.1	400
Potassium, Dissolved (mg/l as K)	-		-		0.2	0.9	0.4	0.2	18
Chloride, Dissolved (mg/l as Cl)	250	S	-		18	11	16	5.0	20
Sulfate, Dissolved (mg/l as SO_4)	500	P	-		3.1	34	18	5.4	2600
Fluoride, Dissolved (mg/l as F)	4	P	-		0.2	0.9	0.7	0.4	1.6
Silica, Dissolved (mg/l as SiO_2)	-		-		4.6	18	15	9.0	88

Table A-3. Complete Water Quality Data from Multiple Sampling Events at Connector Wells at Five Sites in Phosphate Mining Area, Polk and Hillsborough Counties, Florida (Continued)

Constituent	Drinking Water Standards *		Health Advisory Levels **		(1)	(2)	(3)	(4)	(5)
	mg/l	P/S	mg/l	N/C					
Arsenic, Total (mg/l as As)	0.05	P	0.002	C	0.002	0.02	0.002	0.11	0.002
Barium, Total Recoverable (mg/l as Ba)	0.2	P	0.2	N	0.1	<0.05	0.1	<0.05	<0.05
Cadmium, Total Recoverable (mg/l as Cd)	0.005	P	0.005	N	0.002	0.002	0	0	0.008
Chromium, Total Recoverable (mg/l as Cr)	0.1	P	0.1	N	0.01	0.02	0.01	0.02	0.02
Copper, Total Recoverable (mg/l as Cu)	1.3	P	-		0.009	0.097	0.007	0.011	0.015
Iron, Total Recoverable (mg/l as Fe)	0.3	S	-		1	1.2	1.4	0.011	25
Lead, Total Recoverable (mg/l as Pb)	0.015	P	-		0.003	0.010	0.002	0.001	0.008
Manganese, Total Recoverable (mg/l as Mn)	0.05	S	-		0.01	0.04	0.03	0.01	0.71
Silver, Total Recoverable (mg/l as Ag)	0.1	S	0.1	N	0	0	0	0	0
Strontium, Dissolved (mg/l as Sr)	-		17	N	0.07	0.13	0.21	0.13	-
Selenium, Total (mg/l as Se)	0.05	P	-		0	0.001	0	0	0
Mercury, Total Recoverable (mg/l as Hg)	0.002	P	0.002	N	0.0003	0.0007	<0.0001	<0.000 1	0.0002
Perthane, Total (mg/l)	-		-		0.00	0.00	0.00	0.00	0.00
Naphthalenes, Polychlor. Total (mg/l)	-		-		0.00	0.00	0.00	0.00	0.00
Aldrin, Total (mg/l)	-		0.0002	C	0.00	0.00	0.00	0.00	0.00
Lindane, Total (mg/l)	0.0002	P	0.0002	N	0.00	0.00	0.00	0.00	0.00
Chlordane, Total (mg/l)	0.002	P	0.003	C	0.00	0.00	0.00	0.00	0.00
DDD, Total (mg/l)	-		-		0.00	0.00	0.00	0.00	0.00
DDE, Total (mg/l)	-		-		0.00	0.00	0.00	0.00	0.00
DDT, Total (mg/l)	-		-		0.00	0.00	0.00	0.00	0.00
Dieldrin, Total (mg/l)	-		0.0002	C	0.00	0.00	0.00	0.00	0.00
Endosulfan, Total (mg/l)	-		-		0.00	0.00	0.00	0.00	0.00
Endrin, Total (mg/l)	0.002	P	0.002	N	0.00	0.00	0.00	0.00	0.00
Ethion,Total (mg/l)	-		-		0.00	0.00	0.00	0.00	0.00
Toxaphene, Total (mg/l)	0.003	P	0.003	C	0	0	0	0	0
Heptachlor, Total (mg/l)	0.0004	P	0.0008	C	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide, Total (mg/l)	0.0002	P	0.0004	C	0.00	0.00	0.00	0.00	0.00
Methoxychlor, Total (mg/l)	0.04	P	0.04	N	0.00	0.00	0.00	0.00	0.00
PCB, Total (mg/l)	0.0005	P	0.0005	C	0.00	0.00	0.00	0.00	0.00

Table A-3. Complete Water Quality Data from Multiple Sampling Events at Connector Wells at Five Sites in Phosphate Mining Area, Polk and Hillsborough Counties, Florida (Continued)

Constituent	Drinking Water Standards *		Health Advisory Levels **		(1)	(2)	(3)	(4)	(5)
	mg/l	P/S	mg/l	N/C					
Malathion, Total (mg/l)	-		0.2	N	0.00	0.00	0.00	0.00	0.00
Parathion, Total (mg/l)	-		-		0.00	0.00	0.00	0.00	0.00
Diazinon, Total (mg/l)	-		0.0006	N	0.00	0.00	0.00	0.00	0.00
Methylparathion, Total (mg/l)	-		0.002	N	0.00	0.00	0.00	0.00	0.00
2,4-D, Total (mg/l)	-		-		0.00	-	0.00	0.00	0.00
2,4,5-T, Total (mg/l)	-		0.07	N	0.00	-	0.00	0.00	0.00
Mirex, Total (mg/l)	-		-		0.00	0.00	0.00	0.00	0.00
Silvex, Total (mg/l)	-		-		0.00	-	0.00	0.00	0.00
Total Trithion, (mg/l)	-		-		0.00	0.00	0.00	0.00	0.00
Methyl Trithion, Total (mg/l)	-		-		0.00	0.00	0.00	0.00	0.00
Cesium 137 Dissolved (pCi/l)	-		-		<1.0	<1.0	<1.0	<1.0	<1.0
Strontium 90 Dissolved (pCi/l)	-		-		<0.4	<0.4	<0.4	<0.4	<0.4
Radium 226, Dissolved, Radon Method (pCi/l)	5	P	20	C	4.8	1.1	.95	.93	8.9
Gross Alpha, Dissolved (mg/l as U-NAT)	-		-		0.012	<0.004	<0.0058	0.0061	0.099
Gross Beta, Dissolved (PSI/l as CS-137)	-		-		6.9	3.9	2.3	4.2	110
Gross Beta, Dissolved (PCI/l as YT-90)	-		-		6.7	3.7	2.1	4.0	110
Uranium, Dissolved, Extraction (mg/l)	0.02	P	***		0.0051	0.0014	0.0013	0.011	0.0016

Source: Kimrey and Fayard, 1984.
(1) Watson Mine. Sampling events took place at Watson Mine on August 20, 1980.
(2) Silver City Mine . Sampling events took place at Silver City Mine on August 20, 1980.
(3) Fort Meade Mine . Sampling events took place at Fort Meade Mine
(4) Nichols Mine. Sampling events took place at Nichols Mine on August 19, 1980.
(5) Phosphoria Mine. Sampling events took place at Phosphoria Mine on August 21, 1980.
-No standards or advisory levels available.
* Drinking Water Standards: P= Primary; S= Secondary
** Health Advisory Levels: N= Noncancer Lifetime; C= Cancer Risk
*** Under review.

Table A-4. Complete Water Quality Data from Druid Mine Shaft

Constituent	Drinking Water Standards *		Health Advisory Levels **		Results mg/l (dissolved basis)
	mg/l	P/S	mg/l	N/C	
Alkalinity, as CaCO3	-		-		91
Aluminum	0.05 - 0.2	S	-		0.14
Arsenic, total	0.05	P	0.002	C	0.002
Barium, dissolved	2	P	2	N	<.02
Beryllium, dissolved	0.004	P	0.0008	C	<.02
Boron, dissolved	-		0.6	N	0.13
Cadmium, recoverable	0.005	P	0.005	N	0.067
Calcium, total	-		-		667
Chloride	-		-		40.9
Chromium, total	0.1	P	0.1	N	0.02
Copper, recoverable	1.3	P	-		1.10
Cyanide, total	0.2	P	0.2	N	2.24
Fluoride, dissolved	4	P	-		1.71
Hardness, as CaCO3	-		-		91
Hardness, total	-		-		1570
Iron, recoverable	0.3	S	-		0.08
Lead, recoverable	0.015	P	-		<.001
Magnesium, total	-		-		14.8
Manganese, recoverable	0.05	S	-		0.84
Mercury, recoverable	0.002	P	0.002	N	0.0006
Molybdenum, dissolved	-		0.04	N	0.26
Nickel, dissolved	0.1	P	0.1	N	1.75
Nitrogen, Ammonia	-		-		19.9
Nitrogen, Nitrate	10	P	-		37.8
Nitrogen, Nitrite	1	P	-		0.10
pH	6.5 - 8.5	S	-		8.15
Potassium, total	-		-		34.4
Selenium, recoverable	0.05	P	-		0.006
Silver, recoverable	0.1	S	0.1	N	0.026
Sodium, total	-		-		738

Table A-4. Complete Water Quality Data from Druid Mine Shaft (Continued)

Constituent	Drinking Water Standards *		Health Advisory Levels **		Results mg/l (dissolved basis)
	mg/l	P/S	mg/l	N/C	
Solids, dissolved	500	S	-		4560
Sulfate, total	500/250	p/S	-		2080
Zinc, recoverable	5	S	2	N	1.56

Source: Stewart, 1993

* Drinking Water Standards: P= Primary; S= Secondary

** Health Advisory Levels: N= Noncancer Lifetime; C= Cancer Risk

-No standards or advisory levels available.

ATTACHMENT B
STATE AND LOCAL PROGRAM DESCRIPTIONS

This attachment does not describe every state's control program; instead it focuses on the six states where relatively large numbers of special drainage wells are known to exist: Alaska, Florida, Idaho, Indiana, Ohio, and Oregon. Altogether, these six states have a total of 1,916 documented special drainage wells, which is approximately 99% of the documented well inventory for the nation.

With the exception of Florida, which explicitly addresses connector wells and swimming pool drainage wells in its UIC regulations, the states that have special drainage wells do not have regulatory provisions that address them directly. In several states, including Alaska, Idaho, and Oregon, special drainage wells may fall under state regulations addressing wastewater disposal to ground water. If the injectate meets primary treatment standards, however, the requirements may be less stringent. Thus, potable water tank overflow wells are not likely to be subject to permitting requirements that might apply to other special drainage well categories.

Alaska

USEPA Region 10 directly implements the UIC program for Class V injection wells in Alaska. In addition, Chapter 72 of the Alaska Administrative Code (AAC) addresses wastewater disposal to ground water.

Any person who disposes of domestic wastewater to ground water is required to obtain a permit from the Department of Environmental Conservation. A permit is not required if the discharge is less than 500 gpd or it goes to an approved soil absorption system, and the wastewater has received at least primary treatment (18 AAC 072.10).

Florida

Florida is a UIC Primacy state for Class V wells. Chapter 62-528 of the Florida Administrative Code (FAC), effective June 24, 1997, establishes the UIC program, and Part V (62-528.600 to 62-528.900) addresses criteria and standards for Class V wells.

Class V wells are grouped for purposes of permitting into eight categories. The special drainage wells fall into at least three of these categories. Connector wells are included in Group 2. Construction dewatering wells have been permitted as storm water drainage wells (Group 6) (Deuerling, 1999). Swimming pool drainage wells and other wells not described in the other Class V groups, such as potable water overflow wells, are in Group 8. The regulatory requirements for these three groups are described below, because they can be expected to include most special drainage wells in the state.

Permitting

Underground injection through a Class V well is prohibited, except as authorized by permit by the Department of Environmental Protection (DEP). Owners and operators are required to obtain a Construction/Clearance Permit before receiving permission to construct. The applicant is required to submit detailed information, including well location and depth, description of the injection system and of the proposed injectate, and any proposed pretreatment. When site-specific conditions indicate a threat to a USDW, additional information must be submitted. In addition, all Class V wells are required to obtain a plugging and abandonment permit.

In Florida, owners of swimming pool drainage wells at single-family residences are only required to submit inventory information on their well (Deuerling, 1997). All other swimming pool drainage wells are constructed and operated under a general permit for construction of swimming pool drainage wells that are designed in accordance with the standards and criteria in Rule 62-528.605 FAC, provided that notice is provided to the DEP. The general permit is subject to the conditions in Rule 62-4.540 FAC. The permittee or engineer of record must certify to the DEP that construction is complete and done in accordance with plans submitted to the DEP. Such wells must satisfy the conditions in Rule 62-528.630 (3) through (6), which provide that the well may not cause or allow movement of fluid containing any contaminant into a USDW, and that the DEP may take actions to address violations of primary drinking water standards or other threats to health from the well.

Florida treats their two types of dewatering wells, connector wells and construction dewatering wells, as storm water wells. The applicant is required to provide information concerning known contamination sites in the area. In addition, an individual permit is required to operate the well, and the applicant must show that the injectate meets MCLs or will not be injected into a USDW. Most connector wells in the state have been closed by Florida DEP and the agency is not issuing new permits unless an applicant can demonstrate that injectate will meet MCLs at the point of injection (Cadmus, 1999). According to Florida DEP, no new connector wells are permitted, and old wells are terminated and plugged as they are discovered (Richtar, 1999).

Well Construction Standards

Specific construction standards for Class V wells have not been enacted by Florida because of the variety of Class V wells and their uses. Instead, the state requires the well to be designed and constructed for its intended use and in accordance with good engineering practices. State staff approve the well's design and construction through a permit. State staff can apply any of the criteria for Class I wells to the permitting of Class V wells, if it determines that without such criteria the Class V well may cause or allow fluids to migrate into a USDW and cause a violation of the state's primary or secondary drinking water standards, which are contained in Chapter 62-550 of the FAC. However, if the injectate meets the primary and secondary drinking water quality standards and the minimum criteria contained in Rule 62-520-400 of the FAC, Class I injection well permitting standards will not be required.

Class V wells are required to be constructed so that their intended use does not violate the water quality standards in Chapter 62-520 FAC at the point of discharge, provided that the drinking water standards of 40 CFR Part 142 are met at the point of discharge.

Operating Requirements

All Class V wells are required to be used or operated in such a manner that they do not present a hazard to USDWs. Domestic wastewater effluent must meet criteria established in specified rules of the FAC. Pretreatment of injectate must be performed, if necessary, to ensure the fluid does not violate the applicable water quality standards in 62-520 FAC.

Monitoring Requirements

Monitoring generally is required for Group 2 wells, including connector wells, unless the wells inject fluids that: (1) meet the primary and secondary drinking water standards in 62-550 FAC and the minimum criteria in Rule 62-520, and (2) have been processed through a permitted drinking water treatment facility. Group 6 wells, which include construction dewatering wells, must be monitored if injection occurs into a USDW. Monitoring is required for Group 8 wells, except swimming pool drainage wells (62-528.615 (1)(a)2 and 3 FAC). Monitoring is not required for swimming pool drainage wells that receive a general permit under Rules 62-528.710 FAC. Monitoring frequency is addressed in the permit and is based on well location and the nature of the injectate.

Plugging and Abandonment

The owner or operator of any Class V well must apply for a plugging and abandonment permit when the well is no longer used or usable for its intended purpose. Plugging must be performed by a licensed water well contractor.

Idaho

Idaho is a UIC Primacy state for Class V wells. Idaho promulgated regulations for the UIC control program in the Idaho Administrative Code (IDAPA), Title 3, Chapter 3. Deep injection wells are defined as being more than 18 feet in vertical depth below the land surface (37.03.03.010.11 IDAPA). Wells are further classified, with Class V Subclass 5G30 defined as special drainage water and 5X27 defined as “other wells” (37.03.03.01.k and bb IDAPA).

Permitting

Construction and use of shallow injection wells are authorized by rule, provided that inventory information is provided and use of the well does not result in unreasonable contamination of a drinking water source or cause a violation of water quality standards that would affect a beneficial use (37.03.03.03.d IDAPA). Construction and use of Class V deep injection wells may be authorized by permit (37.03.03.03.c IDAPA). The regulations outline detailed specifications for the information that must be supplied in a permit application (37.03.03.035 IDAPA).

Construction Requirements

In Idaho, where pump control valve discharge and potable water tank overflow wells are located, the Director of the Idaho Department of Environmental Quality may impose certain siting restrictions on Class V wells. Specifically, the state may require permitted wells to locate a minimum distance from any point of diversion for beneficial use that could be harmed by bacterial contaminants. These siting requirements may be waived if the well owner/operator can demonstrate that any springs or wells within a specified radius of the perched water zone will not be contaminated by the injection well (Cadmus, 1999).

Operating Requirements

Standards for the quality of injected fluids and criteria for location and use are established for rule authorized wells, as well as for wells requiring permits. The rules are based on two factors: (1) the injected fluids must meet MCLs for drinking water for physical, chemical, and radiological contaminants at the wellhead, and (2) ground water produced from adjacent points of diversion for beneficial use must meet the water quality standards found in Idaho's "Water Quality Standards and Wastewater Treatment Requirements," 16.01.02 IDAPA, administered by the Idaho Department of Health and Welfare. If a well meets these two criteria, the aquifer will be protected from unreasonable contamination. The state may, when it is deemed necessary, require specific injection wells to be constructed and operated in compliance with additional requirements (37.03.03.050.01 IDAPA (Rule 50)). Rule-authorized wells "shall conform to the drinking water standards at the point of injection and not cause any water quality standards to be violated at the point of beneficial use" (37.03.03.050.04.d. IDAPA).

Monitoring, recordkeeping, and reporting may be required if the state finds that the well may adversely affect a drinking water source or is injecting a contaminant that could have an unacceptable effect upon the quality of the ground waters of the state (37.03.03.055 IDAPA (Rule 55)).

Financial Responsibility

No financial responsibility requirement exists for rule authorized special drainage wells. Permitted wells are required by the permit rule to demonstrate financial responsibility through a performance bond or other appropriate means to abandon the injection well according to the conditions of the permit (37.03.03.35.03.e IDAPA).

Plugging and Abandonment

The Idaho Department of Water Resources (IDWR) has prepared "General Guidelines for Abandonment of Injection Wells," which are not included in the regulatory requirements. IDWR expects to approve the final abandonment procedure for each well. The General Guidelines recommend the following:

- Pull the casing, if possible. If the casing is not pulled, cut it to a minimum of two feet below land surface.
- Measure the total depth of the well.
- If the casing is left in place, perforate it and fill the hole by pressure grouting with neat cement with up to 5% bentonite. As an alternative, when the casing is not pulled, use coarse bentonite chips or pellets. If the well extends into the aquifer, run the chips or pellets over a screen to prevent any dust from entering the hole. No dust is allowed to enter the bore hole because of the potential for bridging. Perforation of the casing is not required under this alternative.
- If the well extends into the aquifer, fill the bore hole with a clean pit-run gravel or road mix to up to 10 feet below the top of the saturated zone or 10 feet below the bottom of the casing, whichever is deeper. Use cement grout or bentonite clay to surface. The use of gravel may not be allowed if the lithology is undetermined or unsuitable.
- Place a cement cap at the top of the casing if it is not pulled, and place a minimum of two feet of soil over the foiled hole/cap.
- An IDWR representative should witness abandonment of the well.

Indiana

USEPA Region 5 directly implements the UIC program for Class V injection wells in Indiana. Class V owners and operators contact the USEPA Region 5 UIC Program directly to report inventory or are referred to the USEPA Regional UIC program by state, city, or county personnel or consultants. The USEPA Region retains all records regarding well location, injectate information, and regulatory requirements. Generally, USEPA Region 5 authorizes all Class V wells by rule; however, they require and have the authority to impose conditions which ensure that wells do not endanger USDWs.

Ohio

Ohio is a UIC Primacy state for Class V wells. Regulations establishing the underground injection control program are found in Chapter 3745-34 of the Ohio Administrative Code (OAC).

Permitting

Class V injection well definitions do not explicitly address swimming pool drainage wells, connector wells, potable water tank overflow wells, or other special drainage wells (3745-34-04 OAC). However, any underground injection, except as authorized by permit or rule, is prohibited. The construction of any well required to have a permit is prohibited until the permit is issued (3745-34-06 OAC).

Injection into Class V injection wells is authorized by rule (3745-34-13 OAC). However, a drilling and operating permit is required for injection into or above a USDW of sewage, industrial wastes, or other wastes, as defined in § 6111.01 of the Ohio Revised Code, (3745-34-13 OAC and 3745-34-14 OAC).

Siting and Construction

There are no specific regulatory requirements for the siting and construction of wells permitted by rule.

Operating Requirements

There are no specific operating or monitoring requirements for wells permitted by rule.

Oregon

Oregon is a UIC Primacy state for Class V wells. The UIC program is administered by the Department of Environmental Quality (DEQ). Under the state's Administrative Rules (OAR) pertaining to underground injection, a "waste disposal well" is defined as any bored, drilled, driven, or dug hole, whose depth is greater than its largest surface dimension, which is used or is intended to be used for disposal of sewage, industrial, agricultural, or other wastes. The definition includes drain holes, drywells, cesspools, and seepage pits, along with other underground injection wells (340-044-0005(22) OAR). Construction and operation of a waste disposal well without a water pollution control facility (WPCF) permit is prohibited. Certain categories of wells are prohibited entirely, including wells used for underground injection activities that allow the movement of fluids into a USDW if such fluids may cause a violation of any primary drinking water regulation or otherwise create a public health hazard or have the potential to cause significant degradation of public waters.

Permitting

Any underground injection activity that may cause, or tend to cause, pollution of ground water must be approved by the DEQ, in addition to any other permits or approvals required by other federal, state, or local agencies (340-044-0055 OAR). Permits are not to be issued for construction, maintenance, or use of waste disposal wells where any other treatment or disposal method that affords better protection of public health or water resources is reasonably available or possible (340-044-0030 OAR). A waste disposal well, unless absolutely prohibited, must obtain a WPCF permit (340-044-0035 OAR, 340-045-0015 OAR).

Siting and Construction

Permits for construction or use of waste disposal wells include minimum conditions relating to their location, construction, and use (340-044-0035 OAR).

Abandonment and Plugging

Upon discontinuance of use or abandonment, a waste disposal well is required to be rendered completely inoperable by plugging and sealing the hole. All portions of the well that are surrounded by "solid wall" formation must be plugged and filled with cement grout or concrete. The top portion of the well must be effectively sealed with cement grout or concrete to a depth of at least 18 feet below land surface. If this method of sealing is not effective, a manner approved by the DEQ must be used to seal the well.

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