DOE/PI-0004

Coal Combustion Waste Management at Landfills and Surface Impoundments, 1994–2004

U.S. Department of Energy

Office of Fossil Energy
and the
Office of Policy and International Affairs

U.S. Environmental Protection Agency

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DOE/PI-0004
ANL-EVS/06-4

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August 2006

work sponsored by
U.S. Department of Energy,
Office of Fossil Energy and the Office of Policy and International Affairs

ACKNOWLEDGMENTS

The authors wish to thank the U.S. Department of Energy (DOE) project team—Debra Jo Littleton, the initiator of the study and the DOE project manager (DOE Office of Fossil Energy), and David O. Moses (DOE Office of Policy and International Affairs)—and the U.S. Environmental Protection Agency (EPA) project team—Alexander Livnat, the EPA project manager for the study, and Steve Souders and Richard Kinch (EPA Office of Solid Waste). We also wish to thank Jim Roewer of the Utility Solid Waste Activities Group for coordinating the survey responses and facilitating the collection of more than 60 permits. We also acknowledge the operators of the fossil fuel power industry's disposal units for responding to the questionnaires and follow-up questions, as well as the State regulators who provided information to the project team. We thank Elizabeth K. Hocking and Markus G. Puder of Argonne National Laboratory for their support in data collection and analysis. Finally, we would like to thank the peer reviewers, who represent the Association of State and Territorial Solid Waste Management Officials, the Clean Air Task Force, and the Utility Water Act Group, for their comments and input.

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NOTATION

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

GENERAL ACRONYMS AND ABBREVIATIONS

ACAA	American Coal Ash Association
ADEM	Alabama Department of Environmental Management
Adm. Code	Administrative Code
AGA	American Gas Association
APPA	American Public Power Association
CCB	coal combustion by-product
CCR	coal combustion residue
CCW	coal combustion waste
CFR	*Code of Federal Regulations*
CSR	Code of State Regulations
DEP	Department of Environmental Protection
DNR	Department of Natural Resources
DOE	U.S. Department of Energy
EEI	Edison Electric Institute
EIA	Energy Information Administration
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
FAC	Florida Administrative Code
FBC	fluidized bed combustion
FGD	flue gas desulfurization
FR	*Federal Register*
FS	Florida Statutes
GDNR	Georgia Department of Natural Resources
HDPE	high-density polyethylene
IAC	Indiana Administrative Code
IDEM	Indiana Department of Environmental Management
IEPA	Illinois Environmental Protection Agency
ILCS	Illinois Compiled Statutes
ISWLF	Industrial Solid Waste Landfill
IWDR Rule	Industrial Waste Disposal and Reuse Rule

MCL	maximum contaminant level
MoDNR	Missouri Department of Natural Resources
NETL	National Energy Technology Laboratory
NPDES	National Pollutant Discharge Elimination System
NR	Natural Resources (chapter designation in WAC)
NRECA	National Rural Electric Cooperative Association
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
ORC	Ohio Revised Code
PADEP	Pennsylvania Department of Environmental Protection
PAL	preventive action limit
PPSA	Power Plant Siting Act
RCRA	Resource Conservation and Recovery Act
RD	Regulatory Determination
RTC	Report to Congress
SMCRA	Surface Mining Control and Reclamation Act
SSI	statistically significant increase
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TCLP	Toxicity Characteristic Leaching Procedure
TRI	Toxic Release Inventory
USWAG	Utility Solid Waste Activities Group
VAC	Virginia Administrative Code
VDEQ	Virginia Department of Environmental Quality
VPDES	Virginia Pollutant Discharge Elimination System
WAC	Wisconsin Administrative Code
WDNR	Wisconsin Department of Natural Resources
WEPA	Wisconsin Environmental Protection Agency
WPDES	Wisconsin Pollutant Discharge Elimination System

UNITS OF MEASURE

cm	centimeter(s)
ft	foot (feet)
gal	gallon(s)
GW	gigawatt(s)
in.	inch(es)
L	liter(s)
lb	pound(s)
m	meter(s)
mg	milligram(s)
mi	mile(s)
MW	megawatt(s)
psi	pound(s) per square inch ($lb/in.^2$)
µg	microgram(s)
µm	micrometer(s)
s	second(s)

SUMMARY

On May 22, 2000, as required by Congress in its 1980 Amendments to the Resource Conservation and Recovery Act (RCRA), the U.S. Environmental Protection Agency (EPA) issued a *Regulatory Determination on Wastes from the Combustion of Fossil Fuels*. On the basis of information contained in its 1999 *Report to Congress: Wastes from the Combustion of Fossil Fuels*, the EPA concluded that coal combustion wastes (CCWs), also known as coal combustion by-products (CCBs), did not warrant regulation under Subtitle C of RCRA, and it retained the existing hazardous waste exemption for these materials under RCRA Section 3001(b)(3)(C). However, the EPA also determined that national regulations under Subtitle D of RCRA were warranted for CCWs that are disposed of in landfills or surface impoundments. The EPA made this determination in part on the basis of its findings that "present disposal practices are such that, in 1995, these wastes were being managed in 40 percent to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of groundwater monitoring; and while there have been substantive improvements in state regulatory programs, we have also identified gaps in State oversight" (EPA 2000).

The 1999 Report to Congress (RTC), however, may not have reflected the changes in CCW disposal practices that occurred since the cutoff date (1995) of its database and subsequent developments. The U.S. Department of Energy (DOE) and the EPA discussed this issue and decided to conduct a joint DOE/EPA study to collect new information on the recent CCW management practices by the power industry. It was agreed that such information would provide a perspective on the chronological adoption of control measures in CCW units based on State regulations. A team of experts from the EPA, industry, and DOE (with support from Argonne National Laboratory) was established to develop a mutually acceptable approach for collecting and analyzing data on CCW disposal practices and State regulatory requirements at landfills and surface impoundments that were permitted, built, or laterally expanded between January 1, 1994, and December 31, 2004. The scope of the study excluded waste units that manage CCWs in active or abandoned coal mines.

The EPA identified the following three areas of interest:

1. Recent and current CCW industry surface disposal management practices,

2. State regulatory requirements for CCW management, and

3. Implementation of State requirements (i.e., the extent to which States grant or deny operator requests to waive or vary regulatory requirements and the rationales for doing so).

DOE and the EPA obtained data on recent and current disposal practices from a questionnaire that the Utility Solid Waste Activities Group (USWAG) distributed to its members that own or operate coal-fired power plants. USWAG, formed in 1978, is responsible for addressing solid and hazardous waste issues on behalf of the utility industry. It is an informal consortium of approximately 80 utility operating companies, the Edison Electric Institute (EEI),

the National Rural Electric Cooperative Association (NRECA), the American Public Power Association (APPA), and the American Gas Association (AGA). EEI is the principal national association of investor-owned electric power and light companies. NRECA is the national association of rural electric cooperatives. APPA is the national association of publicly owned electric utilities. AGA is the national association of natural gas utilities. Together, USWAG member companies and trade associations represent more than 85% of the total electric generating capacity of the United States and service more than 95% of the nation's consumers of electricity. To verify the survey findings, the EPA also asked State regulators from nine selected States that are leading consumers of coal for electricity generation for information on disposal units that may not have been covered in the USWAG survey. The selected States were Georgia, Illinois, Indiana, Michigan, Missouri, North Carolina, North Dakota, Ohio, and Texas. A total of 56 waste units were identified, and information from these units[1] formed the basis for the analysis of recent and current surface disposal management practices. Table S-1 summarizes the numbers of units for the various categories covered in this study.

The total number of CCW disposal units permitted, built, or laterally expanded between January 1, 1994, and December 31, 2004 ("new units") is not known, as no industry organization or government agency tracks this information. However, by using coal-fired power plant generating capacity as a proxy for calculating sample coverage, we estimate that the 56 units on which the analysis is based represent at least 63% of the total universe of new or expanded

TABLE S-1 CCW Units in Study

Unit Category as Defined in This Study	Description	Questionnaire Sent and Returned	Number		
			Landfill	Surface Impoundment	Total
Surveyed	Identified in December 2004 USWAG survey	Yes	29	16	45
Nonsurveyed	Identified by the EPA	No	9	2	11
Identified	Sum of surveyed and nonsurveyed units	45 yes 11 no	38	18	56
Supplemental[a]	Identified in 2006 USWAG follow-up	No	4	2	6
Total	Sum of identified and supplemental units	45 yes	42	20	62

[a] Supplemental units were identified in a 2006 USWAG follow-up to identify any units that were not reported in the 2004 survey. The supplemental units were not included in the analysis.

1 Identified units included 45 surveyed units, or units that returned the questionnaires, and 11 nonsurveyed units, or units that resulted from the EPA investigation (no complete questionnaires).

disposal units. In addition, a January 2006 follow-up identified six supplemental disposal units from four utilities that had not responded to the December 2004 survey. Adding the capacities of these utilities to the total brings the response rate up to 71%, using the capacity proxy. This is a conservative estimate for the following reasons: (1) the actual coal-fired power plant capacity requiring CCW disposal capacity is much less than the generating capacity that was used to calculate the sample coverage rate; (2) the total U.S. coal-fired power plant capacity (335.2 GW in 2004) includes those power plants that are on standby and produce neither power nor CCWs; (3) a significant portion (between 35% and 40%, according to different sources) of CCWs are beneficially used, thus requiring no disposal in waste units; and (4) because less than 3% of the total coal-fired generating capacity has been added during the period that closely corresponds to the survey period, new disposal capacity would be required for only a small portion of the total generating capacity.

For the State regulatory analysis, our initial objective was to compare current CCW-related regulatory requirements with comparable information from earlier reports. It was evident from the outset, however, that a nationwide study of the CCW regulations and their chronological changes in the States that have coal-fired generating capacity would not be feasible under the time and resource constraints of this study. Therefore, an alternative approach was undertaken, namely reviewing the current regulatory programs applicable to CCWs in States that contain units of one or more of the following types and comparing the results with corresponding information from earlier reports: (1) new CCW disposal units (i.e., those permitted, constructed, or laterally expanded between 1994 and 2004) and (2) units that are the basis of proven, potential, or alleged damage cases.[2] Of the 26 States identified as meeting the selection criteria, a pilot study involving five States (Pennsylvania, Illinois, Indiana, Virginia, and Wisconsin) was conducted to determine whether it would be feasible, within the established budget and schedule constraints, to collect enough data for all 26 States to allow comparisons of current regulatory requirements with comparable information from earlier reports and identify changes.

Information collected during the pilot study covered the following categories of regulatory control:

- Regulatory designation of CCWs for disposal,
- Permitting requirements,
- Liner requirements,

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2 In comments to the EPA, public interest groups have identified cases in which they allege that damage to human health or the environment was caused by fossil-fuel-combustion waste management units. As of May 2006, 86 of the alleged damage cases have been investigated by the EPA to verify the existence and cause of the damage. As defined in the 1999 RTC, proven damage cases are those with exceedences of primary maximum contaminant levels (MCLs) or other health-based standards in groundwater or surface water off-site or at a distance from the waste management unit sufficient to conclude that they could cause human health concerns, while potential damage cases are those with (1) documented exceedences of primary MCLs or other health-based standards on-site or beneath or close to the waste source, and/or (2) documented exceedences of secondary MCLs or other non-health-based standards on-site or off-site.

- Groundwater-monitoring requirements,
- Leachate-collection system requirements,
- Corrective action requirements,
- Closure/post-closure requirements,
- Siting controls, and
- Financial assurance requirements.

The pilot study was resource intensive, and we discovered that comparisons between the current regulatory requirements and comparable information reported in earlier reports could rarely be made at the same level of detail. In light of this, the EPA revisited information already available from other sources about current State CCW regulatory programs and concluded that our priority should be on updating how States were actually implementing programs, rather than simply gathering further information on State regulations. Accordingly, we did not conduct comprehensive reviews of State regulations for all of the 26 States mentioned above. Rather, the EPA identified particular aspects of the regulatory programs in specified States that were of interest, and we focused our investigation of regulations on those States in addition to the five pilot States. In all, six additional States (Alabama, Florida, Georgia, Missouri, Ohio, and Texas) were reviewed beyond those in the pilot study. For these additional States, we concentrated on the following five of the nine areas of regulatory control that were reviewed for the pilot States, because these areas have greater potential to affect whether releases to groundwater are controlled:

- Regulatory designation of CCWs for disposal,
- Permitting requirements,
- Liner requirements,
- Groundwater-monitoring requirements, and
- Leachate-collection system requirements.

For each State reviewed, an effort was made to identify regulations applicable to disposal of CCWs in landfills and surface impoundments, regardless of the program (e.g., solid waste, special waste, residual waste, wastewater) into which the State may place such regulations. Regulations covering beneficial use of CCWs and placement of CCWs in mines were not reviewed.

To address the third issue—implementation of State requirements—we conducted a detailed review of all 65 permits received for the surveyed disposal units to determine the nature and extent of variance requests, and how those requests were treated by the regulatory agencies.

The analysis of identified units and State regulations produced the following findings:

1. Between 1994 and 2004, the amount and quality of environmental controls used at CCW management units appear to have increased. A trend toward management in landfills (dry handling) and away from surface impoundments (wet handling) is also evident.

    - The share of landfills developed for disposal has increased, while that for surface impoundments has decreased. Over the 1994 to 2004 period, landfills made up approximately two-thirds of the identified units, and surface impoundments made up one-third of the identified units. None of the identified units used sand and gravel pits for disposal. In the 1999 RTC,[3] just under half of the co-management units were landfills.[4] DOE and the EPA recognize that disposal capacity for new and expanded units may be a better indicator of the amount of waste that has shifted from dry to wet handling, but the survey respondents did not provide disposal capacity information.

    - All of the surveyed units either underwent a pre-permit site characterization, or a site characterization was required as part of the permit.

    - One hundred percent of the surveyed landfills and surface impoundments were authorized by one or more permits. In contrast, the 1999 RTC reported that 94% of the landfills and 85% of the impoundments had one or more permits. For the surveyed units, an average of 1.9 permits (1.8 for landfills and 2.1 for surface impoundments) were issued.

    - The use of liners has become essentially ubiquitous. Fifty-five of the 56 identified units have liners, including all of the 45 surveyed units and 10 of the 11 nonsurveyed units. The one unit with no liner is a landfill that

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3 Here, as well as in the following bullets in this section, the cited 1999 RTC percentages are based on the 1997 Electric Power Research Institute (EPRI) database referred to in the RTC.

4 The RTC surveyed only co-management units, while the current study included co-management and ash-only landfills and surface impoundments. Co-management units are disposal units that manage the large-volume wastes (fly ash, bottom ash, boiler slag, and flue gas emission control wastes from the combustion of coal by electric utility power plants) with one or more low-volume wastes that result from supporting processes that are ancillary to the combustion and power-generation processes. Low-volume wastes include, but are not limited to, coal pile runoff, boiler blowdown, coal mill rejects, floor drain wastes, and water treatment wastes. Ash-only units are those that manage only the large-volume wastes. Because the 2000 regulatory determination stated that any new Subtitle D rules would apply to both co-management and ash-only units, the survey for the current study was not concerned with, nor did it ask, whether the unit was a co-management or ash-only unit. However, the survey did ask about material disposed. Assuming that a unit that reported management of only fly ash, boiler slag, or flue gas desulfurization sludge was an "ash-only" unit and not a co-management unit, it appears that of the surveyed units, 14 landfills are co-management units and 2 surface impoundments are co-management units. If this is true, the trend from co-management surface impoundments to landfills is even more pronounced, with 88% of the new co-management units being landfills and 12% being surface impoundments.

receives only material that the State's regulations classify as inert bottom ash, and thus requires no liner. This compares with liners installed in 75% and 60% of those landfills and surface impoundments, respectively, that were established between 1985 and 1995.

- The protective qualities of the liner materials have improved over the past decade for both landfills and surface impoundments. Most of the liners in the identified newly constructed or expanded units are engineered liners made of compacted clay, synthetic clay, geomembrane, or a combination of these materials. The percentage of combination and multiple liners increased for landfills from less than 10% in the 1999 RTC to more than 50% in the newly constructed/expanded units. Similarly for impoundments, the share of combination/multiple liners increased from 2% in the 1999 RTC to more than 50% in the newly constructed/expanded units.

- The vast majority (91%) of the identified units (landfills and surface impoundments) built or expanded between 1994 and 2004 have groundwater monitoring:

  - Thirty-seven of the 38 landfills (97%) monitor groundwater. The one landfill that does not conduct groundwater monitoring manages only bottom ash, which the State has classified as inert and thus does not require groundwater monitoring. Between 1985 and 1995, 88% of the landfills established had groundwater monitoring.

  - Nearly 80% of the 18 surface impoundments built or expanded between 1994 and 2004 monitor groundwater. While the share of surface impoundments that monitor groundwater is lower than that of landfills, it is still higher than the 65% of surface impoundments established between 1985 and 1995 that had groundwater monitoring.

- Landfills and surface impoundments monitor for a variety of hazardous and nonhazardous constituents at numerous well locations inside and outside the unit boundaries, both upgradient and downgradient, as required by the State agency having jurisdiction. Not all units are required to monitor for the same constituents (e.g., the regulatory agency may have used waste characterization data to determine that certain constituents are not present in the CCWs and thus testing for such constituents is unnecessary). However, commonly monitored constituents include mercury, molybdenum, vanadium, arsenic, cadmium, copper, nickel, zinc, barium, boron, chromium III, chromium VI, lead, selenium, silver, and tin (toxic metals); and ammonia, nitrogen, nitrite, nitrate, phosphorus, sulfate, potassium, iron, manganese, aluminum, dissolved oxygen, oxidation potential, alkalinity, calcium, magnesium, sodium, chloride, total dissolved solids, total suspended solids, temperature, pH, specific

conductance, and appearance (secondary MCLs and other water quality parameters). Monitoring frequency at the surveyed units ranges from monthly to semiannually. The average number of monitoring wells at surveyed landfills that reported monitoring data is 9, and the average at surveyed surface impoundments is 12. Collection of groundwater quality information (e.g., contaminant concentrations) at surveyed sites was beyond the scope of this study.

2. In eight areas of regulatory control reviewed for this report,[5] more CCWs destined for landfills in the States reviewed had tightened[6] regulatory controls than had relaxed controls between the times data were collected for the 1988 RTC and for this report.

    - Table S-2 indicates which of the States reviewed for this report tightened, relaxed, or had no change ("neutral") in regulatory controls in eight areas applicable to landfills between the times data were collected for the 1988 RTC and for this report. For each area of regulatory control, the total net disposable CCWs[7] generated during 2004 in reviewed States that tightened controls is compared with the same quantity in reviewed States that relaxed controls. The comparisons suggest that in all eight areas of regulatory control reviewed, more net disposable CCWs in the States reviewed had a tightening of regulatory controls than had a relaxation of controls between the times data were collected for the 1988 RTC and for this report.

        - In the area of regulatory designation of CCWs, seven States (Illinois, Indiana, Missouri, Ohio, Pennsylvania, Texas, and Wisconsin) underwent tightened controls and one State (Alabama) underwent relaxed controls, with a ratio of net disposable CCWs (relaxed: tightened) of 0.1:1.0.

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5 A total of nine areas of regulatory control were reviewed for this report: regulatory designation of CCWs, solid waste permitting, liners, groundwater monitoring, leachate collection, corrective action, closure and post-closure, siting, and financial assurance. Because corrective action was not addressed in either the 1988 RTC or the 1999 RTC, no evaluation of changes over time in State regulations was made for corrective action. Similarly, the information in the 1988 and 1999 RTCs was insufficient to support an evaluation of changes over time in State regulations applicable to surface impoundments. Therefore, these changes over time are not evaluated for this report.

6 "Tightened" means that during the time frame considered, specific requirements for controls were added to the State's regulations where either none existed before, or prior requirements were less tailored to the characteristics of the wastes being regulated.

7 "Net disposable CCWs" were determined for each State by subtracting the total amount of CCWs beneficially used in the State during 2004 from the total amount of CCWs generated in the State during 2004, on the basis of data from the EIA. The "total net disposable CCWs" were calculated for each type of change in a regulatory category (i.e., tightened, neutral, or relaxed) by summing the net disposable CCWs for all States reviewed for this report that experienced that type of change.

TABLE S-2 Summary Results from Chronological Comparisons of Regulatory Controls for Landfills in States Reviewed[a]

Category of Regulatory Control	*EPA 1988* to 2005[b]		Total Net Disposable CCWs[c] (thousand short tons)	Ratio of Net Disposable CCWs (Relaxed:Tightened)
Type of Change	Number	States		
Regulatory Designation of CCWs[d]				
Tightened[e]	7	IL, IN, MO, OH, PA, TX, WI	26,652	
Neutral[f]	3	FL, GA, VA	6,279	0.1:1.0
Relaxed[g]	1	AL	2,745	
Solid Waste Permitting[d]				
Tightened	4	IN, MO, OH, PA	15,435	
Neutral	5	FL, GA, TX, VA, WI	15,045	0.34:1.0
Relaxed	2	AL, IL	5,196	
Liners[d]				
Tightened	8	GA, IL, IN, MO, OH, PA, VA, WI	22,462	
Neutral	0		0	0.59:1.0
Relaxed	3	AL, FL, TX	13,214	
Groundwater Monitoring[d]				
Tightened	8	GA, IL, IN, MO, OH, PA, VA, WI	22,462	
Neutral	1	FL	1,921	0.50:1.0
Relaxed	2	AL, TX	11,293	
Leachate Collection[d]				
Tightened	8	GA, IL, IN, MO, OH, PA, VA, WI	22,462	
Neutral	2	AL, TX	11,293	0.086:1.0
Relaxed	1	FL	1,921	
Closure and Post-Closure[h]				
Tightened	3	IN, PA, VA	11,706	
Neutral	2	IL, WI	2,669	0.0:1.0
Relaxed	0		0	
Siting[h]				
Tightened	3	IL, IN, VA	11,216	
Neutral	2	PA, WI	3,159	0.0:1.0
Relaxed	0		0	

TABLE S-2 (Cont.)

Category of Regulatory Control	*EPA 1988* to 2005[b]		Total Net Disposable CCWs[c] (thousand short tons)	Ratio of Net Disposable CCWs (Relaxed:Tightened)
Type of Change	Number	States		
Financial Assurance[h]				
Tightened	2	IN, VA	8,765	
Neutral	3	IL, PA, WI	5,610	0.0:1.0
Relaxed	0		0	

[a] A chronological comparison was not possible for corrective action requirements because the historical EPA documents from which data were obtained did not address this area of regulatory control.

[b] For each category of regulatory control, a chronological comparison is provided for the time period "*EPA 1988* to 2005 Data," which is the time period between the time data were collected for the 1988 RTC: *Wastes from the Combustion of Coal by Electric Utility Power Plants* and the time data were collected for this report.

[c] "Net Disposable CCWs" were determined for each State by subtracting the total amount of CCWs beneficially used in the State during 2004 from the total amount of CCWs generated in the State during 2004, on the basis of data from the EIA. "Total Net Disposable CCWs" were calculated for each type of change in a regulatory category (i.e., tightened, neutral, or relaxed) by summing the Net Disposable CCWs for all States that were reviewed for this report which experienced that type of change.

[d] States reviewed for this regulatory category were Alabama, Illinois, Indiana, Florida, Georgia, Missouri, Ohio, Pennsylvania, Texas, Virginia, and Wisconsin.

[e] "Tightened" means that during the time frame indicated in the column heading, specific requirements for controls were added to the State's regulations where either none existed before, or prior requirements were less tailored to the characteristics of the wastes being regulated.

[f] "Neutral" means that either it could not be ascertained from the information reviewed whether any change occurred during the time frame indicated in the column heading, or the information reviewed suggests that no change occurred.

[g] "Relaxed" means that the information reviewed suggests that some or all pre-existing regulatory controls in the category of interest were removed during the time frame indicated in the column heading.

[h] States reviewed for this regulatory category were Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin.

- In the area of solid waste permitting, four States (Illinois, Missouri, Ohio, and Pennsylvania) had tightened controls, and two States (Alabama and Illinois) had relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.34:1.0.

- In the area of liner requirements, eight States (Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Virginia, and Wisconsin) experienced tightened controls, and three States (Alabama, Florida, and Texas) experienced relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.59:1.0.

- In the area of groundwater-monitoring requirements, eight States (Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Virginia, and Wisconsin) experienced tightened controls, and two States (Alabama and Texas) experienced relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.50:1.0.

- In the area of leachate-collection requirements, eight States (Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Virginia, and Wisconsin) experienced tightened controls, and one State (Florida) experienced relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.086:1.0.

- In the area of closure and post-closure requirements, three States (Indiana, Pennsylvania, and Virginia) experienced tightened controls, and no States experienced relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.0:1.0.

- In the area of siting requirements, three States (Illinois, Indiana, and Virginia) experienced tightened controls, and no States experienced relaxed controls, with a ratio of net disposable CCWs (relaxed: tightened) of 0.0:1.0.

- In the area of financial assurance requirements, two States (Indiana and Virginia) experienced tightened controls, and no States experienced relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.0:1.0.

3. In the 16 States hosting surveyed units, we found that State regulators did not issue variances unless there were sound scientific bases to support the variance requests.

   - A comprehensive review of 65 permits, covering 39 newly constructed or expanded units in the time frame of 1994 to 2004, found that approximately half of the units had requested one or more variances.[8] In this review, we erred on the side of overestimating the number of variance requests; anything in a permit that looked like it might be a variance was included, even if the permit itself identified no variances. A total of 52 variance requests in 9 of the 16 States containing surveyed units were identified. Eighteen of the units requesting variances were landfills; one was a surface impoundment.

   - Of the 52 variance requests identified, 5 were rejected and 47 were granted. Of the 47 granted, 16 were granted with provisions that would

8 Copies of the 65 permits (of a total of 85 permits reported for the surveyed units) were received from 39 of the 45 surveyed units. Some of these units have multiple permits (e.g., solid waste, construction, and dam safety).

revoke or alter the variance if certain conditions were not met. Twelve were granted because the requirement for which the variance was sought (e.g., landfill gas monitoring) was not appropriate or necessary for a disposal unit that manages CCW wastes. Ten variances were granted because the State allows variances for which it can be demonstrated that a proposed alternative meets or exceeds the environmental performance of the otherwise applicable requirement. Finally, six were identified and included as granted variances, even though the permit to which these variances pertained did not characterize them as variances.

- Most of the requests reviewed (with the exception of those that were not appropriate because the regulations were developed for wastes other than CCWs) were not to exempt the unit from requirements, but rather to allow for an alternative approach or material that would accomplish the same objective.

- In States where solid waste permits are required for units managing CCWs, few of the variance requests were for liners or groundwater monitoring.

  - There were seven variance requests (covering six units) for variances to liner requirements, but none requested exceptions. Rather, they requested changes to the construction method or liner material that would provide equal or greater protection than that afforded by the regulations.

  - Four variance requests addressed groundwater monitoring, and each request was for a variance only from the requirement to monitor for organic constituents not contained in CCWs; each of the requesting units already conducts groundwater monitoring for numerous other constituents.

- For the variance requests reviewed, those pertaining to cell height, fire protection, landfill gas/methane, leachate collection, location, pre-siting, signs, solid waste management plans, and standards for sewage works were granted with stipulations or were granted because the requirements were not appropriate for CCWs.

The data and analyses documented in this report provide new information that appears to show improved management of CCWs in both landfills and surface impoundments.

1 INTRODUCTION

1.1 DESCRIPTION OF COAL COMBUSTION WASTES

Coal is fired in boilers to heat water in order to generate high-pressure steam, which in turn drives generators that produce electricity. Electric utilities generally use pulverized coal boilers, where the coal is crushed to fine particles and blown into the boiler furnace for combustion. Another type of furnace, used mostly by smaller power generators, is the fluidized bed, which can burn coal of poorer quality or grade and be used for the economical production of electricity. The uncombusted residue is called coal combustion waste (CCW), coal combustion by-product (CCB), or coal combustion residue (CCR).

CCWs can be classified as large-volume CCWs and low-volume CCWs. The large-volume CCWs include fly ash, bottom ash, boiler slag, and flue gas emission control (or flue gas desulfurization [FGD]) waste. Fly ash is a silt-sized residue (typically between 10 and 100 μm), composed mainly of amorphous spherical particles, that is transported from the combustion chamber by exhaust gases and collected by particulate emission control devices before entering the boiler stack. Bottom ash is a dry, coarse material with sintered and agglomerated amorphous particles taken from the bottom of the boiler furnace either in its dry form or as a slurry (via the addition of water). Boiler slag is also taken from the bottom of the furnace, but emerges in a molten form; it is usually quenched immediately in water and forms large, glassy pellets. Flue gas desulfurization residues are generated by units that remove sulfur dioxide ($SO_{2)}$ from flue gas. “Wet” FGD systems are found most frequently at large coal-burning utilities; these systems are installed downstream of the particulate control devices and produce residues that consist mainly of calcium sulfate or calcium sulfite salts. However, a small but growing percentage of FGD residues come from “dry” FGD systems or fluidized bed combustion (FBC) systems that remove sulfur upstream of the particulate control devices; therefore, these “FGD residues” are inseparable mixtures of fly ash, bottom ash, and calcium sulfates/sulfites. Fly ash and “wet” FGD comprise the largest quantity of these four waste types.

Low-volume CCWs result from supporting processes that are ancillary to the combustion and power generation processes. They include the following:

- Coal pile runoff,
- Coal mill rejects/pyrites,
- Boiler blowdown,
- Cooling tower blowdown and sludge,
- Water treatment sludge,
- Regeneration waste streams,

- Air heater and precipitator wash water,
- Boiler chemical cleaning waste,
- Floor and yard drains and sumps,
- Laboratory wastes, and
- Wastewater treatment sludge.

A number of these "low-volume" wastes are considered to be uniquely associated with electricity production if they contact and take on at least some of the chemical characteristics of the coal or CCW (e.g., coal storage pile runoff and waste from the cleaning of boilers to remove chemical deposits and combustion residue). These wastes are typically co-disposed of or co-managed with the four large-volume CCWs. The 1999 *Report to Congress: Wastes from the Combustion of Fossil Fuels* (EPA 1999a) provides more information on co-managed wastes.

1.2 REGULATORY HISTORY

In the Solid Waste Disposal Act Amendments of 1980, which amended the Resource Conservation and Recovery Act (RCRA), Congress temporarily exempted from regulation as hazardous under RCRA Subtitle C certain large-volume wastes generated primarily from the combustion of coal or other fossil fuels (RCRA Section 3001(b)(3)(A)(i)). These large-volume wastes are fly ash, bottom ash, slag waste, and flue gas emission control (or FGD) wastes. In RCRA Section 8002(n), Congress directed the U.S. Environmental Protection Agency (EPA) to conduct a study and submit a Report to Congress (RTC) on the adverse effects on human health and the environment, if any, of the disposal and utilization of these materials. It also directed that within six months of submitting the RTC that the EPA (1) determine whether regulation of the management of the temporarily exempt CCWs as hazardous was warranted and (2) publish its Regulatory Determination (RD) in the *Federal Register*. In February 1988, the EPA submitted an RTC, *Wastes from the Combustion of Coal by Electric Utility Power Plants* (EPA 1988), in which it tentatively determined that the large-volume wastes did not warrant regulation under Subtitle C. Because it did not publish the RD for CCWs within the required time frame, a citizens group filed suit against the EPA. In 1992, the EPA entered into a consent decree that divided CCWs into the following two categories: (1) fly ash, bottom ash, boiler slag, and FGD waste from the combustion of coal by electric utility and independent power-producing facilities, and (2) all remaining wastes subject to RCRA Sections 3001(b) and 8002(n).[1] The consent decree contained separate schedules for providing the RDs for each category.

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[1] The remaining wastes include large-volume CCWs generated at electric utility and independent power-producing facilities that are co-managed with certain other CCWs; CCWs generated by nonutilities; CCWs generated at facilities with FBC technology; petroleum coke combustion wastes; wastes from the combustion of mixtures of coal and other fuels (i.e., co-burning); wastes from the combustion of oil; and wastes from the combustion of natural gas.

In August 1993, the EPA issued an RD in which it determined that the first category (large-volume CCWs generated at electric utility and independent power-producing facilities) did not warrant regulation as hazardous when managed alone. In that determination, the EPA concluded that regulation of these large-volume wastes under Subtitle C of RCRA is inappropriate "because of the limited risks posed by them and the existence of generally adequate State and Federal regulatory programs" (EPA 1993).

In March 1999, the EPA issued an RTC (EPA 1999a) on the remaining wastes, in which it tentatively concluded that disposal of these wastes should remain exempt from RCRA Subtitle C. In its May 22, 2000, RD (EPA 2000), the EPA concluded that the remaining wastes "do not warrant regulation under Subtitle C of RCRA and [that it] is retaining the hazardous waste exemption under RCRA Section 3001(b) (3) (C)." However, the EPA also determined that "national regulations under Subtitle D of RCRA are warranted for CCWs when they are disposed of in landfills or surface impoundments, and that regulations under Subtitle D of RCRA (and/or possibly modifications to existing regulations established under authority of the Surface Mining Control and Reclamation Act [SMCRA]) are warranted when these wastes are used to fill surface or underground mines." The EPA stated that to ensure that CCWs are "consistently regulated across all waste management scenarios," it also planned to "make these national regulations for disposal in surface impoundments and landfills and minefilling applicable to CCWs generated at electric utility and independent power-producing facilities that are not co-managed with low-volume wastes" (EPA 2000).

The EPA based its decision to write Subtitle D regulations on information in the 1999 RTC, which contained the most comprehensive and current information available at the time. However, much of the information pertained to management practices and State regulations that were in effect prior to 1995. For example, the EPA stated that it based its decision to write Subtitle D regulations for CCWs, in part, on its findings that in 1995, CCWs "were being managed in 40 percent to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of groundwater monitoring; and while there have been substantive improvements in State regulatory programs, we have also identified gaps in State oversight" (EPA 2000).

1.3 CCW GENERATION, USE, AND DISPOSITION

In 2004, according to U.S. Department of Energy (DOE) Energy Information Administration (EIA) data, approximately 129 million tons of CCWs were produced (EIA 2004a; 2006a,b).[2] More than half of these CCWs (56%) were fly ash, 24% were FGD

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2 The EIA data reported that 7,016 thousand tons of CCWs were generated in Connecticut (EIA 2004a). In a comparison between coal-fired generating capacity and CCW generation, this amount seemed high. Similarly, there appeared to be an error in reporting of CCWs for a plant in Kentucky. We asked the EIA for a clarification of these issues, and the EIA responded that the data for Connecticut and Kentucky were in fact misreported. Also, the amount of CCWs reported for Delaware, 3,662 thousand tons (EIA 2004a), appeared to be high, and communications between the EPA and EIA revealed that one Delaware plant had misreported its data to the EIA, thereby producing the high number for the State. The numbers in the text and in Table 1 reflect the corrected Connecticut and Kentucky values (EIA 2006a) and the corrected Delaware values (EIA 2006b).

wastes, and 17% were bottom ash. The remaining CCWs were "other by-products."[3] The EIA does not report boiler slag separately, but this material is generally recognized to compose less than 3% of the total CCWs generated. The American Coal Ash Association (ACAA) also reported CCW generation data for 2004. It reported a total of approximately 122 million tons of CCWs, with the following components: fly ash (58%), FGD wastes (26%), bottom ash (14%), boiler slag (2%), and FBC ash (1%). Discrepancies in the CCW generation amounts between the EIA and the ACAA may reflect differences in reporting requirements. The EIA does not require reporting of CCW generation amounts for power plants with capacities less than 100 MW; the ACAA figures are industrywide estimates based on voluntary data received from electric utilities that are representative of the utility power plants in the United States (ACAA 2004).

Significant amounts of CCW are used beneficially. The single most common beneficial application of CCW is the use of fly ash as a partial substitute for Portland cement in concrete. CCWs are also used for road-base materials, manufactured aggregates, flowable fills, structural fills and embankments, roofing tiles and shingles, snow and ice control, soil modification, and to replace natural materials in the production of Portland cement. Gypsum (calcium sulfate) from FGD waste is commonly used as a raw material in wallboard manufacturing. Any wastes used beneficially do not require disposal in waste management units of the types considered for this study. The EIA data indicate that in 2004, approximately 44.7 million tons (35%) of the 129 million tons of CCWs generated was beneficially used,[4] while the ACAA estimates that about 49.1 million tons (40%) of the 122 million tons of CCWs generated was beneficially used in 2004.[5] The EIA provides CCW generation and use data at the State level, but the ACAA does not.[6] Table 1 shows the amounts of CCWs generated and beneficially used by State in 2004, as reported by the EIA. Among the larger CCW-generating States, Florida (62%) and Tennessee (57%) beneficially use well above the EIA national average of 35%, and North Carolina (46%), Missouri (46%), and Illinois (45%) have above-average rates of beneficial use.

CCWs that are not used must be otherwise managed. Management occurs in disposal units (landfills and surface impoundments) and in mines (minefill). In 1995, an estimated 8% of CCWs were managed as minefill (EPA 2000). Disposal units can be located at the power plant

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3 "Other by-products" is an entry on Form 767, which the EIA uses to collect data on power plants. The EIA does not define this term; rather it allows utilities to enter volumes in this category that have not been reported in any of the other categories. A review of the data indicates that few if any utilities have specified the materials reported in this category.

4 The 44.7-million ton estimate is likely an underestimate, because the EIA does not require utilities to report amounts of CCWs beneficially used by plants that have less than 100 MW of generating capacity.

5 Another possible explanation for the discrepancy between the EIA and the ACAA estimates of beneficial reuse may lie in the way the data are reported. Because the EIA data reporting form asks for the amount of CCWs "sold," it does not consider the possibility that the CCWs may have been "given away" for use off-site as a structural fill, for off-site mine reclamation, etc. Depending on how the generator reported the data, these practices could be classified as "off-site disposal" by the EIA but as "beneficial use" by the ACAA; in any event, the CCW materials would not be disposed into a waste management unit of any kind.

6 The ACAA data are disaggregated by clusters of States corresponding to the EPA's regions.

TABLE 1 CCW Generation and Beneficial Use by State, 2004

State[a]	Total CCWs Generated[b] (thousand short tons)	Total CCWs Used Beneficially[c] (thousand short tons)	% CCWs Used Beneficially
KY[d]	14,537	2,521	17
TX	**12,943**	**4,395**	**34**
IN	**9,549**	**3,023**	**32**
PA	**9,545**	**2,941**	**31**
WV	**7,220**	**2,401**	**33**
OH	**6,980**	**2,290**	**33**
FL	**5,092**	**3,171**	**62**
IL	**4,419**	**1,968**	**45**
TN	**3,803**	**2,163**	**57**
NM	**3,668**	**864**	**24**
NC	**3,545**	**1,641**	**46**
AL	3,408	663	19
GA	**3,141**	**1,022**	**33**
AZ	2,764	1,161	42
ND	**2,757**	**731**	**27**
VA	**2,442**	**203**	**8**
MO	**2,348**	**1,070**	**46**
UT	2,341	812	35
WA	2,301	1,683	73
SC	2,172	1,169	54
MI	**2,145**	**614**	**29**
WY	2,106	508	24
MD	1,983	646	33
MS	1,758	681	39
LA	1,588	716	45
MN	**1,561**	**387**	**25**
CO	1,548	252	16
WI	**1,437**	**1,219**	**85**
KS	1,399	575	41
NY	1,379	368	27
OK	1,277	625	49
IA	1,260	750	60
MT	952	51	5
NV	825	314	38
AR	688	324	47
NJ	600	112	19
NE	469	299	64
MA	310	130	42
CT[d]	181	0	0
NH	**141**	**57**	**40**
DE[e]	121	24	20
SD	105	28	27
OR	95	81	84
CA	50	0	0
HI	48	0	0

TABLE 1 (Cont.)

State[a]	Total CCWs Generated[b] (thousand short tons)	Total CCWs Used Beneficially[c] (thousand short tons)	% CCWs Used Beneficially
ME	36	0	0
Total	129,037	44,653	35

[a] States in bold are States with identified new (1994–2004) CCW disposal units. The following States reported no CCW generation: Alaska, Idaho, Rhode Island, and Vermont, as well as the District of Columbia. The totals in the table reflect only the data on CCW generation and use reported to the EIA; however, the EPA's 2003 Toxic Release Inventory (TRI) data suggest that Alaska produced approximately 43 tons of CCWs.

[b] CCWs include fly ash, bottom ash, sludge, gypsum, and other by-products.

[c] Beneficial use includes CCWs that were identified as sold and those that were identified as "on-site use and storage," which is assumed to reflect a combination of storage of CCWs en route for sale and CCWs used for local engineering fill.

[d] CCW generation and beneficial use amounts revised per the EIA (EIA 2006a).

[e] CCW generation and beneficial use amounts revised per the EIA (EIA 2006b).

Sources: EIA (2004a; 2006a,b).

facility (on-site) or away from the facility (off-site). Surface impoundments are almost always on-site, because the material disposed of in them is typically sluiced directly from the power plant to the impoundment, and moving such waste off-site would entail large transportation costs. Off-site landfills are generally used by smaller power plants, whereas larger power plants manage their CCWs in either on-site or off-site landfills.[7]

1.4 IMPORTANCE OF CCW REGULATORY DETERMINATION TO DOE

In the last several years, DOE has conducted further investigation into current disposal practices of the remaining wastes, as defined in the 1999 RTC (EPA 1999a). A significant basis of the EPA's 2000 RD had been the concern that many landfills and surface impoundments for managing the so-called "remaining wastes" (also known as "co-managed and co-burned" wastes) do not have appropriate controls in place. Because of comments and representations made by Utility Solid Waste Activity Group (USWAG) members, DOE thought it possible that

[7] However, many of the off-site landfills are also owned by the power-generating utilities, because of the economic advantage of avoiding the high tipping fees charged by nonutility owners of municipal waste landfills. Analysis of data from the EPA's TRI may have provided additional information on the proportion of on-site versus off-site disposal volumes, but TRI data of suitable quality to perform such analyses were not available in time for inclusion in this report.

management practices may have improved to the point where concerns over environmental exposures have been mitigated, minimized, or possibly eliminated. Therefore, DOE, in consultation with the EPA, conducted further investigation into current disposal practices for these remaining wastes with the objective of updating the 1995 information base on management practices. If, in fact, controls and State oversight have improved since 1995, this development would have a bearing on how the EPA would describe any further controls that might be necessary to protect human health and the environment, which could minimize costs to industry and its customers.

1.5 STUDY OBJECTIVE

The information on which the EPA based its 2000 RD—a 1997 Electric Power Research Institute (EPRI) study reflecting information up to 1995 (EPA 1999a)—does not account for changes in industry disposal and State regulatory practices pertaining to CCWs that might have occurred since 1995. DOE was concerned that the imposition of additional regulations could increase energy costs for consumers without a significant concomitant improvement in human health or environmental quality. DOE and the EPA agreed to conduct a joint study to examine data on CCW disposal practices; State regulatory practices; and the numbers, types, and rationales for variances to regulatory requirements granted by States between 1994 and 2004. This report describes the approach used to collect and analyze the data and the findings produced by that analysis.

The objective of this study is to collect, analyze, and provide accurate, current, and verifiable data on CCW management practices, State regulatory requirements, and the implementation of those requirements. Its findings will be used to assist the EPA in determining what requirements are appropriate in developing a Federal regulation of CCWs under a RCRA Subtitle D rule.

1.6 STUDY SCOPE

The EPA identified the following three areas of interest:

1. Recent and current CCW industry surface disposal management practices,

2. State regulatory requirements for CCW management, and

3. Implementation of State requirements (e.g., the extent to which States grant or deny operator requests to waive or vary regulatory requirements and the rationales for doing so).

For each of these factors, the EPA is most interested in the extent to which liners and groundwater monitoring are incorporated into new and expanded disposal units. This study, therefore, focuses on liners and groundwater monitoring.

The remainder of this report contains three chapters. Chapter 2 details the methodologies used to collect and analyze information to address each of the EPA's primary interest areas. Chapter 3 details the findings of the analyses for each of the three interest areas, and Chapter 4 provides conclusions. Twelve appendices provide detailed data tables and other supporting information. Appendix A describes the approach used to study State regulatory requirements, summarizes the current status of pertinent regulatory controls in 11 States, and lists relevant findings. Appendices B through D contain information on the data collection process; Appendices E through I provide data on recent and current CCW industry management disposal unit practices; and Appendices J through L contain information on the extent to which States grant and deny permit variance requests.

2 APPROACH

This chapter explains the approach used to collect and analyze the data. The following three tasks were undertaken to address the primary areas of interest for the EPA:

1. Collect, assemble, and analyze data on CCW disposal unit management practices for new and expanded units between January 1, 1994, and December 31, 2004;

2. Collect information on State regulatory requirements governing CCW disposal units in targeted States selected in the manner described in Subsection 2.2; and

3. Collect and analyze information on variances to CCW disposal unit permit requirements in States hosting new units addressed under (1) above.

The following sections provide detail on the specific methodologies used to complete each of these tasks.

2.1 RECENT AND CURRENT CCW INDUSTRY DISPOSAL MANAGEMENT PRACTICES

The first task was to identify the data that would be needed to determine whether improvements have been made in disposal unit permitting, construction, and management over the past 11 years. The following kinds of information were particularly important:

- Use of liners,

- Use of groundwater monitoring, and

- An indication that variances to permit conditions that may circumvent the regulatory requirements were not being granted without due consideration of site-specific conditions.

The EPA also indicated that information on pre-permit site characterization and permit requirements would be useful.

DOE and the EPA used information collected from a survey conducted by USWAG to identify and obtain data on new units that were not considered in the 1999 RTC. “New units” are those that were permitted, built, or laterally expanded between January 1, 1994, and December 31, 2004. In December 2004, USWAG distributed the questionnaire to all of its member companies that own or operate coal-fired power plants. (These companies represent 224 GW, or 67% of total U.S. utility coal-fired capacity.) Appendix B provides a copy of the questionnaire. In addition, because the National Rural Electric Cooperative Association

(NRECA) and the American Public Power Association (APPA) are members of USWAG, these trade associations distributed the questionnaire to their member companies, and their responses are included in the analysis. Rural electric cooperatives are private, independent electric utilities that supply electricity in rural areas. They include generation, transmission, and distribution systems, and they are generally much smaller than investor-owned facilities. The 70 NRECA coal-fired plants represent about 24 GW, or 7% of total coal-fired generating capacity, and range in size from 15 to 1,180 MW, with an average of 353 MW. APPA utilities are not-for-profit, community, and state-owned electric utilities that also represent about 24 GW of coal-fired capacity. The 177 publicly owned coal-fired power plants range in capacity from less than 1 to 820 MW, with an average of 137 MW. The 279 investor-owned USWAG coal-fired plants range in capacity from 11 to 3,564 MW, with an average of 804 MW. USWAG, NRECA, and APPA requested that their member companies return completed questionnaires for all units permitted, built, or laterally expanded between 1994 and 2004, and provide copies of all permits issued for these units.

Because a response (in the form of a returned, completed survey) was requested only if a company had new units, a lack of response was assumed to mean that the member company had no new units. In January 2006, USWAG contacted members that did not respond to the 2004 survey to verify that assumption. As explained in detail in Section 3.1.1, the results of the December 2004 survey combined with the January 2006 follow-up resulted in responses from 100% of USWAG's coal-fired utilities. To verify independently the assumption that a lack of response meant that the utility had no new units, and to obtain information on units that may have been missed by the 2004 USWAG survey, as well as on units owned by non-USWAG, non-NRECA, and non-APPA members, the EPA asked State regulators from nine selected States[8] for information on new units that may not have been identified in the USWAG survey. Appendix C contains additional details on the approach taken to ensure that as many new units as possible were captured for the analysis.

The EPA obtained information on the locations of these units, date of permit, construction and/or lateral expansion, and whether they had liners and groundwater monitoring. However, the EPA did not ask States identifying these new units to have operators of these units complete the questionnaire and, therefore, no additional information about unit operations was collected for these units.

The completed questionnaires and the data provided to the EPA by the State regulators were reviewed to verify that (1) all units were, in fact, surface disposal units (i.e., landfills or surface impoundments and not minefills), (2) all units were permitted, built or laterally expanded between 1994 and 2004, and (3) there were no duplications between the USWAG survey and the EPA verification units. The data for the resulting units were then entered into a database developed specifically to store, sort, and query the disposal unit data. Finally, the disposal unit

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8 The EPA's selected States were those that top the list of consumption of coal for electricity generation and/or CCW generation. The selected states, however, do not include those States with extensive coal-mining operations where significant portions of the CCWs are inferred to be disposed of as minefill, and those that do not require permits for disposal of dry ash and, therefore, lack pertinent records. The selected states were Georgia, Illinois, Indiana, Michigan, Missouri, North Carolina, North Dakota, Ohio, and Texas.

data were analyzed to identify trends and patterns in permitting, construction, and management practices. Where possible, the findings for the newly constructed/expanded units were compared with the findings in the 1999 RTC (EPA 1999a). However, the findings may not be entirely comparable because of differences in the types of units covered in the two studies. That is, the data on management unit practices and controls in the 1999 RTC came from a 1997 EPRI report of survey results for a sample of existing co-management units (i.e., units managing a combination of large-volume wastes and remaining wastes). The current study is limited to landfills and surface impoundments that were permitted, built, or laterally expanded between 1994 and 2004, but it is not restricted to co-management units, and it includes some units that manage only the large-volume wastes that the 1993 RD concluded did not warrant regulation as hazardous waste under RCRA Subtitle C. Despite the differences in the data sets for the two studies, we believe the comparisons of findings are instructive, because the Subtitle D regulations would apply to all CCW disposal units, not just co-management units.

2.2 STATE REGULATORY REQUIREMENTS FOR CCW MANAGEMENT

In the RD issued on May 22, 2000, the EPA stated that CCWs do not warrant regulation as hazardous wastes under RCRA; the EPA also expressed a concern, however, that gaps may exist in some State regulatory programs that could lead to future environmental damages. This section describes the approach used to investigate this concern.

It was evident from the outset that a nationwide study of the CCW regulations and their chronological changes in all States that address CCWs would not be feasible under the time and resource constraints of this study. Therefore, an alternative approach was undertaken, namely the review of the current regulatory programs applicable to CCWs in States that contain identified units of one or both of the following types and comparison of the results with corresponding information from earlier reports: (1) new CCW disposal units (i.e., those permitted, constructed, or laterally expanded between 1994 and 2004), and (2) units that are the basis of proven, potential, or alleged damage cases.[9] Of the 26 States identified as meeting the selection criteria, a pilot study involving five States (Pennsylvania, Illinois, Indiana, Virginia, and Wisconsin) was conducted to determine whether it would be feasible, within the established budget and schedule constraints, to collect enough data for all 26 States to allow comparisons of current regulatory requirements with comparable information from earlier reports and to identify changes.

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9 In comments to the EPA, public interest groups have identified cases in which they allege that damage to human health or the environment was caused by fossil fuel combustion waste management units. As of May 2006, 86 of the alleged damage cases have been investigated by the EPA to verify the existence and cause of the damage. As defined in the 1999 RTC, proven damage cases are those with exceedences of primary maximum contaminant levels (MCLs) or other health-based standards in groundwater or surface water off-site or at a distance from the waste management unit sufficient to conclude that they could cause human health concerns, while potential damage cases are those with (1) documented exceedences of primary MCLs or other health-based standards on-site or beneath or close to the waste source, and/or (2) documented exceedences of secondary MCLs or other non-health-based standards on-site or off-site.

Information collected during the pilot study covered the following categories of regulatory control:

- Regulatory designation of CCWs for disposal,
- Permitting requirements,
- Liner requirements,
- Groundwater-monitoring requirements,
- Leachate-collection system requirements,
- Corrective action requirements,
- Closure/post-closure requirements,
- Siting controls, and
- Financial assurance requirements.

During the course of the resource-intensive pilot study, we discovered that comparisons between the current regulatory requirements and comparable information in the earlier reports could rarely be made at the same level of detail. For example, the 1999 RTC (EPA 1999a) and its supporting technical background documents (EPA 1999b) provide primarily aggregated information regarding State regulatory controls. Thus, in the case of liner requirements, the 1999 RTC indicates that 43 States adopted liner requirements for landfills before data were collected. It does not, however, explain what types of liner materials or design requirements were specified by any particular State. Similarly, the report does not explain whether, at the time data were collected, particular States had differing requirements for landfills receiving wastes with differing toxicity levels. Furthermore, the names of States for which information was aggregated are not provided in the 1999 RTC. Similar difficulties were identified for all areas of regulatory control, which hindered most State-specific comparisons between current regulations and the regulations in effect at the time data were collected for the 1999 RTC.

In light of this, the EPA revisited information already available from other sources about current State CCW regulatory programs and concluded that our priority should be to update how States were actually implementing programs, rather than simply to gather further information on State regulations. Accordingly, we did not conduct comprehensive reviews of State regulations for all of the 26 States mentioned above. Instead, the EPA identified particular aspects of the regulatory programs in specified States that were of interest, and we focused our investigation of State regulations on those States, in addition to the five pilot States. In all, six additional States were reviewed beyond those in the pilot study: Alabama, Florida, Georgia, Missouri, Ohio, and Texas. For these additional States, we concentrated on the following five of the nine areas of

regulatory control that were reviewed for the pilot States, because these areas are most closely associated with the control of potential releases to groundwater:

- Regulatory designation of CCWs for disposal,
- Permitting requirements,
- Liner requirements,
- Groundwater-monitoring requirements, and
- Leachate collection system requirements.

For each State reviewed, an effort was made to identify regulations applicable to disposal of CCWs in landfills and surface impoundments, regardless of the regulatory program (e.g., solid waste, special waste, residual waste, or wastewater) into which the State may place such regulations. Regulations covering beneficial use of CCWs and placement of CCWs in mines were not reviewed. The data collected are reported in Appendix A. The findings are provided in Section 3.2. The remainder of the investigation focused on State implementation of the regulatory requirements, as described in Section 2.3.

2.3 IMPLEMENTATION OF STATE REQUIREMENTS

The EPA, DOE, and industry agreed that an identification and examination of variances to State regulations in disposal unit permits granted by regulators would provide a good indication of the degree to which the State regulations were being implemented as intended. The analysis team took the following steps to conduct this assessment:

- Reviewed responses to the survey questions regarding variances. (The questionnaire asked if the permit granted any variances and, if so, for an explanation of the variances.)
- Obtained copies of permits issued for each of the surveyed units. Because some units had multiple permits (e.g., solid waste, discharge), the number of permits received was greater than the number of completed questionnaires received.
- Conducted an independent review of each permit to identify any variances or other waivers that may have been requested but not identified in the questionnaire responses, and, if so, whether they had been granted.
- For each identified variance request, collected the following additional information (where available) from the permit:

- Type of variance (e.g., closure/post-closure, cover/dust controls, groundwater monitoring, groundwater-protection standards, liners, and other).

- Regulatory citation for the requirement(s) to which the variance request applied.

- The text and a summary of the regulatory requirements corresponding to the variance request.

- Whether the request was granted. If the request was granted:

  - Regulator's rationale for granting the variance,
  - Provisions for revoking the variance,
  - Duration of the variance, and
  - Triggers that could alter the variance provisions.

- If the request was rejected, the regulator's reason(s) for the rejection.

- Entered the collected information into the database and reviewed it for clarity, consistency, and completeness.

- In cases where the permit information was unclear, inconsistent, or incomplete, developed a list of questions to ask the unit manager or State regulator.

- Contacted operators of each unit where there were variance questions, and obtained either written or verbal clarifications. For the verbal clarifications, the response was documented, and verification from the operator that the documented information was correct was obtained.

- Analyzed the results to determine the types of variances that were requested, the extent to which variance requests were granted, and the circumstances under which they were granted. We sought to identify, for each case where a variance was granted, the scientific or other basis upon which the regulator based the decision. The results were used to assess whether the regulations were being implemented as intended and whether there were science-based reasons for granting or rejecting variance requests.

3 FINDINGS

This chapter presents the findings obtained for each of the three investigation areas: recent and current CCW industry surface disposal management practices, State requirements for CCW management, and implementation of State requirements.

3.1 RECENT AND CURRENT CCW INDUSTRY SURFACE DISPOSAL MANAGEMENT PRACTICES

The findings presented in this section were derived primarily from the responses received from unit operators who completed and returned the questionnaires. Supplemental information came from disposal unit data provided by the EPA. However, because the EPA obtained this information from State regulators, and not unit operators, only a subset of the data requested in the questionnaires is available for these units.

3.1.1 Identified Units

The number and completeness of the survey responses provided a substantial database from which to identify trends in CCW management and disposal practices over the past 11 years. Fifty-three completed questionnaires were received from the December 2004 survey conducted by USWAG.[10] Of the completed questionnaires, 45 were useable, and the remaining 8 could not be used because of one or both of the following reasons:

- The returned questionnaire addressed a minefill rather than a surface disposal unit, so it was not appropriate for this study, or
- The unit did not meet the criterion of being permitted, built, or laterally expanded during the 1994 to 2004 period.

In the remainder of this report, the 45 units for which completed, useable surveys were received are referred to as the *surveyed units*.

The EPA provided DOE with a subset of data (location, unit type, liner, and groundwater-monitoring information) for 17 additional units. The EPA obtained this information through its data verification process, by contacting State regulatory agencies.[11] To avoid

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10 In addition, six companies responded that they had no new units, even though no response was required unless the company had new units.

11 The EPA's selected States were those that top the list of consumption of coal for electricity generation and/or CCW generation. The selected States, however, do not include those States with extensive coal-mining operations where significant portions of the CCWs are inferred to be disposed of as minefill, and those that do not require permits for disposal of dry ash and, therefore, lack pertinent records. The selected States were Georgia, Illinois, Indiana, Michigan, Missouri, North Carolina, North Dakota, Ohio, and Texas.

potential duplication with the surveyed units, we compared the surveyed units with the EPA-identified units. We found that some of the EPA-identified units were already included in the surveyed units. We also reviewed the EPA-identified units (as we did the USWAG-identified units) to verify that the criteria that the units were surface disposal (and not minefill) units and that they were permitted or constructed between 1994 and 2004 were met. Several EPA-identified units did not meet these criteria. Presented with the results of this comparative analysis, representatives from the EPA, USWAG, and DOE began a process to reconcile the discrepancies. In the meantime, the EPA obtained information on six additional units, which were included in the reconciliation process. The reconciliation was that a total of 11 units identified by the EPA, and not already included in the set of surveyed units, met the criteria and would be added. In the remainder of this report, these 11 units are referred to as the *nonsurveyed units*. Appendix D summarizes the reconciliation of the EPA-identified units.

As mentioned in Section 2.1, in January 2006, USWAG contacted utilities that did not respond to the 2004 survey to verify the assumption that a nonresponse meant that the utility had no new units. During this follow-up, four companies identified six units that met the criteria for new units and that should have been included in the original December 2004 survey. Because this information was received late, these units were not included in the analysis presented in this report. However, we did review basic information about these units to ascertain how the inclusion of these "supplemental units" might have altered the findings and conclusions of the report. A comparison showing that the liner and ground-monitoring practices for these supplemental units were consistent with those of units identified by USWAG in December 2004 and by the EPA is presented in Section 3.1.9. It should be noted that between the December 2004 survey and the January 2006 follow-up, responses (either in the form of a completed survey or a statement that the utility had no new disposal units) were received from 100% of the USWAG utilities with coal-fired capacity.

Information from the surveyed and nonsurveyed units was entered into a database specifically developed to store unit information and facilitate analysis. The surveyed and nonsurveyed units compose what is referred to in the remainder of this report as the *identified units, the analysis units,* or *the units***.** The total number of identified units, that is, those used to conduct the study analysis, is 56 (45 surveyed plus 11 nonsurveyed) units, located in 17 States. These States with identified units have a combined coal-fired generating capacity of 207 GW or 62% of all coal-fired generating capacity in the United States. Supplemental units added an additional two States, for a total of 19 States, representing 67% of U.S. coal-fired capacity.[12] Table 2 lists the identified units, the States and counties in which they are located, whether they are landfills or surface impoundments, and whether they were surveyed. Table 3 lists the supplemental units, the States and counties in which they are located, and whether they are landfills or surface impoundments. Appendix C provides additional detail on the response rates to the USWAG survey and the verification efforts.

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12 For comparison, there were 323 units in the EPRI survey used in the 1999 RTC (the EPRI survey covered units built between 1960 and 1995).

TABLE 2 Units Included in the Analysis

ID[a]	Unit Name	State	County	Unit Type[b]	Surveyed
232	Tampa Electric Company Polk Power Station	FL	Polk	LF	Yes
218	Georgia Power Company Plant Arkwright Private Industry Landfill	GA	Bibb	LF	Yes
206	Hutsonville Power Station	IL	Crawford	SI	Yes
246	Newton Power Station	IL	Jasper	LF	Yes
215	Wood River West Ash Pond System - Polishing Pond	IL	Madison	SI	Yes
216	Wood River West Ash Pond System - Primary Cell	IL	Madison	SI	Yes
211	Havana East Ash Pond Cell #3	IL	Mason	SI	Yes
210	Havana East Ash Pond Cell #2	IL	Mason	SI	Yes
253[c]	Coffeen Power Station Landfill	IL	Montgomery	LF	Yes
213	Hennepin PS New East Ash Pond - Raise Liner	IL	Putman	SI	Yes
212	Hennepin PS New East Ash Pond - New Unit	IL	Putnam	SI	Yes
214	Vermilion East Ash Pond	IL	Vermillion	SI	Yes
228	Gibson FSS Restricted Waste Type II Landfill	IN	Gibson	LF	Yes
226	NIPSCO R.M. Schahfer Generating Station RWS I Phase III	IN	Jasper	LF	Yes
223	IPL - Petersburg Generating Station	IN	Pike	LF	Yes
222	Hoosier Energy REC, Merom Generating Station	IN	Sullivan	LF	Yes
248	Wabash River Station Flyash Pond	IN	Vigo	SI	Yes
237	Presque Isle Power Plant Ash Landfill #3	MI	Marquette	LF	Yes
236	Sherco 3 Ash Landfill	MN	Sherburne	LF	Yes
235	Sherco Pond # 3	MN	Sherburne	SI	Yes
233	A.S. King Landfill (Moelter Site)	MN	Washington	LF	Yes
224	Hawthorn Utility Waste Landfill	MO	Jackson	LF	Yes
247	Sioux Plant	MO	St. Charles	SI	Yes
244	Meramec Plant 22-4788	MO	St. Louis	SI	Yes
245	Meramec Plant 498	MO	St. Louis	SI	Yes
331	Marshall Plant FGD Residue LF, Catawba Co.	NC	Catawba	LF	No
227	Roxboro Steam Electric Plant Dry Ash Landfill	NC	Person	LF	Yes
219	Great River Energy - Coal Creek Station (Section 16)	ND	McLean	LF	Yes
359	Great River Energy (Underwood) SP-174	ND	McLean	LF	No
220	Great River Energy - Stanton Station (GlenHarold Mine)	ND	Mercer	LF	Yes
252	Great River Energy - Stanton Station (Stanton Station - Surface Impoundment)	ND	Mercer	SI	Yes
221	Great River Energy - Stanton Station (Stanton Station - Landfill)	ND	Mercer	LF	Yes
358	Basin Electric Power Coop - AVS SP-160	ND	Mercer	LF	No
345	Montana Dakota Utilities - Heskett Station SP-087	ND	Morton	LF	No
225	Flue Gas Desulfurization Sludge Disposal Facility	ND	Oliver	SI	Yes
361	Otter Tail Power Company Coyote Station Blue Pit SP-182	ND	Oliver	LF	No
360	Minnkota Power Cooperative - M.R. Young Station Bottom Ash IT-205	ND	Oliver	LF	No
229	Merrimack Station Coal Ash Landfill	NH	Merrimack	LF	Yes
207	Arizona Public Service Company, Four Corners Power Plant	NM	San Juan	SI	Yes
362	Dayton Power & Light Stuart Fly Ash Landfill #11	OH	Adams	LF	No
351	Dayton Power & Light Stuart Fly Ash Impoundment #10	OH	Adams	SI	No
352	Tonkovich Monofill Expansion	OH	Belmont	LF	No
201	Conesville Residual Waste Landfill	OH	Coshocton	LF	Yes
202	AEP Gavin Plant Landfill	OH	Gallia	LF	Yes

TABLE 2 (Cont.)

ID[a]	Unit Name	State	County	Unit Type[b]	Surveyed
353	Ohio Valley Electric-Kyger Creek Power Plant Impoundments (OVEC)	OH	Gallia	LF	No
217	Westwood Ash Facility	OH	Lorain	LF	Yes
239	Keystone Generating Station Ash Disposal Site	PA	Armstrong	LF	Yes
230	Shawville Generating Station Ash Disposal Site	PA	Clearfield	LF	Yes
240	Conemaugh Generating Station Ash Disposal Site	PA	Indiana	LF	Yes
363	Welsh Bottom Ash Pond	TX	Camp	SI	No
203	Appalachian Power Glen Lyn Landfill	VA	Giles	LF	Yes
241	Clover Power Station Industrial Landfill	VA	Halifax	LF	Yes
200	Appalachian Power Clinch River Industrial Waste Landfill	VA	Russell	LF	Yes
209	Alma Off-Site Phase IV	WI	Buffalo	LF	Yes
204	AEP Little Broad Run Landfill - Area 5	WV	Mason	LF	Yes
205	AEP Quarrier Landfill - Area B	WV	Putnam	LF	Yes

[a] An ID number was assigned to each unit to facilitate data collection and retrieval. (In general, units in the 200 series were surveyed; units in the 300 series were not.)

[b] LF = landfill; SI = surface impoundment.

[c] For tracking purposes, this unit was originally a nonsurveyed unit identified by the EPA (ID #357). However, the unit operator subsequently submitted a completed questionnaire, and it thus became a surveyed unit. To maintain consistency, its ID number was changed to a 200-series number.

TABLE 3 Supplemental Units Not Included in the Analysis

Unit Name	State	County	Unit[a] Type
Williams Station	SC	Berkeley	LF
McMeckim Station	SC	Lexington	LF
Cope Station	SC	Orangeburg	LF
Johnsonville North Rail Loop Dredge Cell	TN	Humphries	SI
Taconite Harbor Energy Center	MN	Cook	LF
Monticello Plant	TX	Titus	SI

[a] LF = landfill; SI = surface impoundment.

3.1.2 Sample Coverage

The size of the universe, that is, the total number of CCW disposal units permitted, built, or laterally expanded between January 1, 1994, and December 31, 2004 (“new units”), is not known. No industry organization or government agency tracks this information. Because the number of new units is not known, we considered the use of two different proxies to assess the sample coverage. The first uses the amount of CCWs available for disposal in States that have

coal-fired power plant capacity, and the second uses the coal-fired generating capacity of utilities owning the identified disposal units.

3.1.2.1 CCW Proxy

This proxy uses the amount of CCWs available for disposal (i.e., the amount generated less the amount recycled [used beneficially]) in those states with identified disposal units and compares it with the total CCWs available for disposal in all States with coal-fired electrical power capacity. With this approach (using the data in Table 1, Section 1.3), the coverage is estimated to be 61%. This is calculated by dividing the amount of CCWs available for disposal in the 17 States with identified units—51 million tons (79 million tons generated less 28 million tons used beneficially)—by the amount available for disposal in all States with coal-fired generating capacity, which is 84 million tons (129 million tons generated less 45 million tons used beneficially). The result is that an estimated 61% of the CCWs requiring disposal in the United States is covered in the study.

The January 2006 USWAG follow-up identified units in two additional States beyond the 17 States hosting units identified in the 2004 USWAG survey and the EPA verification investigation. Adding the amounts of CCWs available for disposal—3 million tons—in these two States (Tennessee and South Carolina) to the 51 million tons available for disposal in the previously identified 17 States brings the total amount available for disposal in the covered States to 54 million tons, or 64% of the 84 million tons available for disposal in all States with coal-fired generating capacity. The weakness of this proxy is that without data on available disposal capacity in the period of the study's time frame (1994 to 2004), it is impossible to predict which States have had the need for additional waste-disposal capacity. In addition, disposal capacity for new plants is generally designed and built to last 40 years, to match the life expectancy of newly constructed power-generation units, and thus there would be no need to build or expand disposal capacity for a power plant until a time approaching roughly 40 years since it was built or last expanded. We, therefore, resorted to using the other proxy, the coal-fired generating capacity of the utilities owning the identified disposal units, for estimating sample coverage.

3.1.2.2 Coal-Fired Generating Capacity Proxy

The use of coal-fired generating capacity as a proxy probably underestimates coverage significantly. This is because the denominator (total U.S. coal-fired power plant generating capacity—335.2 GW) is much larger than the actual coal-fired generating capacity for which new disposal capacity is needed. Actual generating capacity requiring new disposal capacity from 1994 to 2004 is lower than the total U.S. coal-fired generating capacity for the following reasons:

- Total U.S. generating capacity includes the capacity of all coal-fired units, most of which have a life span of more than 40 years. Many of these units are standby units that produce neither power nor CCWs.

- Because new power plants built during the past decade added only about 9 GW (less that 3% of total capacity), new disposal units would be required for only a small portion of the total generating capacity.

- Newly constructed plants may recycle the by-products for beneficial use, obviating the need for disposal. The amount of beneficially used CCWs is estimated to be approximately 35%[13] according to data obtained from the EIA (2004a; 2006a,b), and about 40% according to data provided by the ACAA (2004).

The following paragraphs describe how the coverage of the sample was estimated. Additional detail is provided in Appendix C.

The 23 USWAG members that responded to the original survey with completed questionnaires for new units had coal-fired power plants totaling 138.4 GW of capacity.[14] In 2004, total USWAG coal-fired generating capacity was 224.2 GW. Thus, the responses received from those that reported new units covered roughly 62% of USWAG coal-fired capacity. This response rate includes the two NRECA companies that responded to the survey. (Total NRECA member coal-fired generating capacity is about 24 GW.)

The EPA's efforts to obtain information on units that may have been missed by the USWAG survey and on units owned by non-USWAG members identified 11 additional units at utilities that have a combined coal-fired generating capacity of 14 MW (or 4% of the total U.S. coal-fired power plant generating capacity of 335.2 GW).

The January 2006 USWAG follow-up indicated that of the 29 members that did not respond to the 2004 survey, or that previously responded that they had no new units, 25 (representing 58.2 GW of generating capacity) indeed had no new units that met the criteria, and 4 (with 27.5 GW of generating capacity) had 6 units that met the criteria and were missed in the original (2004) survey (Table 4).

By dividing the sum of the generating capacities of the USWAG units that responded with a completed survey (138.4 GW) or a statement that they had no new units (58.2 GW) plus the capacities of the EPA-identified units (14.0 GW) and the generating capacities of the companies with the supplemental units (27.5 GW) by the total U.S. coal-fired generating capacity (335.2 GW), the overall sample coverage rate is estimated to be 71%. This represents the percentage of total generating capacity covered by the utilities with new disposal units and those reporting that they had no disposal units. If we omit the generating capacity of the utilities

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13 The 35% estimate is likely an underestimate, because the EIA does not require utilities to report amounts of CCWs beneficially used by plants that have less than 100 MW of generating capacity.

14 USWAG asked for a response from each member company (in the form of a returned, completed survey) only if the company had any "new units." A given utility could provide more than one survey if it had power plants operating different disposal units.

TABLE 4 Results of the January 2006 Follow-up to the USWAG Survey

Utility Companies (USWAG members)[a]	Number	Coal-Fired Capacity (GW) (2004)
Number not responding to survey or responding that they had no new units in the original survey	29	85.7
Number verifying that they had no new units in the follow-up	25	58.2
Number indicating that they did have new units that should have been included in the survey	4	27.5
Number that did not respond to follow-up calls	0	0

[a] A utility company may have multiple generating plants or facilities and thus multiple disposal units.

with the supplemental units newly identified in the 2006 follow-up (since they were not included in the analysis), the sample coverage is 63%.

On the basis of the above findings on sample coverage, we believe that the information obtained and analyzed can be used to identify general trends in CCW disposal practices from 1994 to 2004.

3.1.3 Characteristics of Identified Units

This subsection describes the share of landfills relative to surface impoundments, share of newly constructed units relative to expansions, and trends in unit completions and openings over time.

3.1.3.1 Share of Landfills Relative to Surface Impoundments

Identified units include 38 landfills (about two-thirds of the total identified units) and 18 surface impoundments (about one-third of the identified units). No sand and gravel pits were identified by USWAG or the EPA as being new or expanded disposal units for the 1994 to 2004 time period. The EPRI data used in the 1999 RTC (EPA 1999a) of 323 existing co-management units showed that by 1995, just under half of the total units were landfills. Thus, for the management of CCWs, the trend for new units is toward more landfills than impoundments. Part of this shift may relate to New Source Performance Standards under the Clean Water Act that require zero discharge for fly-ash-handling water in surface impoundments.[15] Also, landfills provide more capacity per square foot than do surface impoundments and, therefore, are more cost effective. (DOE and the EPA recognize that disposal capacity for new and expanded units may be a better indicator of the amount of waste that has shifted from dry to wet handling than

[15] See 40 CFR Part 423, 47 FR 52290–52309, November 19, 1982.

the number of new and expanded units; however, the survey respondents did not provide unit disposal capacity information.)

Table 5 shows the distribution of units by type and State. States with the largest numbers of identified new and expanded units include Illinois (two landfills and eight surface impoundments), North Dakota (eight landfills and two surface impoundments), and Ohio (six landfills and one surface impoundment). Except for Illinois, Missouri, New Mexico, and Texas, States with identified units have been building or expanding more landfills than surface impoundments over the last 11 years.

3.1.3.2 Share of Newly Constructed Units Relative to Expansions

Forty-three percent of the identified units were newly constructed, 30% were lateral expansions, while 16% were "other" (e.g., both new unit and lateral expansion). For 11% of the units, no information was provided about whether the unit was new or an expansion. Table 6 shows the distribution of new units and expansions by State.

TABLE 5 Distribution of Identified Disposal Units by State

	Number of Units		
State	Landfills	Surface Impoundments	Total
Florida	1	0	1
Georgia	1	0	1
Illinois	2	8	10
Indiana	4	1	5
Michigan	1	0	1
Minnesota	2	1	3
Missouri	1	3	4
North Carolina	2	0	2
North Dakota	8	2	10
New Hampshire	1	0	1
New Mexico	0	1	1
Ohio	6	1	7
Pennsylvania	3	0	3
Texas	0	1	1
Virginia	3	0	3
West Virginia	2	0	2
Wisconsin	1	0	1
Total	38	18	56

TABLE 6 Distribution of New and Expanded Units by State

State	Number of Units				
	New	Lateral Expansion	Other[a]	Not Specified	Total
Florida	1	0	0	0	1
Georgia	1	0	0	0	1
Illinois	6	0	4	0	10
Indiana	0	5	0	0	5
Michigan	1	0	0	0	1
Minnesota	1	2	0	0	3
Missouri	2	0	2	0	4
New Hampshire	0	1	0	0	1
New Mexico	0	0	1	0	1
North Carolina	1	1	0	0	2
North Dakota	4	3	0	3	10
Ohio	3	1	0	3	7
Pennsylvania	0	2	1	0	3
Texas	1	0	0	0	1
Virginia	1	1	1	0	3
West Virginia	1	1	0	0	2
Wisconsin	1	0	0	0	1
Total	24	17	9	6	56

[a] "Other" typically includes both lateral and vertical expansion or new unit and lateral expansion.

3.1.3.3 Trends in Unit Completions and Openings over Time

Unit operators (for the surveyed units) and State regulators (for the nonsurveyed units) were asked to provide the dates of unit completion and unit opening. Some provided both, some provided one date but not the other, and some provided neither. For 45 (83%) of the units reporting data, construction was completed between 1994 and 2004, while 9 of the units had not opened, either because construction had not been completed or for other reasons (e.g., scrubbers had not been installed in the associated power-generating facility). For two of the units, no dates were provided. There appear to be no discernable trends regarding construction timing. Appendix E shows, for each disposal unit, the year of construction completion and unit opening. Table 7 shows the total number of landfills and surface impoundments that were completed by year. For units where the construction completion date was not provided but where the opening date was provided, the opening date is used. The results are shown in Figure 1.

TABLE 7 Trends in Construction Completions by Year

Year Construction Completed[a]	Number of Units		
	Landfills	Surface Impoundments	Total
Not complete	8	1	9
2004	0	0	0
2003	5	3	8
2002	3	2	5
2001	4	0	4
2000	0	4	4
1999	0	0	0
1998	0	2	2
1997	3	2	5
1996	4	0	4
1995	4	2	6
1994	5	2	7
Not specified	2	0	2
Total	38	18	56

[a] For 12 units where the construction completion date was not provided but the opening date was provided, the year of the unit opening was used.

FIGURE 1 Disposal Unit Completions by Year (Note: Two units did not specify a completion date.)

3.1.4 Wastes Disposed

As explained in Section 1.2, in 1988, the EPA released an RTC (EPA 1988) for large-volume CCWs (fly ash, bottom ash, boiler slag, and FGD waste) generated by coal-fired electric utilities. In its 1993 RD (EPA 1993), the EPA stated that the regulation of the large-volume CCWs as hazardous waste under Subtitle C of RCRA was not warranted. The RD stated that the 1988 RTC found that the majority of the materials present in the four large-volume wastes were not of major concern. The EPA also found that potentially hazardous constituents in CCWs, including arsenic, barium, cadmium, chromium, lead, mercury, and selenium, have the potential to leach into groundwater under certain conditions, but that the data suggest that contamination stems from older, unlined units representing past practices (EPA 1993). The EPA said that the "results of its analysis indicate that the wastes rarely exhibit any characteristics of hazardous waste and the wastes pose very limited risk to human health or the environment" (EPA 1993). It concluded that "current management practices and regulatory controls are adequate for managing the four large-volume fossil-fuel combustion wastes" (EPA 1993). In its 2000 RD (EPA 2000), the EPA stated that while large-volume CCWs that are co-managed with other CCWs derive their characteristics largely from these large-volume wastes, both the large-volume CCWs and the co-managed CCWs warrant the promulgation of national regulations under Subtitle D of RCRA (RCRA Sections 1008(a) and 4004(a)).

Table 8 summarizes the percentages of the various wastes disposed of at surveyed landfills and surface impoundments based on the responses to the questionnaire, and Appendix F provides this information for each unit. Of the wastes managed at the 42 units reporting amounts, more than 95% are, on average, the large-volume wastes that the EPA found to not have unacceptable risks when managed alone, and virtually no risk when managed in lined units. (The three units that did not report percentages were all landfills.) The percentage of large-volume wastes managed at surface impoundments (99%) is greater than that managed at landfills (92%).

Eleven units (26% of the 42 units that reported amounts of wastes disposed of) reported that fly ash comprised more than 90% of the total wastes disposed of at their facilities. The majority of units (93%) manage at least some fly ash. Bottom ash comprises an average of 19%, and FGD comprises an average of 16% of the wastes disposed of at the units. Boiler slag comprises less than 1%. None of the surveyed units reported disposal of the following materials: FBC ash, petroleum coke combustion waste, oil combustion waste, or natural gas combustion waste.

Thirteen of the 29 surveyed landfills reported disposing of wastes in addition to or instead of the four large-volume wastes. Three of the surveyed landfills reported disposal of co-managed wastes, which were further identified as coal mill rejects commingled with the fly ash, cooling tower sediment, coal pile pond sediment, etc. At these units, the co-managed wastes composed from 1% to 8% of the total wastes disposed of. One landfill reported disposal of nonutility wastes (2.5% of total wastes disposed of), and 10 reported disposal of "other" wastes. (One landfill reported disposal of both nonutility and "other" wastes.) "Other" wastes included general plant trash and miscellaneous industrial wastes from power plant operations such as sandblast grit, demolition debris, and intake-structure cleaning wastes. The percentages of these other

TABLE 8 Percentages of Wastes Disposed of at Surveyed Units

Type of Waste Disposed of	Percentage of Wastes Disposed of at Surveyed Units[a]					
	Landfills		Surface Impoundments		All Units	
	Average	Range	Average	Range	Average	Range
Large-volume wastes						
Coal fly ash	57.3	0–100	63.6	0–100	59.7	0–100
Coal bottom ash	13.2	0–95	28.9	0–95	19.2	0–95
Boiler slag	0.7	0–15	0.3	0–5	0.5	0–15
Wet FGD waste	15.9	0–98	6.5	0–80	12.6	0–98
Dry FGD waste	4.6	0–85	0	0	3.2	0–85
Subtotal large-volume	91.8		99.3		95.2	
Other wastes						
Co-managed waste	0.4	0–8	0.3	0–5	0.4	0–8
Nonutility CCWs	0.1	0–3	0	0	0.1	0–3
Other materials	7.8	0–100	0.3	0–5	4.9	0–100
Subtotal other	8.3		0.6		5.4	
Number of units reporting data	26		16		42	

[a] The data are for 42 units currently managing wastes that reported percentages. Averages were calculated using the unit-specific percentages for each type of waste shown in Appendix F. Totals may not sum due to rounding.

wastes generally ranged from 1% to 5% of the total. However, one landfill reported 100% of its wastes as other, which consisted of slag produced by the plant's integrated gasification combined-cycle gasifier. Another reported 75% of its wastes as other (70% clinker ash and 5% ancillary small-volume wastes).

Only 2 of the 16 surveyed surface impoundments manage wastes other than the 4 large-volume wastes. One unit co-manages boiler cleaning wastes (about 5% of the total waste co-managed at the unit), and the other unit co-manages plant drains and demineralizer regenerant (less than 5% of the total). Also, while liners and other protective measures are discussed in more detail later in this report, it should be noted here that both of these units have liners and groundwater-monitoring requirements.

3.1.5 Permit Information

For all of the surveyed units, a pre-permit site characterization was conducted, or a site characterization was required as part of the permit. Typically, the pre-permit characterization includes a hydrogeological report, but it can also include more detailed investigations, such as

archeological investigations, soil borings, and/or determinations of the nearest groundwater and wetlands.

All of the surveyed units were authorized by one or more permits. As noted in the 1999 RTC (EPA 1999a), permits are important because they can dictate use of specific operating practices and control technologies. The 1999 RTC reported that 94% of the landfills and 85% of the impoundments had permits; 100% of the 45 surveyed units in the current study have permits, and many have more than one.

On average, 1.9 permits have been issued for each of the surveyed units. For landfills, the average is 1.8 permits per unit, and for surface impoundments the average is 2.1. As noted, a given unit can have multiple permits. For example, six surface impoundments have each of the following three State-issued permits: dam safety, National Pollutant Discharge Elimination System (NPDES), and construction/operating. The highest share of permits issued (29 permits, or 34% of the total) were waste permits, followed by NPDES permits (20 permits, or 24% of the total). State solid-waste regulatory programs applicable to CCWs often exclude units that are regulated under State water pollution control programs. Although most of the surveyed surface impoundments are not subject to regulation as solid waste storage or disposal units, they are regulated as wastewater treatment facilities, which are evaluated on a case-specific basis to determine the need for groundwater-protection measures such as liners and groundwater monitoring.

Table 9 shows the numbers and types of permits issued for the surveyed units. Appendix G shows, for each of the surveyed units, the unit type (landfill or surface impoundment), permit type, State, issuing agency, and, where available, the dates of permit issue and expiration. It also indicates whether a copy of the permit was received.

We received and analyzed a total of 65 permits (33 for landfills and 32 for surface impoundments) of a total of 85 permits reported as issued by the surveyed units. The following two sections describe specific permit requirements for landfills and surface impoundments, respectively. Discussions of the use of liners and groundwater monitoring at all identified units (as opposed to the permit requirements for liners and groundwater monitoring for surveyed units only) are provided in Sections 3.1.6 and 3.1.7, respectively.

3.1.5.1 Landfill Permit Requirements

Of the 29 surveyed landfills, 100% have permits that require both liners and groundwater monitoring. As detailed in Table 10, between 90% and 100% of the landfills, depending on the requirement, also have permit requirements for groundwater protection,[16] corrective action,

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16 Groundwater-protection requirements differ from groundwater-monitoring requirements. Groundwater-protection standards are contaminant concentrations in groundwater that cannot be exceeded. They can include primary and secondary drinking water standards, background concentration levels, and preventive action limits. Groundwater-monitoring requirements are requirements to monitor, and possibly record or report, concentration levels of one or more specified contaminants in groundwater.

TABLE 9 Numbers and Types of Permits Issued for Surveyed Units

Permit Type	Number Issued		
	Landfills	Surface Impoundments	Total
Construction	3	6	9
Construction/operating	0	8	8
Dam safety	0	7	7
NPDES	10	10	20
Waste[a]	27	2	29
Other[b]	11	1	12
Total permits	51	34	85
Number of units	29	16	45

[a] Includes waste, State waste, restricted waste, and residual waste permits

[b] Includes air, conditional use, health department, operating, industrial landfill, groundwater, storm water, and wastewater.

closure/post-closure, inspections, and bonding/financial assurance. Roughly 45% of the landfills have additional permitting requirements for areas such as air monitoring, surface water monitoring, quality assurance standards for liner and cover construction, storm-water permits, requirements for preoperational and operational plans, periodic ash testing, storm-water runoff controls, construction documentation, leachate-collection systems, and operating plans. In addition to the permit requirements listed in Table 10, two landfill units in Ohio (one of which does not have permit requirements for groundwater-protection standards per se) have the following requirements: rainfall runoff and leachate collection and treatment; NPDES permit; groundwater intercept and drainage system under clay liner; 5-ft isolation zone between uppermost aquifer and bottom of clay liner; fugitive dust control; statistical analysis of groundwater data; annual operating report to the Ohio Environmental Protection Agency; annual operating license from the Ohio Department of Health; off-site rainfall diversion away from landfill area; and daily operating and maintenance logs.

The 1999 RTC did not include a review of specific permit requirements, but it did report the shares of units that employed various controls. It found that 94% of the landfills had closure/post-closure controls (covers), compared with 100% of the landfills built or expanded from 1994 to 2004. It also found that 77% of the landfills had groundwater-protection standards, compared with 90% of the landfills built since 1994. This RTC did not contain data for corrective action, bonding/financial assurance, or inspection controls or requirements. Comparisons of the 1999 RTC and the current study regarding use of liners and groundwater monitoring are contained in Sections 3.1.6.1 and 3.1.7, respectively.

TABLE 10 Permit Requirements for Surveyed Landfills

Requirement	Surveyed Landfills with Requirement in Permit (29 total surveyed landfills)	
	Number	%
Liners	29	100
Groundwater monitoring	29	100
Groundwater-protection standards	26	90
Corrective action[a]	27	93
Closure/post-closure	29	100
Inspections of the unit	29	100
Bonding/financial assurance	26	90
Other[b]	13	45

[a] These requirements are for operators to take corrective action should it be needed to contain, clean up, and eliminate the future potential for migration of contaminants from a CCW disposal unit via above-ground pathways or leaching to groundwater. The questionnaire did not ask for permit-specific details on specific corrective action and remediation triggers and requirements.

[b] Examples of other permit requirements for landfills include air monitoring, surface water monitoring, quality assurance standards for liner and cover construction, storm-water permits, requirements for pre-operational and operational plans, periodic ash testing, storm-water runoff controls, construction documentation, leachate-collection systems, and operating plans.

3.1.5.2 Surface Impoundment Permit Requirements

For the 16 surveyed surface impoundments, 12 (75%) have liner requirements in their permits. The remaining four units (25%) have voluntarily installed liners. Thus, 100% of the surveyed surface impoundments have liners. Permits for 10 of the surveyed surface impoundments (63%) require groundwater monitoring, and for two additional surface impoundments groundwater monitoring is conducted voluntarily. Thus, groundwater monitoring is conducted for 75% of the surveyed surface impoundments (Table 11).

In addition to liner and groundwater-monitoring requirements, surface impoundments have permit requirements for groundwater protection, corrective action, unit inspections, closure and post-closure, bonding/financial assurance, and other areas (Table 12).

TABLE 11 Liner and Groundwater-Monitoring Requirements for Surveyed Surface Impoundments

	Surveyed Units with Requirement in Permit		Surveyed Units That Conduct Activity Voluntarily		Total Surveyed Units That Conduct Activity	
Requirement	Number	%	Number	%	Number	%
Liners	12	75	4	25	16	100
Groundwater monitoring	10	63	2	12	12[a]	75

[a] Three of the surface impoundments without groundwater monitoring are in Missouri. Missouri regulates CCW settling basins as water pollution control units subject to the Missouri Clean Water Law. The Missouri Clean Water Law requires such units to obtain construction and operating permits from the Missouri Department of Natural Resources (DNR) Water Protection Program, but does not require them to obtain solid waste permits (10 CSR 80-2.020(9)(A)7). The Missouri DNR Water Protection Program has authority to impose groundwater-monitoring requirements for water pollution control units on a case-specific basis (10 CSR 20-6.010), but did not do so for the three units in this table.

TABLE 12 Other Permit Requirements for Surveyed Surface Impoundments

	Units with Requirement in Permit (16 Surveyed Surface Impoundments)	
Requirement	Number	%
Groundwater-protection standards	3	19
Corrective action[a]	10	63
Closure/post-closure	3	19
Inspections of the unit	11	69
Bonding/financial assurance	2	12
Other[b]	1	6

[a] These requirements are for operators to take corrective action should it be needed to contain, clean up, and eliminate the future potential for migration of contaminants from a CCW disposal unit via aboveground pathways or leaching to groundwater. The questionnaire did not ask for permit-specific details on specific corrective action and remediation triggers and requirements.

[b] Other requirements include construction/closure, quality assurance/quality control, and NPDES discharge permit.

The data indicate that, in general, the percentage of landfills subject to the various types of permit requirements, such as groundwater-protection standards, closure/post-closure, bonding/financial assurance, as well as others, is greater than the percentage of surface impoundments subject to the same requirements. This observation can be explained largely by the fact that many State solid-waste regulatory programs applicable to CCWs have exemptions or exclusions for units that are regulated under State water pollution control programs. As a result, most of the surface impoundments included in this study are not subject to regulation as solid waste storage or disposal units. Nevertheless, they are regulated as wastewater treatment facilities, which are evaluated on a case-specific basis to determine the need for groundwater-protection measures such as liners and groundwater monitoring. Section 3.2.1.2 provides additional information regarding State regulatory programs applicable to surface impoundments that receive CCWs.

3.1.6 Liners

The previous section addressed how many of the 45 surveyed landfills and surface impoundments that were built or expanded between 1994 and 2004 have liners, that is, the new units that reported liners required by permits. This section describes the use of liners at all identified disposal units—both surveyed and nonsurveyed—built or expanded between 1994 and 2004. It also addresses changes in the liner materials, which provide an indication of liner integrity.

3.1.6.1 Liner Use at Disposal Units

The vast majority (98%) of the 56 identified units (both landfills and surface impoundments) have liners. This includes all of the 45 surveyed units and 10 of the 11 nonsurveyed units. The one unit lacking a liner is a landfill in North Dakota that receives only bottom ash, which the State considers inert and, therefore, no liner is required. Figure 2 compares the number of landfills and surface impoundments that have been constructed with the number that have been constructed with liners (since 1994). It shows that the trend is for more construction of landfills than surface impoundments and that, with the aforementioned exception, virtually all new and expanded disposal units have been constructed with liners. (The number of units constructed by year, as opposed to the cumulative yearly total numbers, is shown in Figure 1.)

It is not possible to provide a direct comparison of the findings regarding the newly constructed and expanded units in the current study with the findings regarding the disposal units in the 1999 RTC. The 1999 RTC uses data from a 1997 EPRI survey intended to include *all* co-management units, regardless of their construction date, while this study includes only recently constructed or expanded units, but includes co-management and ash-only units. However, 1995 data compiled from industry and DOE surveys for the 2000 RD indicate that the corresponding values for liners in landfills and surface impoundments constructed between 1985 and 1995 were

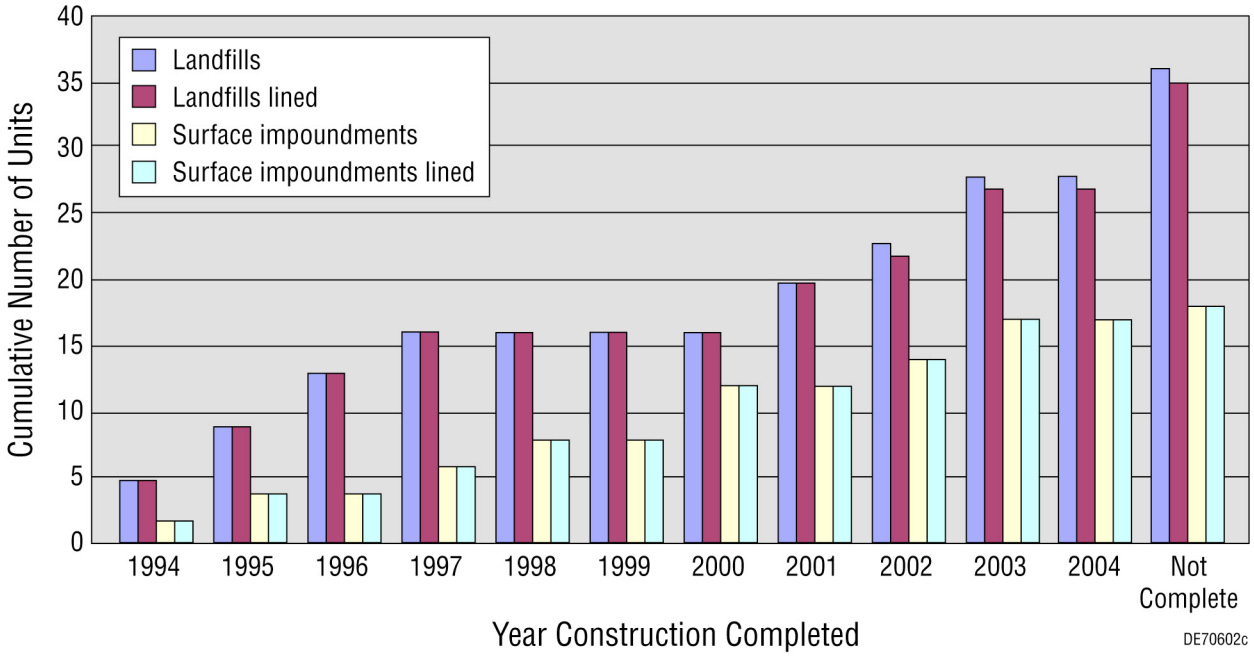

FIGURE 2 Liners in Identified New or Expanded Disposal Units since 1994 (cumulative yearly total numbers)

75% and 60%, respectively. The current data indicate that virtually all newly constructed landfills and all newly constructed impoundments are lined, whether as a permit requirement or voluntarily.

3.1.6.2 Liner Integrity

The protective qualities of the liner materials have improved over the past decade for both landfills and surface impoundments. Most of the liners in these newly constructed or expanded units are engineered liners made of compacted clay or synthetic clay, or a geomembrane (specialized plastic sheeting), or a combination thereof. In general, single liners consist of one type of liner, composite liners consist of a geomembrane combined with a clay liner, and double liners consist either of two single liners, two composite liners, or a single and a composite liner. Some units reported multiple types of liners. For example, a single unit indicating double, synthetic, and compacted clay liners would be reported as having multiple types. Liner type information was collected for each of the 56 identified disposal units, but terminologies varied and may be inconsistent. Table 13 summarizes the numbers and types of liner systems reported for landfills and impoundments. The relative shares of liner types are shown in Figure 3 for landfills and in Figure 4 for surface impoundments. Appendix H contains detailed data on the materials, thicknesses, and permeabilities for these liner systems.

TABLE 13 Liner Types at Recently Constructed Landfills and Surface Impoundments

	Landfills		Surface Impoundments		Total	
Liner Type	Number	%	Number	%	Number	%
Clay/compacted clay	11	29	3	17	14	25
Single/synthetic	4	11	6	33	10	18
Double	2	5	0	0	2	4
Combination	7	18	8	44	15	27
Multiple types[a]	13	34	1	6	14	25
Subtotal units with liners[b]	37	97	18	100	55	99
Not lined[c]	1	3	0	0	1	2
Total units[b]	38	68	18	32	56	100

[a] Multiple types refers to cases where the survey response provided multiple liner classifications. For example, a case in which a respondent checked double, synthetic, and compacted clay is reported under multiple types.

[b] Percentage total has been rounded.

[c] Inert bottom ash, as defined by the State.

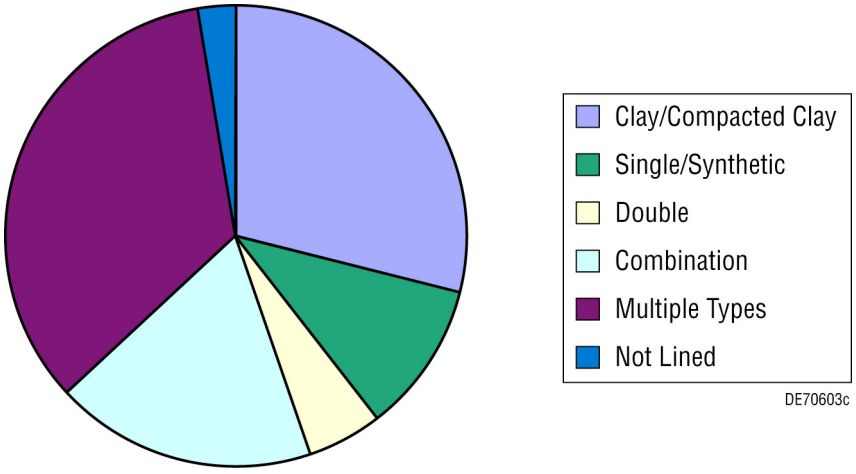

FIGURE 3 Liner Types Reported for Landfills (Note: One unit is unlined because the material disposed of was classified by the State as inert bottom ash, and, therefore, no liner is required.)

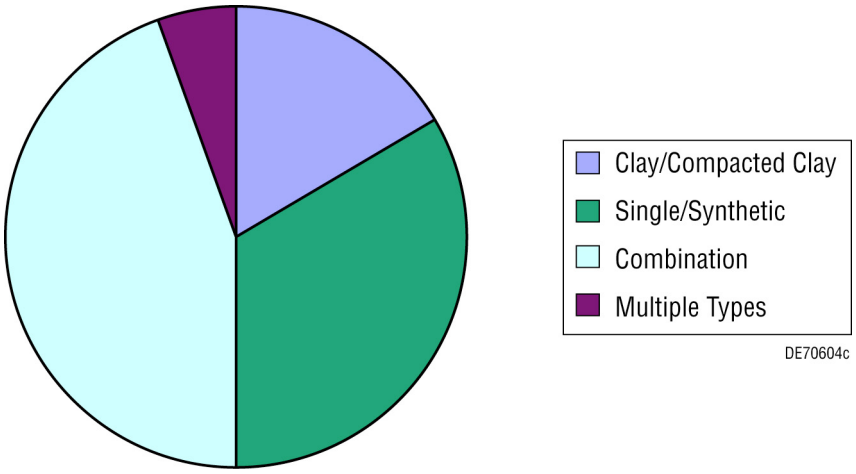

FIGURE 4 Liner Types Reported for Surface Impoundments

The 1999 RTC categorized liner types differently than does this study, so direct comparisons are not possible. Nonetheless, it appears that liner materials and types have improved since 1994. For example, the 1999 RTC reported that 43% of the landfills and 74% of the surface impoundments constructed between 1985 and 1995 had no liners or soil-only liners. Since 1994, only one landfill (less than 3%) was constructed without a liner (and only because the State within which the landfill is located has classified the waste-managed bottom ash as inert). All of the surface impoundments reported a liner other than compacted in situ soil. While about 9% of the units in the 1999 RTC used compacted ash, no units used solely compacted ash since 1994. The percentage of clay liners remained about the same or decreased slightly, to about 29% for landfills and 17% for surface impoundments. The percentage of double liners increased slightly for landfills, from 1% to 5%. Finally, the percentage of combination and multiple liners increased for landfills, from less than 10% in the 1999 RTC to more than 50% in the newly constructed/expanded units. For impoundments, the percentage of combination/multiple liners increased from 2% to more than 50% since 1994.

3.1.7 Groundwater Monitoring

The vast majority (91%) of the 56 identified newly constructed or expanded units (landfills and surface impoundments) monitor groundwater. All but one of the 38 landfills (97%) conduct groundwater monitoring, and because this landfill manages only bottom-ash waste, which the State has classified as inert, groundwater monitoring is not required. Of the 18 surface impoundments, 14, or 78%, monitor groundwater.[17] Table 14 shows the percentage of identified

[17] Two surface impoundments that were not surveyed—and, therefore, are not included in Section 3.1.5.2, which addressed only the 45 surveyed units (29 landfills and 16 surface impoundments)—reported groundwater monitoring. Thus, of the total 18 identified surface impoundments (surveyed and nonsurveyed), 14 conduct groundwater monitoring.

TABLE 14 Disposal Units with Groundwater Monitoring by State

	Landfills			Surface Impoundments			Total		
State	Total	Units with Ground-water Monitoring	% Units with Ground-water Monitoring	Total	Units with Ground-water Monitoring	% Units with Ground-water Monitoring	Total	Units with Ground-water Monitoring	% Units with Ground-water Monitoring
FL	1	1	100	0	0	–[a]	1	1	100
GA	1	1	100	0	0	–	1	1	100
IL	2	2	100	8	8	100	10	10	100
IN	4	4	100	1	0	0	5	4	80
MI	1	1	100	0	0	–	1	1	100
MN	2	2	100	1	1	100	3	3	100
MO	1	1	100	3	0	0	4	1	25
NC	2	2	100	0	0	–	2	2	100
ND	8	7[b]	88	2	2	100	10	9	90
NH	1	1	100	0	0	–	1	1	100
NM	0	0	–	1	1	100	1	1	100
OH	6	6	100	1	1	100	7	7	100
PA	3	3	100	0	0	–	3	3	100
TX	0	0	–	1	1	100	1	1	100
VA	3	3	100	0	0	–	3	3	100
WI	1	1	100	0	0	–	1	1	100
WV	2	2	100	0	0	–	2	2	100
Total	38	37	97	18	14	78	56	51	91

[a] – = not applicable.

[b] Inert bottom ash (as defined by the State) in one landfill; groundwater monitoring not required.

landfills and surface impoundments that monitor groundwater for each State. While the percentage of surface impoundments that monitor groundwater is less than the percentage of landfills, it is higher than the percentage reported in the 1999 RTC for units constructed between 1985 and 1995 (65%). The percentage of landfills in the 1999 RTC with groundwater monitoring was 88%; thus, there has been an increase in groundwater monitoring for both landfills and surface impoundments since 1994. Table 14 also shows that the surface impoundments that did not report groundwater-monitoring were in two States, Indiana and Missouri. These two States impose groundwater monitoring requirements for surface impoundments on a case-specific basis in water pollution control permits. The unit in Indiana is permitted under the NPDES program. Missouri regulates CCW settling basins as wastewater treatment units subject to the Missouri Clean Water Law. The Clean Water Law requires such units to obtain construction and operating permits from the Missouri Department of Natural Resources (DNR) Water Protection Program, but does not require them to obtain solid waste permits (10 CSR 80-2.020(9)(A)7). The Missouri DNR Water Protection Program has authority to impose groundwater-monitoring requirements for wastewater treatment facilities on a case-specific basis (10 CSR 20-6.010), but did not do so for these three units.

For the surveyed units, information was obtained on the groundwater constituents monitored, the monitoring frequency, and the number of monitoring wells and their locations. Appendix I presents detailed data on groundwater monitoring; key findings are highlighted below.

- *Constituents monitored*. Landfills and surface impoundments monitor for a variety of hazardous and nonhazardous constituents. Thirty of the 37 landfills and 12 of the 14 surface impoundments that monitor groundwater listed the constituents monitored in their response to the survey. Not all units are required to monitor for the same constituents (e.g., the regulatory agency may have used waste characterization data to determine that certain constituents are not present in the CCWs and, thus, testing for such constituents is not necessary). However, commonly monitored constituents include mercury, molybdenum, vanadium, arsenic, cadmium, copper, nickel, zinc, barium, boron, chromium III, chromium VI, lead, selenium, silver, and tin (toxic metals); and ammonia, nitrogen, nitrite, nitrate, phosphorus, sulfate, potassium, iron, manganese, aluminum, dissolved oxygen, oxidation potential, alkalinity, calcium, magnesium, sodium, chloride, total dissolved solids, total suspended solids, temperature, pH, specific conductance, and appearance (secondary MCLs and other water quality parameters).

- *Monitoring frequency*. Monitoring frequency ranges from monthly to semiannually. Of the 37 landfills at which groundwater monitoring is conducted, 29 reported the frequency of their monitoring activities. Of these, 15 monitor quarterly, and 14 monitor semiannually. Of the 14 surface impoundments at which groundwater monitoring is conducted, 12 reported frequency. Of these, 1 monitors monthly, 9 monitor quarterly, and 2 monitor semiannually.

- *Number of and location of wells*. For the 28 landfills and 12 surface impoundments that reported monitoring well numbers, the number of wells at landfills ranges from 4 to 41, with an average of 9. At surface impoundments, the range is from 5 to 22, with an average of 12. Survey respondents were asked to indicate not only the number of monitoring wells, but the location of the wells with respect to the disposal unit (i.e., upgradient of unit or downgradient of unit, inside the unit boundaries or outside the unit boundaries). Although most of the responses provided the number of wells in the various locations, the responses were inconsistent on reporting of locations. Thus, it is not possible to determine the relationship between upgradient and downgradient wells, and whether the wells are located inside/outside the unit boundary. Table 15 shows the ranges in number and the average number of wells inside and outside the unit boundaries, and Table 16 shows the ranges in number and average number of wells upgradient and downgradient of the units.

3.1.8 Regulatory Inspections

The questionnaire asked respondents to indicate whether any regulators had inspected their units. Of the 45 surveyed units, 37 (82%) said that regulators had inspected their units.

TABLE 15 Summary Statistics on Groundwater-Monitoring Wells and Locations within and outside the Boundaries of Surveyed Units

	Landfills		Surface Impoundments	
	Number of Wells		Number of Wells	
Monitoring Wells	Range	Average	Range	Average
Within boundaries of unit	0–25	7	0–17	5
Outside boundaries of unit	0–41	6	0–22	7
Number of units reporting locations of wells within and outside boundaries of unit	21		11	

TABLE 16 Summary Statistics on Groundwater-Monitoring Wells and Locations Upgradient and Downgradient of Surveyed Units

	Landfills		Surface Impoundments	
	Number of Wells		Number of Wells	
Monitoring Wells	Range	Average	Range	Average
Upgradient of unit	1–12	3	1–7	3
Downgradient of unit	3–29	8	4–20	8
Number of units reporting locations of upgradient and downgradient wells	27		12	

Twenty-seven of the 29 surveyed landfills have been inspected; the 2 that have not been inspected have not been built yet. Ten of the 16 surveyed surface impoundments (63%) indicated that they have been inspected. Respondents indicated that inspections ranged in frequency from monthly to annually. The six surface impoundments that did not report any inspections are in Illinois. The questionnaire did not ask for information on inspection findings.

3.1.9 Testing for Potential Misrepresentation of Data Caused by the Exclusion of Supplemental Units

As explained in Section 3.1.1, the analysis in this report is based on information for 56 disposal units that were permitted, built, or laterally expanded between January 1, 1994, and December 31, 2004. Information on these units was obtained from (1) the results of USWAG's December 2004 survey (29 landfills and 16 surface impoundments), and (2) the EPA's subsequent effort to identify units not included in the USWAG survey (9 landfills and 2 surface

impoundments). The analysis does not include the six supplemental units identified by USWAG's January 2006 follow-up that was conducted to identify any units that had not responded to the 2004 survey.[18] To determine if the exclusion of these six units from the analysis may have produced findings that were not representative of the 56 units that comprised the analysis, we compared the results for the key parameters of interest (liners and groundwater monitoring) for the following groups of units:

- USWAG-surveyed units (from December 2004 survey),
- EPA-identified units, and
- USWAG supplemental units (identified by USWAG in the 2006 follow-up).

The results are summarized in Table 17 and are described below:

- *Liners*. The percentage of USWAG units identified as having liners in the 2004 survey was 100% (45 of 45); the percentage of EPA-identified units was 91% (10 of 11); and the percentage of supplemental units was 67% (4 of 6). All of the surface impoundments (surveyed, nonsurveyed, and supplemental) have liners. The three landfills with no liners (of the total 42 landfills) include the following:
  - One EPA-identified landfill that manages only bottom ash in North Dakota. North Dakota regulations classify bottom ash as inert, and inert wastes in the State do not require liners.[19]
  - Two supplemental units (owned by the same utility company) in South Carolina. One of these landfills is located over a thick geologic unit (marl) that has a permeability of $< 1 \times 10^{-6}$ cm/s (the required permeability of liners) and receives CCWs that are classified by the State as low-toxicity

18 These units were not included because of time and resource constraints.

19 According to ND Chapter 33-20-01.1, "inert waste" means nonputrescible solid waste that will not generally contaminate water or form a contaminated leachate. Inert waste does not serve as food for vectors. It includes, but is not limited to, construction and demolition material such as metal, wood, bricks, masonry, and cement concrete; asphalt concrete; tree branches; bottom ash from coal-fired boilers; and waste coal fines from air pollution control equipment.

TABLE 17 Comparison of Key Results for Surveyed, Nonsurveyed, and Supplemental Units

	Surveyed Units (USWAG)		Nonsurveyed Units (EPA)		Supplemental Units (USWAG)		Total (All Units)	
	Number	%	Number	%	Number	%	Number	%
All units	45		11		6		62	
All units with liners	45	100	10[a]	91	4[b]	67	59	95
All units with groundwater monitoring	41	91	10[a]	91	6	100	57	92
All landfills	29		9		4		42	
Landfills with liners	29	100	8[a]	89	2[b]	50	39	93
Landfills with groundwater monitoring	29	100	8[a]	89	4	100	41	98
All surface impoundments	16		2		2		20	
Surface impoundments with liners	16	100	2	100	2	100	20	100
Surface impoundments with groundwater monitoring	12[c]	75	2	100	2	100	16	80

[a] One landfill has neither a liner nor groundwater monitoring, because the State within which the landfill is located has classified bottom ash as inert.

[b] Two units in South Carolina do not have liners. However, one of these landfills is located over a thick geologic unit (marl) that has a permeability less than that required for liners (1×10^{-6} cm/s). The other unit is a lateral expansion of an existing waste unit that required extensive hydrogeological characterization prior to permitting. In addition, groundwater has been monitored at the site since 1987.

[c] Three of the surface impoundments without groundwater monitoring are in Missouri. Missouri regulates CCW settling basins as wastewater treatment units subject to the Missouri Clean Water Law. The Missouri Clean Water Law requires such units to obtain construction and operating permits from the Missouri Department of Natural Resources (DNR) Water Protection Program, but does not require solid waste permits (10 CSR 80-2.020(9)(A)7). The Missouri DNR Water Protection Program has authority to impose groundwater-monitoring requirements for wastewater treatment facilities on a case-specific basis in construction and operating permits (10 CSR 20-6.010), but did not do so for the three units in this table.

(Class I) wastes for which no liners are required.[20] The other unit is a lateral expansion of an existing landfill that also receives CCWs classified by the State as Class I wastes.

- *Groundwater monitoring*. The percentage of USWAG units identified in the 2004 survey with groundwater monitoring was 91% (41 of 45); the percentage of EPA-identified units with groundwater monitoring was also 91% (10 of 11); and the percentage of USWAG supplemental units with groundwater monitoring was 100% (6 of 6).

- For all new units (surveyed, nonsurveyed, and supplemental), 95% have liners and 92% have groundwater monitoring.

3.2 STATE REQUIREMENTS

3.2.1 Overview

As explained in Section 2.2, a pilot study was performed consisting of detailed reviews in nine categories of regulatory controls that apply to landfills and surface impoundments in Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin. For six additional States—Alabama, Florida, Georgia, Missouri, Ohio, and Texas—detailed reviews were conducted in the five regulatory categories most closely associated with the control of potential releases to groundwater. Information about regulatory controls applicable to CCW disposal was collected from 11 States as shown in Table 18. The detailed data are reported in Appendix A.

3.2.1.1 Permitting Requirements for Landfills

Permitting requirements applicable to the disposal of CCWs in landfills were reviewed for the 5 pilot States (Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin) and 6 additional

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20 The South Carolina regulations (R. 61-107.16) for Industrial Solid Waste Landfills (ISWLFs) require that the waste streams be characterized and that the TCLP results from characterization are compared with ranges based on the drinking water MCLs. The utility's coal ash landfills have so far tested as a Class I material (Toxicity Characteristic Leaching Procedure [TCLP]) results are < 10 × drinking water MCLs). A Class I waste does not require a liner. A Class II waste (> 10 but < 30 × drinking water MCLs) would require a clay liner system. A Class III waste (>30 × drinking water MCLs) requires a synthetic liner system. Waste streams must be characterized every 5 years or if a process change occurs that may change the characteristics (on a per-occurrence basis). This may occur, for instance, with the installation of a selective catalytic reduction unit or change in traditional coal source. The regulations are crafted such that the status of a permitted landfill is monitored over time on the basis of the tested character of the waste. At this time, no characterization work has indicated that a reevaluation of the Class status for any ash landfill is required. In addition, groundwater monitoring, statistical analysis of groundwater data, corrective action, closure/post-closure, and financial mechanisms are required for ISWLFs in South Carolina.

TABLE 18 Areas of Regulatory Control Reviewed by State[a]

State[b]	Regulatory Designation of CCWs for Disposal	Permitting	Liners	Groundwater Monitoring	Leachate-Collection System	Closure and Post-Closure	Corrective Action	Siting Controls	Financial Assurance
Alabama	X	X	X	X	X				
Florida	X	X	X	X	X				
Georgia	X	X	X	X	X				
Illinois	X	X	X	X	X	X	X	X	X
Indiana	X	X	X	X	X	X	X	X	X
Missouri	X	X	X	X	X				
Ohio	X	X	X	X	X				
Pennsylvania	X	X	X	X	X	X	X	X	X
Texas	X	X	X	X	X				
Virginia	X	X	X	X	X	X	X	X	X
Wisconsin	X	X	X	X	X	X	X	X	X

[a] "X" indicates that the area of control described in the column heading was reviewed for the State, while a blank cell indicates that the area of control described in the column heading was not reviewed for the State. All 11 States were reviewed for the five areas having greater potential to affect whether releases to groundwater are controlled.

[b] The pilot review covered Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin, which are indicated in boldface type. Alabama, Florida, Georgia, Missouri, Ohio, and Texas were selected for supplemental reviews in the regulatory areas having greater potential to affect whether releases to groundwater are controlled.

States (Alabama, Florida, Georgia, Missouri, Ohio, and Texas). All 11 States have regulations that expressly exclude CCWs from the definition of hazardous waste. Thus, in general, landfills that receive CCWs in any of the 11 States reviewed are not required to obtain hazardous waste disposal permits, although Missouri requires fly ash to be disposed of in a hazardous waste disposal facility if it fails the TCLP. Ten States designate CCWs as a type of nonhazardous industrial solid waste and regulate landfills receiving CCWs under their solid waste regulatory programs. Alabama regulations exclude CCWs from the definition of solid waste.

Detailed examination of CCW landfill permitting requirements in the 11 States reviewed revealed that 6 States (Georgia, Indiana, Missouri, Pennsylvania, Virginia, and Wisconsin) require solid waste permits for all landfills receiving CCWs for disposal. The other 5 States (Alabama, Florida, Illinois, Ohio, and Texas) have adopted laws and regulations that result in exemptions from solid waste permitting requirements for certain CCW landfills. The exemptions are described in Table 19. Section A.3.3 in Appendix A provides State-specific discussions.

TABLE 19 Description of Permitting Exemptions in Five States

State	Description of Exemption
Alabama	CCWs are expressly excluded from the definition of solid waste in Alabama. Hence, CCW landfills, whether located on-site or off-site, are not required to obtain solid waste permits.
Florida[a]	On-site[b] landfills may have Power Plant Siting Act (PPSA) certifications in lieu of solid waste permits, if they are located at power plants; OR If the site of a landfill is not subject to the PPSA, an on-site landfill may, in lieu of solid waste permits, obtain either another permit issued by the Florida Department of Natural Resources or an approved groundwater-monitoring plan, which addresses or authorizes the environmental effects on groundwater and surface water.
Illinois	For on-site landfills, initial notice to the permitting agency is required, as are quarterly and annual groundwater reports, but no solid waste permit is required.
Ohio	If the landfill is a monofill that receives only "nontoxic" fly ash, bottom ash, and/or foundry sand (as determined by the Ohio Environmental Protection Agency),[c] solid waste permits are not required.
Texas	On-site landfills must be registered with the Texas Commission on Environmental Quality and provide updated information when changes occur, but solid waste permits are not required.

[a] In Florida, the PPSA (FS 403.501 through 518) provides for certification (licensure) of steam electric power plants that are 75 MW or larger in size. The Florida Department of Environmental Protection is the lead agency for coordination of the power plant siting process conducted pursuant to the PPSA and has jurisdiction over many of the activities that the PPSA certification process may replace.

[b] "On-site" means located at the same site where the CCWs were generated. In Texas, an "on-site" landfill may be located at a nearby facility (i.e., within 50 mi) having the same owner.

[c] Wastes are considered "nontoxic" in Ohio if leachate obtained by using the TCLP or modified TCLP contains (1) concentrations of arsenic, barium, cadmium, chromium, lead, and/or mercury that are less than 30 times the limits established by the EPA for these metals in drinking water and/or (2) a concentration of selenium of 1 mg/L or less, which the Ohio Environmental Protection Agency has established as the "nontoxic" criterion for selenium (USWAG 2005).

Because permits are techniques by which States ensure environmental control of waste management activities, the fact that 5 of the 11 States reviewed have solid waste permitting exemptions for certain CCW landfills raised a question during peer review of this report, even though an absence of solid waste permitting does not mean the absence of regulatory oversight. Specifically, peer reviewers were interested in whether the adoption of similar solid waste permitting exemptions for landfills might be prevalent among many States. Accordingly, USWAG member companies provided input regarding CCW landfill solid waste permitting practices in States that have coal-fired electric generating capacity. The results are reported in Table 20.

As Table 20 indicates, USWAG confirmed that 30 States with coal-fired electric generating capacity require solid waste permits for all CCW landfills under their nonhazardous solid waste programs. Six States were confirmed to not require solid waste permits for disposal units receiving CCWs, if the CCWs being disposed of were generated at the same site as the landfill (and in Texas, at a nearby facility [i.e., within 50 mi] and having the same owner). One State, Alabama, which expressly excludes all nonhazardous CCWs from the definition of solid waste, does not require a solid waste permit for a landfill that receives only CCWs. Another State, Ohio, expressly excludes "nontoxic" fly ash, bottom ash, and boiler slag from the definition of solid waste. According to USWAG, virtually all coal ash and slag produced in Ohio meets the "nontoxic" criteria for the metals of concern (USWAG 2005). This means that of all CCWs in Ohio, only landfills receiving FGD residues typically require solid waste permits. Appendix A provides detailed reviews of the solid waste regulatory programs in three of the six States that exempt CCWs from solid waste permitting (Florida, Illinois, and Texas). The areas of regulatory control covered for these States are designation of CCWs for disposal, permitting, liner requirements, groundwater-monitoring requirements, and leachate-collection system requirements. Appendix A also provides detailed reviews of the same areas of regulatory control for the two States (Alabama and Ohio) that exempt some or all CCWs from the definition of solid waste.

Table 21 shows how the States with solid waste permitting exemptions compare with the nation in coal-fired generating capacity, rate of CCW generation, and beneficial use of CCW.

As Table 21 reports, the total quantity of CCWs generated by facilities located in all States having coal-fired generating capacity in the United States was approximately 129 million tons in 2004. In comparison, the States that *do not* either exempt on-site CCW landfills from solid waste permitting requirements or exclude CCWs from the definition of solid waste generated a total of approximately 60 million tons of net disposable CCWs in 2004, which is approximately 71% of the total net disposable CCWs generated for all States. The six States that have solid waste permitting exemptions for certain on-site CCW landfills generated a total of approximately 17 million tons of net disposable CCWs in 2004, which is 20% of the total net disposable CCWs generated for all States. The one State that excludes CCWs from all solid waste regulations, Alabama, generated a total of approximately 2.7 million tons of net disposable CCWs in 2004, which is about 3.3% of the total net disposable CCWs generated in all States. Ohio, which excludes "nontoxic" fly ash, bottom ash, and boiler slag from solid waste regulations, generated a total of 5.9 million tons of these wastes and 1.1 million tons of FGD

TABLE 20 Solid Waste Permitting Requirements by State[a]

States That Do Not Exempt On-Site CCW Landfills from State Solid Waste Permitting Requirements		States That Exempt Certain On-Site CCW Landfills from State Solid Waste Permitting Requirements	States That Exclude CCWs from All Solid Waste Regulations
Arizona	New Hampshire	Colorado	Alabama
Arkansas	New Jersey	Florida	Ohio[b]
Connecticut	New Mexico	Illinois	
Delaware	New York	Maryland	
Georgia	North Carolina	Texas	
Indiana	North Dakota	Utah	
Iowa	Oklahoma		
Kansas	Pennsylvania		
Kentucky	South Carolina		
Louisiana	South Dakota		
Michigan	Tennessee		
Minnesota	Virginia		
Mississippi	West Virginia		
Missouri	Wisconsin		
Montana	Wyoming		

[a] Solid waste permitting requirements for Nebraska, Nevada, Oregon, and Washington were not confirmed because there are no USWAG member companies with facilities located in those States. Solid waste permitting requirements for Massachusetts were not confirmed because of time and resource constraints. Note that none of the States with coal-fired generating capacity absent from this table is a major generator of CCWs, and that the rates of beneficial use in the States absent from the table are normally either above or well above the national average (42% to 84% of total CCW generated in the State is beneficially used) (see Section 1.3).

[b] Ohio expressly excludes "nontoxic" fly ash, bottom ash, and boiler slag from the definition of solid waste. Wastes are considered "nontoxic" in Ohio if leachate obtained by using the TCLP or modified TCLP contains (1) concentrations of arsenic, barium, cadmium, chromium, lead, and/or mercury that are less than 30 times the limits established by the EPA for these metals in drinking water and/or (2) a concentration of selenium of 1 mg/L or less, which the Ohio Environmental Protection Agency has established as the "nontoxic" criterion for selenium. According to USWAG, virtually all coal ash and slag meet the "nontoxic" criteria (USWAG 2005).

TABLE 21 Power Generation Capacity, CCW Generation, and CCW Beneficial Use in States with Solid Waste Permitting Exemptions, 2004

States That Exempt Certain On-Site CCW Landfills from Solid Waste Permitting Requirements	Power Generation Capacity		CCW Generation		CCWs Used Beneficially	Net Disposable CCWs
	MW	% of Total U.S.	Thousand Tons	% of Total U.S.	Thousand Tons	Thousand Tons
Colorado	5,309	1.6	1,548	1.2	252	1,296
Florida	11,378	3.4	5,092	3.9	3,171	1,921
Illinois	17,462	5.2	4,419	3.4	1,968	2,451
Maryland	5,236	1.6	1,983	1.5	646	1,337
Texas	21,155	6.3	12,943	10.0	4,395	8,548
Utah	4,973	1.5	2,341	1.8	812	1,529
States that exclude CCWs from all solid waste regulations						
Alabama	12,458	3.7	3,408	2.6	663	2,745
Ohio[a]	24,028	7.2	6,980	5.4	2,290	4,690
Total of above States	101,969	30.4	38,714	30.0	14,197	24,517
Total United States	335,243		129,037		44,653	84,384

[a] Of the total CCWs generated in Ohio, 5,883 thousand tons (84%) are fly ash, bottom ash, and boiler slag, which are excluded from State solid waste regulations, and 1,096 (16%) are FGD wastes, which are not excluded from regulation. Of the 2,290 thousand tons of CCWs that are beneficially used, 1,302 thousand tons (57%) are fly ash, bottom ash, and boiler slag, and 987 thousand tons (43%) are FGD wastes.

Sources: EIA (2004a,b; 2006a,b).

wastes (about 7 million tons total) in 2004. Of these amounts, about 1.3 million tons of "nontoxic" fly ash, bottom ash, and boiler slag are beneficially used and about 1 million tons of FGD sludge are beneficially used. Hence, the net disposable CCWs that were potentially exempt from solid waste permitting requirements in Ohio in 2004 (i.e., "nontoxic" fly ash, bottom ash, and boiler slag) amount to about 4.6 million tons (5.9 million minus 1.3 million). Flue gas desulfurization wastes in Ohio are subject to full regulation as solid waste. Thus, the amount of net disposable CCWs in Ohio that is potentially exempt from solid waste permitting requirements represents about 5.4% of the total net disposable CCWs generated for all States. Overall, the portion of the net disposable CCWs that is potentially exempt from solid waste permitting requirements is approximately 24 million tons, which corresponds to 29% of the total net disposable CCWs generated in the United States during 2004.

In terms of electric generating capacity, the six States that have solid waste permitting exemptions for certain on-site CCW landfills generated a total of approximately 66,000 MW, which is approximately 20% of the total coal-fired electric generating capacity in the

United States in 2004. The one State that excludes CCWs from all solid waste regulations, Alabama, generated a total of approximately 12,000 MW in 2004, which is about 3.7% of the total. Ohio, which excludes "nontoxic" fly ash, bottom ash, and boiler slag from solid waste regulations, generated a total of about 24,000 MW in 2004. This represents about 7.2% of the total coal-fired electric generating capacity in the United States. Overall, the portion of the coal-fired electric generating capacity in the States that potentially exempt CCW landfills from solid waste permitting requirements and that exclude certain CCWs from all solid waste regulation is approximately 102,000 MW, which corresponds to about 30% of the total coal-fired electric generating capacity in the United States in 2004.

Four of the six States not requiring solid waste permits for disposal units receiving only CCWs generated on-site (Colorado, Florida, Illinois, and Texas) have other mechanisms for identifying and tracking such exempt facilities. While the mechanisms vary from State to State, they suggest that the absence of a solid waste permit in these four States does not mean the absence of regulatory oversight. A brief summary of these alternative mechanisms is provided below.

In Florida, if CCWs are disposed of in an on-site landfill at a coal-fired electric generating plant authorized under the Florida Power Plant Siting Act (PPSA), no separate permits, including solid waste construction and operation permits, are required. Instead, the entire facility is covered under the PPSA certification, which will contain the same substantive requirements as would otherwise have been imposed by other permits. In addition, if a solid waste generator other than an electric generating plant disposes of solid waste (including CCWs) that resulted from its own activities on its own property, a solid waste permit is not required provided that the environmental effects of such disposal on groundwater and surface water are addressed or authorized by another permit issued by the Florida Department of Environmental Protection or by an approved groundwater-monitoring plan (FAC 62-701.320).

In Illinois, a CCW landfill that qualifies for an exemption from solid waste permitting as a result of on-site disposal must comply with the design, construction, and operating standards applicable to other nonhazardous solid waste landfills that receive chemical wastes (35 Ill. Adm. Code 816.500(a)). These standards include requirements for liner systems, leachate-collection systems, and groundwater-monitoring programs (35 Ill. Adm. Code 811, Subpart C). In addition, exempt CCW landfills in Illinois must file an initial facility report containing information on facility location and disposal practices. Other reporting requirements for such landfills include quarterly reports containing groundwater monitoring results and annual reports containing raw data from groundwater and leachate-system monitoring networks (35 Ill. Adm. Code 815.203).

In Texas, if a CCW landfill is exempt from solid waste permitting because it receives nonhazardous industrial waste generated only by its owner, the generator of the waste is required to register with the Texas Commission on Environmental Quality (TCEQ) (30 TAC 335.6(a)). With the registration, the TCEQ requires submission of information, including, but not limited to, information concerning waste composition, waste management methods, facility engineering plans and specifications, or the geology where the facility is located (30 TAC 335.6(b)). In addition, the landfill is subject to general prohibitions against polluting water, creating a nuisance, and endangering public health and welfare (30 TAC 335.4).

Finally, in Colorado, if a CCW landfill is exempt from solid waste permitting requirements because it is located on the waste generator's site and receives only waste generated on that site, a Special Use Permit must be obtained from the local governing authority (typically a County) for the landfill. Colorado law authorizes each local government to plan for and regulate the use of land within its respective jurisdiction. To accomplish this, local governments in Colorado have enacted land-use regulations that require approvals, including Special Use Permits, for development. Special Use Permits are typically required for large-scale industrial projects such as power plants (see, e.g., Rio Blanco County 2002).

3.2.1.2 Permitting Requirements for Surface Impoundments

Permitting requirements applicable to surface impoundments were reviewed for the five pilot States (Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin) and six additional States (Alabama, Florida, Georgia, Missouri, Ohio, and Texas). Pennsylvania is the only State reviewed that requires a solid waste permit for all surface impoundments that receive CCWs. Wisconsin also regulates surface impoundments used for disposal as solid waste landfills. Otherwise, in the States reviewed, surface impoundments are regulated as water pollution control facilities rather than as solid waste management units. In general, water pollution control facilities treat or store wastewater, including industrial wastewater, and discharge it directly or indirectly into waters of a State, which usually encompass both surface water and groundwater located wholly or partially within the State.

All 11 States require surface impoundments that discharge wastewater from a point source into State waters to obtain an NPDES permit (or the State equivalent), although Wisconsin exempts from this requirement surface impoundments used for disposal, which are thereby subject to regulation as solid waste disposal units. For surface impoundments receiving CCWs that do not discharge from a point source (and thus are not required to obtain an NPDES permit), seven of the States reviewed (Florida, Georgia, Illinois, Indiana, Missouri, Ohio, and Virginia) require alternative water pollution control permits, and Texas requires compliance with permitting requirements for solid waste landfills. Indiana, Missouri, and Virginia expressly exclude surface impoundments that obtain water pollution control permits from solid waste permitting requirements.

Ten of the 11 States reviewed allow requirements (e.g., installation of groundwater-monitoring systems, liner systems, and leachate-control systems) to be placed in NPDES permits, and other water pollution control permits, to protect human health and the environment. In Pennsylvania, such requirements are placed into solid waste permits. It should also be noted that in Florida such requirements may be placed into the PPSA certification rather than in water pollution control permits for CCW surface impoundments located on-site at an electric generating company.

3.2.2 Findings

Table 22 summarizes the chronological comparisons of regulatory controls for landfills in the States reviewed. As Section 2.2 explains, a total of 11 States—Alabama, Florida, Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Texas, Virginia, and Wisconsin—were reviewed for regulatory designation of CCWs for disposal, permitting requirements, liner requirements, groundwater-monitoring requirements, and leachate-collection system requirements. Five of the 11 States (i.e., the pilot study States)—Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin—were also reviewed for closure and post-closure requirements, corrective action requirements, siting controls, and financial assurance.[21] Because corrective action was not addressed in either the 1988 RTC (EPA 1988) or the 1999 RTC (EPA 1999a), no chronological comparison was made for corrective action. Similarly, the information in these RTCs was insufficient to support an evaluation of changes over time in State regulations applicable to surface impoundments. Therefore, changes over time were not evaluated for this report.

The terms used in Table 22 to describe the types of change observed during two time periods—the period between collection of data for the 1999 RTC and collection of data for this report (2005), and the period between collection of data for the 1988 RTC and 2005—are defined in the footnotes. "Neutral" means that either it could not be ascertained from the information reviewed whether any change occurred during the time frame indicated, or that the information review suggested that no change occurred. For the period between collection of data for the 1999 RTC and 2005, the change observed was "neutral" for either all or all but one State in every category of regulatory control. This suggests that the absence of details about regulatory controls in most States reviewed in the 1999 RTC and its supporting technical documents made it difficult to ascertain whether regulatory changes occurred before or after data were collected for the 1999 RTC for the majority of the States. However, for the period between data collection for the 1988 RTC and 2005, the type of change observed for most States was either "tightened" or "relaxed." Therefore, from these data it was possible to confirm that, during the period between data collection for the 1988 RTC and 2005, the regulation of landfill liners, leachate-collection systems, and groundwater monitoring tightened in most States reviewed.

Table 22 indicates which of the States reviewed for this report tightened, relaxed, or were neutral with respect to regulatory controls in eight areas applicable to landfills between the times data were collected for the 1988 RTC and for this report. For each area of regulatory control, the total net disposable CCWs[22] generated in 2004 in reviewed States that tightened controls were

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21 For each State reviewed, an effort was made to identify regulations applicable to the disposal of CCWs in landfills and surface impoundments, regardless of the program (e.g., solid waste, special waste, residual waste, or wastewater) into which the State may place such regulations. Regulations covering beneficial use of CCWs and placement of CCWs in mines were not reviewed.

22 "Net disposable CCWs" were determined for each State by subtracting the total amount of CCWs beneficially used in the State during 2004 from the total amount of CCWs generated in the State during 2004, on the basis of data from EIA (2004a). The "total net disposable CCWs" were calculated for each type of change in a regulatory category (i.e., tightened, neutral, or relaxed) by summing the net disposable CCWs for all States reviewed for this report that experienced that type of change.

TABLE 22 Summary Results from Chronological Comparisons of Regulatory Controls for Landfills in States Reviewed[a]

Category of Regulatory Control	*EPA 1999* to 2005[b]		*EPA 1988* to 2005	
Type of Change	Number	State	Number	State
Regulatory Designation of CCWs[c]				
Tightened[d]	1	WI	7	IL, IN, MO, OH, PA, TX, WI
Neutral[e]	10	AL, FL, GA, IL, IN, MO, OH, PA, TX, VA	3	FL, GA, VA
Relaxed[f]	0		1	AL
Solid Waste Permitting[c]				
Tightened	1	MO	4	IN, MO, OH, PA
Neutral	10	AL, FL, GA, IL, IN, OH, PA, TX, VA, WI	5	FL, GA, TX, VA, WI
Relaxed	0		2	AL, IL
Liners[c]				
Tightened	0		8	GA, IL, IN, MO, OH, PA, VA, WI
Neutral	11	AL, FL, GA, IL, IN, MO, OH, PA, TX, VA, WI	0	
Relaxed	0		3	AL, FL, TX
Groundwater Monitoring[c]				
Tightened	0		8	GA, IL, IN, MO, OH, PA, VA, WI
Neutral	11	AL, FL, GA, IL, IN, MO, OH, PA, TX, VA, WI	1	FL
Relaxed	0		2	AL, TX
Leachate Collection[c]				
Tightened	0		8	GA, IL, IN, MO, OH, PA, VA, WI
Neutral	11	AL, FL, GA, IL, IN, MO, OH, PA, TX, VA, WI	2	AL, TX
Relaxed	0		1	FL
Closure and Post-Closure[g]				
Tightened	0		3	IN, PA, VA
Neutral	5	IL, IN, PA, VA, WI	2	IL, WI
Relaxed	0		0	

TABLE 22 (Cont.)

Category of Regulatory Control	*EPA 1999* to 2005[b]		*EPA 1988* to 2005	
Type of Change	Number	State	Number	State
Siting[g]				
Tightened	0		3	IL, IN, VA
Neutral	5	IL, IN, PA, VA, WI	2	PA, WI
Relaxed	0		0	
Financial Assurance[g]				
Tightened	0		2	IN, VA
Neutral	5	IL, IN, PA, VA, WI	3	IL, PA, WI
Relaxed	0		0	

[a] A chronological comparison was not possible for corrective action requirements because the historical EPA documents from which data were obtained did not address this area of regulatory control.

[b] For each category of regulatory control, a chronological comparison is provided for two time periods: (1) "*EPA 1999* to 2005 Data," which is the time period between the time data were collected for the 1999 EPA *Report to Congress: Wastes from the Combustion of Fossil Fuel* (EPA 1999a) and the time data were collected for this report, and (2) "*EPA 1988* to 2005 Data," which is the time period between the time data were collected for the 1988 EPA *Report to Congress: Wastes from the Combustion of Coal by Electric Utility Power Plants* (EPA 1988) and the time data were collected for this report.

[c] States reviewed for this regulatory category were Alabama, Illinois, Indiana, Florida, Georgia, Missouri, Ohio, Pennsylvania, Texas, Virginia, and Wisconsin.

[d] "Tightened" means that during the time frame indicated in the column heading, specific requirements for controls were added to the State's regulations where either none existed before, or prior requirements were less tailored to the characteristics of the wastes being regulated.

[e] "Neutral" means that either it could not be ascertained from the information reviewed whether any change occurred during the time frame indicated in the column heading, or the information reviewed suggested that no change occurred.

[f] "Relaxed" means that the information reviewed suggested that some or all pre-existing regulatory controls in the category of interest were removed during the time frame indicated in the column heading.

[g] States reviewed for this regulatory category were Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin.

calculated from Table 1 and compared with the same quantity in reviewed States that relaxed controls. The comparisons suggest that in all eight of the areas of regulatory control reviewed, more net disposable CCWs in the States reviewed underwent a tightening of regulatory controls than underwent a relaxation between the times data were collected for the 1988 RTC and for this report. A summary of the comparison for each area of regulatory control is provided below.

- In the area of regulatory designation of CCWs, seven States (Illinois, Indiana, Missouri, Ohio, Pennsylvania, Texas, and Wisconsin) experienced tightened

controls, and one State (Alabama) experienced relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.1:1.0.

- In the area of solid waste permitting, four States (Illinois, Missouri, Ohio, and Pennsylvania) experienced tightened controls, and two States (Alabama and Illinois) experienced relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.34:1.0.

- In the area of liner requirements, eight States (Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Virginia, and Wisconsin) experienced tightened controls, and three States (Alabama, Florida, and Texas) experienced relaxed controls, with a ratio of net disposable CCWs (relaxed: tightened) of 0.59:1.0.

- In the area of groundwater-monitoring requirements, eight States (Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Virginia, and Wisconsin) experienced tightened controls, and two States (Alabama and Texas) experienced relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.50:1.0.

- In the area of leachate-collection requirements, eight States (Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Virginia, and Wisconsin) experienced tightened controls, and one State (Florida) experienced relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.086:1.0.

- In the area of closure and post-closure requirements, three States (Indiana, Pennsylvania, and Virginia) experienced tightened controls, and no States experienced relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.0:1.0.

- In the area of siting requirements, three States (Illinois, Indiana, and Virginia) experienced tightened controls, and no States experienced relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.0:1.0.

- In the area of financial assurance requirements, two States (Indiana and Virginia) experienced tightened controls and no States experienced relaxed controls, with a ratio of net disposable CCWs (relaxed:tightened) of 0.0:1.0.

3.3 IMPLEMENTATION OF STATE REQUIREMENTS

Although current State regulatory programs to address the risks associated with CCW disposal in landfills and surface impoundments examined in this report appear to have improved, we did not have sufficient information on actual program implementation to confirm that the intended protections were occurring. To assess the level to which regulators were implementing the laws and regulations that had been enacted and promulgated, a review of permits issued for

the surveyed units was conducted to identify the nature and extent of any variances to the regulatory requirements. This section describes the findings associated with the review of information in the CCW permits and follow-up interviews with utilities and States, where necessary, to ascertain the degree to which regulators are implementing State requirements as intended.

3.3.1 Overview of Variance Requests

The permit review found that from 1994 to 2004, 52 variances were requested by operators of new or recently expanded disposal units in 9 of the 16 States containing surveyed units: Florida, Georgia, Illinois, Indiana, Minnesota, Ohio, Virginia, West Virginia and Wisconsin. No variance requests were identified in the remaining seven States: Michigan, Missouri, North Carolina, North Dakota, New Hampshire, New Mexico, and Pennsylvania. The review also found that few of these requests were related to liners or groundwater monitoring. For example, only four variances to groundwater-monitoring requirements were requested. While all four were granted, they applied only to organic constituents not found in CCWs. Similarly, only seven variances to liner requirements were requested. These were not to exempt the units from using liners, but rather to allow the use of alternative construction methods or liner materials. Of the seven liner variance requests, two were rejected, three were granted with stipulations, and two were granted only after the protectiveness of the proposed alternatives was demonstrated to the regulators. For one of the two liner requests granted, approval of a request to use an alternative (unconventional) method to consolidate subgrade foundation soils was granted after the success of the alternative approach was demonstrated at the specific site for which it was requested. In the second case, permeability data for an alternative liner material (soil combined with compacted Poz-O-Tec) submitted by the company demonstrated that the permeability of the combination liner would be no greater than that allowed for the 3-ft compacted soil liner specified in the regulations.

The following paragraphs describe the overall review of the variances requested and the State agency responses; Section 3.3.2 describes specific variance requests. Appendix J summarizes variance requests by State and category of requirement (e.g., liner, groundwater protection standards); Appendix K provides, for each of the 52 variance requests, the variance category, a description of the specific request, whether it was granted or not, a summary of the regulation to which the variance applies, the citation of the regulation, and the host State of the unit for which the variance was requested; and Appendix L provides, for each variance request, the granting rationale (if granted), the revocation provisions (if any), and any comments that further explain the variance.

In their survey responses, operators of surveyed units reported that 11 units in 6 States had one or more variances in their permits. All were for landfills. Because the information in the survey responses lacked the detail needed to investigate the variance issue thoroughly, we examined all 65 permits received from unit operators (whether or not the associated survey reported a variance) to determine whether variances had been requested and granted and, if so, the rationale behind the decision.

The survey responses reported that a total of 85 permits had been issued for the 45 surveyed units. (Section 3.1.5 describes the types of permits issued.) We asked for copies of all 85 permits and received 65. These 65 permits were issued for 39 of the 45 surveyed units. The analysis of all 65 permits found that 21 had variance requests, representing 19 units (2 units each had 2 separate permits with variance requests). Eighteen of the units requesting variances were landfills, and one was a surface impoundment. Of the 16 States with surveyed units, 9 had permits with variance requests and 8 had granted variances. The review was conservative in that it captured everything that could be construed as a variance. Thus, several conditions that we considered to be variances were not identified as such in the permits. For example, a landfill in Georgia has a design and operational plan that contains numerous conditions, such as "Methane gas control is not necessary as no gases are generated from coal ash," which is not identified as a variance in either the plan or the permit. Because some States consider such conditions variances, we included them as such in this study. As a result, if anything, the number of variances for the surveyed units for the permits reviewed is overestimated rather than underestimated.

Because individual permits often contain multiple variance requests (e.g., 1 permit had 6 variance requests), the total number of requests was 52. Of the 52 requests, 5 were rejected and 47 were granted. Of the 47 granted, 16 were granted with stipulations (e.g., provisions that would revoke or alter the variance if certain conditions are not met). Twelve were granted because the requirement from which the variance was sought (e.g., landfill gas monitoring) applied to a municipal solid waste or commercial landfill and was not appropriate to a CCW disposal unit. Six were identified and included as granted variances even though the permit itself did not characterize them as variances. All 6 of these variances were associated with 1 permit. They were included as variance requests in the database because sometimes other States consider waivers of the types of requirements covered to be variances. For example, one of these requests was to waive the fire protection measures otherwise required by the State regulations. Ten variances were granted because the State regulations provide for variances if it can be demonstrated that the proposed alternative meets or exceeds the environmental performance of the requirement from which the variance is requested. Three variances were granted for other reasons. For example, in one case, it appears that the regulator included the variance in a permit because an identical variance was granted for an earlier stage of the landfill.

Table 23 shows, for each State that received variance requests, the number of units requesting variances and the number of variances requested, rejected, and granted. It also identifies, for the variances that were granted, the number granted with restrictions, the number that were for requirements not germane to CCWs, the number that the regulations expressly allow if performance meets or exceeds the standards, and the number that were granted for other reasons.

3.3.2 Discussion of Variance Requests by Category

Variances were requested in the following categories: liners, groundwater monitoring, closure and post-closure, cover/dust controls, groundwater protection, and "other." The "other"

TABLE 23 Variance Requests and Disposition by State for Surveyed CCW Units

		Variances							
					Summary Explanations for Granted Variances[a]				
State	No. of Units	Requested	Rejected	Granted	Restrictions on Variance	Requirement Not Germane to CCW[b]	Not Considered Variance in Permit[c]	Regulations Allow Flexibility with Demonstrated Performance	Other[d]
FL	1	2	2	0	0	0	0	0	0
GA	1	6	0	6	0	0	6	0	0
IL	3	4	0	4	0	1	0	3	0
IN	4	8	0	8	7	0	0	1	0
MN	2	4	0	4	1	2	0	1	0
OH	2	5	2	3	1	0	0	2	0
VA	3	8	0	8	4	1	0	1	2
WI	1	4	1	3	3	0	0	0	0
WV	2	11	0	11	0	8	0	2	1
Total	19	52	5	47	16	12	6	10	3

[a] Included in variances granted.

[b] For example, a regulation developed for municipal solid waste or commercial landfill.

[c] Included because other States treat request as a variance.

[d] For example, in one case it appears that the regulator included a variance in the landfill permit because it was granted for an earlier stage of the landfill. In another case, wetlands must be added in a 2:1 ratio to compensate for location nearer surface water than allowed, and in yet a third case, a variance was granted on the basis of findings in the engineering report.

category includes several one-of-a-kind or other rarely requested variances, such as fire protection and signage. It is important to note that most of the requests (with the exception of those addressing requirements that were developed for municipal solid waste or commercial landfills that are not appropriate to CCW disposal units) were not to exempt the unit from the requirement, but rather to allow for an alternative approach or material that would accomplish the same objective.

Table 24 summarizes the categories of variance requests by State, and the following sections discuss individual categories of variances. Three appendices provide additional variance information. Appendix J shows the number of identified variance requests for all variance categories (including the individual types within the "other" category) for the States with surveyed units; Appendix K provides, for each disposal unit, a description of the variance, the variance category, the regulation for which the variance was requested, and whether it was granted or not; and Appendix L provides, for each unit and variance request, the granting rationale (if appropriate), any revocation provisions, and additional comments.

3.3.2.1 Liner Variance Requests

Seven requests (covering six units) were made for variances to liner requirements. All were for landfills. None of the applicants asked that their units be exempted from the installation of liners. Rather, the requests were for technical variances to construction method, liner materials, or liner requirements for the leachate-collection system that would provide protection equal to or greater than the liner system specified in the regulations. Variance requests were made in four States (Ohio, West Virginia, Indiana, and Wisconsin). Before granting a variance

TABLE 24 Summary of Variance Request Categories by State for Surveyed CCW Units

Surveyed States with Variance Requests	Total	Category of Variance Request					
		Liner Requirements	Groundwater Monitoring	Closure/ Post-Closure	Cover/Dust Controls	Groundwater-Protection Standards	Other[a]
FL	2	0	0	0	0	2	0
GA	6	0	0	1	1	0	4
IL	4	0	0	0	3	0	1
IN	8	1	0	2	5	0	0
MN	4	0	0	0	0	1	3
OH	5	3	0	0	2	0	0
VA	8	0	4	0	0	3	1
WI	4	1	0	0	0	2	1
WV	11	2	0	0	4	0	5
Total	52	7	4	3	15	8	15

[a] Includes cell height, fire protection, landfill gas/methane, leachate collection, location, pre-siting, signs, solid waste management plans, and standards for sewage works.

request, the State regulatory agencies require operators to demonstrate that proposed alternatives provide equal or better environmental performance, and include permit provisions that allow variances to be revisited based on environmental performance. Table 25 summarizes the types of liner variance requests, whether they were granted or rejected, and the granting/rejection rationale.

3.3.2.2 Groundwater-Monitoring Variance Requests

Three of the 45 surveyed units requested variances to the groundwater-monitoring requirements. One unit requested two variances, but for different stages of unit development; thus, there were a total four variance requests. All of these requests were for Virginia landfills, and each requested a variance only to the broad nonhazardous industrial waste requirement to monitor for organic constituents. In the State of Virginia, the disposal of CCWs not beneficially used is regulated in the same manner as disposal of other nonhazardous industrial solid wastes. This includes a requirement that groundwater be monitored for a set of constituents that includes organics. CCWs do not contain appreciable levels of organics. However, the permit requirements for each of these landfills call for the monitoring of numerous other constituents, including mercury, as well as other toxic metals and inorganics. The number of monitoring wells at each of the three units ranges from 11 to 17.

3.3.2.3 Closure/Post-Closure Requirements

Three of the surveyed units, all landfills, requested variances for some aspect of closure/post-closure controls. Two were requested in Indiana, and one in Georgia. Both of the variances requested in Indiana were granted with the stipulation that the variance would be revoked if the conditions included as part of the regulatory agency's decision were not met. Table 26 summarizes the closure and post-closure variances requested by the surveyed units.

3.3.2.4 Cover/Dust Controls

Fifteen requests (for 10 units) were made for variances to daily or intermediate cover requirements. All were for landfills. Of these, seven were granted with stipulations, three were granted because the regulations provide for alternatives that offer equal or better environmental protection, and five were granted because the requirements were designed to protect against vectors at municipal solid waste landfills. Cover variances were requested and granted in Ohio (two, both for the same unit), West Virginia (four [two each: one daily and one intermediate] for two separate units), Georgia (one), Indiana (five, two each for two separate units plus one for a third unit), and Illinois (three, two of which were for the same unit). Table 27 summarizes the daily and intermediate cover variance requests.

TABLE 25 Disposition of Liner Variance Requests for Surveyed Units

Variance Request	State	Granted or Rejected	Granting/Rejection Rationale
To use a coarser material to construct the liner than that required by the regulations.	OH	Rejected	The variance request was for a larger particle size than required in the regulations for an isolation zone, not the liner itself. The request was rejected because the data used in the request were based on a nearby facility and the regulator wanted data from the specific facility at which the substitute material would be used.
To use an alternative means for densifying the subgrade foundation soils below the liner system prior to constructing the liner system.	OH	Rejected	The request was not a variance from any regulatory requirements, but to use an alternative (unconventional) method to consolidate subgrade foundation soils. Nonetheless, it was rejected because its success had not been demonstrated.
To waive the requirement that a surface impoundment receiving leachate from a landfill's drainage system have a double liner.[a]	WV	Granted, with stipulations	The West Virginia Solid Waste Management Rule allows options for liner systems for surface impoundments receiving leachate (as distinguished from surface impoundments receiving CCWs). The rule requires that an appropriate groundwater interceptor drainage system be installed under all liner systems. Thus, the CCW landfill has a leachate collection system under its 2-ft compacted clay liner, and a leachate collection pond (surface impoundment) receives any collected leachate. The variance applies to the liner for the landfill's leachate collection pond.
To waive the requirement that a surface impoundment receiving leachate from a landfill's drainage system have a double liner.[a]	WV	Granted, with stipulations	The West Virginia Solid Waste Management Rule allows options for liner systems for surface impoundments receiving leachate (as distinguished from surface impoundments receiving CCWs). The rule requires that an appropriate groundwater interceptor drainage system be installed under all liner systems. Thus, the CCW landfill has a leachate collection system under its 2-ft compacted clay liner, and a leachate collection pond (surface impoundment) receives any collected leachate. The variance applies to the liner for the landfill's leachate collection pond.
To allow a penetration through a side-slope of the liner to accommodate a gravity drain to the leachate-collection tank.	WI	Granted, with stipulations	The Wisconsin Department of Natural Resources reserves the right to require the submittal of additional information and to modify this approval at any time, if in the Department's opinion, modifications are necessary.
To use an alternative means for densifying the subgrade foundation soils below the liner system prior to constructing the liner system.	OH	Granted	The request was not a variance from any regulatory requirements, but to use an alternative (unconventional) method to consolidate subgrade foundation soils. Approval was granted once the success of the alternative approach was demonstrated at the specific site for which it was requested.
To allow the use of 1 ft of soil and 2 ft of compacted Poz-O-Tec (a blended mixture of FGD scrubber sludge, fly ash, and lime) for a liner, rather than 3 ft of soil, as specified in the regulations.	IN	Granted	Permeability data for compacted Poz-O-Tec submitted by the company demonstrated that the permeability of the soil/ Poz-O-Tec combination liner would be no greater than that allowed for the 3-ft compacted soil liner specified in the regulations. The variance applies to an expansion area in the landfill that has not yet been constructed.

[a] These are two separate landfills in two separate locations.

TABLE 26 Variance Requests by Surveyed Units Pertaining to Closure and Post-Closure Requirements

Variance Request	State	Granted or Rejected	Granting/Rejection Rationale
To allow the use of 2.5 ft of fine sandy loam soils for the final cover rather than 2 ft of soil of Unified Soil Classification and 6 in. of vegetative topsoil, as specified in the regulations.	IN	Granted, with stipulations	State regulations allow the use of alternative cover material if it can be demonstrated that an alternate cover or site design will provide an adequate level of environmental protection. The material being placed into the landfill (Poz-O-Tec) is an engineered material containing a mixture of FGD sludges and fly ashes that are stabilized with lime. Poz-O-Tec is a relatively impermeable material that is not significantly infiltrated by rainwater. Thus, it is important to provide lateral drainage at the interface between the final cover on the landfill and the Poz-O-Tec; the composition of the final cover specified in the variance accomplishes this better than the composition specified in the regulations. Also, Poz-O-Tec leaches significantly fewer toxic constituents than materials in a municipal landfill, which is the landfill type for which the regulations were intended. If vegetation is not established to the satisfaction of the State, soils specified in the regulation will be required.
To allow the use of ash, ash/soil mixture, and 40-mil low-density polyethylene as final cover, rather than compacted soil as the regulations specify.	IN	Granted, with stipulations	State regulations allow the use of alternative cover material if it can be demonstrated that an alternate cover or site design will provide an adequate level of environmental protection. The alternative requested provides a more protective final cover than would be provided by 2 ft of soil as otherwise required by the regulations. The variance will be revoked if the permittee chooses not to use the mixtures described or if the mixture cannot be proven to have a permeability of 1×10^{-5} cm/s.
To waive the leachate collection and treatment otherwise required during the post-closure care period.	GA	Granted	Leachate collection and treatment are not deemed necessary during post-closure care because of the nontoxic, nonhazardous nature of the ash to be disposed of in the monofill. (The materials disposed of are 75% fly ash and 25% bottom ash.)

3.3.2.5 Groundwater-Protection Standards

Eight requests, covering five units, were made for variances to the groundwater-protection standards. Three units requested two variances each, and two requested one variance each. All of these requests were for landfills. Two requests were granted, three were rejected, and three were granted with stipulations. The requests were made in the following four States: Virginia (three, two for the same unit), Florida (two, both for the same unit), Wisconsin (two, both for the same unit), and Minnesota (one). The granted variances did not authorize exceedences of any generally applicable groundwater protection standards. In one case, the State (Minnesota) used variance provisions in the regulations as the mechanism for incorporating updated health-based standards into the permit in place of the standards specified in the regulations. In the other case, groundwater-protection standards at solid waste management units are established for constituents that lack background data or EPA-established MCLs based on case-specific proposals submitted by unit operators. Because the operator had not yet submitted proposed groundwater-protection standards, it did not yet consider itself to have been granted the

TABLE 27 Variance Requests by Surveyed Units Pertaining to Daily and Intermediate Cover Requirements

Variance Request	State	Granted or Rejected	Granting/Rejection Rationale
To allow the cementitious surface that forms when the FGD waste is placed in the Phase B area of the landfill to be a substitute for the required intermediate cover consisting of a 12-in.-thick layer of soil.[a]	OH	Granted, with stipulations	The variance will not create a nuisance or a health hazard and is unlikely to result in the violation of any regulations. If the lack of an intermediate soil cover proves ineffective in minimizing infiltration, or is otherwise unsatisfactory to the Ohio Environmental Protection Agency, or likely to result in a nuisance or health hazard or violation of any regulations, then the variance may be revoked. Upon revocation, placement of an intermediate cover must immediately begin in accordance with the requirements of the otherwise applicable Ohio Administrative Code rule.
To allow the cementitious surface that forms when the FGD waste is placed in the Phase A area of the landfill to be a substitute for the required intermediate cover consisting of a 12-in.-thick layer of soil.[a]	OH	Granted, with stipulations	The variance will not create a nuisance or a health hazard and is unlikely to result in the violation of any regulations. If the lack of intermediate soil cover proves ineffective in minimizing infiltration, or is otherwise unsatisfactory to the Ohio Environmental Protection Agency, or likely to result in a nuisance or health hazard or violation of any regulations, then the variance may be revoked. Upon revocation, placement of an intermediate cover must immediately begin in accordance with the requirements of the otherwise applicable Ohio Administrative Code rule.
To waive the requirement for a cover with greater than 6 in. of compacted cover material at the end of each operating day.[b]	WV	Granted	Requirements for daily cover are not necessary for this unit because coal ash should not cause vector problems, windblown litter, or other problems associated with municipal waste. Also, this facility is to be constructed as a structural landfill and thus would not utilize cells or daily cover.
To waive the requirement for cover with greater than 6 in. of compacted cover material at the end of each operating day.[b]	WV	Granted	Requirements for daily cover are not necessary for this unit because of the fact that coal ash should not cause vector problems, windblown litter, or other problems associated with municipal waste. Also, this facility is to be constructed as a structural landfill and thus would not utilize cells or daily cover.
To waive the regulatory requirement that 12 in. of compacted intermediate cover material be placed on landfill areas exposed to weather for periods in excess of 30 days.[c]	WV	Granted	Requirements for intermediate cover are not necessary because coal ash is not expected to cause vector problems, windblown litter, or other problems associated with municipal waste. Also, the facility is to be constructed as a structural landfill and thus would not utilize cells or daily cover.
To waive the regulatory requirement that 12 in. of compacted intermediate cover material be placed on landfill areas exposed to weather for periods in excess of 30 days.[c]	WV	Granted	Requirements for an intermediate cover are not necessary because coal ash is not expected to cause vector problems, windblown litter, or other problems associated with municipal waste. Also, the facility is to be constructed as a structural landfill and thus would not utilize cells or daily cover.
To waive the daily cover otherwise required by the regulations.	GA	Granted	CCWs will be loaded, transported, unloaded, and placed in a condition at, or near, optimum moisture content. When compacted at, or near, optimum moisture, the CCW will form a surface crust that will prevent blowing dust, thereby eliminating the need for operational cover. Since no blowing trash or disease vectors will be present, a daily cover is not required.

TABLE 27 (Cont.)

Variance Request	State	Granted or Rejected	Granting/Rejection Rationale
To waive the monthly cover and semiannual permeability testing otherwise required by the regulations.[d]	IN	Granted, with stipulations	The Phase III design includes a composite liner constructed by using 12 in. of clay having a permeability of 1×10^{-7}, a 60-mil high-density polyethylene geomembrane, and a leachate-collection system. Accordingly, the State agreed to eliminate the semiannual permeability testing requirement for the lined cell and to lengthen the time period between required application of an intermediate cover (from monthly to 90 days in unused areas), provided that adequate dust control measures remain in place. The variance can be revoked if dust emissions are not satisfactorily controlled.
To allow the use of Soil-Sement®, a polymer-based material, as an intermediate cover rather than 1 ft of clay type soil, as the regulations specify.[d]	IN	Granted, with stipulations	The regulator has the authority to approve an alternative cover if it can be demonstrated that the alternative will provide an adequate level of environmental protection. The operator plans to use the Soil-Sement polymer as an intermediate cover to control dust in unused or seldom-used fill areas and to control rainfall infiltration to minimize leachate formation. Properly applied Soil-Sement is more effective at repelling storm water than the soil cover specified in the regulations. Agency personnel observed an area of the landfill treated with this product, were familiar with use of Soil-Sement at other coal combustion facilities in the State, and have been satisfied that Soil-Sement is an effective alternative to soil cover for this type of facility. In the event that the alternative cover material does not perform as intended, or does not appear to be equivalent to 1 ft of intermediate cover soil, 1 ft of an intermediate cover of clay type soil may be required by 329 IAC 10-28-12(a)(3).
To waive the intermediate cover otherwise required by the regulations.	IN	Granted, with stipulations	The regulations were developed for municipal landfills, for which vectors and fugitive dust are problems. Because the CCWs (fly ash and FGD sludge) are composed of inorganic constituents, vector control is not needed. Also, dusting from coal combustion products can be controlled by using compaction techniques and water. The facility has developed and implemented a fugitive dust control plan. The variance can be revoked if there is a documented violation of the requirement to maintain sediment control structures and drainage ditches or if it is documented that fugitive dust is creating a nuisance.
To allow the use of sandy loam soil for intermediate cover rather than soil of Unified Soil Classification, as specified in the regulations.	IN	Granted, with stipulations	State regulations allow for the use of covers other than the designated soil types if it can be demonstrated that an alternate cover or site design will provide an adequate level of environmental protection. The material being placed into the landfill is Poz-O-Tec, an engineered material containing a mixture of FGD sludges and fly ashes that are stabilized with lime. Poz-O-Tec is a relatively impermeable material that is not infiltrated significantly by rainwater. Thus, it is important to provide lateral drainage at the interface between the intermediate cover on the landfill and the Poz-O-Tec. The composition of the intermediate cover specified in the variance

TABLE 27 (Cont.)

Variance Request	State	Granted or Rejected	Granting/Rejection Rationale
			accomplishes this better than the composition specified in the regulations. In addition, Poz-O-Tec in this coal combustion by-product monofill leaches significantly less toxic constituents than materials in a municipal landfill, which is the landfill type to which the regulations were intended to apply. If vegetation is not established to the satisfaction of the State, soils specified in the regulation will be required.
To allow the use of conditioned fly ash as an alternative daily cover rather than at least 6 in. of clean soil, as the regulations specify.	IL	Granted	The daily cover regulations allow alternative materials or procedures as long as they meet the same standards of performance as 6 in. of soil. Data included in the permit application included an analysis of the conditioned fly ash and a description of its properties to demonstrate that, when hardened, it is an even better sealant than the standard 6 in. of soil. The permit specifies that the conditioned fly ash must be used in compliance with the way its use was described in the permit application.
To allow the use of conditioned fly ash as an alternative daily cover rather than at least 6 in. of clean soil, as the regulations specify.[e]	IL	Granted	State regulations allow flexibility in cover design, as long as the alternative can meet the same performance standard as the design specified in the regulations. Data included in the permit application included an analysis of the conditioned fly ash and a description of its properties to demonstrate that, when hardened, it is a better filter than the standard 6 in. of soil.
To allow the use of conditioned fly ash as an intermediate cover rather than 1 ft of compacted clean soil material, as required by the regulations.[e]	IL	Granted	State regulations allow flexibility in cover design, as long as the alternative can meet the same performance standard as the design specified in the regulations. Data included in the permit application included an analysis of the conditioned fly ash and a description of its properties to demonstrate that, when hardened, it is a better filter than the standard 12 in. of soil.
To waive the intermediate cover otherwise required by the regulations.	IN	Granted, with stipulations	Almost 90% of the materials disposed of at the landfill are wet FGD sludge. The company's landfill operating plan, which was the basis for the variance request and which was approved by the regulatory agency, requires compacting and curing of stabilized sludge to minimize wind and water erosion and fugitive dust generation, and it also requires plant water trucks to moisten surfaces where vehicular dust may be generated. Variance can be revoked if there is a documented violation of the requirement to maintain sediment control structures and drainage ditches or documented evidence that fugitive dust is creating a nuisance.

[a] These variances are for the same unit.

[b] These are two separate units in two separate locations.

[c] These are two separate units in two separate locations.

[d] These variances are for the same unit.

[e] These variances are for the same unit.

variance. However, the State (Virginia) appears to have included the variance language in the permit for the purpose of administrative efficiency. Two other stages of the same landfill have already been approved for this variance, and the operator plans to apply for the variance as soon as adequate supporting data are collected, which is likely to occur before the existing permit requires renewal. Although no revocation provisions were specified, in a parallel variance for earlier-stage landfills at the same site, the permit provided that if any of the conditions in the variance were violated, the variance would be immediately withdrawn. Table 28 summarizes the variance requests pertaining to groundwater-protection standards.

3.3.2.6 Other Variance Requests

Other variance requests pertain to the following types of requirements: cell height, fire protection, landfill gas/methane, leachate collection, location, pre-siting, signs, solid waste management plans, and standards for sewage works. Information on these requests is provided in Table 29 and is summarized below. Appendices K and L provide further details.

For each of the following types—cell height, fire protection, pre-siting, signs, solid waste management plans, and standards for sewage works—one variance was requested. All six of these requests were granted, because the regulations for which the variance was requested were not germane to CCW disposal.

Five requests pertained to landfill gas/methane monitoring requirements. Three were requests to waive the requirement for management (monitoring, collection and treatment) of decomposition gases generated within a landfill. All three were granted, because the waste disposed of does not produce waste gases. Two requests were to waive the requirements to monitor for methane or decomposition gas. Both were granted for the same reason (the waste does not produce gases). In one case, the State (Minnesota) stated that if operational records or other reports indicate possible decomposition gas production in or around the facility, the Commissioner reserves the right to require monitoring.

Two requests pertained to leachate collection. One requested a waiver to the leachate-collection and treatment system otherwise required by the regulations. It was granted because the ash being disposed of is nontoxic. The other requested a variance to allow leachate to flow more than 130 ft across the base of the liner before encountering a perforated leachate-collection pipe. This variance was granted, but the State (Wisconsin) regulator reserved the right to require the submittal of additional information and to modify the approval at any time, if, in the regulator's opinion, modifications were necessary.

Two of the requests pertained to location requirements. One was to waive the prohibition on locating a new solid waste landfill above an underground mine. This request was granted because the State (West Virginia) Department of Environmental Protection found that the site had an acceptable margin of safety. The second request was to allow the unit to be located within 100 ft of a regularly flowing surface water body or river, which the regulations otherwise prohibit. This request was granted, but the permit requires the company to mitigate 2.8 acres of affected wetlands by adding emergent wetlands in a 2:1 ratio and imposes additional conditions.

TABLE 28 Variance Requests by Surveyed Units Pertaining to Groundwater-Protection Standards

Variance Request	State	Granted or Rejected	Granting/Rejection Rationale
To allow the use of alternative concentration limits (ACLs) as groundwater-protection standards for copper, silver, and zinc rather than the maximum contaminant levels (MCLs) or background concentrations as otherwise required by the regulations.	VA	Granted, with stipulations	The director may grant a variance to State groundwater-protection standards to an owner or operator of a solid waste disposal facility by establishing an ACL for a solid waste constituent if the owner or operator shows to the satisfaction of the director that the constituent will not pose a substantial present or potential hazard to human health or the environment as long as the ACL is not exceeded. The Virginia Department of Environmental Quality rationale for granting the variance was based on using groundwater as a future potential source of drinking water. It used conservative calculations for the most receptive sensor, a child. If an MCL is promulgated under Section 1412 of the Safe Drinking Water Act for any of the constituents covered by the variance, the new MCL will be used as the groundwater-protection standard for that respective constituent.
To allow development of a landfill in an area where the preventive action limit (PAL) for lead in groundwater has been attained or exceeded rather than prohibiting such development, as the regulations specify.[a]	WI	Rejected	Mean baseline concentrations at three wells approach, but do not exceed the PAL for lead. No lead exemption is needed at these wells since six of the eight test results are nondetect. A company representative explained that the variance was requested because there had been lead mining in the area surrounding the landfill, which suggested the possibility that background lead levels in groundwater might be at or higher than the PAL. Notwithstanding, baseline monitoring showed that mean baseline concentrations at three wells approach, but do not exceed, the PAL for lead, which signaled that no variance was needed. Since compliance monitoring began in June 2001, no lead has been detected.
To allow development of a landfill in an area where the PAL for selenium in groundwater has been attained or exceeded.[a]	WI	Granted, with stipulations	Groundwater concentrations for selenium that exceed groundwater standards are due to baseline groundwater quality. The proposed unit will not cause the concentration of selenium to exceed the enforcement standard for selenium at the point of standards application because of the landfill's liner and leachate-collection system design. Granting the exemption will not inhibit compliance with Wisconsin solid waste management standards. The Wisconsin Department of Natural Resources reserves the right to require the submittal of additional information and to modify this approval at any time, if in the Department's opinion, modifications are necessary.

TABLE 28 (Cont.)

Variance Request	State	Granted or Rejected	Granting/Rejection Rationale
To allow ambient values for iron and color in groundwater to exceed the secondary drinking water quality standards rather than comply with the secondary drinking water standards, as the regulations specify.[b]	FL	Rejected	Consideration of the variance request was postponed until 2 years after start of plant operations, awaiting a demonstration that levels of iron and color in the groundwater already exceed the secondary drinking water standards. A company representative explained that because the facility did not pursue any further consideration of the variance request, no action was taken by the regulatory agency on approving or denying it. The request had been included in the permit application as a placeholder based on predictive modeling that iron and color in the groundwater might exceed the secondary drinking water standard. The model included historical data and site conditions; the area on which the utility facility was built in 1995 was an area filled with mine pits. The area had not been in use for several years prior to 1995 and was leveled to allow for utility facility construction. Note: The company requested two variances based on predictive modeling. The agency deferred consideration of the variance requests for 2 years pending collection of actual groundwater monitoring data. The company never submitted groundwater-monitoring data or pursued the variances further.
To allow the concentration of antimony in groundwater to exceed the drinking water quality standard, rather than comply with the drinking water standard, as the regulations specify.[b]	FL	Rejected	Consideration of the variance request was postponed until 2 years after start of plant operations, awaiting a demonstration that levels of antimony in the cooling pond exceed the drinking water standards. A company representative explained that because the facility did not pursue any further consideration of the variance request, no action was taken by the regulatory agency on approving or denying it. The request had been included in the permit application as a placeholder based on predictive modeling that antimony in the groundwater might exceed the secondary drinking water standard. The model included historical data and site conditions; the area on which the utility facility was built in 1995 was an area filled with mine pits. The area had not been in use for several years prior to 1995 and was leveled to allow for utility facility construction. Note: The company requested two variances based on predictive modeling. The agency deferred consideration of the variance requests for 2 years pending collection of actual groundwater-monitoring data. The company never submitted groundwater-monitoring data or pursued the variances further.
To establish analytical limits set forth in the Limits Table in the permit as groundwater-protection standards rather than the otherwise applicable groundwater protection standards.	MN	Granted	The alternative groundwater-performance standards are based on the Minnesota Department of Health, Health Risk Limits. The analytical limits set forth in the permit do not constitute a variance; the State uses variance provisions in the regulations as the basis for incorporating updated health-based standards into permits in place of the standards specified in the regulations. Apparently this is more efficient than changing the regulations every time health-based standards are updated.

TABLE 28 (Cont.)

Variance Request	State	Granted or Rejected	Granting/Rejection Rationale
To allow Landfill Stages I and II to use ACLs as groundwater-protection standards (GPSs) for specified constituents that lack background data or an EPA MCL.[c]	VA	Granted, with stipulations	The owner or operator may request and the director may establish alternate concentration levels as groundwater-protection standards for any constituent for which MCLs have not been established or for which site-specific background data are unavailable. If any of the conditions in the variance are violated in any form or manner, the variance will be immediately withdrawn.
To allow Landfill Stage III to use ACLs as GPSs for specified constituents that lack background data, or an EPA MCL.[c]	VA	Granted[d]	The owner/operator may request and the director may establish ACLs as GPSs for any constituent for which site-specific background data are unavailable. Although no revocation provisions were specified, in a parallel variance for Stages I and II landfills, the variance provides that if any of the conditions in the variance are violated in any form or manner, the variance will be immediately withdrawn.

[a] These variance requests are for the same unit.

[b] These variance requests are for the same unit.

[c] These variance requests are for the same unit.

[d] Since the company has not yet submitted proposed groundwater-protection standards and does not yet consider itself to have been granted this variance for ACLs and GPSs, the company believes that the State included the variance language in the permit for the purpose of administrative efficiency.

TABLE 29 Variance Requests by Surveyed Units Pertaining to "Other" Regulatory Requirements

Variance Type	State	Number of Variances: Granted	Number of Variances: Granted with Restrictions	Granting Rationale
Cell height	WV	1	0	Unit is constructed as a structural landfill and does not utilize cells; coal ash does not cause vector problems, windblown litter, or other problems associated with municipal waste.
Fire protection	GA	1	0	Fire protection measures are not required for a coal combustion by-products monofill.
Landfill gas/methane	MN WV	5	1	Waste being disposed of is not putrescible or biodegradable; waste disposed of does not produce waste gases. Therefore, no need for gas management.
Leachate collection	GA WI	2	1	**WI**: Upon review of engineering design, regulator was satisfied that it would provide adequate drainage, thus protecting human health and the environment. The Wisconsin Department of Natural Resources reserves the right to require the submittal of additional information and to modify this approval at any time, if in the Department's opinion, modifications are necessary. **GA**: Leachate collection and treatment deemed unnecessary due to the nontoxic, nonhazardous nature of the ash to be disposed of in the monofill.
Location requirements	VA WV	2	1	**VA**: Because no other siting options were available for treatment pond expansion, a variance allowing the unit to be located within 100 ft of the water body was requested and granted, and mitigation of the impacted wetland area was required. **WV**: An engineering company report on the safety of locating the unit above an underground mine was reviewed by the West Virginia Department of Environmental Protection, and it was found that the site had an acceptable margin of safety.
Pre-siting	WV	1	0	Requirements (waiver of requirement to serve public notice) are for commercial facilities, and the unit is not a commercial facility.
Signs	GA	1	0	Because only utility personnel are to use this site, no directional or informational signs are required.
Solid waste management plan	MN	1	0	Waste management plan is not necessary because waste disposal operations are restricted to specified waste types.
Standards for sewage works	IL	1	0	The piping system was not expected to be an integral part of a sewage works system; thus, sewage works standards were not appropriate.

4 CONCLUSIONS

On the basis of information presented in the 1999 RTC, the EPA determined in its May 2000 RD that national Subtitle D regulations for CCW disposal in landfills and surface impoundments were warranted. The data collection and analysis documented in this report provide new information on the management of CCWs from 1994 to 2004. This information indicates that improved disposal unit management practices and State application of environmental regulations appear to be occurring.

A comprehensive review of information on the 56 identified landfills and surface impoundments permitted, built, or expanded between 1994 and 2004 indicates that disposal management practices and the enforcement of State requirements has resulted in liners for virtually all newly built or expanded units (97% of landfills and 100% of surface impoundments) and groundwater monitoring for the majority of units (97% of landfills and nearly 80% of surface impoundments).

A review of the regulations for 11 States indicates that between the time when data were collected for the 1988 RTC and the time of this study, a majority of the States reviewed for this report tightened regulation of landfill liners, leachate-collection systems, and groundwater monitoring. In addition, comparisons of the total net disposable CCWs generated during 2004 in reviewed States that tightened controls with the same quantity in reviewed States that relaxed controls suggest that more net disposable CCWs in the States reviewed underwent a tightening rather than a relaxation of regulatory controls in eight regulatory areas, between the times data were collected for the 1988 RTC and for this report. However, the absence of details about most States' regulatory controls in the 1999 RTC and its supporting technical documents made it not possible to ascertain whether particular regulatory changes occurred before or after data were collected for the 1999 RTC in most of the States reviewed.

A detailed analysis of variance requests in 65 permits in 16 States indicates that State regulators have not issued variances unless a sound scientific basis supports the request. Variances are generally granted only when the underlying regulation was developed for settings unlike those of CCW units (e.g., a municipal solid waste or commercial landfill where landfill gas or vectors are issues), or when the operator has demonstrated that an alternative approach or material will achieve the same objective as intended by the regulation.

5 REFERENCES

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APPENDIX A:

STATE-SPECIFIC REGULATORY REVIEWS

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STATE-SPECIFIC REGULATORY REVIEWS

A.1 APPROACH

In the regulatory determination (RD) issued on May 22, 2000 (EPA 2000), the U.S. Environmental Protection Agency (EPA) stated that coal combustion wastes (CCWs) do not warrant regulation as hazardous wastes under the Resource Conservation and Recovery Act (RCRA); the EPA expressed a concern, however, that gaps may exist in some State regulatory programs that could lead to future environmental damages. This section describes the approach used to investigate this concern.

It was evident from the outset that a nationwide study of the CCW regulations and their chronological changes in all States that address CCWs would not be feasible under the time and resource constraints of this study. Therefore, an alternative approach was assessed, namely reviewing the current regulatory programs applicable to CCWs in States that contain units of one or more of the following types and comparing the results with corresponding information from earlier reports: (1) new CCW disposal units (i.e., those permitted, constructed, or laterally expanded between 1994 and 2004) and (2) units that are the basis of proven, potential, or alleged damage cases.[1] Of the 26 States identified as meeting the selection criteria, a pilot study involving five States (Pennsylvania, Illinois, Indiana, Virginia, and Wisconsin) was conducted to determine whether it would be feasible, within the established budget and schedule constraints, to collect enough data for all 26 States to allow comparisons of current regulatory requirements with comparable information from earlier reports and to identify changes. Information collected during the pilot study covers the following categories of regulatory control:

- Regulatory designation of CCWs for disposal,
- Permitting requirements,
- Liner requirements,
- Groundwater-monitoring requirements,
- Leachate-collection system requirements,

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[1] In comments to the EPA, public interest groups have identified cases in which they allege that damage to human health or the environment was caused by fossil fuel combustion waste management units. As of May 2006, 86 of the alleged damage cases have been investigated by the EPA to verify the existence and cause of the damage. As defined in the 1999 Report to Congress (RTC) (EPA 1999a), proven damage cases are those with exceedences of primary maximum contaminant levels (MCLs) or other health-based standards in groundwater or surface water off-site or at a distance from the waste management unit sufficient to conclude that they could cause human health concerns, while potential damage cases are those with (1) documented exceedences of primary MCLs or other health-based standards on-site or beneath or close to the waste source, and/or (2) documented exceedences of secondary MCLs or other non-health–based standards on-site or off-site.

- Corrective action requirements,
- Closure/post-closure requirements,
- Siting controls, and
- Financial assurance requirements.

The pilot study was resource intensive, and we discovered that comparisons between the current regulatory requirements and comparable information reported in the earlier reports could rarely be made at the same level of detail. For example, the 1999 Report to Congress (RTC) and its supporting technical background documents provide primarily aggregated information regarding State regulatory controls. Hence, in the case of liner requirements, the report indicates that a total of 43 States adopted liner requirements for landfills before data were collected for the RTC (EPA 1999a). It does not, however, explain what types of liner materials or design requirements were specified by any particular State. Similarly, the report does not explain whether, at the time data were collected, particular States had differing requirements for landfills receiving wastes with differing toxicity levels. Furthermore, the names of States for which information was aggregated are not provided in the 1999 RTC. Similar difficulties were identified for all areas of regulatory control, which hindered most State-specific comparisons between current regulations and the regulations in effect at the time data were collected for the 1999 RTC.

In light of this, the EPA revisited information already available from other sources about current State CCW regulatory programs and concluded that our priority should be to update how States were actually implementing programs, rather than to simply gather further information on State regulations. Accordingly, we did not conduct comprehensive reviews of State regulations for all of the 26 States mentioned above. Instead, the EPA identified particular aspects of the regulatory programs in specified States that were of interest, and we focused our investigation of State regulations on those States in addition to the five pilot States. In all, six additional States were reviewed beyond those in the pilot study: Alabama, Florida, Georgia, Missouri, Ohio, and Texas. For these additional States, we concentrated on the following five of the nine areas of regulatory control that were reviewed for the pilot States, because these areas have greater potential to affect whether releases to groundwater are controlled:

- Regulatory designation of CCWs for disposal,
- Permitting requirements,
- Liner requirements,
- Groundwater-monitoring requirements, and
- Leachate-collection system requirements.

For each State reviewed, an effort was made to identify regulations applicable to the disposal of CCWs in landfills and surface impoundments, regardless of the regulatory program (e.g., solid waste, special waste, residual waste, wastewater) into which the State may place such regulations. Regulations covering beneficial use of CCWs and placement of CCWs in mines were not reviewed.

Overall, information was collected about regulatory controls applicable to CCW disposal for the 11 States, as shown in Table A.1.

Sections A.2 through A.6 summarize the current status of requirements in the 5 areas of regulatory control reviewed for all 11 States, which are indicated on Table A.1. Sections A.7 through A.10 cover the current status of requirements in the remaining 4 areas of regulatory control—closure and post-closure requirements, corrective action, siting controls, and financial assurance—for only the 5 pilot States. For each category of regulatory control, a chronological comparison of requirements applicable to landfills is also provided, which is based on the data gathered for this report and data from the two following reports:

- U.S. Environmental Protection Agency, *Report to Congress: Wastes from the Combustion of Coal by Electric Utility Power Plants* (EPA 1988); and

- U.S. Environmental Protection Agency, *Technical Background Document for the Report to Congress on Remaining Wastes from Fossil Fuel Combustion: Existing State Regulatory Controls* (EPA 1999b).

The chronological comparisons are limited to landfills because the historical reports did not provide sufficient data to support similar comparisons for surface impoundments.

Section A.11 summarizes additional information collected during the pilot study that is not reported elsewhere, and Section A.12 lists findings.

A.2 REGULATORY DESIGNATION OF COAL COMBUSTION WASTES FOR DISPOSAL IN SELECTED STATES

A.2.1 Summary

Table A.2 summarizes the regulatory designations given to CCWs in Alabama, Florida, Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Texas, Virginia, and Wisconsin. As the table indicates, all States have regulations that expressly exclude CCWs from the definition of hazardous waste, either by reference to the Federal exclusion in Title 40, Section 261.4(b)(4) of the *Code of Federal Regulations* (40 CFR 261.4(b)(4)) or by exclusionary text in the State's regulations themselves. However, in Missouri, fly ash that fails the Toxicity Characteristic Leaching Procedure (TCLP) must be disposed of in a hazardous waste disposal facility. In

TABLE A.1 Areas of Regulatory Control Investigated by State Reviewed[a]

State[b]	Regulatory Designation of CCWs for Disposal	Permitting	Liners	Groundwater Monitoring	Leachate-Collection System	Closure and Post-closure	Corrective Action	Siting Controls	Financial Assurance
Alabama	X	X	X	X	X				
Florida	X	X	X	X	X				
Georgia	X	X	X	X	X				
Illinois	X	X	X	X	X	X	X	X	X
Indiana	X	X	X	X	X	X	X	X	X
Missouri	X	X	X	X	X				
Ohio	X	X	X	X	X				
Pennsylvania	X	X	X	X	X	X	X	X	X
Texas	X	X	X	X	X				
Virginia	X	X	X	X	X	X	X	X	X
Wisconsin	X	X	X	X	X	X	X	X	X

[a] "X" indicates that the area of control described by the column heading was reviewed for the named State, while a blank cell indicates that the area of control described in the column heading was not investigated for the named State. All 11 States were reviewed for the 5 areas having greater potential to affect whether releases to groundwater are controlled.

[b] The pilot review covered Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin, which are indicated in boldface type. Alabama, Florida, Georgia, Missouri, Ohio, and Texas were selected for supplemental reviews in the areas of regulatory control having greater potential to affect whether releases to groundwater are controlled.

TABLE A.2 Summary of Regulatory Designations for CCWs in Selected States

State[a]	Expressly Excluded from Definition of Hazardous Waste?	Regulatory Designation if Disposed of
Alabama	Yes.[b]	Expressly excluded from the definition of industrial solid waste.
Florida	Federal exclusion in 40 CFR 261.4(b)(4) is adopted by reference.	Nonhazardous solid waste.
Georgia	Federal exclusion in 40 CFR 261.4(b)(4) is adopted by reference.	Nonhazardous industrial waste.
Illinois	Yes.	Special (non-RCRA) waste[c] OR Declassified waste[d] (toxicity determination required).
Indiana	Federal exclusion in 40 CFR 261.4(b)(4) is adopted by reference.	Restricted waste, if disposed of in a monofill[e] OR Nonhazardous industrial solid waste, if co-disposed of with dissimilar wastes.
Missouri	Federal exclusion in 40 CFR 261.4(b)(4) is adopted by reference, except that fly ash that is not otherwise exempt from regulation as solid waste and fails the TCLP is not subject to the exclusion in 40 CFR 261.4(b)(4) and must be disposed of in a permitted hazardous waste facility.	Utility waste.[f]
Ohio	Yes.	Residual waste[g] OR Expressly excluded from the definition of solid waste if "nontoxic"[h] (fly ash, bottom ash, and boiler slag only).
Pennsylvania	Federal exclusion in 40 CFR 261.4(b)(4) is adopted by reference.	Residual waste.[i]
Texas	Federal exclusion in 40 CFR 261.4(b)(4) is adopted by reference.	Nonhazardous industrial solid waste.
Virginia	Federal exclusion in 40 CFR 261.4(b)(4) is adopted by reference.	Nonhazardous industrial solid waste.
Wisconsin	Yes.	Nonhazardous industrial solid waste AND High-volume industrial waste (fly ash and bottom ash).

Footnotes on next page.

TABLE A.2 (Cont.)

[a] The pilot study covered Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin in this category of regulatory control. Alabama and Ohio are supplemental review States.

[b] "Yes" means that the State has adopted regulations that expressly exclude fly ash, bottom ash, slag, and flue gas emission control residues generated primarily from the combustion of coal or other fossil fuels from the definition of hazardous waste.

[c] "Special (non-RCRA) wastes" are defined in Illinois to include any industrial process wastes or pollution control wastes that are not hazardous waste as defined in 40 CFR Part 261 (promulgated to implement the Resource Conservation and Recovery Act [RCRA]) and have not been "declassified."

[d] Wastes are "declassified" in Illinois when the generator certifies that the source, physical and chemical characteristics, and degree of hazard of the waste meet defined declassification criteria.

[e] "Restricted wastes" in Indiana are industrial solid wastes that have been divided into four types (I–IV) on the basis of the concentrations of arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver that leach when the TCLP is applied, as specified in 329 Indiana Administrative Code (IAC) 10-9-4.

[f] "Utility waste" in Missouri means fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels.

[g] "Residual waste" in Ohio is a type of solid waste that the Ohio regulations define as including the following wastes generated by, among other things, burning coal: air pollution control wastes, water pollution control wastes, and other wastes with similar characteristics that are approved by the director or his authorized representative. There are four classes of residual waste (I–IV). The concentrations of specified constituents are evaluated with the use of a leach test and the methodology detailed in Ohio Administrative Code (OAC) 3745-30-03.

[h] Wastes are considered "nontoxic" in Ohio if leachate obtained by using the TCLP or modified TCLP contains (1) concentrations of arsenic, barium, cadmium, chromium, lead, and/or mercury that are less than 30 times the limits established by the EPA for these metals in drinking water and/or (2) a concentration of selenium of 1 mg/L or less, which the Ohio Environmental Protection Agency has established as the "nontoxic" criterion for selenium.

[i] "Residual waste" in Pennsylvania includes any industrial waste not classified by law as hazardous. It includes waste materials—solid, liquid, or gas—produced by industrial, mining, and agricultural operations. Certain coal-mining wastes are excluded. There are three classes of residual waste disposal units (I–III) designated on the basis of the potential for wastes received at a disposal unit to adversely affect groundwater. Class I disposal units receive waste that are most likely to affect groundwater, and Class III units receive wastes that are least likely to do so.

addition, the regulations in Alabama expressly exclude CCWs from the definition of industrial solid waste, and the regulations in Ohio expressly exclude "nontoxic"[2] fly ash, bottom ash, and boiler slag from the definition of solid waste. The consequences of the Alabama and Ohio exclusions with respect to the applicability of regulatory controls in those States are further described in Section A.2.3.

Several of the States reviewed, including Illinois, Indiana, Ohio, Pennsylvania, Texas, and Wisconsin, take a graded approach to regulating nonhazardous solid wastes, which is illustrated in Figure A.1. These States subdivide nonhazardous solid wastes into groups. Each group of wastes is assigned a name as a method of designating the applicable subset of the State's solid waste regulations. Typical first-tier groups are municipal solid waste, nonhazardous industrial waste, and construction and demolition wastes. Nonhazardous industrial wastes are then further subdivided based on the degree of hazard associated with handling and disposing of them. Section A.2.3 provides more detailed information about the graded approach adopted by each State.

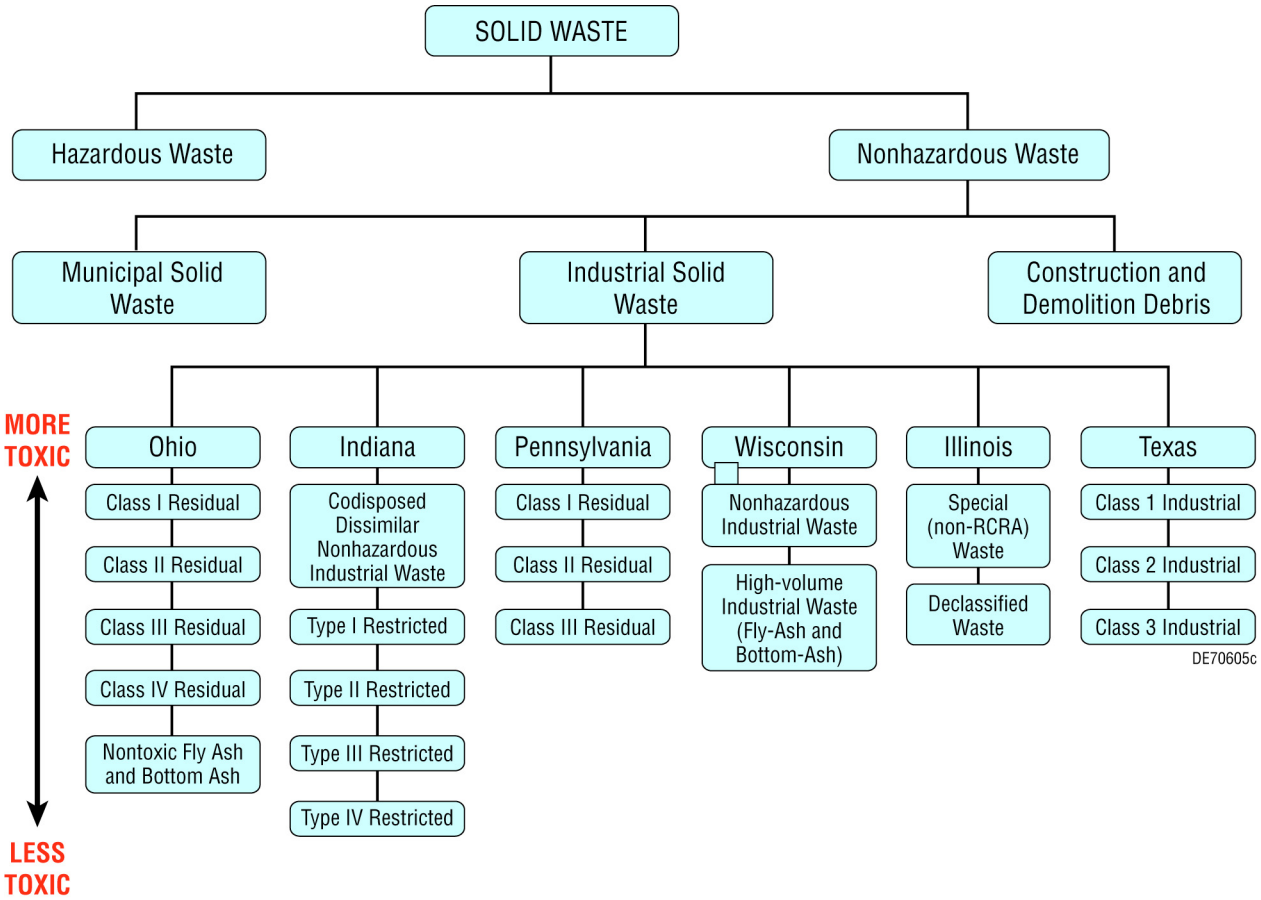

FIGURE A.1 Graded Approach to Regulating Nonhazardous Solid Waste Landfills in Selected States

2 As defined by the Ohio Environmental Protection Agency (see Table A.2, footnote h).

A.2.2 Chronological Comparison of Regulatory Designations of CCWs for Disposal

Table A.3 compares the current designations for CCWs destined for disposal in the five pilot States and six supplemental States ("2005 Data" column) with the historical designations for CCWs in these States as reported in two EPA documents (EPA 1988 and EPA 1999b). Between the times data were collected for the 1988 RTC (EPA 1988) and this report, the regulations in several States appear to have been changed to incorporate a graded approach for designating nonhazardous industrial solid wastes destined for disposal. Each graded designation system allows nonhazardous industrial waste management facilities to be regulated more or less stringently, depending on the toxicity of the wastes they receive.

A.2.3 State-Specific Discussions of Designation for Disposal

Alabama—The definitions of the terms "industrial solid waste" and "ash" provided in the Alabama solid waste regulations expressly exclude fly ash waste, bottom ash waste, boiler slag waste, and flue gas emission control waste that result from the combustion of coal or other fossil fuels at electric- or steam-generating plants (Alabama Department of Environmental Management [ADEM] Administrative [Adm.] Code R.335-13-1-.03(12) and (63)). ADEM personnel confirmed that, because of this exclusion, CCW management units (landfills and surface impoundments) are unregulated under the Alabama solid waste program (ADEM 2005a). Confirmation was important because the ADEM Adm. Code also defines "special waste" as follows: "those wastes requiring specific processing, handling, or disposal techniques as determined necessary by the [ADEM] which are different from the techniques normally utilized for handling or disposal. Examples of such waste types may include, but are not limited to: mining waste; fly ash; bottom ash…." (ADEM Adm. Code R.335-13-1-.05(134)). This definition creates some ambiguity about whether, despite the express exclusions from the definitions of ash and industrial solid waste, fly ash and bottom ash from coal combustion might be considered special waste.

Florida—Florida regulations adopt the Federal RCRA regulations exempting CCWs from regulation as hazardous waste (Florida Adm. Code [FAC] 62-730.030); if CCWs are disposed of, they are currently regulated as nonhazardous solid waste. However, in July 2003, the Florida Department of Environmental Protection (DEP) announced that a new industrial waste disposal and reuse (IWDR) Rule is being developed; it will have sections addressing waste-to-energy ash, electric generation facility wastes, pulp and paper wastes, and wastes from other industrial operations. At the time of the announcement, the Florida DEP expected to develop requirements for the design, operation, and closure of storage and disposal facilities for each type of waste addressed in the rule. The rule was also expected to address requirements or protocols for beneficial use of these waste types. The rule development process is still ongoing and, when complete, may substantially change how the Florida solid waste regulations address the management of CCWs.

Georgia—The Georgia Hazardous Waste Management Act and its implementing regulations adopt by reference the Federal definition of hazardous waste, including

TABLE A.3 Chronological Comparison of Designation of CCWs for Disposal in Landfills in Selected States

State	Designation of CCWs for Disposal		
	EPA 1988	EPA 1999b	2005 Data
Alabama	Solid waste	NC[a]	Excluded from the definition of solid waste
Florida	Solid waste	NC	Nonhazardous solid waste
Georgia	Solid waste	NC	Nonhazardous industrial waste
Illinois	Solid waste	NC	Special (non-RCRA) waste, unless declassified (toxicity determination required)
Indiana	Solid waste	Restricted waste (TCLP required unless disposed of in Type I landfill)[b]	Solid waste that may be disposed of in either a restricted waste site or a nonmunicipal solid waste landfill (TCLP required to determine waste type unless disposed of in a Type I restricted waste landfill)
Missouri	Solid waste	NC	Utility waste, but if fly ash fails the TCLP, it must be disposed of in a hazardous waste disposal facility
Ohio	Exempt	NC	Residual waste OR Excluded from the definition of solid waste if waste is "nontoxic" (fly ash, bottom ash, and boiler slag only) (TCLP or modified TCLP leachate test required)
Pennsylvania	Solid waste	Residual waste (TCLP required)	Residual waste (TCLP required)
Texas	Solid waste	NC[c]	Nonhazardous industrial waste (Class 1, 2, or 3)
Virginia	Solid waste	Solid waste	Nonhazardous industrial solid waste
Wisconsin	Solid waste	Solid waste	Nonhazardous industrial waste AND High-volume industrial waste (fly ash and bottom ash only)

[a] NC = Not covered in the source report.

[b] In 1996, Indiana adopted its graded approach for classification of solid wastes.

[c] In 1994, the Texas tiered classification system for solid waste took effect.

40 CFR 261.4, which exempts CCWs from the definition of hazardous waste (Georgia Department of Natural Resources [GDNR] Rule 391-3-11-.07). CCWs are regulated as nonhazardous industrial wastes when disposed of (GDNR Rule 391-3-4-.01(27)).

Illinois—Each waste generator in Illinois must determine whether waste destined for disposal is hazardous waste or "special (non-RCRA) waste." Status as special (non-RCRA) waste is determined on the basis of the source, degree of hazard, and other characteristics of nonhazardous waste (35 Illinois [Ill.] Adm. Code 808.100 and 808.245). CCWs destined for disposal in Illinois are exempt from the definition of hazardous waste. Accordingly, they are considered special (non-RCRA) waste unless the generator certifies their eligibility for declassification. If CCWs are declassified, they may be disposed of, without restriction, in any solid waste disposal unit. In comparison, CCWs that are special (non-RCRA) wastes must be disposed of in facilities that either meet the requirements for an exemption from solid waste permitting or have permits that expressly allow CCW disposal. To qualify for an exemption from permitting, a solid waste treatment, storage, or disposal unit must receive only wastes generated by the owner's own activities. Additional information about requirements applicable to units that are exempt from permitting in Illinois is provided in Section A.3.3.

The eligibility of a waste for declassification in Illinois is determined either by computing a toxic score for the waste using the methodology specified in the regulations or by employing a bioassay procedure that must be approved by the Illinois EPA (35 Ill. Adm. Code 808.245). Declassification using the computational method involves first determining (from a specified database) the waste's toxic amount on the basis of the concentration and toxicity of the waste's components. If a waste has a toxic amount that is less than 100, its toxic score is zero. If the toxic amount is greater than or equal to 100 and less than 1,000, the waste's toxic score is 1. For a toxic amount greater than 1,000 and less than 10,000, the waste's toxic score is 2, and for an amount greater than or equal to 10,000, the toxic score is 3. To qualify for declassification, the toxic score for a waste must be zero. (35 Ill. Adm. Code 808, Appendix B)

Indiana—Indiana designates CCWs as solid waste that may be disposed of in restricted waste sites (329 Indiana Administrative Code [IAC] 10-9-4(d)) or in nonmunicipal solid waste landfills. A "restricted waste site" is a land disposal facility for solid waste that is designed and operated to accommodate one of four specific types of solid waste designated as Types I through IV. Type I restricted waste sites have the most stringent design requirements, and Type IV have the least stringent. Restricted waste sites cannot receive more than one solid waste type (i.e., they are monofills). The criteria for the types of restricted waste are specified in 329 IAC 10-9-4. Testing is not required for CCWs that will be disposed of in a restricted waste site designed for Type I waste, which is waste that leaches one or more of eight toxic metals in amounts comparable to those that define the RCRA hazardous waste toxicity characteristic defined in 40 CFR Part 261. For management in a restricted waste site designed for Type II, III, or IV waste, CCWs must be tested for metals by using the TCLP to verify that metal concentrations fall within the appropriate ranges for the specified waste type. In addition, retesting must be completed (1) at 5-year intervals, (2) whenever the characteristics of the coal change, (3) whenever the process generating the waste changes, or (4) according to a schedule specified by the regulatory agency on the basis of the variability noted in previous sampling and other factors affecting the predictability of waste characteristics.

A disposal facility in Indiana that co-disposes of nonhazardous CCWs with dissimilar solid wastes must meet the requirements for a nonmunicipal solid waste landfill.

Missouri—Since July 30, 1997, CCWs have been designated in the Missouri Department of Natural Resources (MoDNR) solid waste regulations as "utility waste" (10 Code of State Regulations [CSR] 80-2.010(111)), and a separate set of solid waste regulations has been applied to the design and operation of utility waste landfills (10 CSR 80-11.010).

Ohio—In Ohio, "nontoxic fly ash and bottom ash, including at least ash that results from the combustion of coal and … slag" are excluded from the definition of solid waste (Ohio Revised Code [ORC] 3734.01(E)). Flue gas desulfurization (FGD) residue is not excluded and is regulated as industrial solid waste or, more specifically, residual waste. Ohio law does not define the term "nontoxic," and Ohio courts have not interpreted it. As a matter of policy, the Ohio Environmental Protection Agency (OEPA) has developed criteria for evaluating whether fly ash, bottom ash, and boiler slag are "nontoxic." Specifically, the OEPA considers these wastes nontoxic if leachate obtained by using a specified leachate test (i.e., the TCLP or modified TCLP) contains concentrations of arsenic, barium, cadmium, chromium, lead, and mercury that are less than 30 times the EPA limits in drinking water in place for these metals at the time the OEPA established its criteria. The "nontoxic" concentrations are 1.5 mg/L for arsenic, 60 mg/L for barium, 0.15 mg/L for cadmium, 3 mg/L for chromium, 1.5 mg/L for lead, and 0.06 mg/L for mercury. In addition, the selenium concentration in the leachate must be 1 mg/L or less. According to the Utility Solid Waste Activities Group (USWAG), virtually all coal ash and slag produced in Ohio meets the "nontoxic" criteria for the metals of concern (USWAG 2005). This means that of all CCWs, only FGD residues are typically regulated as residual solid wastes in Ohio.

Pennsylvania—Coal ash not being beneficially used in Pennsylvania is regulated as residual waste destined for disposal. "Residual waste" is a category of solid wastes that includes garbage and refuse and other discarded materials, if they are otherwise not hazardous wastes, including materials resulting from industrial operations and sludge resulting from industrial wastewater treatment facilities or air pollution control facilities (25 Pennsylvania [Pa] Code 287.1). In addition to coal ash, Pennsylvania designates all other CCWs as residual wastes, including slag and FGD wastes.

Chemical, physical, and leachate analyses are used on a case-specific basis to determine the design standards applicable to a residual waste landfill. The Pennsylvania regulations specify design standards for three classes of residual waste landfills (I, II, and III) and two classes of surface impoundments (I and II). The classification systems are based on the potential for wastes received at the landfill to adversely affect groundwater, with Class I facilities receiving waste that are most likely to affect groundwater and Class III facilities receiving wastes that are least likely to do so. The regulations applicable to residual wastes destined for disposal were significantly revised in July 1992 to provide consistency with the Pennsylvania municipal waste regulations, to expand reporting, and to encourage residual waste source reduction.

Texas—Texas regulations adopt by reference the Federal regulation (40 CFR 261.4) that exempts CCWs from the definition of hazardous waste (30 Texas Administrative Code [TAC]

335.1(62)). In Texas, wastes from electric power generation plants, including CCWs, are considered industrial wastes, which if destined for disposal may be further categorized into one of three classes. Class 1 industrial solid wastes include any nonhazardous wastes or mixtures of their wastes that, because of concentration or physical or chemical characteristics, are toxic, corrosive, flammable, pose a substantial danger to human health or the environment, or have other similar characteristics. Class 3 wastes are wastes that are inert, essentially insoluble, and pose no threat to human health or the environment. Class 2 wastes are wastes that are neither hazardous nor Class 1 or Class 3 wastes. This tiered system for designating wastes was adopted in 1993 and took effect in 1994. While a nominal number of power plants have produced CCWs that qualified as Class 1 industrial wastes and some bottom ashes have been categorized as Class 3, most CCWs generated in Texas are Class 2 industrial wastes when disposed of (Buckley 2005).

Virginia—When destined for disposal in Virginia, CCWs are designated as nonhazardous, industrial solid waste. Facilities intended primarily for the disposal of nonhazardous, industrial solid waste are regulated as industrial waste disposal facilities (9 Virginia Adm. Code [VAC] 20-80-270). The facilities are subject to design and operational requirements depending on the volume and the physical, chemical, and biological nature of the waste. Additional requirements, to include groundwater and decomposition gas monitoring, may be imposed, depending on the volume and the nature of the waste involved, as necessary to protect health or the environment.

Wisconsin—When destined for disposal in Wisconsin, CCWs are designated as nonhazardous industrial wastes. Fly ash and bottom ash are further designated as high-volume industrial wastes (Wisconsin Adm. Code [WAC] Natural Resources [NR] Chapter 500.03(101)). The owner/operator of a high-volume industrial waste landfill is allowed to propose either a design consistent with the design criteria for solid waste landfills specified in the Wisconsin regulations, or an alternative design that the owner/operator must demonstrate will adequately protect public health, welfare, and the environment and meet or exceed the otherwise applicable location and performance standards (WAC NR 504.10).

A.3 PERMITTING REQUIREMENTS FOR CCWs IN SELECTED STATES

A.3.1 Summary

While permits and design standards themselves are not control technologies, they are techniques used to ensure environmental control of waste management practices. For example, permits can dictate the use of specific operating practices and control technologies, either because these are mandated in regulations or because they have been determined to be appropriate on a case-specific basis to ensure protection of human health and the environment. Table A.4 lists the permits required for CCW land disposal units (landfills and surface impoundments) in Alabama, Florida, Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Texas, Virginia, and Wisconsin. Further discussion of permitting requirements in each State is provided in Section A.3.3.

TABLE A.4 Permits Required for CCW Management Units in Selected States

State[a]	Permitting Requirements: Landfills	Permitting Requirements: Surface Impoundments
Alabama	No permit required for disposal in landfills because CCWs are expressly excluded from the definition of solid waste	NPDES permit, if there is a point source discharge to State waters.
Florida	Power Plant Siting Act certification (for steam electric power plants ≥75 MW only) [Note: This certification contains the same substantive requirements as would solid waste construction and operating permits. Hence, if a power plant obtains this certification, no separate permits are required.] OR Solid waste construction permit and operating permit, unless landfill receives only wastes resulting from activities on the landfill owner's property (captive wastes) and the environmental effects on groundwater and surface water are addressed or authorized by another permit issued by the Florida DNR or an approved groundwater-monitoring plan.	NPDES/State wastewater permit, if there is a point source discharge to surface waters, OR State wastewater permit, if no NPDES permit is required, AND Groundwater discharge permit, if groundwater-discharge considerations are not addressed in the NPDES/State wastewater permit.
Georgia	Solid waste handling permit	NPDES permit, if there is a point source discharge of pollutants to State waters; OR Written approval from the GDNR Environmental Protection Division, if a discharge of pollutants to State waters from a non-point source is proposed.
Illinois	Development permit, unless landfill receives only wastes generated on-site (captive wastes), AND Operating permit, unless landfill receives only captive wastes. Landfills receiving only captive wastes are not required to have solid waste permits.	NPDES permit, if there is a point source discharge to State waters, OR Construction/operating permit, if no NPDES permit is required.
Indiana	Restricted waste site construction and operating permits (co-disposal only with wastes of the same type [i.e., I, II, or III]). Nonmunicipal solid waste landfill construction and operating permits (co-disposal with wastes of multiple types).	Water pollution control facility construction permit AND NPDES permit, if there is a point source discharge to State waters, OR Permit to operate, if State regulators believe facility operation poses a threat to the environment and no NPDES permit is required. Units that obtain water pollution control permits are expressly exempt from the Indiana solid waste permitting program.

TABLE A.4 (Cont.)

State[a]	Permitting Requirements: Landfills	Permitting Requirements: Surface Impoundments
Missouri	Solid waste construction permit and operating permit for utility waste landfills	Construction permit and operating permit from the Missouri Clean Water Commission, whether or not the design allows discharge. Expressly exempt from the requirement to obtain solid waste permits, if they obtain permits from the Missouri Clean Water Commission and file a survey plat upon closure, as required for disposal facilities by the solid waste regulations.
Ohio	Permit to install for residual waste landfills, unless the landfill receives only fly ash, bottom ash, and/or foundry sand that the OEPA has determined to be "nontoxic." No permit to install is required for a landfill receiving only "nontoxic" fly ash, bottom ash, and/or foundry sand.[d]	Permit to install a treatment or disposal unit; AND NPDES permit, if there is a point source discharge to State waters.
Pennsylvania	Class I, II, or III residual waste[b] landfill permits.	Class I or II residual waste[b] disposal impoundment permits AND NPDES Permit, if there is a point source discharge to State waters.
Texas	Solid waste permit, unless landfill receives only wastes generated on-site (captive wastes). No solid waste permits required for an on-site landfill receiving only captive wastes.	NPDES permit, if there is a point source discharge to State waters OR Solid waste permit, if there is no point source, unless the impoundment receives only wastes generated on-site (captive wastes) or at a facility within 50 mi that has the same owner.
Virginia	Industrial waste landfill permit.	Virginia Pollutant Discharge Elimination System (VPDES) permit, if there is a point source discharge to State waters, OR Virginia pollution abatement permit, if no VPDES permit is required. Units that obtain water pollution control permits are expressly exempt from the Virginia solid waste permitting program.
Wisconsin	Local approvals. Feasibility determination. Plan of operation approval. Operating license.	Wisconsin Pollutant Discharge Elimination System (WPDES) permit, if there is a point source discharge to State waters, OR Operating license, if the facility is used for solid waste disposal (these facilities are expressly exempt from WPDES permitting requirements).

Footnotes on next page.

TABLE A.4 (Cont.)

[a] The pilot study covered this category of regulatory control for Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin. Alabama, Florida, Missouri, Ohio, and Texas are supplemental States.

[b] In Pennsylvania, permits are issued for landfills that receive Class I, II, or III residual wastes and for surface impoundments that receive Class I or II, but not Class III, residual wastes.

[c] Texas defines a tank as a stationary device designed to contain an accumulation of solid waste and constructed primarily of nonearthen materials (e.g., wood, concrete, steel, plastic) that provide structural support (30 TAC 335.1(138) and (160)(C)).

[d] Wastes are considered "nontoxic" in Ohio if leachate obtained by using the TCLP or modified TCLP contains (1) concentrations of arsenic, barium, cadmium, chromium, lead, and/or mercury that are less than 30 times the limits established by the EPA for these metals in drinking water and/or (2) a concentration of selenium of 1 mg/L or less, which the Ohio Environmental Protection Agency has established as the "nontoxic" criterion for selenium.

Landfills—As Table A.4 indicates, Alabama excludes CCWs from the definition of solid waste. Therefore, in Alabama, landfills that receive only CCWs are not required to have solid waste permits. However, surface impoundments in Alabama that have a point source discharge must have NPDES permits.

Ohio excludes "nontoxic" fly ash, bottom ash, and boiler slag from the definition of solid waste. As was reported in Section A.2.3, virtually all coal ash and slag produced in Ohio meets the "nontoxic" criteria for the metals of concern. This means that of all CCW landfills, only landfills receiving FGD residues are typically required to have permits under the solid waste program in Ohio.

Illinois and Texas exempt landfills that receive captive wastes and are located on-site at coal combustion facilities from the requirement to have solid waste disposal permits. However, in these States, the permitting exemption does not mean the absence of regulation, as is further explained in Section A.3.3.

In Florida, all CCW landfills must have solid waste construction and operation permits, with three exceptions:

1. If CCWs are disposed of in an on-site landfill at a coal-fired electric generating plant authorized under the Florida Power Plant Siting Act (PPSA), no separate permits, including solid waste construction and operation permits, are required. Instead, the entire facility is covered under the PPSA certification, which will contain the same substantive requirements as would otherwise have been imposed by other permits.

2. No solid waste permit is required for disposal of solid waste resulting from a person's own activities on his/her own property if such disposal occurred before October 1, 1988 (Section 403.707(2)(d), F.S.).

3. No solid waste permit is required for disposal of solid waste resulting from a person's own activities on his/her own property if such disposal occurred after October 1, 1988, provided that the environmental effects of such disposal on groundwater and surface water are addressed or authorized by another permit issued by the Florida Department of Environmental Protection or by an approved groundwater-monitoring plan (Section 403.707(2)(d), F.S.).

The remaining six States (Georgia, Indiana, Missouri, Pennsylvania, Virginia, and Wisconsin) require permits under their solid waste programs for both on-site and off-site landfills receiving CCWs.

Surface Impoundments—Permitting requirements applicable to surface impoundments were reviewed for the five pilot States (Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin) and six additional States (Alabama, Florida, Georgia, Missouri, Ohio, and Texas). Pennsylvania is the only State reviewed that requires a solid waste permit for all surface impoundments that receive CCWs. Wisconsin also regulates surface impoundments used for disposal as solid waste

landfills. Otherwise, surface impoundments are regulated as water pollution control facilities rather than solid waste management units in the States reviewed. In general, water pollution control facilities treat or store wastewater, including industrial wastewater, and discharge it directly or indirectly into waters of a State, which usually encompass both surface water and groundwater located wholly or partially within the State.

All 11 States require a surface impoundment that discharges wastewater from a point source into waters of the State to have a National Pollutant Discharge Elimination System (NPDES) permit (or the State equivalent), although Wisconsin exempts surface impoundments used for disposal, which are thereby subject to regulation as solid waste disposal units, from this requirement. If a surface impoundment receiving CCWs does not discharge from a point source and is thus not required to have a NPDES permit, seven of the States reviewed (Florida, Georgia, Illinois, Indiana, Missouri, Ohio, and Virginia) require alternative water pollution control permits, and Texas requires compliance with permitting requirements for solid waste landfills. Indiana, Missouri, and Virginia expressly exclude surface impoundments that have water pollution control permits from solid waste permitting requirements.

Ten of the 11 States reviewed allow requirements (such as the installation of groundwater-monitoring systems, liner systems, and leachate control systems) to be placed in NPDES permits and other water pollution control permits, to protect human health and the environment. In Pennsylvania, such requirements are placed into solid waste permits. It should also be noted that in Florida, such requirements may be placed into the PPSA certification rather than in water pollution control permits for CCW surface impoundments located on-site at an electric generating company.

A.3.2 Chronological Comparison of Permitting Requirements for Landfills in Selected States

Table A.5 compares the findings regarding permitting requirements in the five pilot States and six supplemental States (“2005 Data” column) with the historical permitting requirements in these States as reported in EPA 1988 and EPA 1999b.

A.3.3 State-Specific Discussion of Permitting Requirements

Alabama—No permits are required under the Alabama solid waste regulatory program for landfills receiving CCWs for disposal because the definitions of the terms “industrial solid waste” and “ash” provided in the Alabama solid waste regulations expressly exclude fly ash waste, bottom ash waste, boiler slag waste, and flue gas emission control waste, which result from the combustion of coal or other fossil fuels at electric- or steam-generating plants (ADEM Adm. Code R.335-13-1-.03(12) and (63)). However, the ADEM has general authority to regulate activities that may impact groundwater, and the Hydrogeology Unit of the ADEM Groundwater Branch implements a Groundwater-Protection Program. Through this program, the ADEM may exert its general groundwater-protection authority, if necessary, on a case-specific basis.

TABLE A.5 Chronological Comparison of Permitting Requirements for Landfills in Selected States

State	Permitting Requirements for Landfills[a]		
	EPA 1988	EPA 1999a	2005 Data
Alabama	On-site and off-site	NC[b]	CCWs are expressly excluded from the definition of solid waste in Alabama. Hence, CCW landfills, whether located on-site or off-site, are not required to have solid waste permits.
Florida	Off-site	NC	Off-site (on-site landfill may have PPSA[c] certification in lieu of solid waste permits if located at a power plant, OR may, in lieu of solid waste permits, obtain either another permit issued by the Florida DNR or an approved groundwater-monitoring plan which addresses or authorizes the environmental effects on groundwater and surface water).
Georgia	On-site and off-site		On-site and off-site for industrial solid wastes (including CCWs)
Illinois	On-site and off-site	NC	Off-site (on-site landfill is required to give initial notice to the permitting agency, plus quarterly and annual groundwater reports, but no solid waste permit is required)
Indiana	On-site and off-site[d]	NC	On-site and off-site for landfills receiving CCWs that are nonmunicipal solid waste landfills or Type I, II, or III restricted waste sites; Type IV restricted waste sites do not require permits.
Missouri	On-site and off-site	NC[f]	On-site and off-site for utility waste landfills
Ohio	Not applicable	NC	On-site and off-site for residual waste landfills receiving CCWs, unless the landfill is a monofill which receives only "nontoxic" (as determined by the OEPA) fly ash, bottom ash, and/or foundry sand. Solid waste permits are not required for monofills that receive only such wastes.
Pennsylvania	On-site and off-site	Yes[e]	On-site and off-site for landfills in Classes I, II, and III
Texas	Off-site	NC	Off-site (on-site landfills must register with the TCEQ and provide updated information when changes occur)
Virginia	On-site and off-site	Yes	On-site and off-site
Wisconsin	On-site and off-site	Yes	On-site and off-site

Footnotes on next page.

TABLE A.5 (Cont.)

[a] "On-site" means this State is reported to require on-site CCW landfills to have permits. "Off-site" means this State is reported to require off-site CCW landfills to have permits. "Yes" means this State is reported to require CCW landfills to have permits, but the source document does not differentiate between on-site and off-site landfills. "None" means this State is reported to require no permits for CCW landfills, whether they are located on or off-site.

[b] NC = Not covered in the source report.

[c] PPSA (FS 403.501 through 518) provides for certification (licensure) of steam electric power plants that are 75 MW or larger in size. The Florida DEP is the lead agency for coordination of the power plant siting process conducted pursuant to the PPSA and has jurisdiction over many of the activities that the PPSA certification process may replace.

[d] Research for this report (2005 data) suggests that on-site landfills in Indiana may have been exempt from permitting requirements before 1996.

[e] Pennsylvania adopted its graded approach for landfills in 1992.

[f] Research for this report (2005 data) revealed that Missouri implemented its utility waste landfill regulations in 1997.

Surface impoundments that receive CCWs in Alabama are regulated as industrial waste treatment facilities, which must have National Pollutant Discharge Elimination System (NPDES) permits for discharges to waters of the State, including groundwater (335 ADEM Adm. Code R.335-6-6-.02 and R.335-6-6-.03). The ADEM has authority to impose requirements in NPDES permits for liners or groundwater monitoring if a potential for groundwater contamination from a surface impoundment is believed to exist (ADEM 2005b; ADEM Adm. Code R.335-6-6-.08(1)(j)).

Florida—The PPSA (Florida Statutes [FS] 403.501 through 518) provides for certification (licensure) of steam electric power plants that are 75 MW or larger in size. The Act was created by the Florida legislature in 1973. Power plants constructed before 1973 were not required to obtain a PPSA certification. On-site management of CCWs in landfills at power plants required to have PPSA certifications would not require any other solid waste permits. However, if CCWs are disposed of in an off-site landfill or at a power plant not required to have a PPSA certification, the landfill must have a solid waste permit, or obtain either another permit issued by the Florida DNR or an approved groundwater-monitoring plan, which addresses or authorizes the environmental effects on groundwater and surface water.

Under the PPSA, the Florida DEP is the lead agency for coordination of the siting process and has jurisdiction over many regulatory programs for which the certification substitutes. Thus, the DEP "wears two hats," one for supporting the "Siting Board," and the other for its standard jurisdictional activities, which include implementation of Federally approved or delegated permit programs, wetlands permits, State lands oversight, coastal protection, and so forth. As a part of the PPSA certification application, permit applications for Federally delegated or approved permit programs must be submitted. Currently, these include NPDES and wastewater program permits as well as solid waste program permits. The review of these permit applications is interwoven with the PPSA certification process.

The Florida solid waste regulations require disposal facilities to obtain permits from the Florida DEP before construction, operation, modification, and closure, with the following three exceptions:

1. If CCWs are disposed of in an on-site landfill at a coal-fired electric generating plant authorized under the Florida Power Plant Siting Act (PPSA), no separate permits, including solid waste construction and operation permits, are required. Instead, the entire facility is covered under the PPSA certification, which will contain the same substantive requirements as would otherwise have been imposed by other permits.

2. No solid waste permit is required for disposal of solid waste resulting from a person's own activities on his/her own property if such disposal occurred before October 1, 1988 (Section 403.707(2)(d), F.S.).

3. No solid waste permit is required for disposal of solid waste resulting from a person's own activities on his/her own property if such disposal occurred after October 1, 1988, provided that the environmental effects of such disposal on

groundwater and surface water are addressed or authorized by another permit issued by the Florida DEP or by an approved groundwater-monitoring plan (Section 403.707(2)(d), F.S.).

Surface impoundments that receive CCWs in Florida are regulated as industrial wastewater treatment facilities. If a surface impoundment would receive CCWs and have a point source discharge into waters of the State, it must have a NPDES/State wastewater permit (FAC 62-620), unless the facility is a power plant that must obtain a PPSA certification, in which case the PPSA certification would substitute for the NPDES permit. If the surface impoundment would also discharge contaminants into groundwater, either the NPDES/State wastewater permit or a separate groundwater-discharge permit must address groundwater-discharge considerations (FAC 62-522-300). Alternatively, groundwater considerations could be addressed in a PPSA certification for an electric power company required to obtain this certification. Wastewater permitting for power plants is unique in that permitting is done through the Industrial Wastewater Section at the Florida DEP headquarters, in Tallahassee, instead of through the district offices.

Georgia—In Georgia, landfill facilities that dispose of CCWs or other industrial wastes must obtain solid waste handling permits before construction and operation begins (GA Rule 391-3-4-.02).

Surface impoundments that receive CCWs in Georgia are regulated as potential sources of pollutant discharges to waters of the State, which include groundwaters. If a surface impoundment would have a point source discharge, it must have a NPDES permit (GA Rule 391-3-6-.06(3)(a)). If a surface impoundment would have a non-point source discharge, written approval from the GDNR Environmental Protection Division would be required (GA Rule 391-3-6-.06(3)(b)). In either case, the facility would be required to use best management practices to minimize to the extent feasible the introduction of pollutants into State waters.

Illinois—CCWs destined for disposal in Illinois are considered special (non-RCRA) wastes unless the generator certifies their eligibility for declassification. If CCWs are declassified, they may be disposed of, without restriction, in any solid waste disposal unit. In comparison, CCWs that are special (non-RCRA) wastes must be disposed of in facilities that either meet the requirements for an exemption from solid waste permitting or hold permits that expressly allow CCW disposal.

Illinois requires a “development permit” before construction or modification of any facility that stores, treats, or disposes of solid wastes, including both declassified and special (non-RCRA) wastes. In addition, an “operating permit” is required before using or operating such a facility, unless (1) the facility is a landfill used only for disposal of waste generated on-site or (2) the facility is a surface impoundment receiving special (non-RCRA) waste that is expressly listed in a NPDES permit (415 Illinois Compiled Statutes [ILCS] 5/21(d) and 35 Ill. Adm. Code 807.201 and 807.202).

A CCW landfill that qualifies for the statutory solid waste permitting exemption must notify the Illinois Environmental Protection Agency (IEPA) of its operations and file annual

reports (35 Ill. Adm. Code 815.301). In addition, landfills receiving solely CCWs produced by coal combustion power generating facilities must be designed, constructed, and operated in compliance with applicable sections of the regulatory standards for landfills (35 Ill. Adm. Code 816.500). Sections applicable to landfills receiving CCWs (which fall within the definition of chemical waste) are located in 35 Ill. Adm. Code 811, and address liners, leachate systems, and groundwater monitoring. A chemical waste is a nonputrescible solid for which any contaminated leachate is expected to be formed through chemical or physical processes rather than biological processes, and no gas is expected to be formed as a result (35 Ill. Adm. Code 810.103).

Surface impoundments that receive CCWs in Illinois are regulated as wastewater treatment facilities. If a surface impoundment would have a point source discharge into waters of the State, it must have a NPDES permit (35 Ill. Adm. Code 309.102). If a surface impoundment would receive CCWs, but not have a point source discharge, a State construction/operating permit would be required (35 Ill. Adm. Code 309.201).

Indiana—Indiana designates CCWs as solid waste that may be disposed of in either restricted waste sites or nonmunicipal solid waste landfills. Restricted waste sites can receive wastes of only one type. A site that accepts only wastes of Type I, II, or III is required to obtain a restricted waste site permit before starting construction and operation (329 IAC 10-11-1). No permit is required for a restricted waste site that accepts only Type IV solid wastes.

A facility in which CCWs would be co-disposed of with dissimilar wastes is required to obtain a nonmunicipal solid waste landfill permit before construction and operation (329 IAC 10-11-1). The permit must specify that the landfill is allowed to receive CCWs (329 IAC 10-9-5).

Indiana's restricted waste site and nonmunicipal solid waste landfill permitting programs do not distinguish between on-site and off-site facilities. However, industrial facilities operating in Indiana before 1996 that disposed of solid waste, including CCWs, in disposal units that were located either (1) on the site where the waste was generated or (2) off the site but were owned and operated by the generator for its exclusive use, may not have been required to obtain permits. In 1996, such facilities, as well as new solid waste disposal units, became subject to the permitting requirements indicated above (329 IAC 10-5).

In Indiana, any ash pond that receives coal ash transported into it by water is exempt from both the solid waste permitting requirements and the solid waste facility design standards imposed by the Indiana solid waste program (329 IAC 10-3-1). Even so, ash ponds and other surface impoundments that receive CCWs may be categorized as water pollution treatment/control facilities, which include units or structures used to control, prevent, pretreat, or treat pollutant discharges into waters of the State, including surface and underground waters (327 IAC 3-1-2). As such, new construction of these facilities may require water pollution control facility construction permits. Furthermore, once a facility with one or more point source discharges to waters of the State is constructed, the owner/operator must obtain an NPDES permit, which acts as an operating permit (327 IAC 5-2-2). If a water pollution treatment/control facility is not subject to the NPDES permit program (e.g., because there is no point source

discharge), the facility may still be required, at the State's discretion, to obtain a permit to operate. Generally, such permits are required only if the State believes operation of the facility will pose a significant threat to the environment (327 IAC 3-4-2).

Missouri—All solid waste disposal areas, including utility waste landfills, in Missouri are required to have construction permits and operating permits from the MoDNR (10 CSR 80-2.020(2)).

Surface impoundments that receive solid wastes in Missouri are expressly exempt from the requirement to have solid waste permits, if they obtain construction and operating permits from the Missouri Clean Water Commission and comply with the requirement in the solid waste regulations regarding filing of a survey plat upon closure (10 CSR 80-2.020(9)). The Missouri Clean Water Law requires construction and operating permits for surface impoundments, whether or not they are designed to discharge wastewater (10 CSR 20-6.010 and .015).

Ohio—The owner or operator of a residual waste landfill in Ohio must obtain a permit to install before construction of the landfill begins (ORC 3734.05 and OAC 3745-30-05(A)).

Surface impoundments are regulated under the OEPA water pollution control program. As such, they are expressly exempt from the OEPA solid waste regulations (OAC 3745-27-03(A)(8)). The water pollution control regulations require that, before starting construction, surface impoundments receiving industrial wastes, such as CCWs, must have permits to install based on an application and engineering plan, which must demonstrate that the surface impoundment will: (1) not prevent or interfere with the attainment or maintenance of applicable water quality standards; (2) not result in a violation of any applicable laws; and (3) employ the best available technology (OAC 3745-42-03 and -04). In addition, if a surface impoundment would have a point source discharge into waters of the State, an NPDES permit would be required (OAC 3745-33-02).

Pennsylvania—Pennsylvania designates CCWs as a "residual waste," which includes garbage, refuse, other discarded material, or other waste, including solid, liquid, semisolid, or contained gaseous materials resulting from industrial, mining, and agricultural operations and sludge from an industrial, mining, or agricultural water supply treatment facility, wastewater treatment facility, or air pollution control facility, if it is not hazardous (25 Pa. Code 287.1). Pennsylvania has a distinct regulatory program for residual wastes, which requires operators of residual waste processing and disposal facilities to have permits to build, operate, expand, and close facilities. Under this program, a CCW processing or disposal facility must have a permit to operate, unless the facility is engaged in the beneficial use of coal ash (25 Pa. Code 287.101(b)).

CCW landfills must have Class I, II, or III residual waste landfill permits, and surface impoundments that dispose of CCWs must have Class I or II residual waste disposal impoundment permits. Surface impoundments that discharge to surface water must also have NPDES permits (25 Pa. Code 92.3). Regulations distinguish between captive facilities (i.e., an on-site facility used solely for the generator's residual waste) and noncaptive facilities, allowing more flexibility concerning matters such as roads, signs, and access control at captive facilities, but not affecting permitting requirements.

Texas—If CCWs are disposed of, they are regulated as industrial waste in Texas. If a generator stores, treats, or disposes of its own nonhazardous industrial waste (either on-site or at another facility it owns located within 50 mi), a nonhazardous industrial waste permit is not required (30 TAC 335.2(d)(1)), but the generator must register with the Texas Commission on Environmental Quality (TCEQ) (30 TAC 335.6(a)). Information that must be submitted with the registration includes, but is not limited to, waste composition, waste management methods, facility engineering plans and specifications, and the geology where the facility is located. This information is used by the TCEQ to determine whether storage, processing, or disposal is compliant with the requirements of the regulations. The generator also has a continuing obligation to notify TCEQ of subsequent changes or additional information concerning waste composition, waste management methods, facility engineering plans and specifications, or the geology of the facility's location (30 TAC 335.6(b)). Furthermore, the landfill is subject to general prohibitions against polluting the water, creating a nuisance, and endangering public health and welfare (30 TAC 335.4), which allow the TCEQ to respond to potential releases of pollutants into or adjacent to waters in the State. Other regulatory requirements applicable to nonpermitted landfills include a requirement to record in county deed records a metes and bounds description of the land on which disposal has occurred (30 TAC 335.5) and a requirement to close and remediate the facility in accordance with the Texas Risk Reduction Program (30 TAC 350). Also, the TCEQ has published technical guidelines concerning landfill site selection, liner systems, and leachate-collection systems, with which nonpermitted landfills are encouraged to comply.

Like landfills, surface impoundments that receive CCWs only from on-site and/or from facilities located within 50 mi that have the same owner are not required to have solid waste permits in Texas, but must register with the TCEQ, as described above. Since CCWs are typically moved to surface impoundments by means of water sluicing, most surface impoundments that receive CCWs are located on-site to avoid long-distance sluicing. Hence, surface impoundments that receive CCWs usually do not need solid waste permits. An NPDES permit is required, however, if a surface impoundment discharges wastewater to waters of the State. For such surface impoundments, TCEQ has established technical guidelines containing design standards for liners, leak detection, and groundwater monitoring (TCEQ 2004b).

Virginia—Virginia designates CCWs destined for disposal as nonhazardous industrial solid waste. Landfills that accept CCWs in Virginia must have industrial waste landfill permits before construction or modification of the landfill begins (9 VAC 20-80-480(A)). The Virginia solid waste permitting requirements for industrial waste landfills do not distinguish between on-site and off-site landfills.

Surface impoundments that manage nonhazardous industrial solid wastes such as CCWs are regulated under Virginia water control law. During the operating life of these facilities, the Virginia regulations governing solid waste management facilities do not apply (9 VAC 20-80-380). A Virginia pollution abatement permit is required for impoundments that do not discharge to sewage treatment works or to State waters (9 VAC 25-32-30). Surface impoundments that discharge must have Virginia Pollutant Discharge Elimination System (VPDES) permits (9 VAC 25-31-50).

Wisconsin—Wisconsin designates CCWs destined for disposal as nonhazardous industrial solid wastes, with fly ash and bottom ash being further designated as high-volume industrial wastes. An operating license must be obtained before a solid waste disposal facility in Wisconsin can be operated (WAC Natural Resources [NR] Chapter 500.6).

For a solid-fuel–fired power plant, the Wisconsin Environmental Policy Act (WEPA) process applies to the feasibility determination. It must consider impacts caused by any landfill required to dispose of ash or other solid waste at the plant site. This process is intended to address the technical issues of site feasibility, including the need for the landfill and its ability to meet design and performance standards and protect public health and welfare and the environment.

If a power plant is deemed feasible, the applicant submits a plan of operation, which must meet performance standards and include specific design elements to address potential impacts. If a plan of operation is approved, the applicant may construct the facility, including the landfill.

The Wisconsin Pollutant Discharge Elimination System (WPDES) permit program regulates industrial wastewater discharges to both surface water and groundwater. However, industrial solid waste facilities required to obtain operating licenses are exempt from the WPDES permitting program requirements.

In general, industrial waste landfills are required to have solid waste operating licenses, and surface impoundments containing industrial wastewaters are required to have WPDES permits. The Wisconsin permitting requirements do not distinguish between on-site and off-site landfills.

A.4 LINER SYSTEM REQUIREMENTS IN SELECTED STATES

A.4.1 Summary

States may impose liner requirements on land-based waste management units to prevent contaminants from being released into groundwater. If a liner is required, standards may include specifications for maximum liner hydraulic conductivity, the type of liner material and its thickness, and the number of liners. Since coal combustion ash may have pozzolanic or cementitious properties, a few States also provide specifications for using the ash as a liner in landfills, either alone or in combination with other materials. Table A.6 summarizes liner requirements for CCW land disposal units (landfills and surface impoundments) in Alabama, Florida, Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Texas, Virginia, and Wisconsin. Additional details are provided in Section A.4.3.

TABLE A.6 Summary of Liner Requirements for CCW Management Units in Selected States

State[a]	Liner Requirements: Landfills	Liner Requirements: Surface Impoundments
Alabama	• *CCW monofills: No applicable liner requirements.* • *Co-disposal with other wastes in a municipal waste landfill: Composite liner* • *Co-disposal with other wastes in an industrial waste landfill: Liners specified by the ADEM on a case-spec*ific basis when natural hydrogeologic conditions are determined to be insufficient to minimize the impact of leachate on waters	Established, as necessary, on a case-specific basis in NPDES permit.
Florida	*Industrial waste landfills: The need for a liner and the specifications for the liner system, if one is needed, are evaluated on a case-specific basis and documented in the solid waste permit or PPSA certification. In lieu of making a case-specific demonstration, an applicant may elect tosign the facility to meet the current requirements applicable to a Class I (municipal sol waste) landfill.*	*Established, as necessary on a case-specific basis and documented in an NPDES permit, a groundwater-discharge permit, or a PPSA certification.*
Georgia	• *Industrial waste monofills:* Liner and leachate-collection system are required, the design of which must be demonstrated to ensure that specified chemicals do not exceed maximum contaminant levels in the uppermost aquifer, OR • A variance from the requirement to install a liner and leachate-collection system may be obtained by monofills that receive waste only from a single industry.	Established, as necessary, on a case-specific basis in NPDES permit or discharge approval letter.
Illinois	• *Special (non-RCRA) waste landfills:* A leachate drainage and collection system and a compacted earth liner designed as an integrated system are required, as follows: – Earth liner: ▪ Permeability < 1×10^{-7} cm/s ▪ Thickness > 5 ft, OR – Composite liner consisting of: ▪ Earth liner: ♦ Permeability < 1×10^{-7} cm/s ♦ Thickness > 3 ft, overlain by ▪ Geomembrane liner: ♦ Thickness > 60 mil, OR	Established, as necessary, on a case-specific basis in NPDES OR construction/operating permit.

TABLE A.6 (Cont.)

State[a]	Liner Requirements: Landfills	Liner Requirements: Surface Impoundments
Illinois (Cont.)	– Other liner configurations, if: ▪ They provide equivalent or superior performance; ▪ They have been used successfully in at least one similar operation; and ▪ Quality assurance can be implemented. ▪ *CCW monofills:* Poz-O-Tecb liners and caps made from CCWs are allowed to replace liner requirements for other solid waste landfills if: – Poz-O-Tec is: ▪ Produced and tested according to specifications provided in the regulations; AND ▪ Permeability < 1×10^{-7} cm/s ▪ Thickness > 3 ft Compressive strength > 150 lb/in.^{2} or psi	
Indiana	• *Types I, II, or III restricted waste sites:* Earth liner having equivalent hydraulic conductivity of 1×10^{-6} cm/s and a minimum thickness as follows: – Type I: 15 ft, or 10 ft with a demonstration that the equivalent hydraulic conductivity of the waste through the barrier will be less than 1×10^{-6} cm/s. – Type II: Ranging from 5 to 10 ft depending on waste permeability. – Type III: 3 ft. • *Type IV restricted waste sites:* No liner required. • *Nonmunicipal solid waste landfills:* – Leachate-collection system coupled with earth liner ≥ 10 ft having hydraulic conductivity of 1×10^{-6} cm/s, OR – Earth liner ≥ 50 ft having hydraulic conductivity of 1×10^{-6} cm/s.	Established, as necessary, on a case-specific basis in water pollution control permits.
Missouri	*Utility waste landfill:* Composite or clay liner meeting required thickness, compaction percentage, and hydraulic conductivity specifications (landfills constructed after July 30, 1997).	Soil or synthetic liner meeting required thickness, compaction percentage, and permeability specifications.

TABLE A.6 (Cont.)

State[a]	Liner Requirements: Landfills	Liner Requirements: Surface Impoundments
Ohio	• *"Nontoxic" fly ash and bottom ash monofill:* No liner required. • *Class IV residual waste landfill:* – Soil liner $\geq$ 3 ft having hydraulic conductivity of 1×10^{-7} cm/c, OR – Geomembrane plus 18 in. of soil having hydraulic conductivity of 1×10^{-7} cm/s, AND – Leachate-management system. • *Class III residual waste landfill:* – Soil liner $\geq$ 3 ft having hydraulic conductivity of 1×10^{-7} cm/s, OR – Geomembrane plus 18 in. of soil having hydraulic conductivity of 1×10^{-7} cm/s, AND – Leachate-management system. • *Class II residual waste landfill:* – Geomembrane plus 3 ft of soil having hydraulic conductivity of 1×10^{-7} cm/s AND – Leachate-management system. • *Class I residual waste landfill:* – Geomembrane plus 5 ft of soil having hydraulic conductivity of 1×10^{-7} cm/s AND • Leachate-management system.	Established, as necessary, on a case-specific basis in water pollution control permits.

TABLE A.6 (Cont.)

State[a]	Liner Requirements: Landfills	Liner Requirements: Surface Impoundments
Pennsylvania	*Class I residual waste landfill:* (1) Subbase prepared of soil or earthen materials; (2) Secondary liner placed on the subbase; (3) Leachate-detection zone placed on the secondary liner; (4) Primary liner placed on the leachate-detection zone; (5) Protective cover and leachate-collection zone placed over the primary liner. Either the primary liner or the secondary liner must be a composite liner, which is a continuous layer of synthetic material over earthen materials. The other liner must be composed of synthetic materials. *Class II residual waste landfill:* (1) Subbase prepared of soil or earthen materials; (2) Leachate-detection zone placed on the subbase; (3) Composite liner of synthetic material over earthen materials placed on the leachate-detection zone; (4) Protective cover and leachate-collection zone placed over the liner. *Class III residual waste landfill:* Attenuating soil must exist naturally or have been placed over the entire disposal area, and: (1) The seasonal high water table, perched water table, or bedrock must be separated from the lowest area where waste is deposited by at least 4 ft. (2) The regional groundwater table must be separated from the lowest area where waste is deposited by at least 8 ft.	*Class I residual waste disposal impoundment:* (1) Subbase prepared of soil or earthen materials; (2) Secondary liner placed on the subbase; (3) Leachate-detection zone placed on the secondary liner; (4) Primary liner placed on the leachate-detection zone; (5) Protective cover and leachate-collection zone placed over the primary liner. Either the primary liner or the secondary liner must be a composite liner, which is a continuous layer of synthetic material over earthen materials. *Class II residual waste disposal impoundment:* (1) Subbase prepared of soil or earthen materials; (2) Leachate-detection zone placed on the subbase; (3) Composite liner of synthetic material over earthen materials placed on the leachate-detection zone; (4) Protective cover and leachate-collection zone placed over the liner.

TABLE A.6 (Cont.)

State[a]	Liner Requirements: Landfills	Liner Requirements: Surface Impoundments
Texas	No liner requirements are specified in the regulations. *TCEQ Recommendation for landfills receiving Class 1 and Class 2 wastes*:[c] Composite liner (compacted clay immediately beneath a synthetic membrane liner) Monofills receiving only bottom ash, fly ash, or FGD residues have been found to not require a membrane.	No liner requirements are specified in the regulations. *TCEQ Recommendation for surface impoundments receiving Class 2 wastes:* • Geomembrane (polyethylene 60 mil, other types 30 mil) and underlying leak detection system; OR • Compacted clay (2 ft); OR • Equivalent in-situ clay; OR • Geosynthetic clay liner overlain by protective soil (1 ft)
Virginia	• ≥1 ft compacted soil with permeability < 1×10^{-7} cm/s; OR • Either ≥ 30-mil synthetic flexible membrane or ≥ 60-mil high-density polyethylene (HDPE) having proven compatibility with waste and its leachate; OR • Other augmented compacted clays or soils with thickness and permeabilities equivalent to those specified above for compacted soil, as documented by appropriate laboratory tests; OR • Natural and undisturbed soil with thickness and permeabilities equivalent to those specified above for compacted soil. • Double liner may be required on a site-specific basis.	Established, as necessary, on a case-specific basis in water pollution control permits.

TABLE A.6 (Cont.)

State[a]	Liner Requirements: Landfills	Liner Requirements: Surface Impoundments
Wisconsin	For *industrial solid waste landfills:* • Composite liner: – ≥ 60-mil geomembrane upper layer overlain by a 1- to 3-ft soil protective layer, and – ≥ 4 ft compacted clay lower layer, OR • Compacted clay: – Permeability < 1×10^{-7} cm/s – Thickness ≥ 5 ft AND • At least 10-ft distance to bedrock from bottom of clay layer for either liner type, OR For *fly ash or bottom ash landfills only:* • Alternative design: – Feasibility report required demonstrating that landfill meets or exceeds otherwise applicable location and performance standards. For *zone-of-saturation landfills*: • Special requirements.	For *surface impoundments licensed as industrial solid waste disposal facilities:* • Same liner requirements as for landfills. For *all other lagoons that receive industrial wastewaters and associated sludges or by-product solids and any resulting leachates,* unless an exemption is granted: • Water losses must not exceed 500 gal per acre per day AND • Compacted natural soil or soil-bentonite mixture: – Thickness ≥ 6 in. – Permeability < 1×10^{-7} cm/s, OR • Synthetic material: – Thickness ≥ 30 mil.

[a] The pilot study covered this category of regulatory control for Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin. Georgia, Ohio, and Missouri are supplemental States.

[b] "Poz-O-Tec" is produced by a stabilization process that blends a mixture of FGD scrubber sludge, fly ash, and lime to produce a relatively impermeable material that is not infiltrated significantly by rainwater.

[c] As Section A.2.3 explains, CCWs in Texas are nearly always designated as Class 2 industrial solid wastes.

A.4.2 Chronological Comparison of Liner Requirements for Landfills in Selected States

Table A.7 compares the findings in this report ("2005 Data") regarding liner requirements for landfills that receive CCWs for disposal in the five pilot States and six supplemental States with the liner requirements for CCW landfills reported in EPA 1988 and EPA 1999b.

A.4.3 State-Specific Discussion of Liner Requirements

Alabama—Because CCWs are expressly excluded from the definition of solid waste in Alabama, landfills that receive only CCWs are not subject to the Alabama solid waste regulations. Therefore, CCW monofills are not required to have liners in Alabama. However, if CCWs are disposed of in a landfill that receives other types of solid waste, such as a commercial industrial waste landfill or a municipal waste landfill, that landfill may be subject to liner requirements, as indicated in ADEM Adm. Code R.335-13. At a minimum, municipal waste landfills must have composite liners. For industrial landfills, the ADEM determines liner requirements on a case-specific basis when natural hydrogeologic conditions are determined to be insufficient to minimize the impact of leachate on waters. Multiple liners, including composite liners, may be required if determined necessary (ADEM Adm. Code R.335-13-4-.18).

Similarly, surface impoundments in Alabama that receive only CCWs are not subject to the Alabama solid waste regulations. However, if there are discharges of pollutants to waters of the State (including groundwater) from such surface impoundments, NPDES permits would be required. The ADEM has authority to include conditions in an NPDES permit on a case-specific basis requiring a surface impoundment to install a liner and other structures if necessary to prevent pollutant discharges to groundwater (ADEM Adm. Code R.335-6-6-.08(j)).

Florida—Florida does not have specific liner or leachate-control system requirements for industrial waste landfills. Instead, these facilities are evaluated on a case-by-case basis. It is the responsibility of the applicant for a solid waste permit to provide reasonable assurance that the proposed facility will not pollute ground or surface waters given the site-specific conditions. In lieu of making this demonstration, an applicant may elect to design the facility to meet current requirements for a Class I (municipal solid waste) landfill.

Florida also does not have specific liner or leachate-control system requirements for surface impoundments. As with landfills, the facilities are evaluated on a case-specific basis.

Georgia—In Georgia, CCWs are industrial wastes (GDNR Rule 391-3-4-.01). For industrial waste landfills, groundwater and surface water monitoring are required in accordance with approved plans (GDNR Rule 391-3-4-.07(3)). In addition, industrial waste disposal facilities must demonstrate that they have liner and leachate-collection system designs that ensure that the concentrations in the uppermost aquifer at the relevant point of compliance do not exceed those listed in Table A.8 for the specified chemicals. Industrial waste disposal facilities permitted to receive only a single type of industrial waste (i.e., monofills) or to receive only

TABLE A.7 Chronological Comparison of Liner Requirements for Landfills in Selected States

State	Liner Requirements for Landfills		
	EPA 1988	EPA 1999b	2005 Data
Alabama	May	NC[b]	No applicable liner requirements unless CCWs are co-disposed of with other wastes in industrial or municipal waste landfills.
Florida	Yes[c]	NC	Specified on a case-specific basis in the PPSA solid waste permit, unless the owner/operator decides to install the liner required for a Class I (municipal solid waste) landfill.
Georgia	No[a]	NC	Liner and leachate-collection system is required, the design of which must be demonstrated to ensure that specified chemicals do not exceed maximum contaminant levels in the uppermost aquifer.
Illinois	No	NC	• 5 ft clay with < 10^{-7} cm/s permeability, OR • 3 ft clay with < 10^{-7} cm/s permeability overlain by 60-mil geomembrane, OR • Other equivalent liner, OR • 3 ft Poz-O-Tec with < 10^{-7} cm/s permeability and > 150 lb/in.^{2} or psi compressibility (CCW monofills only).
Indiana	No	Waste Type I: 10 ft clay Waste Type II: 5 ft to 10 ft clay Waste Type III: 3 ft clay Waste Type IV: No liner required	Type I: 15 ft clay or 10 ft clay having < 10^{-6} cm/s permeability. Type II: 5 to 10 ft clay, depending on waste permeability. Type III: 3 ft clay having < 10^{-6} cm/s permeability. Type IV: No liner required. Nonmunicipal solid waste landfills: Leachate-collection system coupled with >10 ft earth having < 10^{-6} cm/s permeability, OR >50 ft earth having < 10^{-6} cm/s permeability.
Missouri	No	NC (Note: Research for this report indicates that Missouri implemented its requirements for utility waste landfills, including liner requirements, in 1997)	Composite or clay liner meeting required thickness, compaction percentage, and hydraulic conductivity specifications (landfills constructed after July 30, 1997).

TABLE A.7 (Cont.)

State	Liner Requirements for Landfills		
	EPA 1988	EPA 1999b	2005 Data
Ohio	Exempt	NC	Nontoxic[e] fly ash and bottom ash monofill: No liner required. Class I residual waste: Geomembrane plus 5 ft soil having < 10^{-7} cm/s permeability. Class II residual waste: Geomembrane plus 3 ft soil having < 10^{-7} cm/s permeability. Class III residual waste: >3 ft soil having hydraulic conductivity of 1×10^{-7} cm/s, OR geomembrane plus 18 in. of soil having < 10^{-7} cm/s permeability. Class IV residual waste: >3 ft soil having hydraulic conductivity of 1×10^{-7} cm/s, OR geomembrane plus 18 in. of soil having < 10^{-7} cm/s permeability.
Pennsylvania	No	Class I: composite liner + clay or synthetic liner Class II: composite liner Class III: 4 ft of attenuating soil	Class I: Secondary liner (clay or synthetic) + primary (composite). Class II: Composite liner. Class III: > 4 ft of attenuating soil above seasonal high groundwater table and > 8 ft of vertical separation above regional groundwater table, OR Poz-O-Tec material can be substituted as liner material in Class I, II, and III landfills.
Texas	May	NC	No liner specifications in regulations. TCEQ guidance for landfills receiving Class 1 and Class 2 wastes recommends composite liner (compacted clay immediately beneath a synthetic membrane liner). (Note: According to TCEQ guidance, monofills receiving only bottom ash, fly ash, or FGD residues have been found to not require a membrane at some landfills.)

TABLE A.7 (Cont.)

State	Liner Requirements for Landfills		
	EPA 1988	EPA 1999b	2005 Data
Virginia	No	Yes	> 1 ft compacted soil with permeability < 1×10^{-7} cm/s covered with >1 ft drainage layer with permeability > 1×10^{-3} cm/s, OR Either > 30-mil synthetic flexible membrane or > 60-mil high-density polyethylene (HDPE) having proven compatibility with waste and its leachate, OR Other augmented soil or natural soil meeting specifications equivalent to compacted soil liner.
Wisconsin	May[d]	Yes	Composite having lower layer of > 4 ft compacted clay having < 1×10^{-7} cm/s permeability, overlain by > 60-mil geomembrane, overlain by > 1 ft to 3 ft of soil, OR > 5 ft compacted clay having permeability < 1×10^{-7} cm/s.

[a] No = The source report indicates that State regulations do not impose liner requirements.

[b] NC = Not covered in the source report.

[c] Yes = The source report indicates that State regulations impose liner requirements.

[d] May = The source report indicates that the State regulations provide for a case-by-case decision on the need for liner requirements.

[e] Wastes are considered "nontoxic" in Ohio if leachate obtained by using the TCLP or modified TCLP contains (1) concentrations of arsenic, barium, cadmium, chromium, lead, and/or mercury that are less than 30 times the limits established by the EPA for these metals in drinking water and/or (2) a concentration of selenium of 1 mg/L or less, which the Ohio Environmental Protection Agency has established as the "nontoxic" criterion for selenium.

wastes from a single industry are eligible for variances from the requirements to install liners, leachate-collection systems, and groundwater and surface water monitoring systems, if it can be demonstrated in the permit application that the waste to be disposed of would not cause groundwater or surface water contamination. In the absence of a variance, disposal facilities accepting wastes from more than one industrial source, unless the facility is a monofill, must meet all standards applicable to municipal solid waste landfills (GDNR Rule 391-3-4.07(4)).

The design standards for industrial waste landfills in Georgia do not apply to surface impoundments. However, a surface impoundment that receives industrial wastes such as CCWs must have an NPDES permit if it will discharge any pollutant from a point source into waters of the State, including both surface waters and subsurface waters (GDNR Rule 391-3-6-.06 (3)(a)). If there will be a nonpoint-source discharge, a surface impoundment that receives industrial wastes such as CCWs must have written approval for the discharge, either in the NPDES permit, if there is also a point-source discharge, or in a letter. In either case, liner requirements may be established, as necessary, on a case-specific basis to protect subsurface waters (GDNR Rule 391-3-6(14)).

TABLE A.8 Georgia Maximum Aquifer Contamination Levels

Chemical	Maximum Contaminant Level (mg/L)
Arsenic	0.05
Barium	1.0
Benzene	0.005
Cadmium	0.01
Carbon tetrachloride	0.005
Chromium (hexavalent)	0.05
2,4-Dichlorophenoxy acetic acid	0.1
1,4-Dichlorobenzene	0.075
1,2-Dichloroethane	0.005
1,1-Dichloroethylene	0.007
Endrin	0.0002
Fluoride	4
Lindane	0.004
Lead	0.05
Mercury	0.002
Methoxychlor	0.1
Nitrate	10
Selenium	0.01
Silver	0.05
Toxaphene	0.005
1,1,1-Trichloromethane	0.2
Trichloroethylene	0.005
2,4,5-Trichlorophenoxy acetic acid	0.01
Vinyl chloride	0.002

Illinois—In Illinois, landfills receiving CCWs for disposal must be designed, constructed, and operated in compliance with the same requirements as those that are applicable to other solid waste landfills (Ill. Adm. Code 816.500(a)). Such units must be equipped with an integrated leachate drainage, leachate collection, and compacted earth liner system. Alternatively, a composite liner meeting defined specifications could be used, or a demonstration of equivalency for another liner configuration could be made. The required liner specifications are summarized in Table A.9 for solid waste landfills in Illinois. As the table mentions, if a landfill receives solely CCWs produced by coal-fired electricity-generating plants (i.e., it is a monofill), a Poz-O-Tec liner made from FGD sludge and coal combustion ash may be substituted, provided that certain specifications are met (Ill. Adm. Code 816.510).

The design standards for solid waste landfills in Illinois do not apply to surface impoundments (35 Ill. Adm. Code 810.103). However, a solid waste surface impoundment that receives CCWs must have either an NPDES permit or a construction/operating permit. In either case, liner requirements may be established in the permit, as necessary, on a case-specific basis, to protect groundwater. The Illinois Environmental Protection Act (IEPA) prohibits any person from releasing contaminants to groundwater such that (1) a groundwater quality standard would be exceeded, (2) an existing or potential use would be precluded, or (3) treatment or additional treatment would be needed to continue an existing groundwater use or assure a potential future use (35 Ill. Adm. Code 620.301).

Indiana—As explained in the discussions of permitting requirements and how CCWs are designated for regulatory purposes, CCWs may be disposed of in either restricted waste sites or nonmunicipal solid waste landfills in Indiana. Type I restricted waste sites have the most stringent design requirements, and Type IV have the least stringent. Among other things,

TABLE A.9 Illinois Landfill Liner Requirements

Special (Non-RCRA) waste landfills: A leachate drainage and collection system and a compacted earth liner designed as an integrated system is required, as follows:

- Earth liner:
  - Permeability $\leq 1 \times 10^{-7}$ cm/s
  - Thickness $\geq$ 5 ft, OR
- Composite liner consisting of:
  - Earth liner with a permeability $\leq 1 \times 10^{-7}$ cm/s and thickness $\geq$ 3 ft; overlain by
  - Geomembrane liner with a thickness $\geq$ 60 mil; OR
- Other liner configurations, if:
  - They provide equivalent or superior performance;
  - They have been used successfully in at least one similar operation; and
  - Quality assurance can be implemented.

CCW monofills: Poz-O-Tec liners and caps made from CCWs are allowed to replace liner requirements for other solid waste landfills if the Poz-O-Tec:

- Is produced and tested according to specifications provided in the regulations,
- Has a permeability $< 1 \times 10^{-7}$ cm/s,
- Has a thickness > 3 ft, and
- Has a compressive strength of > 150 lb/in.^{2} or psi.

restricted waste site Types I, II, and III, as well as nonmunicipal solid waste landfills, are required to create barriers between the waste and groundwater. The barriers must consist of soil (undisturbed, constructed, or a combination) with an equivalent hydraulic conductivity of less than or equal to 1×10^{-6} cm/s. Indiana regulations also specify minimum thicknesses for such soil barriers in Type I, II, and III restricted waste sites and in nonmunicipal solid waste landfills, as indicated in Table A.10. There are no liner requirements for Type IV restricted waste sites.

Solid waste regulations do not apply to disposal of coal ash transported by water into an ash pond that has received a water pollution control facility construction permit in Indiana (329 IAC 10-3-1). As necessary, however, liner requirements may be specified for a coal ash pond on a case-specific basis in the construction permit or in an NPDES and/or operating permit. A surface impoundment containing CCWs other than coal ash, such as FGD sludge, would also be subject to case-specific liner requirements specified in a water pollution control facility permit or an NPDES permit. When evaluating an application for a surface impoundment construction permit, an NPDES permit, or an operating permit, the Indiana Department of Environmental Management (IDEM) has the authority to ensure that facility equipment, practices, and activities are designed and managed to eliminate or minimize, to the extent feasible, potential adverse impacts to existing groundwater quality by applying controls such as liner requirements (327 IAC 2-11-2).

Missouri—CCWs are designated in the MoDNR solid waste regulations as "utility waste" (10 CSR 80-2.010(111)). A separate set of regulations that apply to the design and operation of utility waste landfills has been adopted by MoDNR (10 CSR 80-11.010). Utility waste landfills constructed after the effective date of the regulations (July 30, 1997) are required to install a composite liner or a clay liner. In both cases, the regulations specify the minimum thickness, compaction percentage, and hydraulic conductivity for clay in the liner. Minimum specifications are also provided for the synthetic geomembrane barrier if a composite liner is to be used. If the owner chooses the single compacted clay liner option, a demonstration justifying omission of the geomembrane based on site-specific conditions and waste characteristics must be provided (10 CSR 80-11.010(9)).

TABLE A.10 Indiana Landfill Liner Requirements

Type I, II, or III restricted waste sites: Earth liner having an equivalent hydraulic conductivity of 1×10^{-6} cm/s and a minimum thickness as follows:

- Type I: 15 ft, or 10 ft with a demonstration that the equivalent hydraulic conductivity of the waste through the barrier will be less than 1×10^{-6} cm/s.
- Type II: Ranging from 5 ft to 10 ft depending on waste permeability.
- Type III: 3 ft.

Type IV restricted waste sites: No liner required.

Nonmunicipal solid waste landfills:

- Leachate-collection system coupled with Earth liner $\geq$ 10 ft having hydraulic conductivity of 1×10^{-6} cm/s, OR
- Earth liner $\geq$ 50 ft having hydraulic conductivity of 1×10^{-6} cm/s.

The design standards for utility waste landfills in Missouri do not apply to surface impoundments. A surface impoundment that receives CCWs is subject to the regulations in Missouri that establish design guides for wastewater treatment ponds (10 CSR 20-8.200). Such regulations require that wastewater treatment ponds be sealed with soil or synthetic liners that can be satisfactorily demonstrated to achieve an adequate seal. Thickness, compaction, and permeability are specified for soil liners. Synthetic liners are required to have a seepage loss equivalent to that specified for soil liners (10 CSR 20-8.200(6)).

Ohio—Table A.11 summarizes the landfill liner requirements for Ohio.

Pennsylvania—A residual waste landfill is a facility for the disposal of residual waste. The term does not include a residual waste disposal impoundment or a facility for the land application of residual waste. The regulations distinguish three types of residual waste landfills, all of which must be permitted. Class I residual waste landfills involve the disposal of residual wastes that have the greatest potential for adversely affecting groundwater and the greatest potential for impacts on public health and safety and the environment. Class II residual waste landfills involve the disposal of residual waste having an intermediate degree of potential for adversely affecting groundwater and an intermediate degree of potential for impacts on public health and safety and the environment. Class III residual waste landfills involve the disposal of residual wastes having the least potential for adversely affecting groundwater and the least potential for having impacts on public health and safety and the environment (25 Pa. Code 288.1(b)). Hence, as is indicated in Table A.12, the regulations establish the most stringent liner requirements for Class I residual waste landfills and progressively less stringent requirements for Class II and Class III residual waste landfills.

TABLE A.11 Ohio Landfill Liner Requirements

"Nontoxic" fly ash and bottom ash monofill:
No liner required.

Class IV residual waste landfill:
- Soil liner $\geq$ 3 ft having hydraulic conductivity of 1×10^{-7} cm/s, OR
- Geomembrane plus 18 in. of soil having hydraulic conductivity of 1×10^{-7} cm/s AND
- Leachate-management system.

Class III residual waste landfill:
- Soil liner $\geq$ 3 ft having hydraulic conductivity of 1×10^{-7} cm/s, OR
- Geomembrane plus 18 in. of soil having hydraulic conductivity of 1×10^{-7} cm/s, AND
- Leachate-management system.

Class II residual waste landfill:
- Geomembrane plus 3 ft of soil having hydraulic conductivity of 1×10^{-7} cm/s, AND
- Leachate-management system.

Class I residual waste landfill:
- Geomembrane plus 5 ft of soil having hydraulic conductivity of 1×10^{-7} cm/s, AND
- Leachate-management system.

Similarly, the Pennsylvania regulations establish two types of residual waste disposal impoundments. Class I residual waste disposal impoundments involve the disposal of residual wastes that have the greatest potential for adversely affecting groundwater and the greatest potential for having impacts on public health and safety and the environment. Class II residual waste disposal impoundments involve the disposal of residual wastes that have an intermediate degree of potential for adversely affecting groundwater and an intermediate degree of potential for having impacts on public health and safety, and the environment (25 Pa. Code 289.1(b)). The regulations establish the most stringent liner requirements for Class I residual waste disposal impoundments and less stringent requirements for Class II residual waste disposal impoundments.

Texas—Texas has no specific regulations for the use of liners in landfills or surface impoundments. However, there are general prohibitions in the Texas regulations on (1) causing the discharge or imminent threat of discharge of industrial solid waste into or adjacent to waters of the State without authorization, (2) creating and maintaining a nuisance, and (3) endangering the public health and welfare. To foster compliance, the TCEQ has developed guidance documents, Technical Guideline Nos. 3 and 4, which outline methods for the use of liner systems designed to aid in the prevention of the prohibited conditions at landfills and surface impoundments (TCEQ 2004a and 2004b).

TABLE A.12 Pennsylvania Landfill Liner Requirements

Class I residual waste landfill:
- Subbase prepared of soil or earthen materials,
- Secondary liner placed on the subbase,
- Leachate-detection zone placed on the secondary liner,
- Primary liner placed on the leachate detection-zone, and
- Protective cover and leachate-collection zone placed over the primary liner.

Either the primary liner or the secondary liner must be a composite liner, which is a continuous layer of synthetic material over earthen materials. The other liner must be composed of synthetic materials.

Class II residual waste landfill:
- Subbase prepared of soil or earthen materials,
- Leachate-detection zone placed on the subbase,
- Composite liner of synthetic material over earthen materials placed on the leachate-detection zone, and
- Protective cover and leachate-collection zone placed over the liner.

Class III residual waste landfill:
- Attenuating soil must exist naturally or have been placed over the entire disposal area,
- The seasonal high water table, perched water table, or bedrock must be separated from the lowest area where waste is deposited by at least 4 ft, and
- The regional groundwater table must be separated from the lowest area where waste is deposited by at least 8 ft.

According to Technical Guideline No. 3, *Landfills*, at landfills receiving Class 1 and Class 2 wastes, the TCEQ recommends the use of a composite liner composed of compacted clay immediately beneath a synthetic membrane liner (high-density polyethylene, polyvinyl chloride, chlorinated polyethylene, butyl rubbers, etc.). However, a monofill that contains only certain specific, consistent, well-characterized wastes that have been found to have low migration potential in a landfill normally would not require a membrane in the liner. "The wastes that have been found to be suitable for placement in clay-lined monofills are asbestos, coal bottom ash, coal fly ash, coal FGD residue, and stabilized steel mill scale" (TCEQ 2004a). TCEQ recommends that high-density polyethylene (HDPE), if used as a liner material, should be at least 60 mil thick.

Technical Guideline No. 4, *Nonhazardous Industrial Solid Waste Surface Impoundments*, advises that waste characteristics are the primary consideration when choosing a surface impoundment liner. Other considerations are the physical aspects of the site, including geology, hydrology, and climate. TCEQ (2004b) suggests that these considerations be used in choosing among the following liner system types (minimum recommended thicknesses are provided in parentheses):

- Geomembrane (polyethylene 60 mil, other types 30 mil) and underlying leak detection system; or
- Compacted clay (2 ft); or
- Equivalent in-situ clay; or
- Geosynthetic clay liner overlain by protective soil (1 ft).

Virginia—In Virginia, an industrial solid waste landfill is required to have a liner system consisting of a primary liner made from compacted soil, synthetic materials, other materials, or in-place soil, provided that specified criteria are met. Regulations establish design and installation standards for double liners when they are either required or used in lieu of groundwater monitoring (9 VAC 20-80-300.B.14).

Virginia regulations contain no liner requirements for surface impoundments. However, the Virginia State Water Control Board has established groundwater standards (9 VAC 25-280-10 et seq.), and the Virginia Department of Environmental Quality (VDEQ) has authority under State water control law to incorporate special conditions in water permits (e.g., VPDES permits and Virginia pollution abatement permits), as necessary, on a case-specific basis, to ensure that activities at the permitted facility will not result in violations of those standards. VDEQ permit writers are instructed to consider whether a water permit for an industrial facility that operates a wastewater treatment lagoon should contain a special condition requiring the permittee to demonstrate that the permeability of the lagoon does not exceed 10^{-6} cm/s (VDEQ 2004).

Wisconsin—Primarily on the basis of the landfill performance and design experience it had gained during the 1980s, Wisconsin established a revised set of solid waste rules

(WAC NR 500–520) in 1988. The 1988 rules required all landfills to be designed with a 5-ft–thick clay liner and a leachate-collection system.

Wisconsin has established minimum design and construction criteria for landfill liners and leachate-collection systems.

Wisconsin requires that any surface impoundments that are not required to have solid waste operating licenses must be sealed to prevent water losses that exceed 500 gal per acre per day (WAC NR 213.10(2)). Natural soil materials, soil-bentonite mixtures, or synthetic liners may be used for sealing. The bottom of each impoundment must be compacted to a depth of 6 in., and an additional inorganic layer to protect the liner may be required. The permeability of a soil or soil-bentonite liner must not exceed 1×10^{-7} cm/s. Specific requirements for soil, soil-bentonite, and synthetic liners are identified in the regulations. Synthetic liners must be at least 30 mil thick. All liners must be compatible with the contents of the impoundment.

A.5 GROUNDWATER MONITORING-REQUIREMENTS IN SELECTED STATES

A.5.1 Summary

Groundwater monitoring is used to assess the performance of a CCW land disposal facility design in preventing contaminants from being released to groundwater. When groundwater monitoring is required, specifications typically include the location(s) of the point(s) of compliance; number, spacing, and design of wells; constituents for which testing is required; and sampling frequency. Table A.13 summarizes the groundwater-monitoring requirements for landfills and surface impoundments in Alabama, Florida, Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Texas, Virginia, and Wisconsin. Additional details are provided in Section A.5.3.

A.5.2 Chronological Comparison of Groundwater-Monitoring Regulations for Landfills

Table A.14 compares the findings on groundwater-monitoring requirements for landfills that receive CCWs in the five pilot States and six supplemental States described in this report (“2005 Data”) with the groundwater-monitoring requirements for CCW landfills reported in EPA 1988 and EPA 1999b.

A.5.3 State-Specific Discussion of Groundwater-Monitoring Requirements

Alabama—Because CCWs are expressly excluded from the definition of solid waste in Alabama, landfills that receive only CCWs are not subject to the Alabama solid waste regulations. Therefore, CCW monofills are not required to have groundwater monitoring in Alabama. However, if CCWs are disposed of in a landfill that receives other types of solid waste,

TABLE A.13 Summary of Groundwater-Monitoring Requirements for CCW Management Units in Selected States

	Groundwater-Monitoring Requirements	
State[a]	Landfills	Surface Impoundments
Alabama	*CCW monofills: No applicable groundwater-monitoring requirements.* *Co-disposal with other wastes in a municipal waste landfill:* • At least enough wells at locations and depths to yield groundwater samples from the first saturated zone that are representative of both background and down-gradient water quality *Co-disposal with other wastes in an industrial waste landfill:* Groundwater-monitoring requirements are specified by the ADEM on a case-specific.	Established, as necessary, on a case-specific basis in NPDES permit.
Florida	Established, as necessary, on a case-specific basis in either the solid waste Construction and Operating Permits, or in the PPSA certification if one substitutes for the solid waste permits.	Established, as necessary, on a case specific basis in NPDES permit, groundwater-monitoring permit, or PPSA certification.
Georgia	• Samples must be collected semiannually and tested for metals and volatile organic compounds (metals may be replaced with indicators upon approval). • The point of compliance defined in the permit must not be more than 150 ft from the waste boundary.	Established, as necessary, on a case-specific basis in land disposal system permit.
Illinois	• Groundwater monitoring is required during the active life of the landfill and during the post-closure care period. • Upgradient monitoring is required to establish background concentration levels. • Monitoring intervals are to be no shorter than quarterly for 5 years, then semiannual. • Under certain circumstances, monitoring can be done annually, but it must return to a quarterly schedule at any well where a statistically significant increase is determined to have occurred in the concentration of any constituent.	Established, as necessary, on a case-specific basis in NPDES or construction/operating permits.

TABLE A.13 (Cont.)

State[a]	Groundwater-Monitoring Requirements: Landfills	Groundwater-Monitoring Requirements: Surface Impoundments
Indiana	Type I and II restricted waste sites and nonmunicipal solid waste landfills: • Groundwater monitoring is required during the active life of the landfill and during the post-closure care period. • At least one upgradient well and three downgradient wells must be installed. • Samples must be collected semiannually. Type III and IV restricted waste sites: • No groundwater monitoring is required.	Established, as necessary, on a case-specific basis in water pollution control permits.
Missouri	• Baseline groundwater quality data are required for at least 1 year. • Thereafter, detection monitoring must be established. • At least one upgradient well and three downgradient wells are required. • Samples must be collected at least semiannually for specified constituents.	Established, as necessary, on a case-specific basis in wastewater treatment unit permits.
Ohio	• Class I, II, and III residual waste landfills: – Hydrologic site investigation is required. – Upgradient sampling is required quarterly for the first year to establish background levels. – Downgradient sampling is required semiannually for indicator parameters. – Downgradient sampling is required annually for water quality parameters (metals plus total organic carbon, total dissolved solids, chloride, sodium, and radionuclides). • Class IV residual waste landfills: – No groundwater monitoring is required unless leachate concentrations exceed background groundwater concentrations. – Requirements are same as above for Classes I, II, and III if leachate concentrations exceed background groundwater concentrations. • Nontoxic fly ash and bottom ash monofills: No groundwater monitoring is required.	Established, as necessary, on a case-specific basis in water pollution control permits.

TABLE A.13 (Cont.)

State[a]	Groundwater-Monitoring Requirements: Landfills	Groundwater-Monitoring Requirements: Surface Impoundments
Pennsylvania	• At least one upgradient well and three downgradient wells located within 200 ft of the disposal area are required. • Monitoring intervals must be no shorter than: – Quarterly for indicator parameters, – Annually for metals and volatile organic compounds.	• At least one upgradient well and three downgradient wells located within 200 ft of the disposal area. • Monitoring intervals no shorter than: – Quarterly for indicator parameters; – Annually for metals and volatile organic compounds.
Texas	• No groundwater-monitoring requirements are specified in the regulations. • *TCEQ Recommendation for landfills receiving Class 1 and Class 2 wastes*: Groundwater-monitoring system following the recommendations in TCEQ Technical Guideline No. 6, *Monitoring Systems* (TCEQ 2004c) • Monofills receiving only bottom ash, fly ash, or FGD residues have been found to not require a membrane	No groundwater-monitoring requirements are specified in the regulations. *TCEQ Recommendation for surface impoundments receiving Class 1 and Class 2 wastes:* At least 3 wells to determine the groundwater-flow direction and enough wells, as determined on a case-specific basis, to detect releases from the unit.
Virginia	• Groundwater monitoring is required during the active life of the landfill and during the post-closure care period, unless a double liner having the following components is used: bottom (secondary) liner of clay or composite materials, leachate-collection system, primary liner of clay or composite materials, and 12-in. drainage layer covered by 6-in. protective layer. • At least one upgradient and three downgradient wells are required.	Established, as necessary, on a case-specific basis in water control permits.
Wisconsin	• Baseline groundwater quality must be established, unless a waiver is granted. • Sampling is required semiannually. • The number of monitoring points must be approved on a case-specific basis, taking into consideration waste type and facility design, and hydrogeologic and geologic setting. • The monitoring program must be adequate to determine upgradient and downgradient water quality, determine horizontal and vertical gradients, and detect impacts on groundwater quality.	Established, as necessary, on a case-specific basis in water control permits.

[a] The pilot study covered this category of regulatory control for Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin. Georgia, Missouri, and Ohio are supplemental States.

TABLE A.14 Chronological Comparison of Groundwater-Monitoring Requirements for Landfills in Selected States

	Groundwater-Monitoring Requirements for Landfills		
State	EPA 1988	EPA 1999b	2005 Data
Alabama	Yes	NC[b]	No, unless CCWs are co-disposed of with other industrial solid wastes
Florida	Yes	NC	Yes
Georgia	No[a]	NC	Yes
Illinois	No	NC	Yes
Indiana	May[d]	Type I: Yes Type II: Yes Type III: No Type IV: No	Type I: Yes Type II: Yes Type III: No Type IV: No Nonmunicipal solid waste landfill: Yes
Missouri	No	NC (Research for this report indicates that Missouri implemented standards for utility waste landfills, including groundwater-monitoring standards in 1997.)	Yes
Ohio	Exempt	NC	Nontoxic monofills: No Class I: Yes Class II: Yes Class III: Yes Class IV: No, unless leachate concentrations exceed background levels
Pennsylvania	May	Class I: Yes Class II: Yes Class III: Yes	Class I: Yes Class II: Yes Class III: Yes
Texas	May	NC	Recommended by TCEQ, but not required
Virginia	No	Yes, unless double liner is used	Yes, unless double liner is used
Wisconsin	May[d]	Yes[c]	Yes

[a] No = The source report indicates that State regulations do not impose groundwater-monitoring requirements.

[b] NC = Not covered in the source report.

[c] Yes = The source report indicates that State regulations impose groundwater-monitoring requirements.

[d] May = The source report indicates that the State regulations provide for a case-by-case decision on the need for groundwater-monitoring requirements.

such as a commercial industrial waste landfill or a municipal waste landfill, that landfill may be subject to groundwater-monitoring requirements, as indicated in ADEM Adm. Code R.335-13-4-.27. At a minimum, municipal waste landfills must have groundwater-monitoring systems that consist of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the first saturated zone that represent both background and downgradient groundwater quality. The wells must be constructed and sampled in accordance with specifications in the regulations. For industrial landfills, the ADEM determines groundwater-monitoring requirements on a case-specific basis (ADEM Adm. Code R.335-13-4-.27).

Similarly, surface impoundments in Alabama that receive only CCWs are not subject to the Alabama solid waste regulations. However, if there are discharges of pollutants to waters of the State (including groundwater) from such surface impoundments, NPDES permits would be required. The ADEM has authority to include conditions in an NPDES permit, on a case-specific basis, requiring a surface impoundment to install structures, such as groundwater-monitoring wells, if necessary to prevent pollutant discharges to groundwater (ADEM Adm. Code R.335-6-6-.08).

Florida—Florida does not have solid waste regulations that govern groundwater monitoring at CCW landfills. However, under Florida water law, any facility that can reasonably be expected to be a source of water pollution affecting State waters (including groundwater) must have a permit [FAC R62-620.100(2)(b)]. Through this permitting process, Florida has authority to impose groundwater-monitoring requirements on a case-specific basis at any landfill or surface impoundment that receives CCWs. Any facility that discharges to groundwater under a permit is required to establish a groundwater-monitoring program (FAC R62-522.600) and submit a groundwater-monitoring plan to the Florida DEP.

Georgia—In Georgia, owners or operators of industrial waste landfills must conduct groundwater monitoring. The groundwater-monitoring data must be evaluated by the owner or operator to determine if "established standards" have been exceeded. All exceedances of "established standards" must be promptly reported. The established standards for analytical constituents are the following:

- The primary standards that are enforceable as maximum contaminant levels (MCLs) defined in the Georgia Safe Drinking Water Act of 1974, as amended in 1986 et seq., and the Rules for Safe Drinking Water, revised in July 1992.

- The background level of the constituent when this level is higher than the MCL.

- When there is no MCL for a constituent, the established standard will be derived from a statistical analysis. The number of samples needed to establish a statistical base must be consistent with appropriate statistical methods defined in the regulations. If a statistically significant increase (SSI) above background occurs, the established standard for the constituent has been exceeded.

Illinois—In Illinois landfills that receive CCWs, groundwater monitoring is required as soon as the waste is emplaced. The monitoring must continue during the active life of the unit and for a minimum period of 15 years after closure. Monitoring points must be positioned at appropriate upgradient locations to establish background concentrations and at enough downgradient locations to detect any discharge of contaminants chosen for monitoring. At least one downgradient well is required. All monitoring points must be sampled quarterly for 5 years, after which the monitoring frequency can be semiannual. Under certain circumstances, monitoring can be done annually, but it must return to a quarterly schedule at any well where a statistically significant increase is determined to have occurred in the concentration of any constituent (35 Ill. Adm. Code 811.318 and 319(a)(1)).

The operator must monitor each well for constituents that provide a means for detecting groundwater contamination. A constituent must be chosen for monitoring if it is expected to appear in the leachate and the State has established a protection or quality standard for it in either public water supplies or groundwater, respectively. A baseline test and subsequent biannual tests for certain organic constituents are also required in each monitoring well (35 Ill. Adm. Code 811.319(a)(2)).

Groundwater quality at or beyond the zone of attenuation must be maintained with regard to all constituents. The applicable groundwater-quality standard established for any constituent must be the background concentration or the standard established as a State groundwater quality standard. If increases in contaminant concentrations are observed, additional samples may be required to confirm the observed increase and to identify the source of the increase. If the landfill is confirmed to be the source of the increase, an assessment of the potential impacts to groundwater outside the zone of attenuation is required to determine if remedial action is needed (35 Ill. Adm. Code 811.319).

The groundwater monitoring requirements for solid waste landfills in Illinois do not apply to surface impoundments (35 Ill. Adm. Code 810.103). However, a surface impoundment that receives CCWs must have an NPDES permit or a construction/operating permit. In either case, groundwater-monitoring requirements may be established in the permit, as necessary, on a case-specific basis, to protect groundwater. The Illinois Environmental Protection Act prohibits any person from releasing contaminants to groundwater such that (1) a groundwater-quality standard would be exceeded, (2) an existing or potential use would be precluded, or (3) treatment or additional treatment would be needed to continue an existing groundwater use or assure a potential future use (35 Ill. Adm. Code 620.301).

Indiana—In Indiana, restricted waste site Types I and II must conduct groundwater monitoring throughout the active life and the post-closure care period of the facilities. Type I and II restricted waste sites must have groundwater-monitoring systems consisting of a sufficient number of monitoring devices, installed at appropriate locations and depths, to yield groundwater samples that represent both background water quality and the quality of potentially affected groundwater that passes the monitoring boundary of the facility. A minimum of four groundwater-monitoring devices (one upgradient and three downgradient) must be installed. Type III and IV restricted waste sites are not required to conduct groundwater monitoring (329 IAC 10-29-10).

The Indiana regulations do not specify groundwater monitoring-requirements for surface impoundments. However, IDEM may specify water pollution control permit conditions as necessary to assure that any pollutants released or threatened to be released by the unit into the environment will not cause or contribute to violations of applicable water quality standards, or otherwise cause a significant adverse impact on the environment or public health (327 IAC 3-4-3).

Missouri—In Missouri, utility waste landfills are required to implement groundwater monitoring capable of determining the impact of the landfill on the quality of the underlying groundwater (10 CSR 80-11.010(11)). Monitoring wells must be installed both hydraulically upgradient (at least one well) and hydraulically downgradient (at least three wells) from the utility waste landfill. The actual number, location, and depth of wells must be determined on the basis of site-specific information to ensure detection of any significant amounts of fluids that migrate from the landfill to groundwater. A groundwater sampling and analysis program must be submitted for State approval. Baseline monitoring to establish background groundwater quality is required for constituents of concern. For baseline monitoring, a minimum of four quarterly samples is required for at least one year. Thereafter, detection monitoring (i.e., routine monitoring) must be performed during May and November of each calendar year for specified constituents and for the water level in each well. The sampling data must be statistically evaluated. If a statistically significant change in the pH or increase in a constituent level occurs and is confirmed, the owner/operator of the landfill must submit a plan for assessment monitoring to better define the extent of groundwater contamination. During assessment monitoring, quarterly sampling is required. If one or more constituents exceed the groundwater-protection standard, the owner/operator must submit a report to the State assessing potential corrective measures.

A surface impoundment that receives CCWs for disposal in Missouri is subject to the regulations that establish design guides for wastewater treatment ponds (10 CSR 20-8.200). Such regulations do not require that every wastewater treatment pond have a groundwater-monitoring system. However, groundwater-monitoring requirements may be imposed on a case-specific basis in construction and operating permits for facilities with point source discharges to waters of the State or in no-discharge permits for facilities that do not discharge (10 CSR 20.8-200(8)(E); 10 CSR 20-6.015 (4)(B)5).

Ohio—Owners and operators of residual waste landfills in Ohio are required to implement and maintain groundwater-monitoring programs capable of determining the impact of their landfill facilities on the quality of the underlying groundwater. Class I, II, and III residual waste landfills are required to conduct a hydrologic site investigation, install monitoring wells, and conduct sampling as follows (OAC 3745-30-08):

- Upgradient sampling quarterly for first year to establish background,
- Downgradient sampling semiannually for indicator parameters, and

- Downgradient sampling annually for water quality parameters (metals plus total organic carbon, total dissolved solids, chloride, sodium, and radionuclides).

No groundwater monitoring is required at Class IV residual waste landfills, unless leachate concentrations exceed background groundwater concentrations. If leachate concentrations exceed background levels, the same schedule of sampling as that described above for Class I, II, and III landfills must be implemented.

No groundwater monitoring is required at nontoxic fly ash and bottom ash monofills.

The Ohio regulations do not specify groundwater-monitoring requirements for surface impoundments. However, the OEPA may establish groundwater-monitoring requirements for surface impoundments on a case-specific basis in water pollution control permits.

Pennsylvania—The Pennsylvania regulations require a groundwater-quality monitoring plan and a monitoring system located within 200 ft upgradient (at least one well) and downgradient (at least three wells) from the disposal area associated with either a residual waste landfill or disposal impoundment. The regulations provide for the following monitoring intervals: (1) quarterly for various indicators (ammonia-nitrogen, bicarbonate, calcium, chloride, fluoride, chemical oxygen demand, nitrate-nitrogen, pH, specific conductance, sulfate, total alkalinity, total organic carbon, total dissolved solids, turbidity, iron, manganese, magnesium, potassium, and sodium) and (2) annually for metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc) and volatile organic compounds (tetrachloroethene, trichloroethene, 1,1,1-trichloroethane, 1,2-dibromoethane, 1,1-dichloroethene, 1,2-dichloroethene (cis and trans isomers), vinyl chloride, 1,1-dichloroethane, 1,2-dichloroethane, methylene chloride, toluene, ethylbenzene, benzene, and xylene). Triggers are established for the need to prepare a groundwater assessment plan and an abatement plan. The Pennsylvania Department of Environmental Protection (PADEP) may approve alternative designs for well casings and alternative sampling and analysis requirements. However, PADEP is not allowed to grant variances from the minimum number of wells or to waive the groundwater-monitoring requirements altogether (25 Pa. Code 288.251-288.258 for landfills; 25 Pa. Code 289.261-289.268 for disposal impoundments).

Abatement standards at compliance points (at and beyond 150 m of the perimeter of the permitted residual waste disposal area or at and beyond the property boundary, whichever is closer) include: (1) statewide health standards, (2) background standards, or (3) risk-based standards calculated in accordance with all applicable regulatory requirements, if there are no primary MCLs under Federal and State law (25 Pa. Code 288.257(c) for landfills; 25 Pa. Code 289.267(c) for disposal impoundments).

Texas—Texas has no specific regulations for groundwater monitoring at landfills or surface impoundments. However, there are general prohibitions in the Texas regulations on: (1) causing the discharge or imminent threat of discharge of industrial solid waste into or adjacent to waters of the State without authorization, (2) creating and maintaining a nuisance, and (3) endangering the public health and welfare. To foster compliance, the TCEQ has

developed guidance documents, Technical Guideline Nos. 3 and 4, which recommend installation of groundwater-monitoring systems at landfills and surface impoundments (TCEQ 2004a and 2004b).

According to Technical Guideline No. 3, *Landfills*, at landfills receiving Class 1 and Class 2 wastes, the TCEQ recommends installation of a groundwater monitoring-system designed as suggested in Technical Guideline No. 6, *Ground-Water Monitoring* (TCEQ 2004c), with monitoring 30 years after closure.

Technical Guideline No. 4, *Nonhazardous Industrial Solid Waste Surface Impoundments*, recommends groundwater monitoring at surface impoundments receiving Class 1 and Class 2 wastes, unless it can be shown that there is no potential for migration of waste constituents to the uppermost water-bearing zone during the active life of the unit, including the closure period and the post-closure care period. This Technical Guideline further recommends installing a sufficient number of wells at appropriate locations and depths to yield groundwater samples, with a minimum of three wells to determine the groundwater-flow direction, as well as enough wells (as determined on a site-specific basis) to detect releases from the unit. Semiannual groundwater monitoring is recommended during the active life and post-closure period of the unit.

Virginia—A groundwater-monitoring program is required at each industrial waste landfill in Virginia (9 VAC 20-80-300). At least one upgradient well and three downgradient wells are required, but the total number, spacing, and depths of monitoring wells are determined on the basis of site-specific technical information. The program must be capable of yielding groundwater samples from the uppermost aquifer that represent both background water quality and water quality at the waste management unit boundary. The downgradient monitoring system must be installed at the waste management unit boundary, unless a variance has been granted.

A groundwater-monitoring plan must specify sampling and analytical methods as well as the statistical methods to be used in evaluating monitoring data for each parameter or constituent in each well. Phase I monitoring is to be conducted at least semiannually for indicator parameters (specific conductance, pH, total organic carbon, total organic halogens), unless and until a statistically significant increase (or decrease, for pH) occurs. Phase II monitoring is instituted within 90 days after a statistically significant change in any indicator parameter is detected.

Phase II monitoring includes the semiannual analysis of parameters listed in Table 5.5 of VAC, Title 9, Section 20-80-300 and, if required, any detected constituents in Table 5.1. Phase II monitoring continues until a demonstration justifies reinstituting Phase I monitoring or until a corrective action monitoring program is implemented.

Virginia regulations contain no requirements that surface impoundments implement groundwater monitoring. However, VDEQ has established groundwater standards (9 VAC 25-280-10 et seq.) and has the authority under State water control law to incorporate special conditions in water permits (e.g., VPDES permits and Virginia pollution abatement permits), as necessary on a case-specific basis, to ensure that activities at the permitted facility will not result in violations of the standards. VDEQ permit writers are instructed to consider whether a water

permit for an industrial facility that operates a wastewater treatment lagoon should contain a special condition requiring a groundwater-monitoring plan (VDEQ 2004).

Wisconsin—By the mid-to-late 1970s, groundwater-monitoring data from numerous unlined landfills in Wisconsin provided documentation that such "natural attenuation" sites were causing significant impacts on groundwater quality. As a result, many were required to close. In 1984, the Wisconsin legislature passed a comprehensive groundwater law, which assigned the Wisconsin Department of Natural Resources (WDNR) responsibility for establishing a list of substances that either had been detected in groundwater or had a reasonable probability of entering groundwater. Since October 1, 1985, all new solid waste landfills in Wisconsin have been required to be designed to meet preventive action limits (PALs) for groundwater. The PALs are trigger levels for constituents that have been detected in groundwater or have a reasonable probability of entering groundwater. They are based on the threat that a particular contaminant poses to public health and the environment. The PALs are applicable at any location where groundwater is monitored, including directly beneath a landfill. To ensure compliance, Wisconsin requires periodic groundwater monitoring of industrial landfills. Prior to 1996, routine monitoring was required quarterly. In 1996, the requirements for landfill design features were upgraded, and the minimum frequency for monitoring at new landfills was reduced to semiannual. However, WDNR may approve other frequencies (more or less often) on the basis of site-specific considerations. The number and locations of monitoring points must be approved on a case-specific basis, taking into consideration the waste type and facility size, design, and hydrogeologic and geologic setting. Detection monitoring (i.e., routine monitoring) must be implemented, unless written approval is obtained for an alternative program. The regulations specify detection monitoring parameters for fly ash and/or bottom ash landfills. For other CCWs, such as FGD waste, detection monitoring parameters will be established on a case-specific basis in the operating license (WAC NR 507.06). The detection monitoring program must be adequate to determine upgradient and downgradient water quality, determine horizontal and vertical gradients, and detect impacts to groundwater quality.

In Wisconsin, surface impoundments must be designed and operated to minimize the level of substances in groundwater and to prevent exceedances of the groundwater PALs, to the extent technically and economically feasible (WAC NR 213.08). Surface impoundments that are not required to have solid waste operating licenses may be required to conduct groundwater monitoring to provide long-term information on the effects of such impoundments on groundwater. When a groundwater-monitoring system is required, the parameters to be monitored and the monitoring frequency are to be established on a case-by-case basis.

A.6 LEACHATE-COLLECTION SYSTEM REQUIREMENTS IN SELECTED STATES

A.6.1 Summary

Leachate-collection systems are frequently required in conjunction with liners to detect contaminants and prevent them from leaking out of CCW land disposal facilities into

groundwater. Table A.15 summarizes the leachate-collection system requirements for landfills and surface impoundments in Alabama, Florida, Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Texas, Virginia, and Wisconsin. Additional details are provided in Section A.6.3.

A.6.2 Chronological Comparison of Leachate-Collection System Requirements for Landfills in Selected States

Table A.16 compares the findings on requirements for leachate-collection systems in landfills that receive CCWs in the five pilot States and six additional States ("2005 Data") with the leachate-collection system requirements for CCW landfills reported in EPA 1988 and EPA 1999b.

A.6.3 State-Specific Discussion of Leachate-Collection System Requirements

Alabama—Because CCWs are expressly excluded from the definition of solid waste in Alabama, landfills that receive only CCWs are not subject to the Alabama solid waste regulations. Therefore, CCW monofills are not required to install leachate-collection systems in Alabama. However, if CCWs are disposed of in a landfill that receives other types of solid waste, such as a commercial industrial waste landfill or a municipal waste landfill, that landfill may be subject to leachate collection requirements, as indicated in ADEM Adm. Code R.335-13-4-.18. According to that regulatory section, a leachate-collection system is required in either landfill type, if the landfill is designed and constructed to maintain less than a 30 cm depth of leachate over the liner.

Similarly, surface impoundments in Alabama that receive only CCWs are not subject to the Alabama solid waste regulations. However, if there are discharges of pollutants to waters of the State (including groundwater) from surface impoundments, NPDES permits would be required. The ADEM has authority to include conditions in an NPDES permit on a case-specific basis requiring a surface impoundment to install structures, such as leachate-collection systems, if necessary to prevent pollutant discharges to groundwater (ADEM Adm. Code R.335-6-6-.08).

Florida—Florida does not have solid waste regulations that specify leachate-control system requirements at CCW landfills. However, under Florida water law, any facility that can reasonably be expected to be a source of water pollution affecting State waters (including groundwater) must have a permit to construct, modify, and operate the facility [FAC 62-620.100(2)(b)]. Through this permitting process, the Florida DEP has authority to impose leachate-collection system requirements at any landfill that receives CCWs on a case-specific basis.

Georgia—In Georgia, all industrial waste disposal facilities are required to have leachate-collection systems. If a permit application is filed indicating that a landfill would receive only a single type of industrial waste (i.e., it would be a monofill) or would receive only wastes from a single industry, the landfill would be eligible for variances from the requirements to install liners,

TABLE A.15 Summary of Leachate-Collection System Requirements for CCW Management Units in Selected States

State	Leachate-Collection System Requirements	
	Landfills	Surface Impoundments
Alabama	*CCW monofills: No applicable leachate-collection system requirements.* *Co-disposal with other wastes in a municipal waste landfill or industrial waste landfill: A leachate-collection system is required that is designed and constructed to maintain less than a 30-cm depth of leachate over the liner.*	Established, as necessary, on a case-specific basis in NPDES permits.
Florida	No specific requirements, but may be established in a permit or PPSA certification, as appropriate.	No specific requirements, but may be established in a permit or PPSA certification, as appropriate.
Georgia	Industrial waste landfills: A leachate collection-system is required. Industrial waste monofills: A variance from the requirement to install a leachate-collection system is available to permit applicants who demonstrate that the waste to be disposed of would not cause groundwater or surface water contamination.	Established, as necessary, on a case-specific basis in NPDES permits.
Illinois	A leachate drainage layer at least 1 ft thick is required in conjunction with a leachate-collection system and a leachate-management system consisting of any combination of storage, treatment, pretreatment, and disposal options that meet specified requirements.	Established, as necessary, on a case-specific basis in NPDES or construction/operating permits.
Indiana	Type I, II and III restricted waste sites: No leachate-collection system is required, but one may be used on a case-specific basis to reduce liner thickness. Type IV restricted waste sites: No leachate-collection system is required. Nonmunicipal solid waste landfill: • A leachate drainage layer at least 1 ft thick with a hydraulic conductivity of $\geq 1 \times 10^{-3}$ cm/s is required. • The upper 3 ft of material beneath the drainage layer must have an equivalent hydraulic conductivity of $\leq 1 \times 10^{-7}$ cm/s. • It must be designed to limit the leachate level above the landfill base to 1 ft or less after the final cover has been placed.	Established, as necessary, on a case-specific basis in water pollution control permits.
Missouri	Utility waste landfills: Leachate-collection systems are required, unless the owner or operator can demonstrate that a leachate collection-system is not needed • The leachate-collection system must be designed to maintain less than 1 ft of leachate head on the liner. • Material thickness, hydraulic conductivity, and particle size are determined on a case-specific basis.	Not required for wastewater treatment ponds.

TABLE A.15 (Cont.)

State	Leachate-Collection System Requirements	
	Landfills	Surface Impoundments
Ohio	• Design and construction specifications for leachate-management systems are provided. • Among other things, the leachate-management system must be designed to do the following: – Limit the level of leachate over the liner to a maximum of 1 ft, – Contain granular material used as a drainage medium that has permeability of no less than 1×10^{-3} cm/s, – Function without clogging, and – Be chemically resistant to attack by the residual waste, leachate, or any other material it may contact.	Established, as necessary, on a case-specific basis in permits to install or NPDES permits.
Pennsylvania	• Performance and design standards for leachate-detection zones in Class I and II residual waste landfills are specified. • Among other things, leachate-detection zones must: – Be at least 12 in. thick, – Contain no particles that exceed 0.5 in., – Have a flow zone with a hydraulic conductivity of $\geq 1 \times 10^{-2}$ cm/s, – Function without clogging, – Withstand chemical attack from waste and leachate, and – Be monitored weekly. • The permit may specify alternative performance and design standards for the leachate system in Class I and II residual waste landfills. – Class I and II residual waste landfills must be equipped with a leachate-collection system meeting specified design and performance standards. The leachate-collection system must, among other things, ensure that the depth of leachate on or above the primary liner does not exceed 1 ft.	• Performance and design standards for leachate-detection zones in Class I and II residual waste disposal impoundments are specified. • Among other things, leachate detection zones must: – Be at least 12 in. thick, – Contain no particles that exceed 0.5 in., – Have a flow zone with a hydraulic conductivity of $\geq 1 \times 10^{-2}$ cm/s, – Function without clogging, – Withstand chemical attack from waste and leachate, and – Be monitored weekly. • A permit may specify alternative performance and design standards for the leachate system in Class I and II residual waste disposal impoundments. • Class I and II residual waste disposal impoundments must be equipped with a leachate-collection system that meets specified design and performance standards.
Texas	• Recommended by TCEQ, but not required by the regulations.	Not required by the regulations, but leak detection is recommended by TCEQ.

TABLE A.15 (Cont.)

State	Leachate-Collection System Requirements	
	Landfills	Surface Impoundments
Virginia	• A leachate-collection system consisting of a drainage layer ≥1 ft thick with a hydraulic conductivity of $\geq 1 \times 10^{-3}$ cm/s is required. • The leachate system must prevent the accumulation of more than a 1-ft head over the liner. • The leachate-storage impoundments must be lined with a synthetic component that provides protection at least equal to that of the landfill cell liner.	Established, as necessary, on a case-specific basis in water pollution control permits.
Wisconsin	• The leachate system shall prevent the accumulation of more than a 1-ft head over the liner. For fly ash or bottom ash landfills—alternative design: • Feasibility report required demonstrating that the landfill design meets or exceeds otherwise applicable location and performance standards.	Established, as necessary, on a case-specific basis in water pollution control permits.

TABLE A.16 Chronological Comparison of Leachate-Collection System Requirements for Landfills in Selected States

	Leachate-Collection System Requirements for Landfills		
State	EPA 1988	EPA 1999b	2005 Data
Alabama	No	NC	No, unless CCWs are co-disposed of with other industrial solid wastes.
Florida	Yes	NC	No specific requirements, but may be established in a permit or PPSA certification, as appropriate.
Georgia	No	NC	Yes, unless the landfill is a monofill and a demonstration has been made that the waste to be disposed of would not cause groundwater or surface water contamination.
Illinois	No[a]	NC[b]	Yes
Indiana	No	No, but may be used on case-specific basis to relax liner thickness	Types I, II, and III: No, but may be used on a case-specific basis to relax liner thickness. Type IV: No Nonmunicipal solid waste landfill: Yes
Missouri	May	NC	Utility waste landfill: Yes
Ohio	Not applicable	NC	Residual waste landfill: Yes
Pennsylvania	No	Class I: Yes Class II: Yes Class III: No	Class I: Yes Class II: Yes Class III: No
Texas	No	NC	Recommended by TCEQ, but not required.
Virginia	No	Yes	Yes
Wisconsin	May	Yes	Yes

[a] No = The source report indicates that State regulations do not impose leachate system requirements.

[b] NC = Not covered in the source report.

[c] Yes = The source report indicates that State regulations impose leachate system requirements.

[d] May = The source report indicates that the State regulations provide for a case-by-case decision on the need for leachate system requirements.

leachate-collection systems, and groundwater and surface water monitoring systems, provided the permit application demonstrates that the waste to be disposed of would not cause groundwater or surface water contamination. In the absence of a variance, industrial waste disposal facilities must demonstrate that their designs ensure that the concentrations in the uppermost aquifer at the relevant point of compliance do not exceed those listed in Table A.8 for the specified chemicals. Disposal facilities accepting wastes from more than one industrial source, unless the facility is a monofill, must meet all standards applicable to municipal solid waste landfills (GDNR Rule 391-3-4.07(4)).

The design standards for industrial waste landfills in Georgia do not apply to surface impoundments. However, best management practices are to be incorporated into NPDES permits and nonpoint-source discharge approval letters (GA Rule 391-3-6-.06(3)).

Illinois—Landfills that receive CCWs in Illinois must have leachate drainage, collection, and management systems designed and built to function for the operational life of the landfills. The drainage layer must cover the entire liner and maintain the leachate head above the liner below 1 ft. The leachate layer must be at least 1-ft thick and have a hydraulic conductivity of 1×10^{-3} cm/s (35 Ill. Adm. Code 811.307). Collection pipes must be designed for open-channel flow to convey leachate. Materials used in the system must be chemically resistant to the leachate expected to be produced. Collection pipes must be constructed within a coarse gravel envelope by the use of a graded filter or geotextile, as necessary, to minimize clogging (35 Ill. Adm. Code 811.308). A leachate-management system consisting of any combination of multiple treatment and storage structures must be designed and constructed as specified in the regulations (35 Ill. Adm. Code 811.309).

The leachate-collection system design standards for solid waste landfills in Illinois do not apply to surface impoundments (35 Ill. Adm. Code 810.103). However, a surface impoundment that receives CCWs in Illinois must have an NPDES permit or a construction/operating permit. In either case, leachate collection system requirements may be established in the permit, as necessary on a case-specific basis, to protect groundwater. The Illinois Environmental Protection Act prohibits any person from releasing contaminants to groundwater such that: (1) a groundwater-quality standard would be exceeded, (2) an existing or potential use would be precluded, or (3) treatment or additional treatment would be needed to continue an existing groundwater use or assure a potential future use (35 Ill. Adm. Code 620.301).

Indiana—Indiana regulations do not specify requirements for leachate-collection systems in landfills for any type of restricted waste site. However, if the owner/operator of such a landfill decides to include a leachate-collection system in the design of a Type I, II, or III restricted waste site, the design may be used to justify decreasing the otherwise required thickness of the soil liner (329 IAC 10-26-1(b)).

The Indiana regulations do not specify leachate-collection system requirements for surface impoundments. However, the IDEM may specify water pollution treatment/control permit conditions, as necessary, to assure that any pollutants released or threatened to be released by the unit into the environment will not cause or contribute to violations of applicable water

quality standards, or otherwise cause a significant adverse impact on the environment or the public health (327 IAC 3-4-3).

Missouri—Missouri regulations require that utility waste landfills install leachate-collection systems unless it has been demonstrated based on waste and site characteristics at a particular landfill that leachate collection is not needed (10 CSR 80-11.010(4)(B)8). Each leachate-collection system must be capable of maintaining less than 1 ft of leachate head on the liner. Construction materials must be chemically compatible with the leachate and possess sufficient strength to prevent collapse under the pressures anticipated. Leachate must flow by gravity to collection points. Material thickness, hydraulic conductivity, and particle size are determined on a case-specific basis

The design standards for utility waste landfills in Missouri do not apply to surface impoundments. A surface impoundment that receives CCWs is subject to the regulations in Missouri that establish design guides for wastewater treatment ponds (10 CSR 20-8.200). Leachate-collection systems are not specified for such ponds.

Ohio—Ohio regulations require installation of a leachate-collection system in new residual waste landfills (Classes I, II, III, and IV) and lateral expansion areas (OAC 3745-30-06(C) and -07(C)(3)). The leachate collection system must be designed to limit the level of leachate above the liner to 1 ft. Any granular material used as a drainage medium must have permeability of no less than 1×10^{-3} cm/s (OAC 3745-30-07(C)(3)). No leachate collection system is required in a monofill that receives only fly ash, bottom ash, or foundry sand determined by the State to be "nontoxic" (OAC 3745-30-02(F)).

Ohio regulations do not specify leachate system requirements for surface impoundments receiving industrial wastes, and the solid waste regulations applicable to residual waste landfills do not apply to such impoundments (OAC 3745-27-03(A)(8)). However, the OEPA has authority to specify liner and leachate system requirements on a case-specific basis in permits to install issued for surface impoundments. To obtain a permit to install, the applicant must demonstrate that the surface impoundment design will: (1) not prevent or interfere with the attainment or maintenance of applicable water quality standards; (2) not result in a violation of any applicable laws; and (3) employ the best available technology (OAC 3745-42-03 and -04).

Pennsylvania—Pennsylvania regulations require leachate detection zones in the disposal areas of Class I and Class II residual waste landfills (25 Pa. Code 288.435 and 288.534) and Class I and Class II residual waste disposal impoundments (25 Pa. Code 289.435 and 289.534). Weekly monitoring is required in the leachate-detection zones. In addition, Class I and II residual waste landfills and disposal impoundments must have leachate collection systems within their final protective covers (25 Pa. Code 288.438, 288.537, 289.438, and 289.537). However, in the case of impoundments, the PADEP may authorize a delay in activating the leachate-collection system in the cover until the unit is closed. Class III residual waste landfills are not required to have either leachate-detection zones or leachate-collection systems in their covers.

Texas—Texas has no specific regulations for leachate-collection systems in landfills or surface impoundments. However, there are general prohibitions in the Texas regulations on

(1) causing the discharge or imminent threat of discharge of industrial solid waste into or adjacent to waters of the State without authorization, (2) creating and maintaining a nuisance, and (3) endangering the public health and welfare. To foster compliance, the TCEQ has developed guidance documents, Technical Guideline Nos. 3 and 4, which recommend installation of leachate-collection systems at landfills and leak detection systems at surface impoundments (TCEQ 2004a and 2004b).

According to Technical Guideline No. 3, *Landfills*, TCEQ recommends that leachate-collection systems be installed over the membrane liners of landfills receiving Class 1 and Class 2 wastes to limit leachate depth to 1 ft or less. TCEQ recommends that the leachate-collection layer consist of at least 1 ft of sand or gravel with a hydraulic conductivity of at least 0.01 cm/s overlain by a fabric or granular filter layer, to prevent clogging.

Technical Guideline No. 4, *Nonhazardous Industrial Solid Waste Surface Impoundments*, recommends that a leak detection system be installed in any surface impoundment that receives Class II wastes and utilizes a geomembrane liner alone.

Virginia—An industrial solid waste landfill in Virginia must have a plan for leachate collection, storage, and treatment. A leachate-collection system must be placed above the landfill's top liner, and collected leachate must be stored such that it does not discharge to groundwater. Tanks or impoundments used for storage of leachate must be equipped with flow equalization and surge capacity at least equal to the maximum expected production of leachate over a 7-day period. A liner providing protection equal to that of the landfill's liner is required in any leachate-storage impoundments. At a minimum, such liners must have a synthetic component. Collected leachate must be transported or discharged to a permitted wastewater treatment facility, treated on-site, and discharged under a VPDES permit, or it must be recirculated within the landfill, provided that the irrigated area is lined (9 VAC 20-80-290)

Wisconsin—Nonmunicipal waste landfills in Wisconsin must be designed to contain and collect leachate to the maximum practical extent. The Wisconsin regulations establish standards that leachate systems for nonmunicipal waste landfills must meet, unless the WDNR approves an alternative design. The standards require that, among other things, a leachate-collection system be designed to (1) route leachate to the perimeter of the landfill in the most direct manner possible and (2) limit the average leachate head level on the liner to 1 ft or less. Other aspects of the leachate system for which standards are specified include the distance that leachate may flow across the base of the liner before encountering a perforated leachate-collection pipe, slope and diameter of leachate-collection pipes, shape and materials for leachate-collection trenches, trench backfill material, limitations on liner penetrations, sump design and capacity, leachate-transfer line design, and leachate-collection tank design.

Wisconsin regulations do not specify any leachate-collection system requirements for surface impoundments, unless the impoundment must have a solid waste operating license. In that case, leachate collection-requirements would be the same as those for landfills.

A.7 CLOSURE/POST-CLOSURE REQUIREMENTS IN THE PILOT STATES

A.7.1 Summary

Closure controls may be required to prevent post-closure migration of contaminants out of a CCW land disposal facility via surface water pathways or leaching to groundwater. If closure controls are required, specifications may address cover system design requirements (i.e., caps), cover material and thickness, and maximum hydraulic conductivity of the cover. Table A.17 summarizes the closure/post-closure requirements for landfills and surface impoundments in the five pilot States of Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin. Additional details are provided in Section A.7.3.

A.7.2 Chronological Comparison of Closure/Post-Closure Requirements for Landfills in Pilot States

Table A.18 compares the findings regarding closure/post-closure requirements for landfills that receive CCWs in the five pilot States ("2005 Data") with the closure/post-closure requirements for CCW landfills reported in EPA 1988 and EPA 1999a.

A.7.3 State-Specific Discussion of Closure and Post-Closure Care Requirements

Illinois—Within 60 days after placement of the final waste volume, a cap must be installed over the entire surface of the landfill. The cap must consist of one of the following:

- Compacted earth at least 3 ft thick having a hydraulic conductivity of no more than 1.0×10^{-7} cm/s;
- Geomembrane capable of performance equal to that of a compacted earthen cap, or
- Any other cap demonstrated to have performed equally as well as or better than a compacted earthen cap.

The owner/operator must prepare and maintain a written closure plan. Final slopes and contours must be designed to complement and blend with the surrounding topography of the proposed final land use of the area, and the final configuration should minimize further maintenance. Quarterly inspections of vegetated areas are required for at least 5 years after closure. Thereafter, annual inspections are required until either 15 years have passed or settling and erosion have stopped, whichever occurs first. Groundwater monitoring also must continue for a minimum period of 15 years after closure (35 Ill. Adm. Code 811.110, 111, and 314).

TABLE A.17 Summary of Closure/Post-Closure Requirements for CCW Management Units in the Pilot States

State	Closure/Post-Closure Requirements: Landfills	Closure/Post-Closure Requirements: Surface Impoundments
Illinois	• Within 60 days after placement of the final waste volume, a cap must be installed over the entire surface of the landfill. • The cap must consist of one of the following: – Compacted earth at least 3 ft thick having a hydraulic conductivity of no more than 1×10^{-7} cm/s, – Geomembrane capable of performance equal to that of a compacted earth cap, OR – Any other cap demonstrated to have performed as well as or better than a compacted earthen cap. • The owner/operator must prepare and maintain a written closure plan. • Quarterly inspections are required for a minimum of 5 years after closure.	Established, as necessary, on a case-specific basis in NPDES or construction/operating permits.
Indiana	Type I restricted waste sites and nonmunicipal solid waste landfills: • A closure plan is required, and closure must comply with following requirements: – Apply and compact >2 ft of final cover: ▪ Within 180 days of receiving final waste volume, or ▪ When any area within the site is filled to its approved elevation. – Apply 6 in. of topsoil over the final cover to establish vegetation. • A post-closure care plan is required. Type II restricted waste sites: • A closure plan is required, and closure must comply with the following requirements: – Apply and compact > 2 ft of final cover within 180 days after: ▪ Solid waste has not been disposed of for 1 year, OR ▪ Any area within the site is filled to its approved elevation. • A post-closure care plan is required. Type III restricted waste sites: • A closure plan is required, and closure must comply with the following requirements: – Apply and compact final cover ≥ 2 ft within 1 year of when an area is filled to its approved elevation. • A post-closure care plan is required. Type IV restricted waste sites: There are no closure or post-closure requirements.	Established, as necessary, on a case-specific basis in water pollution control permits.

TABLE A.17 (Cont.)

State	Closure/Post-Closure Requirements: Landfills	Closure/Post-Closure Requirements: Surface Impoundments
Pennsylvania	• A cap at least 2 ft thick having a hydraulic conductivity of no more than 1×10^{-7} cm/s is required over the entire surface of a residual waste landfill within 1 year after disposal ceases. • The owner/operator must implement an approved closure plan and an approved post-closure land use plan.	• A cap that is at least 2 ft thick having a hydraulic conductivity of no more than 1×10^{-7}cm/s is required over the entire surface of a residual waste disposal impoundment within 1 year after disposal ceases. • The owner/operator must implement a closure plan and a post-closure land use plan.
Virginia	• A final cover system is required. It must have a – Hydraulic conductivity of no more than 1×10^{-5} cm/s and – Layer of earth at least 6 in. thick capable of supporting vegetation. • A post-closure care plan is required that provides for: – Groundwater monitoring, – Leachate-system maintenance, and – Final cover maintenance.	All liquids, wastes, and system components must be removed. If removal is not done, the surface impoundment becomes subject to the closure and post-closure care standards for nonhazardous industrial waste units, unless closure requirements have already been established in a Virginia pollution abatement permit or VPDES permit.
Wisconsin	• Closure requirements are specified that include, among other things: – A final cover consisting of at least 2 ft of compacted earth having a hydraulic conductivity of no more than 1×10^{-5} cm/s, – Final grades sloped adequately to promote storm-water runoff and prevent storm-water run-on, and – Implementation of a long-term care schedule.	Established, as necessary, on a case-specific basis in water control permits.

TABLE A.18 Chronological Comparison of Closure/Post-Closure Requirements for CCW Management Units in the Pilot States

	Closure/Post-Closure Care Requirements for Landfills		
State	EPA 1988	EPA 1999b	2005 Data
Illinois	Yes[a]	NC[b]	Yes
Indiana	No[c]	Type I: Yes Type II: Yes Type III: Yes Type IV: No	Type I: Yes Type II: Yes Type III: Yes Type IV: No Nonmunicipal solid waste landfill: Yes
Pennsylvania	Yes	Class I: Yes Class II: Yes Class III: Yes	Class I: Yes Class II: Yes Class III: Yes
Virginia	No	Yes	Yes
Wisconsin	Yes	Yes	Yes

[a] Yes = The source report indicates that State regulations impose closure/post-closure care system requirements.

[b] NC = Not covered in the source report.

[c] No = The source report indicates that State regulations do not impose closure/post-closure care system requirements.

A surface impoundment that receives CCWs in Illinois is regulated as a wastewater facility and must have an NPDES permit or a construction/operating permit; however, as a general rule, it is not required to have a solid waste permit or to abide by the design requirements applicable to industrial waste landfills. However, if the surface impoundment decides to undergo closure with waste in place, the standards for solid waste landfills would apply to the closure (including, among others, requirements for capping, inspections, and groundwater monitoring) (IEPA 2005). The need for permit provisions to address this contingency would be decided on a case-specific basis.

Indiana—The Indiana regulations require Type I and II restricted waste sites and nonmunicipal solid waste landfills to be closed in a manner that (1) minimizes the need for further maintenance and controls; (2) minimizes post-closure escape of waste, waste constituents, leachate, contaminated precipitation, and waste decomposition products to the groundwater, surface water, or atmosphere; and (3) is in compliance with applicable closure provisions and conditions imposed in the facility permit. Technical design requirements specify that a final cover consisting of at least 2 ft of clay-type soils be applied and compacted over closed areas. In addition, at least 6 in. of topsoil must be placed over the clay, and vegetation must be established (329 IAC 10-30-1 to 10-30-7; 329 IAC 10-31-1 to 10-31-7).

Type III restricted waste sites in Indiana must also meet the three-part performance standard for closure mentioned in the paragraph above, and must apply and compact 2 ft of soil as a final cover (329 IAC 10-32).

The Indiana regulations do not establish requirements for closure or post-closure of Type IV restricted waste facilities.

The Indiana regulations also do not specify closure or post-closure requirements for surface impoundments being regulated as water pollution treatment/control facilities. Units that obtain water pollution treatment/control permits are expressly exempt from the Indiana solid waste permitting and regulatory program. However, the IDEM may specify conditions, as necessary, in water pollution treatment/control facility permits to assure that any pollutants released or threatened to be released by the unit into the environment will not cause or contribute to violations of applicable water quality standards or otherwise cause a significant adverse impact on the environment or public health (327 IAC 3-4-3).

Pennsylvania—A cap having a hydraulic conductivity of no more than 1.0×10^{-7} cm/s is required over the entire surface of a residual waste landfill or disposal impoundment within 1 year after disposal ceases. Vegetation must be established over at least 70% of the capped area. The owner/operator must implement a closure plan and a post-closure land use plan approved by PADEP. At least 180 days before implementation of a closure plan, the owner/operator must review its approved closure plan to determine whether the plan requires modification and submit proposed changes to PADEP for approval. If groundwater degradation exists at or after closure, an approved abatement plan must be implemented, or an application for a closure plan modification must be filed, and remediation standards that meet final closure certification requirements must be selected (25 Pa. Code 288.234, 236, 291, and 292 for landfills; 25 Pa. Code 289.242, 244, 311, and 312 for disposal impoundments).

Virginia—All industrial waste landfills must have a final cover system to accomplish the following:

- Minimize the need for further maintenance,
- Control the escape of leachate and surface runoff,
- Limit hydraulic conductivity through the infiltration layer to whichever is lower, 1×10^{-5} cm/s or the hydraulic conductivity of the landfill's bottom liner, and
- Maintain a 6-in. layer of earth capable of supporting vegetation over the infiltration layer for erosion control (9 VAC 20-80-270.E).

Verification of closure for an industrial waste landfill must be certified by a registered professional engineer. Following closure, a sign must be posted at the facility entrance, the location and dimensions of disposal areas must be recorded on a survey plot and submitted to the

local land recording authority, and a notation must be placed on the deed to the facility property (9 VAC 20-80-270.E).

An industrial waste landfill in Virginia is required to have a post-closure care plan and conduct post-closure care activities for 10 years after closure or for as long as leachate is generated. During the post-closure care period, groundwater monitoring must be conducted, the leachate system must be maintained and operated, and the integrity of the final cover must be maintained (9 VAC 20-80-270.F).

The owner or operator of an industrial wastewater treatment impoundment must remove all waste residue, contaminated containment system components (liners, etc.), and contaminated subsoils, and it must decontaminate structures and equipment contaminated with waste, and manage them as solid waste or hazardous waste, if applicable, unless a Virginia pollution abatement permit or VPDES permit contains conditions establishing alternative closure requirements. If the owner or operator decides to close the impoundment with waste in place, then the impoundment must be closed in accordance with the requirements for closure of a landfill (including the elimination of free liquids by removing liquid waste and waste residue, the monitoring of groundwater, the stabilization of remaining waste residues to a bearing capacity sufficient to support the final cover, and the installation of a final cover), and post-closure care must be provided as it is for a landfill (9 VAC 20-80-380).

Wisconsin—The owner of any industrial waste landfill is responsible for its closure, any remedial actions required by WDNR, and its perpetual long-term care.

A plan outlining the proposed method of abandonment for lagoons that will no longer be used must be approved by the WDNR. This plan must contain a procedure to identify the presence and characteristics of any accumulated solid waste and provide appropriate removal, disposal, or recycling or treatment alternatives. The plan also must address site restoration, and groundwater monitoring may be required to assess groundwater impacts (NR 213.07).

A.8 CORRECTIVE ACTION REQUIREMENTS IN THE PILOT STATES

A.8.1 Summary

Corrective action may be needed to contain and clean up a CCW land disposal facility and eliminate the future potential for migration of contaminants out of it via aboveground pathways or leaching to groundwater. Table A.19 summarizes the corrective action requirements for landfills and surface impoundments in the five pilot States of Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin. Additional details are provided in Section A.8.3.

TABLE A.19 Summary of Corrective Action Requirements for CCW Management Units in the Pilot States

State	Corrective Action Requirements	
	Landfills	Surface Impoundments
Illinois	When assessment monitoring is triggered, a remedial action plan is required. Once implemented, the remedial action program must continue until monitoring shows that the concentrations of all monitored constituents have returned to acceptable levels over a period of four consecutive quarters.	Established, as necessary, on a case-specific basis in NPDES or construction/operating permits.
Indiana	Type I and II restrictive waste sites and nonmunicipal solid waste landfills: A corrective action program is required whenever the groundwater-protection standard is exceeded at statistically significant levels. A corrective action program may be required at the discretion of the IDEM if any secondary groundwater-monitoring standard is exceeded. Type III and IV restrictive waste sites: There are no corrective action requirements.	Established, as necessary, on a case-specific basis in water pollution control permits.
Pennsylvania	The regulations include triggers for groundwater assessment and pollution abatement.	The regulations include triggers for groundwater assessment and pollution abatement.
Virginia	Corrective action must be initiated whenever a groundwater protection standard is exceeded at statistically significant levels.	None are specified in the Virginia regulations.
Wisconsin	Corrective action is required if concentration levels in groundwater for constituents of concern exceed enforcement standards outside the design management zone.	Established, as necessary, on a case-specific basis in water control permits.

A.8.2 Chronological Comparison of Corrective Action Requirements for Landfills in Pilot States

A chronological comparison was not possible for corrective action requirements for landfills because EPA 1988 and EPA 1999b did not address this area of regulatory control.

A.8.3 State-Specific Discussion of Corrective Action Requirements

Illinois—If assessment monitoring is triggered at a landfill that receives CCWs, other than a municipal solid waste landfill, the owner/operator must submit plans for remedial action to the IEPA. The remedial action program must consist of one or a combination of the following solutions:

- Retrofit additional groundwater protective measures within the unit;
- Construct an additional hydraulic barrier, such as a cutoff wall or slurry wall system;
- Pump and treat the contaminated groundwater; or
- Use any other equivalent technique that will prevent further contamination of groundwater (35 Ill. Adm. Code 811.319(d)).

The remedial action program must continue until groundwater monitoring shows that the concentrations of all monitored constituents have returned to acceptable levels over a period of four consecutive quarters (35 Ill. Adm. Code 811.319(d)).

A surface impoundment that receives CCWs in Illinois is regulated as a wastewater facility and must have an NPDES permit or a construction/operating permit; however, as a general rule, it is not required to have a solid waste permit or abide by the design requirements applicable to industrial waste landfills. However, if the surface impoundment would undergo closure with waste in place, the standards for solid waste landfills would apply to the closure (including requirements for capping, inspections, and groundwater monitoring) (IEPA 2005). The need for permit provisions to address this contingency would be decided on a case-specific basis. The need for corrective action requirements in permits would also be decided on a case-specific basis.

Indiana—A corrective action program is required for Type I and II restricted waste sites and for nonmunicipal solid waste landfills whenever the groundwater protection standard is exceeded. In addition, the IDEM has discretion to require corrective action if any of the secondary standards exceed specified levels. Monitoring is required to determine the areal extent of any plume of contamination that exceeds background levels and to demonstrate corrective action effectiveness. Corrective actions that may be imposed include notifying people who own or reside on land overlying a plume and replacing currently used sources of groundwater lying in

the plume (329 IAC 10-29-9). The Indiana regulations establish no corrective action requirements for Type III and IV restricted waste sites.

The Indiana regulations do not specify corrective action requirements for surface impoundments. However, the IDEM may specify conditions in a water pollution control permit, as necessary, to assure that any pollutants released or threatened to be released by the unit into the environment will not cause or contribute to violations of applicable water quality standards or otherwise cause a significant adverse impact on the environment or the public health (327 IAC 3-4-3).

Pennsylvania—The Pennsylvania regulations include triggers for groundwater assessment and pollution abatement at residual waste landfills and disposal impoundments. (25 Pa. Code 288.256 and 257 for landfills; 25 Pa. Code 289.266 and 267 for disposal impoundments).

Virginia—A corrective action program is required whenever the groundwater protection-standard at an industrial waste landfill in Virginia is exceeded at statistically significant levels. The owner or operator must propose a groundwater-protection standard for all detected constituents listed in Table 5.1 of 9 VAC 20-80-300. The groundwater-protection standard for a constituent is the MCL if one has been promulgated. In the absence of a promulgated MCL, the groundwater-protection standard for a constituent is the background concentration, as approved by the regulator and established on the basis of data from the upgradient wells. If the background level for a constituent is higher than its MCL or health-based levels, the background concentration becomes the groundwater-protection standard for the constituent, as approved by the regulator. The regulator may establish an alternate concentration level as a groundwater protection standard for any constituents for which MCLs have not been established or for which site-specific background data are unavailable by granting a variance based on a petition submitted by the owner or operator in accordance with 9 VAC 20-80-760.

The Virginia regulations specify no corrective action requirements for industrial waste surface impoundments.

Wisconsin—If a PAL, alternative concentration limit (ACL), or enforcement standard (ES) is attained or exceeded at a landfill in Wisconsin, the owner or operator must notify WDNR and may be required to develop a site investigation work plan and report and a remedial action plan and to implement remedial action.

Wisconsin regulations do not specify corrective action requirements for lagoons that are not required to have solid waste operating licenses. However, as previously reported, a plan outlining the proposed method of abandonment for such lagoons that will no longer be used must be approved by WDNR. The plan must address site restoration.

A.9 SITING CONTROLS IN THE PILOT STATES

A.9.1 Summary

Siting controls place restrictions on the location of landfills and surface impoundments used for waste storage and disposal. Examples of siting controls include restrictions on disposal below the natural water table; restrictions on locating a unit within a floodplain, within a wetland, near a fault, or in a seismic impact zone; and standards for locating a unit in unstable areas. Table A.20 summarizes the siting controls for landfills and surface impoundments in the five pilot States of Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin. Additional details are provided in Section A.9.3.

A.9.2 Chronological Comparison of Siting Controls for Landfills in the Pilot States

Table A.21 compares the findings regarding siting controls for landfills that receive CCWs in the five pilot States ("2005 Data") with the siting controls for CCW landfills reported in EPA 1988 and EPA 1999b.

A.9.3 State-Specific Discussion of Siting Controls

Illinois—Landfills that accept CCWs designated as either declassified or special (non-RCRA) wastes must not restrict the flow of a 100-year flood or violate any State or Federal environmental law. No part of a unit may be located within a setback zone; recharge zone; or within 1,200 ft, vertically or horizontally, of a sole-source aquifer, unless there is a stratum between the bottom of the waste disposal unit and the top of the aquifer that meets stipulated minimum requirements. Without prior written permission, no part of a unit may be located closer than 500 ft from an occupied dwelling, school, or hospital that was occupied at the time the operator applied for a permit (35 Ill. Adm. Code 811.102 and 811.302).

Indiana—Type I and II restricted waste sites and nonmunicipal solid waste landfills in Indiana must not be located within wetlands; critical habitats; floodways; floodplains; karst areas; areas that overlie mines; areas closer than 600 ft from wells, dwellings, and surface water; and areas closer than 50 ft from the disposal facility boundary. The Indiana regulations contain similar location limitations for Type III restricted waste sites. However, there are no limitations on locating Type III residual waste sites in floodplains, areas near dwellings, or areas near surface water bodies. Type IV restricted waste sites are subject to limitations on disposal within wetlands, critical habitats, floodways, standing water that reflects the level of the water table, karst areas, areas that overlie mines, and areas within 600 ft of wells (329 IAC 10-25-1 for Types I and II; 329 IAC 10-33-1 for Type III; 329 IAC 10-9-4 for Type IV).

Surface impoundments that Indiana regulates as water pollution treatment/control facilities must not be constructed within 500 ft of a dwelling, unless the owner of the dwelling

TABLE A.20 Summary of Siting Controls for CCW Management Units in the Pilot States

State	Siting Controls	
	Landfills	Surface Impoundments
Illinois	• Distance restrictions are applicable with respect to sole-source aquifers, occupied dwellings, schools, and hospitals. • Location is prohibited where it would (1) be within the setback zone or recharge zone of a sole source aquifer, (2) restrict the flow of a 100-year flood, or (3) violate a State or Federal environmental law.	Established, as necessary, on a case-specific basis in NPDES or construction/operating permits.
Indiana	Type I and II restricted waste sites: • Location is prohibited within wetlands, critical habitats, floodways, floodplains, karst areas,[a] and areas that overlie mines. • Distance restrictions are applicable with respect to wells, dwellings, surface water, and the disposal facility boundary. Type III restricted waste areas: • Restrictions apply to disposal within wetlands, critical habitats, floodways, karst areas,[a] and areas that overlie mines. • Distance restrictions apply with respect to wells and the disposal facility property boundary. Type IV restricted waste sites: Restrictions apply to disposal within wetlands, critical habitats, floodways, standing water that reflects the level of the water table, karst areas, and areas that overlie mines. Distance restrictions apply with respect to wells and the disposal facility property boundary. Nonmunicipal solid waste landfills: Controls are the same as those for Type I and II restricted waste sites, plus there are distance restrictions with respect to public water supply wells.	Established, as necessary, on a case-specific basis in water pollution control permits.

TABLE A.20 (Cont.)

State	Siting Controls	
	Landfills	Surface Impoundments
Pennsylvania	• All residual waste landfills are subject to distance restrictions with respect to the 100-year floodplain, wetlands, perennial streams, property boundaries, private water sources, occupied dwellings, schools, parks, and playgrounds. – Location over certain coal deposits and limestone or carbonate formations is restricted. • A coal ash monofill must be located in a previously mined but unreclaimed area, unless the operator of the monofill provides a detailed written explanation in the permit application of why it is not feasible to locate the facility in such an area.	• All residual waste disposal impoundments are subject to distance restrictions with respect to the 100-year floodplain, wetlands, perennial streams, property boundaries, private water sources, occupied dwellings, schools, parks, and playgrounds. – Location over certain coal deposits and limestone or carbonate formations is restricted.
Virginia	Industrial landfills are subject to location restrictions on the basis of flooding potential; geological stability; and proximity to surface water, underground sources of drinking water, roadways, residences, schools, parks, and facility boundaries.	No restrictions are specified in the Virginia regulations.
Wisconsin	Industrial solid waste landfills are subject to distance restrictions with respect to navigable waters, floodplains, major highways, public parks, water supply wells, certain faults, seismic impact zones, unstable areas, wetlands, and critical habitat areas.	Lagoons not licensed as solid waste disposal facilities are subject to distance restrictions with respect to public water supply wells, other potable water supplies, inhabited dwellings, floodways, wetlands, and groundwater tables.

[a] Karst areas consist of regions underlain by limestone or other readily soluble rocks causing characteristic physiographic features such as, but not limited to, sinkholes, sinking streams, blind valleys, caves, and large springs. Generally, karst areas are characterized by high fluid transmissivity values and predominant fracture flow.

TABLE A.21 Chronological Comparison of Siting Controls for Landfills in Selected States

State	Siting Controls for Landfills		
	EPA 1988	EPA 1999b	2005 Data
Illinois	No[a]	NC[b]	Yes[c]
Indiana	No	Type I: Yes Type II: Yes Type III: Yes Type IV: Yes	Type I: Yes Type II: Yes Type III: Yes Type IV: Yes Nonmunicipal solid waste landfills: Yes
Pennsylvania	Yes	NC	Yes
Virginia	No	NC	Yes
Wisconsin	Yes	NC	Yes

[a] No = The source report indicates that State regulations do not impose siting controls.

[b] NC = Not covered by the source report.

[c] Yes = The source report indicates that State regulations impose siting controls.

agrees to a closer separation and records the agreement as an easement in the county property records or the dwelling is an office located on the surface impoundment property and occupied by the surface impoundment owner (327 IAC 3-2-6). This is the only siting location requirement applicable to surface impoundments that may receive CCWs for storage or disposal in Indiana.

Pennsylvania—In Pennsylvania, a coal ash monofill must be located in an area that has been previously mined but not reclaimed, unless the operator provides a detailed written explanation in the permit application of why locating the facility in such an area is not feasible (25 Pa. Code 288.201(e)). Class I, II, and III residual waste landfills and Class I and II residual waste disposal impoundments (25 Pa Code 288.422, 522, and 622 for landfills; 25 Pa. Code 289.422 and 522 for disposal impoundments) cannot be sited:

- Within the 100-year floodplain of any State waters;
- Within 300 ft of an exceptional value wetland;
- Within 100 ft of a wetland other than an exceptional value wetland, unless certain conditions exist;
- Over mineable or recoverable coal, unless the owner/operator owns the underlying coal;

- In areas that would result in elimination, pollution, or destruction of a portion of a perennial stream, unless rechanneling is approved;

- In certain areas underlain by limestone and carbonate formations;

- Within certain distances of an occupied dwelling, unless the dwelling owner signs a written waiver and other conditions are met;

- Within 100 ft of a perennial stream, except under certain conditions;

- Within 100 ft of a property line, except under certain conditions;

- Within 0.25 mi upgradient or 300 ft downgradient of a private water source, except under certain conditions; and

- Within 300 yards of a school, park, or playground, except under certain conditions.

A waiver for some of the siting restrictions mentioned above may be granted to captive landfills and disposal impoundments under certain conditions.

Virginia—Industrial landfills in Virginia (9 VAC 20-80-270A) are not to be sited:

- In areas subject to base floods;

- In geologically unstable areas;

- Within 100 ft of regularly flowing surface water;

- Within 500 ft of a underground source of drinking water;

- Within 1,000 ft of any primary highway or 500 ft of any other highway, unless the landfill is not visible from the roadway or the area has been zoned for industrial use;

- Within 200 ft of a residence, school, or park; and

- Within 50 ft of the facility boundary.

In addition, landfill sites must be big enough and have terrain that will allow for management of leachate. New industrial landfills and lateral expansions of existing facilities cannot be located in wetlands or areas where groundwater monitoring cannot be conducted. Certain site characteristics may also prevent approval or require substantial limitations on the site use or require incorporation of sound engineering controls.

The Virginia regulations specify no siting controls for industrial waste surface impoundments.

Wisconsin—Any person intending to establish a new landfill or expand an existing landfill must have an initial site report from WDNR. A feasibility report discussing constraints for development is required to determine whether a proposed property has potential for use as a landfill and to identify any conditions that must be addressed in the operating plan. Areas to be covered include location criteria, performance standards, and geotechnical information. Landfills (NR 504.04) are not to be sited:

- Within 1,000 ft of a navigable lake, pond, or flowage;
- Within 300 ft of any navigable river or stream;
- Within a floodplain;
- Within 1,000 ft of a primary State or Federal highway or interstate right-of-way, or the boundary of a public park, unless screened from view;
- Within 1,200 ft of any water supply well;
- Within 200 ft of a fault that has had displacement in Holocene time;
- Within any seismic impact zone;
- Within any unstable area; and
- Where there is a reasonable probability that it will:
  - Impact critical habitat areas significantly,
  - Impact wetland significantly,
  - Detrimentally affect surface water, or
  - Detrimentally affect groundwater quality.

WDNR may grant an exemption to these siting restrictions on the basis of a demonstration that the circumstances warrant it (NR 504.04(1)).

Wisconsin regulations applicable to lagoons that are not licensed as solid waste disposal facilities stipulate that such lagoons may not be located within (1) 1,000 ft of a well serving a community public water supply system, (2) 250 ft of other potable water supplies, or (3) 500 ft of an inhabited dwelling. Additionally, lagoons cannot be placed in a floodway or in a wetland. A separation of 5 ft or more is required between the bottom of the lagoon and either bedrock or the groundwater table, whichever is higher.

A.10 FINANCIAL ASSURANCE REQUIREMENTS IN THE PILOT STATES

A.10.1 Summary

Financial assurance may be required to protect future generations by helping ensure adequate planning for future costs of closure, post-closure care, and corrective action. Table A.22 summarizes the financial assurance requirements for landfills and surface impoundments in the five pilot States of Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin. Additional details are provided in Section A.10.3.

A.10.2 Chronological Comparison of Financial Assurance Requirements for Landfills in the Pilot States

Table A.23 compares the findings regarding financial assurance requirements for landfills that receive CCWs in the five pilot States ("2005 Data") with the financial assurance requirements for CCW landfills reported in EPA 1988 and EPA 1999b.

TABLE A.22 Summary of Financial Assurance Requirements for CCW Management Units in the Pilot States

	Financial Assurance Requirements	
State	Landfills	Surface Impoundments
Illinois	Yes[a]	No,[b] unless the surface impoundment will be closed with waste in place.
Indiana	Yes	No
Pennsylvania	Yes	Yes
Virginia	Yes	No, unless the surface impoundment is regulated as a waste management facility.
Wisconsin	Yes	No, unless a solid waste operating permit is required or the impoundment will be used for ultimate disposal of solid waste.

[a] "Yes" means the State regulations reviewed for this study impose financial assurance requirements on CCW disposal facilities.

[b] "No" means the State regulations reviewed for this study do not impose financial assurance requirements on CCW disposal facilities.

TABLE A.23 Chronological Comparison of Financial Assurance Requirements for Landfills in the Pilot States

	Financial Assurance Requirements for Landfills		
State	EPA 1988	EPA 1999b	2005 Data
Illinois	Yes[a]	NC[b]	Yes
Indiana	No	NC	Yes
Pennsylvania	Yes	NC	Yes
Virginia	No	NC	Yes
Wisconsin	Yes	NC	Yes

[a] Yes = The source report indicates that State regulations impose financial assurance requirements.

[b] NC = Not covered by the source report.

[c] No = The source report indicates that State regulations do not impose financial assurance requirements.

A.10.3 State-Specific Discussion of Financial Assurance Requirements

Illinois—Financial assurance may be provided for landfills in Illinois by a trust agreement, a bond guaranteeing payment, a bond guaranteeing either payment or performance, a letter of credit, insurance, or self-insurance (35 Ill. Adm. Code 811.700).

Illinois regulations do not specify financial assurance requirements for surface impoundments, but if a surface impoundment will be closed with waste in place, the regulatory agency may decide on a case-specific basis to include financial assurance requirements in the NPDES or construction/operating permits.

Indiana—All solid waste land disposal facilities that are required to have solid waste disposal permits in Indiana must provide financial responsibility for implementing closure and post-closure requirements (329 IAC 10-39-1). The Indiana regulations exclude ash ponds that receive water-transported coal ash from the requirement to have solid waste disposal permits (329 IAC 10-3-1(8)). Accordingly, such surface impoundments are not subject to the financial assurance requirements that apply to solid waste disposal facilities. The Indiana regulations do not specify financial assurance requirements for surface impoundments that receive other types of CCWs.

Pennsylvania—Regulations provide minimum requirements for demonstrating sufficient financial responsibility for the operation of residual waste processing or disposal facilities by providing for bond guarantees for the operation of the facilities, and by providing for minimum standards for insurance protection for personal injury and property damage to third parties arising from the operation of those facilities (25 Pa. Code 287.301 through 287.375).

Virginia—The owner/operator of an industrial waste landfill in Virginia must have one or a combination of the financial responsibility mechanisms described in 9 VAC 20-70. The amount of financial assurance obtained must be equal to a cost estimate approved by the VDEQ using specified procedures.

Virginia regulations do not specify financial assurance requirements for surface impoundments that are not required to have a solid waste management permit.

Wisconsin—The owner of any landfill in Wisconsin is responsible for its closure, for any remedial actions required by WDNR, and for its perpetual long-term care. Owners of landfills or other solid waste facilities must provide proof of financial responsibility as part of their operating license applications and once a year during the active facility life, or longer, if necessary to ensure compliance with closure, long-term care, or remedial actions.

Wisconsin regulations do not specify financial assurance requirements for lagoons not required to have solid waste operating licenses.

A.11 ADDITIONAL INFORMATION FROM PILOT STUDY

In addition to documenting the information on how the five States in the pilot study address the nine regulatory categories, the pilot study documented, to the extent possible and in the time available, State responses to the following questions:

- Does the State have a regulatory program dedicated solely to CCWs?
- Is the State authorized to implement an NPDES permitting program?
- What is the effective date of the regulation or regulatory program applicable to CCW land disposal units?
- What State agency is responsible for the regulation or regulatory program applicable to CCW land disposal units?
- Do the regulations contain grandfather provisions?
- Is public involvement required in permitting CCW land disposal units?

The responses to these questions are summarized in Table A.24 for landfills and Table A.25 for surface impoundments. The responses to these questions were not documented for the six additional States not covered by the pilot study.

TABLE A.24 Summary of Additional Information Collected for Landfills in the Pilot States

State	Program Dedicated Solely to CCW	NPDES Authorization	Effective Date of Regulations	Responsible State Agency	Grandfather Provisions	Public Involvement
Illinois	No	Yes	NF[a]	IEPA Bureau of Land, Division of Land Pollution Control	Yes	No
Indiana	No	Yes	NF	IDEM Office of Land Quality	Yes	Yes
Pennsylvania	Yes	Yes	July 4, 1992	PADEP Division of Municipal and Residual Waste	Yes	Yes
Virginia	Yes	Yes	NF	VDEQ	Yes	Yes
Wisconsin	No	Yes	1988	WDNR Division of Air and Waste	Yes	No

[a] NF = Not found.

TABLE A.25 Summary of Additional Information Collected for Surface Impoundments in the Pilot States

State	Program Dedicated Solely to CCW	NPDES Authorization	Effective Date of Regulations	Responsible State Agency	Grandfather Provisions	Public Involvement
Illinois	No	Yes	NF[a]	IEPA Bureau of Water	NF	Yes
Indiana	No	Yes	NF	IDEM Office of Water Quality	NF	Yes
Pennsylvania	Yes	Yes	July 4, 1992	PADEP Division of Municipal and Residual Waste and Bureau of Water Supply and Wastewater Management	Yes	Yes
Virginia	Yes	Yes	NF	VDEQ	No	Yes
Wisconsin	No	Yes	NF	WDNR Division of Water	Yes	Yes

[a] NF = Not found.

A.12 FINDINGS

Table A.26 summarizes the chronological comparisons of regulatory controls for landfills in the States reviewed. As the table indicates, a total of 11 States—Alabama, Florida, Georgia, Illinois, Indiana, Missouri, Ohio, Pennsylvania, Texas, Virginia, and Wisconsin—were reviewed for regulatory designation of CCWs for disposal, permitting requirements, liner requirements, groundwater-monitoring requirements, and leachate-collection system requirements. Five of the 11 States (i.e., the pilot study States)—Illinois, Indiana, Pennsylvania, Virginia, and Wisconsin—were also reviewed for closure and post-closure requirements, corrective action requirements, siting controls, and financial assurance.

The footnotes in Table A.26 define the terms used in the table to describe the types of change observed during three time periods—the period between collection of data for the 1988 RTC (EPA 1988) and collection of data for the 1999 RTC (EPA 1999b), the period between collection of data for the 1999 RTC and collection of data for this report (i.e., 2005), and the period between collection of data for the 1988 RTC and 2005. "Neutral" means that either it could not be ascertained from the information reviewed whether any change occurred during the time frame indicated, or the information reviewed suggests that no change occurred. For the periods between the 1988 RTC and the 1999 RTC and between the 1999 RTC and 2005, Table A.27 summarizes the States having "neutral" changes in each area of regulatory control based on Table A.26.

The data in Table A.27 suggest that the absence in the 1999 RTC and its supporting technical documents of details about regulatory controls in most individual States made it difficult to ascertain whether regulatory changes occurred before or after data were collected for the 1999 RTC for most of the States reviewed. However, for the overall period between the 1988 RTC and 2005, the types of change observed for most States were either "tightened" or "relaxed," rather than "neutral." Therefore, from the overall data it was confirmed that regulation of landfill liners, leachate-collection systems, and groundwater monitoring tightened in most States reviewed during the period between the collection of data for the 1988 RTC and 2005.

TABLE A.26 Summary of Chronological Comparisons of Regulatory Controls for Landfills in the States Reviewed[a]

Description of Change	Type of Change	States with Change from EPA 1988 to EPA 1999		States with Change from EPA 1999 to 2005 Data		States with Change from EPA 1988 to 2005 Data	
		No.	Name	No.	Name	No.	Name
REGULATORY DESIGNATION OF CCWS FOR DISPOSAL							
Exempt to Graded[b]	Tightened[c]	0		0		1	OH
Solid waste (SW) to Graded	Tightened	3	IN, PA, TX	1	WI	6	IL, IN, MO, PA, TX, WI
	Total Tightened	**3**	**IN, PA, TX**	**1**	**WI**	**7**	**IL, IN, MO, OH, PA, TX, WI**
Uncertain[d]	Neutral[e]	4	AL, IL, MO, OH	4	AL, IL, MO, OH	0	
SW to SW	Neutral	4	FL, GA, VA, WI	3	FL, GA, VA	3	FL, GA, VA
Graded to Graded	Neutral	0		3	IN, PA, TX	0	
	Total Neutral	**8**	**AL, FL, GA, IL, MO, OH, VA, WI**	**10**	**AL, FL, GA, IL, IN, MO, OH, PA, TX, VA**	**3**	**FL, GA, VA**
SW to Excluded	Relaxed[f]	0		0		1	AL
	Total Relaxed	**0**		**0**		**1**	**AL**
PERMITTING							
(On-site and off-site)[g] to (On-site and off-site, Graded)	Tightened	3	IN, PA, MO	1	MO	3	IN, PA, MO
No[h] to (On-site and off-site)	Tightened	0		0		1	OH
	Total Tightened	**3**	**IN, PA, MO**	**1**	**MO**	**4**	**IN, OH, MO, PA**
Uncertain	Neutral	3	AL, IL, OH	3	AL, IL, OH	0	
Off-site to off-site	Neutral	2	FL, TX	2	FL, TX	2	FL, TX
(On-site and off-site) to (On-site and off-site)	Neutral	3	GA, VA, WI	3	GA, VA, WI	3	GA, VA, WI
(On-site and off-site, Graded) to (On-site and off-site, Graded)	Neutral	0		2	IN, PA	0	
	Total Neutral	**8**	**AL, FL, GA, IL, OH, TX, VA, WI**	**10**	**AL, FL, GA, IL, IN, OH, PA, TX, VA, WI**	**5**	**FL, GA, TX, VA, WI**

TABLE A.26 (Cont.)

Description of Change	Type of Change	States with Change from EPA 1988 to EPA 1999		States with Change from EPA 1999 to 2005 Data		States with Change from EPA 1988 to 2005 Data	
		No.	Name	No.	Name	No.	Name
(On-site and off-site) to off-site	Relaxed	0		0		1	IL
(On-site and off-site) to None	Relaxed	0		0		1	AL
	Total Relaxed	**0**		**0**		**2**	**AL, IL**
LINERS							
No to Yes[i]	Tightened	1	VA	0		4	GA, IL, MO, VA
May[j] to Yes	Tightened	1	WI	0		1	WI
No to Graded	Tightened	2	IN, PA	0		2	IN, PA
Exempt to Graded	Tightened	0		0		1	OH
	Total Tightened	**4**	**VA, WI, IN, PA**	**0**		**8**	**GA, IL, IN, MO, OH, PA, VA, WI**
Uncertain	Neutral	7	AL, FL, GA, IL, MO, OH, TX	7	AL, FL, GA, IL, MO, OH, TX	0	
Graded to Graded	Neutral	0		2	IN, PA	0	
Yes to Yes	Neutral	0		2	VA, WI	0	
	Total Neutral	**7**	**AL, FL, GA, IL, MO, OH, TX**	**11**	**AL, FL, GA, IL, IN, MO, OH, PA, VA, WI, TX**	**0**	
May to No	Relaxed	0		0		2	AL, TX
Yes to May	Relaxed	0		0		1	FL
	Total Relaxed	**0**		**0**		**3**	**AL, FL, TX**
GROUNDWATER MONITORING							
No to Yes	Tightened	1	VA	0		4	GA, IL, MO, VA
May to Yes	Tightened	1	WI	0		1	WI
May to Graded	Tightened	2	IN, PA	0		2	IN, PA
Exempt to Graded	Tightened	0		0		1	OH
	Total Tightened	**4**	**IN, PA, VA, WI**	**0**		**8**	**GA, IL, IN, MO, OH, PA, VA, WI**

TABLE A.26 (Cont.)

Description of Change	Type of Change	States with Change from EPA 1988 to EPA 1999		States with Change from EPA 1999 to 2005 Data		States with Change from EPA 1988 to 2005 Data	
		No.	Name	No.	Name	No.	Name
Uncertain	Neutral	6	AL, GA, IL, MO, OH, TX	6	AL, GA, IL, MO, OH, TX	0	
Graded to Graded	Neutral	0		2	IN, PA	0	
Yes to Yes	Neutral	1	FL	3	FL, VA, WI	1	FL
	Total Neutral	**7**	**AL, FL, GA, IL, MO, OH, TX**	**11**	**AL, FL, GA, IL, IN, MO, OH, PA, VA, WI, TX**	**1**	**FL**
Yes to No	Relaxed	0		0		1	AL
May to No	Relaxed	0		0		1	TX
	Total Relaxed	**0**		**0**		**2**	**AL, TX**
LEACHATE-COLLECTION SYSTEM							
No to Yes	Tightened	1	VA	0		4	GA, IL, OH, VA
May to Yes	Tightened	1	WI	0		2	MO, WI
No to Graded	Tightened	2	IN, PA	0		2	IN, PA
	Total Tightened	**4**	**IN, PA, VA, WI**	**0**		**8**	**GA, IL, IN, MO, OH, PA, VA, WI**
Uncertain	Neutral	5	FL, GA, IL, MO, OH	5	FL, GA, IL, MO, OH	0	
Graded to Graded	Neutral	0		2	IN, PA	0	
Yes to Yes	Neutral	0		2	VA, WI	0	
No to No	Neutral	2	AL, TX	2	AL, TX	2	AL, TX
	Total Neutral	**7**	**AL, FL, GA, IL, MO, OH, TX**	**11**	**AL, FL, GA, IL, IN, MO, OH, PA, VA, WI, TX**	**2**	**AL, TX**
Yes to May	Relaxed	0		0		1	FL
	Total Relaxed	**0**		**0**		**1**	**FL**

TABLE A.26 (Cont.)

Description of Change	Type of Change	States with Change from EPA 1988 to EPA 1999		States with Change from EPA 1999 to 2005 Data		States with Change from EPA 1988 to 2005 Data	
		No.	Name	No.	Name	No.	Name
CLOSURE and POST-CLOSURE CARE							
No to Yes	Tightened	1	VA	0		1	VA
No to Graded	Tightened	1	IN	0		1	IN
Yes to Graded	Tightened	1	PA	0		1	PA
	Total Tightened	**3**	**IN, PA, VA**	**0**		**3**	**IN, PA, VA**
Graded to Graded	Neutral	0		2	IN, PA	0	
Yes to Yes	Neutral	2	IL, WI	3	IL, VA, WI	2	IL, WI
	Total Neutral	**2**	**IL, WI**	**5**	**IL, IN, PA, VA, WI**	**2**	**IL, WI**
SITING CONTROLS							
No to Yes	Tightened	1	IN	0		3	IL, IN, VA
	Total Tightened	**1**	**IN**	**0**		**3**	**IL, IN, VA**
Uncertain	Neutral	2	IL, VA	2	IL, VA	0	
Yes to Yes	Neutral	2	PA, WI	3	IN, PA, WI	2	PA, WI
	Total Neutral	**4**	**IL, PA, VA, WI**	**5**	**IL, IN, PA, VA, WI**	**2**	**PA, WI**
FINANCIAL ASSURANCE							
No to Yes	Tightened	0		0		2	IN, VA
	Total Tightened	**0**		**0**		**2**	**IN, VA**
Uncertain	Neutral	2	IN, VA	2	IN, VA	0	
Yes to Yes	Neutral	3	IL, PA, WI	3	IL, PA, WI	3	IL, PA, WI
	Total Neutral	**5**	**IL, IN, PA, VA, WI**	**5**	**IL, IN, PA, VA, WI**	**3**	**IL, PA, WI**

Footnotes on next page.

TABLE A.26 (Cont.)

[a] No chronological comparison was prepared for corrective action requirements because the historical EPA documents did not address this area of regulatory control. The chronological comparisons are limited to landfills because the historical EPA documents did not provide sufficient data to support similar comparisons for surface impoundments.

[b] "Graded" means that nonhazardous industrial wastes are categorized based on the degree of hazard associated with handling and disposing of them, and regulatory controls placed on disposal facilities vary based on the category of waste received.

[c] "Tightened" means that during the time frame indicated in the column heading, specific requirements for controls were added to the State's regulations where either none existed before, or prior requirements were less tailored to the characteristics of the wastes being regulated.

[d] "Uncertain" means that for the States indicated in each column, it was not possible to ascertain from the information reviewed whether or not a change in the named regulatory control occurred during the time frame designated in the column heading.

[e] "Neutral" means that either it could not be ascertained from the information reviewed whether any change occurred during the time frame indicated in the column heading, or the information reviewed suggests that no change occurred.

[f] "Relaxed" means that the information reviewed suggests that some or all pre-existing regulatory controls in the category of interest were removed during the time frame indicated in the column heading.

[g] "On-site and off-site" means that the State requires a solid waste permit for a landfill that receives CCWs, whether the landfill is located on the same site as the facility that generated the CCWs or not.

[h] "No" means the source report indicates that State regulations do not impose the regulatory requirement.

[i] "Yes" means the source report indicates that State regulations impose the regulatory requirement.

[j] "May" means the source report indicates that the State regulations provide for a case-by-case decision on the need for the regulatory requirement.

TABLE A.27 Summary of States with "Neutral" Changes

Area of Regulatory Control	Total States Reviewed	States with "Neutral" Changes from 1988 RTC to 1999 RTC	States with "Neutral" Changes from 1999 RTC to 2005
Regulatory designation	11	8	10
Permitting	11	8	10
Liners	11	7	11
Groundwater monitoring	11	7	11
Leachate collection	11	7	11
Closure and post-closure care	5	2	5
Siting controls	5	4	5
Financial assurance	5	5	5

A.13 REFERENCES

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APPENDIX B:

QUESTIONNAIRE FOR NEWLY PERMITTED, BUILT, OR LATERALLY EXPANDED DISPOSAL/MANAGEMENT UNITS

APPENDIX B:

QUESTIONNAIRE FOR NEWLY PERMITTED, BUILT, OR LATERALLY EXPANDED DISPOSAL/MANAGEMENT UNITS

(Information on Units Where New Construction or Lateral Expansion Was Permitted on or after January 1, 1994)

1.0 Identification

1.1 Disposal Unit
Name: _____
Street address: _____
City: _____
County: _____
State: _____
Zip code: _____
Phone number: _____

1.2 Owner
Name: _____
Street address (if different): _____
City: _____
County: _____
State: _____
Zip code: _____
Phone number: _____

1.3 Dates
Date construction complete: _____
Date opened: _____
Comments: _____

1.4 Type of Unit
_____ Landfill
_____ Surface impoundment
_____ Sand and gravel pit
_____ Other (explain): _____

_____

_____ New unit
_____ Lateral expansion
_____ Other (please explain): _____

Comments: _____

_____

_____

_____

_____

2.0 Materials Managed/Disposed of at Unit

2.1 Please indicate the types of materials managed/disposed of at the unit and the approximate percent of total materials.

_____ Coal fly ash (_____ %)
_____ Coal bottom ash (_____ %)
_____ Boiler slag (_____ %)
_____ Fluidized bed combustion ash (_____ %)
_____ Petroleum coke combustion waste (_____ %)
_____ Wet FGD materials (_____ %)
_____ Dry FGD materials (e.g., spray dryer ash) (_____ %)
_____ Oil combustion waste (_____ %)
_____ Natural gas combustion waste (_____ %)
_____ Ancillary small volume wastes (e.g., co-managed waste) (_____ %)
_____ Coal combustion by-products (CCBs) from nonutilities (_____ %)
_____ Other (specify): (_____ %)

_____

Comments: _____

_____

3.0 Was pre-permit site characterization conducted for the unit?

Yes _____
No _____

Comments: _____

_____

4.0 Disposal/Management Unit Liner Characteristics

Please indicate liner type:

____ Single liner
____ Double liner
____ Clay liner
____ Synthetic liner
____ Compacted clay

_____ Compacted ash
_____ Compacted in-situ soil
_____ Combination (please describe): _____
_____ Other (please specify): _____
Liner thickness: _____
Liner hydraulic conductivity (in-cm/sec): _____
____ Not lined.
If not lined, describe supporting rationale:

_____
_____
_____
Comments: _____
_____
_____

5.0 Permit Information

5.1 Is the unit authorized by one or more permits?
_____ No
_____ Yes

5.2 If yes, please indicate which of the following are required by the permit(s):
_____ Liner
_____ Groundwater monitoring
_____ Groundwater-protection standards
_____ Obligations to take corrective action
_____ Bonding/financial assurance
_____ Closure & post-closure requirements
_____ Inspections of the unit
_____ Other requirements (please specify): _____
_____
_____
_____
_____
Comments: _____
_____
_____
_____

5.3 For each permit, please indicate the following:

Issuing Agency	Type (e.g. State waste permit, local permit, SMCRA, NPDES)	Date Issued	Expiration Date	Permit Number

Please provide a copy of the primary permit for the unit that contains requirements identified in Section 5.2.

5.4 Were any variances granted?

_____ No

_____ Yes

If yes, please explain: _____

Comments: _____

6.0 Regulator Inspections

Have any regulators inspected the unit?

_____ No

_____ Yes

Comments: _____

7.0 Monitoring

7.1 Is groundwater monitoring of the disposal/management unit conducted?

_____ No
_____ Yes

7.2 If yes, is that due to:

_____ Permit requirements
_____ Regulatory requirements
_____ Agreement
_____ Voluntary
_____ Other (please explain): _____

_____

_____

7.3 Groundwater constituents monitored (Please list)

_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

7.4 Groundwater-monitoring frequency

_____ Annual
_____ Semiannual
_____ Quarterly
_____ Monthly
_____ Other (please specify)

7.5 Number of groundwater-monitoring wells

_____ Total
_____ Within boundaries of unit
_____ Outside boundaries of unit
_____ Upgradient of unit
_____ Downgradient of unit
_____ In disposal/management area

Comments: _____

_____

_____

_____

_____

_____

_____

_____

8.0 Other comments on the adequacy of current regulations for disposal/management unit

8.1 Please provide any other comments or data to support the concept that the disposal/ management unit has been designed and is operating in a fashion that is protective of human health and the environment

8.2 Please provide any other comments or data regarding how current regulations will prevent past practices that may have led to damages at other sites from occurring in the future.

Other comments:

8.3 Please provide point of contact who can respond to possible additional questions:

Name:
Title:
Email:
Address:
Telephone:

APPENDIX C:

SURVEY RESPONSE RATE AND SAMPLE SIZE BASED ON COAL-FIRED POWER PLANT GENERATING CAPACITY

APPENDIX C:

SURVEY RESPONSE RATE AND SAMPLE SIZE BASED ON COAL-FIRED POWER PLANT GENERATING CAPACITY

C.1 SUMMARY

The U.S. Department of Energy (DOE) and U.S. Environmental Protection Agency (EPA) obtained data on recent and current disposal practices from a six-page questionnaire that the Utility Solid Waste Activities Group (USWAG), a utility trade association that represents 85% of total U.S. electric generating capacity, had distributed to its members in December 2004. In addition, the EPA asked State regulators from nine selected States for information on disposal units that might not have been covered in the USWAG survey. From both these sources, a total of 56 units (45 surveyed and 11 not surveyed) were identified. Information on these units formed the basis for this analysis of recent and current disposal practices.

The total number of coal combustion waste (CCW) disposal units permitted, built, or laterally expanded between January 1, 1994, and December 31, 2004, ("new units") is not known. No industry organization or government agency tracks this information.[1] However, by using total coal-fired power plant generating capacity as a proxy for waste produced, and, therefore, for new disposal units built or expanded, we estimate that the 56 disposal units identified in this analysis (and on which the analysis is based) represent 63% to 71% of the total universe of such new disposal units. This coverage estimate is conservative, and thus likely underestimates the actual coverage for the following reasons. First, the coal-fired power plant generating capacity that actually creates CCW that requires disposal is much less than the total generating capacity that was used to calculate the sample coverage rate. This is because the total U.S. coal-fired power plant generating capacity (335.2 GW in 2004) includes power plants that are on standby and thus do not produce power or CCW. Second, a significant portion of CCW is beneficially used and thus does not require disposal. This portion is estimated to be roughly 35% according to data obtained from the Energy Information Administration (EIA 2004; 2006a,b), and roughly 40% according to data provided by the American Coal Ash Association (ACAA 2004). Finally, because the coal-fired generating capacity that was added between January 1995 and August 2005 (a period that closely corresponds to the period covered by the survey) was less than 3% of the total coal-fired generating capacity, it follows that new disposal capacity would be required for only a small portion of the total generating capacity.

C.2 BACKGROUND

As stated above, the number of new disposal units is not known. However, even though the total number of new disposal units permitted, built, or laterally expanded during the 1994 to 2004 period is not known, information from the National Energy Technology Laboratory

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1 For a glimpse into the possible size of this universe in the 1990s and the uncertainties associated with efforts to define it, see DPRA (2004).

(NETL)[2] indicates that very few new coal-fired plants were built during roughly that same period. In other words, between January 1995 and August 2005, only 8.8 GW of the total coal-fired capacity (2.6% of the total capacity) was added.

In addition, disposal capacity for new plants is generally designed and built to last 40 years, to match the life expectancy of newly constructed power generation units, and thus there would be no need to build or expand disposal capacity for a power plant until a time approaching roughly 40 years since it was built or last expanded. The implication of the cited parameters for the expected disposal unit coverage can be illustrated using information on the commissioning dates of coal-fired power plants in Texas. Of the 22 coal-fired power plants in Texas, only two—a 2-MW plant built in 1921 and a 363-MW plant built in 1953—are more than 40 years old and thus potentially needing additional disposal capacity. However, because these two plants are so old, it is likely that any additional capacity would have already been built before the 1994 to 2004 period covered by this study. Also, none of the 22 Texas plants were built or expanded after 1992, so there would have been no new disposal units built to provide disposal capacity for any new or expanded units in the 1994 to 2004 time period.

C.3 USWAG SURVEY

DOE and the EPA obtained data on the number of new units and the CCW management practices carried out at those units from a six-page questionnaire that USWAG had distributed in December 2004 to all 52 of its members that own or operate coal-fired electric utilities. USWAG is a utility trade association whose members owned or operated coal-fired power plants that had a capacity of 224.2 GW in 2004; this was 67% of total U.S. utility coal-fired capacity of 335.2 GW.[3,4] In addition, since the National Rural Electric Cooperative Association (NRECA) and American Public Power Association (APPA) are members of USWAG, these trade associations distributed the survey to all of their member companies (representing 24 GW of coal-fired capacity for each of the associations). The combination of NRECA, APPA, and investor-owned utilities in the survey ensures a comprehensive coverage of different size power plant populations in the survey.[5] Responses from these utilities are included in the USWAG totals in the following discussion. DOE and the EPA also obtained data from contacts made by the EPA with regulators in selected States.

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2 The NETL New Power Plant Database, August 2005, was derived from the EIA's Utility and Nonutility Databases, the Utility Data Institute's North American Business Directory, The McIlvaine Company's Electric Utility Database, and the EPA's emissions databases. The NETL New Power Plant Database is available at http://www.netl.doe.gov/coal/refshelf/ncp.pdf.

3 USWAG members also include operators of non-coal-fired power plants and trade associations. The association has about 80 members in all.

4 *Electric Power Annual with Data for 2004*, a report released in November 2005, is available at http://www.eia.doe.gov/cneaf/electricity/epa/epat2p2.html.

5 NRECA's average power plant has a generating capacity of 353 MW and a range of 15 to 1,180 MW (for 70 members). APPA's average power plant has a generating capacity of 137 MW and a range of less than 1 to 820 MW (for 177 member plants). Investor-owned USWAG member plants have an average generating capacity of 804 MW and a range of 11 to 3,564 MW (for 279 member plants).

USWAG asked for a response from each member company (in the form of a returned, completed survey) *only if* the company had any "new units." If a member company did not return a survey, it was assumed that the member company had no new units. (The validity of this assumption is addressed later in this appendix.) Twenty-three USWAG members responded by returning completed questionnaires for units that they believed met the criteria for new units;[6] members that had more than one new unit sent completed surveys for each of their new units. (In addition, six USWAG, one APPA, and two NRECA member companies responded by saying that they had no new units.)

The 23 USWAG members that responded with completed surveys for new units had coal-fired power plants totaling 138.4 GW of capacity. In 2004, total USWAG coal-fired generating capacity was 224.2 GW. Thus, the responses received from those that reported new units covered roughly 62% of USWAG coal-fired capacity.

Since the total number of new units is not known, we used coal-fired generating capacity to serve as a proxy for calculating the response rate and sample coverage. The use of this proxy likely resulted in a significant underestimation of the sample size, but it appeared to be the best proxy that could be developed, given the lack of available knowledge on the total number of new disposal units. Reasons that total coal-fired capacity results in an underestimation of sample size include the following:

- Total U.S. generating capacity includes the capacities of all coal-fired units, most of which have a life span of more than 40 years. Many of these units are on standby and thus do not produce power or CCW.

- Since only about 9 GW (less than 3% of total coal-fired generating capacity) was added as new power plants during the past decade, it follows that new or expanded disposal units would be required for only a small portion of total capacity.

- Newly constructed plants may not dispose of CCW but instead recycle the by-products for beneficial use. Of the total amount of CCW generated each year in the United States, roughly 35%, based on data obtained from the EIA (EIA 2004; 2006a,b) and roughly 40%, according to the ACAA (ACAA 2004), is used beneficially and does not need disposal.

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6 Some members sent surveys for mine disposal units; units that were permitted, constructed, or laterally expanded either before or after the 1994 to 2004 time frame; and units that had only been expanded vertically (i.e., no change of footprint) within the 1994 to 2004 time frame. These survey responses were not included in the analysis.

C.4 FOLLOW-UP TO VERIFY COMPLETENESS OF USWAG MEMBER RESPONSE TO SURVEY

To verify the assumption that the lack of a response from a utility meant that it had no new units that met the criteria (meaning that it could, in fact, have had new units that were not covered in the survey), and to determine whether any USWAG members had new units that they did not identify, USWAG conducted a follow-up in January 2006. USWAG contacted each of the members that did not respond to the December 2004 survey request. The follow-up indicated that of the 29 members that either did not respond or had previously responded that they had no new units, 25 (representing 58.2 GW of capacity) did indeed have no new units that met the criteria, but 4 (with 27.5 GW of capacity) actually did have units that met the criteria and were missed in the original 2004 survey (Table C.1). Thus, all USWAG members with coal-fired capacity responded either to the December 2004 survey or the January 2006 follow-up, and the overall response rate (which includes both those that responded to the survey and those contacted during the follow-up) was 100%.

C.5 INDEPENDENT EPA VERIFICATION

To verify independently the assumption that a lack of response meant the utility had no new units, and to obtain information on units that might have been missed by the 2004 USWAG survey and on units owned by non-USWAG, non-NRECA, and non-APPA members, the EPA asked State regulators from nine selected States[7] for information on new units. The USWAG survey responses identified 45 new units (the surveyed units), and the EPA effort identified 11 new units that had not already been identified for inclusion by the USWAG survey (the

TABLE C.1 Results of the January 2006 Follow-up to the USWAG Survey

Utility Companies (USWAG members)[a]	Number	Coal-Fired Capacity in 2004 (GW)
Companies that did not respond to the survey or that responded that they had no new units in the original survey	29	85.7
Companies that verified that they had no new units in the follow-up	25	58.2
Companies that indicated that they had new units that should have been included in the 2004 survey	4	27.5
Companies that did not respond to follow-up calls	0	0

[a] A utility company can have multiple generating plants or facilities and hence multiple disposal units.

[7] The EPA's selected States were those that top the list of consumption of coal for electricity generation and/or CCW generation. The selected states, however, do not include those States that have extensive coal-mining operations where a significant portion of the CCWs are inferred to be disposed of as minefill, and those that do not require permits for disposal of dry ash and, therefore, lack pertinent records.

nonsurveyed units). The capacity represented by companies owning these nonsurveyed 11 units was 14 GW. Information on the 56 identified units formed the basis for this analysis of recent and current disposal practices.

C.6 SAMPLE COVERAGE

The data collection effort was intended to identify and include as many new units in the universe as possible. As stated previously, the total number of new disposal units (the size of the universe of CCW disposal units) is not known. However, assuming that the number of units is proportional to utility coal-fired generating capacity, it appears that the 56 identified new units represent roughly 45% of the universe of such units. This number is calculated by adding the capacity of the UWSAG member utilities reporting new units (138.4 GW) to the capacity of the additional 11 units identified by the EPA (14 GW), and dividing the total (152.4 GW) by the total U.S. coal-fired generating capacity (335.2 GW).

To incorporate the capacity of the utilities that responded that they had no new units into the "sample," this 45% was adjusted by adding the generating capacities of the utilities that verified that they had no new units (58.2 GW) and the utilities that had qualifying units that did not respond to the original 2004 survey[8] (27.5 GW) to the numerator cited above (152.4 GW) and dividing the total by the total U.S. capacity (335.2 GW). The result is 71%. This represents the percent of total capacity covered by the utilities with new disposal units and those reporting that they had no disposal units. If we omit the capacity of the utilities with supplemental (newly identified) units in the 2006 follow-up (since they were not included in the analysis), the sample coverage is 63%.

Because the sample represents 63% of the coal-fired generating capacity in the United States (this includes both USWAG and non-USWAG companies that responded to the survey, as well as the EPA-identified units), and because the size of the universe of new units is not known, we believe that the information obtained and analyzed can be used to identify general trends in CCW disposal practices between 1994 and 2004.

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8 Because these units were identified only in the January follow-up, they are not included in this analysis. However, to determine if the exclusion of these units from the analysis may have produced findings that were not representative of the units that comprised the analysis, we compared the results for the key parameters of interest (liners and groundwater monitoring) for the USWAG-identified units with those for the EPA-identified units and the supplemental units; the results from all groups were found to be consistent.

C.7 REFERENCES

ACAA 2004 American Coal Ash Association, 2004, Coal Combustion Product (CCP) Production and Use Survey. Available at http://www.acaa-usa.org/PDF2004_CCP_Survey(9-9-05).pdf.

DPRA 2004 DPRA Incorporated, 2004, *Validation of Fossil Fuel Combustion Regulation Proposed Rule Cost Elements*, draft report prepared for the U.S. Environmental Protection Agency, Washington, DC, Nov. 30.

EIA 2004 Energy Information Administration, 2004, "Annual Steam-Electric Plant Operation and Design Data, EIA-767 Data Files." Available at http://www.eia.doe.gov/cneaf/electricity/page/eia767.html.

EIA 2005 Energy Information Administration, 2005. *Electric Power Annual with Data for 2004*, Nov. Available at http://www.eia.doe.gov/cneaf/electricity/epa/epat2p2.html.

EIA 2006a Energy Information Administration, 2006a, e-mail message from N. Ko (Survey Manager, EIA 767, Electric Power Division, Energy Information Administration) regarding data clarification for Kentucky and Connecticut to D. Littleton (U.S. Department of Energy), April 15.

EIA 2006b Energy Information Administration, 2006b, e-mail message from N. Ko (Survey Manager, EIA 767, Electric Power Division, Energy Information Administration) regarding data clarification for Delaware to M.A. Hunt (U.S. Environmental Protection Agency, Region III), July 20.

APPENDIX D:

RECONCILIATION OF UNITS IDENTIFIED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

TABLE D.1 Reconciliation of Units Identified by the U.S. Environmental Protection Agency

ID	Unit Name	Issue	Resolution[a]
302	Savannah Electric and Power Company (SEPCO), Grumman Rd. (LI) (Port Wentworth)	A solid waste permit was issued in 1986, and a State vertical expansion permit was issued in 1998. Since 1994, the only permit issued has been the permit for vertical expansion. Vertical expansion permits are not included.	No
303	SEPCO, Plant McIntosh, Ash Monofill #4	The permit was issued in April 2005. The unit has not been built; it is outside the 1994 to 2004 range.	No
314	Hutonsville Power Station	This unit is already in the database; the operator submitted a completed survey.	Yes, but already included
321	JH Campbell Type III Landfill	Unit built or expanded before the U.S. Environmental Protection Agency (EPA)-specified cutoff date. JH Campbell is not included in the database because the permit was issued in 1993 (outside the range).	No
331	Marshall Plant, Flue Gas Desulfurization (FGD) Residue Landfill, Catawba Co.		Yes
336	Basin Electric Power Coop, Leland Olds Station	Unit built or expanded before the EPA-specified cutoff date. Leland Olds was originally identified but not included in the Utility Solid Waste Activities Group (USWAG) survey, because the permit was issued in 1993.	No
337	Minnkota Power Coop, M.R. Young Station	Unit built or expanded before the EPA-specified cutoff date. EPA information says that the unit was opened in 1982 and upgraded with clay liners in the 1980s; disposal of FGD/fly ash was discontinued, and the disposal unit is now empty.	No
338 and 345	Montana Dakota Utilities, Heskett Station	Unit appears two times in the EPA list, both times with an opening year (1989) prior to the cut-off date, but with phased construction ongoing.	No and Yes
343	Dakota Gasification Company (2) SP SP-169	This unit is not a coal combustion disposal unit. This is a coal gasification plant, not a coal combustion site.	No
344	Otter Tail Power Company, Coyote Station Ponds	Unit built or expanded before the EPA-specified cutoff date. EPA information indicates that the unit opened in 1979.	No
351	Dayton Power & Light, Stuart Fly Ash Impoundment #10	The EPA data appear to be inaccurate. The utility, via USWAG, said that the impoundment received a permit from the Ohio Environmental Protection Agency (OEPA) in November 1999. Construction was initiated in 2000.	Yes, with corrected data
352	Tonkovich Monofill Expansion		Yes
353	Ohio Valley Electric Corporation (OVEC), Kyger Creek Power Plant Impoundments		Yes
354	Cardinal Fly Ash Reservoir II Impoundment	Unit built or expanded before the EPA cutoff date. An application for an OPEA Permit to Install (PTI) for Fly Ash Reservoir II was submitted to OEPA on April 23, 1984. The PTI was issued by OEPA on February 4, 1985.	No

TABLE D.1 (Cont.)

ID	Unit Name	Issue	Resolution[a]
355	Richmond Mill 2 Monofill	Unit built or expanded before the EPA-specified cutoff date. The facility was originally permitted in 1985. Subsequent permitting involved (1) approval to receive ash from power plants other than that for which the facility was originally constructed and (2) a vertical expansion on the original footprint of the facility.	No
356	Muskingum River Power Plant Impoundments	Prior to EPA cutoff date. The existing fly ash pond at the Muskingum River Plant has been in operation since 1975. In March 2004, a request for a permit modification to raise the elevation of the dam that was originally constructed before 1975 was submitted to OEPA. OEPA issued a PTI for raising the elevation in May 2004. The modification required the installation of 15 groundwater monitoring wells around the impoundment.	No
357[b]	Coffeen Power Station Landfill[b]		Yes
358	Basin Electric Power Coop, Antelope Valley Station (AVS), SP-160		Yes
359	Great River Energy (Underwood) SP-174		Yes
360	Minnkota Power Cooperative, M.R. Young Station, Bottom Ash IT-205		Yes
361	Otter Tail Power Company, Coyote Station, Blue Pit SP-182		Yes
362	Dayton Power & Light, Stuart Fly Ash Landfill #11		Yes
363	Welsh Bottom Ash Pond		Yes

[a] Yes means included in database; no means not included.

[b] A completed survey was subsequently obtained for this unit, and to maintain consistency with the numerical identification/tracking system (surveyed units are numbered between 200 and 299; nonsurveyed units are numbered between 300 and 399), this unit was reclassified with the number 253.

APPENDIX E:

UNIT COMPLETION DATA

TABLE E.1 Trends in Unit Completion

ID	Year Construction Complete	Year Opened	Type[b]	Comments
207	2003	2004	SI	
227	2003	2003	LF	Original unlined landfill opened in 1988. Lined expansion was built on top of the original unlined portion. Phase I was completed in November 2003. After State approval of Phase I, expanded landfill opened in December 2003.
213	2003	2003	SI	
222	2003	1996	LF	Landfill was constructed over time. Liner was completed in September 2003. There are at least 6 more years of life in the landfill, which is in three noncontiguous areas. While Area 2 was being built, Area 1, which is across railroad tracks from Area 2, was being used.
237	2003	–[a]	LF	Operating license was applied for on November 17, 2004; landfill is not yet opened.
230	2003	–	LF	Construction phases were completed in 1993 (Phase I), 1994 (Phase IIA), 1995 (Phase IIB), 1997 (Phase III), 1998 (Phase IV), and 2003 (Phase V). Facility opened in the 1950s.
233	2002	2002	LF	The King (Moelter) Landfill has been expanded four times since 1993 (in 1994, 1997, 2000, and 2002).
211	2002	2002	SI	
214	2002	2002	SI	
228	2002	2001	LF	The original landfill opened in the early 1980s.
229	2001	2001	LF	Most recent liner expansion was in 2001. A Hypalon® liner was installed in 1985. Start-up was in 1978, with a clay liner.
209	2001	2001	LF	Landfill will have four cells, with the cells constructed in phases. The first cell was completed in the summer of 2001. Landfill cells are constructed in phases to limit leachate production. When one cell is full, it is capped, and the next cell is opened.
236	2001	2001	LF	Landfill opened within months of cell completion. The Sherco #3 Ash Landfill has been expanded three times since 1993 (in 1994, 1999, and 2001).
202	2001	1995	LF	The 255-acre landfill was constructed in six phases; the last phase was completed on January 22, 2001. The first phase of construction was completed on November 17, 1994.
363	2000	2000	SI	
351	2000	–	SI	Permit was issued in 1999. Construction began in 2000.
210	1998	1998	SI	
216	1998	1998	SI	
225	1997	1997	SI	
215	1997	1997	SI	
353	1997	–	LF	
226	1996	1998	LF	
352	1996	–	LF	
240	1996	–	LF	Landfill is active.
218	1995	1995	LF	
232	1995	1995	LF	

TABLE E.1 (Cont.)

ID	Year Construction Complete	Year Opened	Type	Comments
212	1995	1995	SI	
221	1995	1994	LF	Construction was completed in 1995.
252	1995	1994	SI	Construction was completed in 1995.
358	1995	–	LF	Liner construction is complete.
201	1994	1994	LF	The initial cell (Phase B) was completed in August 1994.
217	1994	1994	LF	
235	1994	–	SI	This is not in operation.
362	–	2003	LF	
360	–	2002	LF	
361	–	1997	LF	
359	–	1996	LF	
345	–	1989	LF	Construction is ongoing, in phases; construction started in 1989.
331	–	–	LF	Landfill is not operational because scrubbers are not yet installed. Landfill should be operating by late 2006.
245	–	2003	SI	
206	–	2000	SI	
244	–	2000	SI	
204	–	1998	LF	Construction is ongoing.
246	–	1997	LF	
205	–	1995	LF	Construction is ongoing.
200	–	1994	LF	New landfill permit was issued.
203	–	1994	LF	Expansion permit was issued.
220	–	1994	LF	Construction is ongoing.
223	–	1994	LF	
247	–	1994	SI	
241	–	–	LF	Permit was issued on September 23, 1993. The landfill was built in two stages: Stage I/II and Stage III. Stage I/II is closed. In Stage III, the landfill began receiving waste in the 2002–2003 time frame.
253	–	–	LF	Landfill is not yet constructed. The company has a permitted area on which a landfill can be constructed, but nothing has been constructed except groundwater-monitoring equipment for background assessment.
219	–	–	LF	Construction is ongoing.
224	–	–	LF	Construction has been deferred; permit was issued on May 14, 2001.
239	–	–	LF	Landfill is under active operation. Permit was issued in April 2000.
248	–	–	SI	Unit is still under construction.

[a] – = data not provided.

[b] LF = landfill; SI = surface impoundment.

APPENDIX F:

MATERIALS DISPOSED OF AT SURVEYED UNITS

TABLE F.1 Materials Disposed of at Surveyed Units[a]

ID	Unit Type	Coal Fly Ash (%)	Coal Bottom Ash (%)	Boiler Slag (%)	Wet FGD Waste (%)	Dry FGD Waste (%)	Co-managed Waste (%)	Nonutility CCB (%)	Other Materials (%)	Description of "Other Materials"	Comments
246	LF	100	0	0	0	0	0	0	<5	General plant trash in an amount of less than 5%	
217	LF	100	0	0	0	0	0	0	0	NA	None
233	LF	99.5	0	0.5	0	0	0	0	0	NA	None
227	LF	99	0	0	0	0	1	0	0	NA	Small volumes of co-managed wastes, such as coal mill rejects, are commingled with the fly ash. Bottom ash is sluiced to an active ash pond. Fly ash would be sent to the active ash pond only when a malfunction occurred during dry ash handling.
226	LF	98	0	0	2	0	0	0	0	NA	Numbers are based on four quarters, ending with Quarter 3 in 2004.
205	LF	94	6	0	0	0	0	0	0	NA	None
204	LF	92	8	0	0	0	0	0	0	NA	None
220	LF	85	0	0	10	0	0	2.5	2.5	Filter, baghouse bags subject to approval	None
203	LF	80	20	0	0	0	0	0	0	NA	None
200	LF	80	20	0	0	0	0	0	0	NA	None
230	LF	76	22	0	0	0	0	0	2	Miscellaneous industrial waste materials from operating coal-fired power plant: refractory, sandblast grit	None

TABLE F.1 (Cont.)

ID	Unit Type	Coal Fly Ash (%)	Coal Bottom Ash (%)	Boiler Slag (%)	Wet FGD Waste (%)	Dry FGD Waste (%)	Co-managed Waste (%)	Nonutility CCB (%)	Other Materials (%)	Description of "Other Materials"	Comments
218	LF	75	25	0	0	0	0	0	0	NA	None
239	LF	70	20	0	0	0	8	0	2	Miscellaneous industrial waste materials from operating coal-fired power plant: asbestos, demolition debris, intake dredge material, sand-blasting grit, intake structure cleanings	Co-managed: cooling tower sediment, demineralized resin, filter media, coal pile pond sediment
219	LF	70	30	0	0	0	0	0	0	NA	None
240	LF	67	14	0	12	0	0	0	7	Miscellaneous industrial waste materials from operating coal-fired power plant	None
236	LF	65	0	0	0	35	0	0	0	NA	None
209	LF	48	52	0	0	0	0	0	<1	<1% asbestos and wastewater treatment sludge	Asbestos waste <1%; remainder is fly ash and bottom ash.

TABLE F.1 (Cont.)

ID	Unit Type	Coal Fly Ash (%)	Coal Bottom Ash (%)	Boiler Slag (%)	Wet FGD Waste (%)	Dry FGD Waste (%)	Co-managed Waste (%)	Nonutility CCB (%)	Other Materials (%)	Description of "Other Materials"	Comments
228	LF	39	0	0	58	0	0	0	3	Quicklime added for fixation/stabilization	Coal fly ash was estimated at 35–40% and adjusted to 39%. Wet FGD waste was estimated at 55–60% and adjusted to 58%. Other wastes were estimated at 2–3% and adjusted to 3%. Fly ash and FGD solids are pug-milled together with quicklime to produce a coal combustion product commonly known as fixated scrubber sludge (FSS) and then landfilled.
201	LF	28	3	3	66	0	0	0	0	NA	None
223	LF	20	2	0	78	0	0	0	0	NA	Poz-O-Tec
229	LF	10	0	15	0	0	0	0	75	5% ancillary small-volume wastes and 70% clinker ash	None
202	LF	.05	1.3	0	98.4	0	0	0	.26	0.25% stone and rock for roads and 0.01% lime ball mill rejects and pulverizer rejects	Bottom ash used for road construction
221	LF	0	95	0	0	0	0	0	5	Boiler cleaning - physical	Facility consists of two bottom ash ponds used for dewatering and an inert-bottom ash landfill for materials removed from dewatering ponds.
224	LF	0	15	0	0	85	0	0	0	NA	None

TABLE F.1 (Cont.)

ID	Unit Type	Coal Fly Ash (%)	Coal Bottom Ash (%)	Boiler Slag (%)	Wet FGD Waste (%)	Dry FGD Waste (%)	Co-managed Waste (%)	Nonutility CCB (%)	Other Materials (%)	Description of "Other Materials"	Comments
222	LF	0	10	0	89	0	1	0	0	NA	Co-managed wastes include inert wastes, such as bricks generated in outages and wastewater treatment sludges, which, for the most part, are either ash or lime waste, and ancillary small-volume wastes.
232	LF	0	0	0	0	0	0	0	100	Slag produced by the IGCC gasifier	A state-of-the-art gasifier (not a boiler) is used in the IGCC system. The slag material is a by-product of the gasification process that uses coal to generate electricity. The coal is used to create a synthetic gas that is then cleaned of sulfur-bearing compounds. Ultimately, the process results in a glassy inert slag by-product that is used in cement manufacturing.
253	LF	0	0	0	0	0	0	0	0	NA	This is a permitted but unused landfill. The power company currently does not plan to use it. The landfill was permitted to manage coal fly ash (30%) and boiler slag (70%). Additional wastes permitted for the site include general trash from the plant (less than 5% total waste accepted) and coal and soil from ditch cleanings.
241	LF	See comments	0	0	See comments	See comments	See comments	0	See comments	Wastewater basin sludge, oil-contaminated soil	Percentages are not known. Fly ash and FGD sludge are the primary wastes placed in the landfill.
237	LF	See comments	See comments	0	0	See comments	0	0	0	NA	Coal fly ash, coal bottom ash, and dry FGD materials are marked, but no percentages were indicated.
244	SI	100	0	0	0	0	0	0	0	NA	None

TABLE F.1 (Cont.)

ID	Unit Type	Coal Fly Ash (%)	Coal Bottom Ash (%)	Boiler Slag (%)	Wet FGD Waste (%)	Dry FGD Waste (%)	Co-managed Waste (%)	Nonutility CCB (%)	Other Materials (%)	Description of "Other Materials"	Comments
245	SI	100	0	0	0	0	0	0	0	NA	None
247	SI	100	0	0	0	0	0	0	0	NA	None
206	SI	95	0	0	0	0	5	0	0	NA	Co-managed wastes consist of plant drains and demineralizer regenerant.
248	SI	80	20	0	0	0	0	0	0	NA	None
210	SI	80	20	0	0	0	0	0	0	NA	None
214	SI	80	20	0	0	0	0	0	0	NA	None
211	SI	80	20	0	0	0	0	0	0	NA	None
207	SI	78	22	0	10	0	0	0	0	NA	Coal fly ash: Unit 1 = 75%, Units 2 and 3 = 80%. Coal bottom ash: Unit 1 = 25%, Units 2 and 3 = 20%.
216	SI	50	50	0	0	0	0	0	0	NA	None
215	SI	50	50	0	0	0	0	0	0	NA	None
235	SI	50	25	0	25	0	0	0	0	NA	None
213	SI	30	70	0	0	0	0	0	0	NA	None
212	SI	30	70	0	0	0	0	0	0	NA	None

TABLE F.1 (Cont.)

ID	Unit Type	Coal Fly Ash (%)	Coal Bottom Ash (%)	Boiler Slag (%)	Wet FGD Waste (%)	Dry FGD Waste (%)	Co-managed Waste (%)	Nonutility CCB (%)	Other Materials (%)	Description of "Other Materials"	Comments
225	SI	15	0	5	80	0	0	0	0	NA	None
252	SI	0	95	0	0	0	0	0	5	Boiler cleaning - physical	Facility consists of two bottom ash ponds used for dewatering and an inert-bottom ash landfill for materials removed from dewatering ponds.

[a] CCB = coal combustion by-products; FGD = flue gas desulfurization; IGCC = integrated gasification combined cycle; LF = landfill; NA = not applicable; SI = surface impoundment.

APPENDIX G:

PERMITS ISSUED FOR SURVEYED UNITS

TABLE G.1 Permits Issued for Surveyed Units

ID	State	Unit Type[a]	Permit Type[b]	Issuing Agency[c]	Issue Date	Expiration Date	Was Copy of Permit Submitted with Survey Response?
217	OH	LF	Air	OEPA	2/1/1994	–	No
221	ND	LF	Conditional use	County	–[d]	–	No
220	ND	LF	Conditional use	County	–	–	No
219	ND	LF	Conditional use	County	4/1/2000	3/31/2005	No
237	MI	LF	Construction	MDEQ	2/27/2002		Yes
224	MO	LF	Construction	MoDNR	5/14/2001	5/14/2006	Yes
241	VA	LF	Construction	Halifax County	–	–	No
229	NH	LF	Health department	State	1/1/1978		No
227	NC	LF	Industrial LF	NC Division of Waste Management	11/1/1988	11/1/2008	Yes
222	IN	LF	NPDES	IDEM	10/1/1997	10/1/2002	No
224	MO	LF	NPDES	MoDNR	–	–	No
227	NC	LF	NPDES	NC Division of Water Quality	2/1/2003	3/31/2007	Yes
220	ND	LF	NPDES	NDDH	1/1/2002	12/31/2006	Yes
221	ND	LF	NPDES	NDDH	1/1/2002	12/31/2006	Yes
219	ND	LF	NPDES	NDDH	1/1/2002	12/31/2006	No
202	OH	LF	NPDES	OEPA	6/27/2002	7/31/2007	Yes
201	OH	LF	NPDES	OEPA	5/1/2000	4/30/2005	Yes
217	OH	LF	NPDES	OEPA	2/1/1994	–	No
241	VA	LF	NPDES	VDEQ	12/27/2000	12/27/2005	Yes
224	MO	LF	Operating	MoDNR	–	–	No
201	OH	LF	Operating	Ohio DOH	–	–	No
240	PA	LF	Residual waste	PADEP	3/15/1999	11/4/2008	No
230	PA	LF	Residual waste	PADEP	6/5/1997	6/5/2007	No
239	PA	LF	Residual waste	PADEP	4/11/2000	4/11/2010	No
222	IN	LF	Restricted waste	IDEM	1/1/1996	1/1/2001	Yes
229	NH	LF	State groundwater	NHDES	–	1/1/2006	Yes
232	FL	LF	State waste	FDEP	1/1/1995	–	Yes
218	GA	LF	State waste	GA EPD Land Protection Branch	1/10/1994	–	Yes
246	IL	LF	State waste	IEPA	9/3/1998	–	Yes
253	IL	LF	State waste	IEPA	11/23/2004	9/1/2009	Yes

TABLE G.1 (Cont.)

ID	State	Unit Type[a]	Permit Type[b]	Issuing Agency[c]	Issue Date	Expiration Date	Was Copy of Permit Submitted with Survey Response?
228	IN	LF	State waste	IDEM	3/1/2001	3/1/2006	Yes
226	IN	LF	State waste	IDEM	7/1/2003	7/1/2008	Yes
223	IN	LF	State waste	IDEM	1/1/1995	1/1/2007	Yes
236	MN	LF	State waste	MPCA	12/2/2004	12/2/2009	Yes
233	MN	LF	State waste	Washington County	7/1/2004	6/30/2005	Yes
220	ND	LF	State waste	NDDH	12/19/1994	12/19/2004	Yes
219	ND	LF	State waste	NDDH	11/3/1997	11/3/2007	No
221	ND	LF	State waste	NDDH	12/19/1994	12/19/2004	Yes
229	NH	LF	State waste	NHDES	1/1/1985	–	No
201	OH	LF	State waste	OEPA	5/21/1993	–	Yes
202	OH	LF	State waste	Ohio DOH	–	–	Yes
202	OH	LF	State waste	OEPA	1/27/1994	–	Yes
200	VA	LF	State waste	VDEQ	1/6/1994	–	Yes
203	VA	LF	State waste	VDEQ	9/8/1994	–	Yes
241	VA	LF	State waste	VDEQ	9/23/1993	–	Yes
209	WI	LF	State waste	WDNR	10/1/2004	9/30/2005	Yes
205	WV	LF	State waste	WVDEP	10/4/2004	10/3/2009	Yes
204	WV	LF	State waste	WVDEP	3/10/2004	6/30/2008	Yes
209	WI	LF	Storm water	WDNR	8/1/2001	3/31/2006	Yes
233	MN	LF	Waste	MPCA	3/31/2003	3/31/2008	Yes
217	OH	LF	Wastewater	OEPA	2/1/1994	–	No
252	ND	SI	Conditional use	County	–	–	No
214	IL	SI	Constr/operating	IEPA	1/28/2002	–	Yes
212	IL	SI	Constr/operating	IEPA	12/12/1994	–	Yes
211	IL	SI	Constr/operating	IEPA	6/5/2002	–	Yes
210	IL	SI	Constr/operating	IEPA	8/15/1997	–	Yes
206	IL	SI	Constr/operating	IEPA	–	–	Yes
215	IL	SI	Constr/operating	IEPA	5/29/1997	–	Yes
213	IL	SI	Constr/operating	IEPA	5/29/2003	–	Yes
216	IL	SI	Constr/operating	IEPA	4/13/1998	–	Yes

TABLE G.1 (Cont.)

ID	State	Unit Type[a]	Permit Type[b]	Issuing Agency[c]	Issue Date	Expiration Date	Was Copy of Permit Submitted with Survey Response?
248	IN	SI	Construction	IDEM	10/1/2001	–	Yes
245	MO	SI	Construction	MoDNR	7/26/2001	–	Yes
247	MO	SI	Construction	MoDNR	5/10/1993	–	Yes
244	MO	SI	Construction	MoDNR	11/14/1995	–	Yes
225	ND	SI	Construction	ND State Water Commission	6/2/1994	–	Yes
207	NM	SI	Dam construction	NM State Engineer's Office	2/25/2003	–	No
212	IL	SI	Dam safety	IDNR	8/16/2004	–	Yes
211	IL	SI	Dam safety	IDNR	10/25/2002	–	Yes
210	IL	SI	Dam safety	IDNR	4/10/1998	–	Yes
215	IL	SI	Dam safety	IDNR	8/12/1997	–	Yes
214	IL	SI	Dam safety	IDNR	5/28/2002	–	Yes
213	IL	SI	Dam safety	IDNR	11/10/1994	–	Yes
216	IL	SI	Dam safety	IDNR	6/4/1998	–	Yes
213	IL	SI	NPDES	IEPA	5/1/2002	4/30/2007	Yes
212	IL	SI	NPDES	IEPA	4/30/2002	4/30/2007	Yes
215	IL	SI	NPDES	IEPA	5/1/2002	4/30/2007	Yes
211	IL	SI	NPDES	IEPA	4/25/2002	4/30/2007	Yes
214	IL	SI	NPDES	IEPA	3/1/2003	2/28/2008	Yes
210	IL	SI	NPDES	IEPA	4/25/2002	4/30/2007	Yes
216	IL	SI	NPDES	IEPA	5/1/2002	4/30/2007	Yes
248	IN	SI	NPDES	IDEM	1/1/1990	–	Yes
235	MN	SI	NPDES	MPCA	4/12/2004	3/31/2009	Yes
252	ND	SI	NPDES	NDDH	1/1/2002	12/31/2006	Yes
252	ND	SI	State waste	NDDH	12/19/1994	12/19/2004	Yes
225	ND	SI	State waste	NDDH	6/14/1995	6/14/2005	Yes

Footnotes on next page.

TABLE G.1 (Cont.)

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[a] LF = landfill; SI = surface impoundment.

[b] NPDES = National Pollutant Discharge Elimination System.

[c] FDEP = Florida Department of Environmental Protection; GA EPD = Georgia Environmental Protection Division; IDEM = Indiana Department of Environmental Management; IDNR = Illinois Department of Natural Resources; IEPA = Illinois Environmental Protection Agency; MDEQ = Michigan Department of Environmental Quality; MoDNR = Missouri Department of Natural Resources; MPCA = Minnesota Pollution Control Agency; NDDH = North Dakota Department of Health; NHDES = New Hampshire Department of Environmental Services; Ohio DOH = Ohio Department of Health; OEPA = Ohio Environmental Protection Agency; PADEP = Pennsylvania Department of Environmental Protection; VDEQ = Virginia Department of Environmental Quality; WDNR = Wisconsin Department of Natural Resources; WVDEP = West Virginia Department of Environmental Protection.

[d] – = data not provided.

APPENDIX H:

LINER DATA

TABLE H.1 Liner Data

ID	State	Unit Type	Is Unit New or an Expansion?	Type of Liner	Description of Combination Liner[a]	Liner Thickness	Liner Hydraulic Conductivity (cm/s)	Comments
223	IN	LF	Lateral expansion	Clay	–[b]	2.5 ft	1×10^{-6}	–
361	ND	LF	Lateral expansion	Clay	–	–	–	–
359	ND	LF	–	Clay	–	–	–	–
358	ND	LF	–	Clay	–	–	–	–
219	ND	LF	Lateral expansion	Clay	–	3 ft	1×10^{-7}	–
200	VA	LF	Both new and lateral expansion	Combination	Select fill sub-base, synthetic liner, geocomposite leachate collection, and select bottom ash protective layer	30 mil	See comments	Conductivities of select fill sub-base and liner are not available. Geocomposite conductivity is 11 cm/s. Conductivity for select bottom ash layer is 5×10^{-3} cm/s.
222	IN	LF	Other	Combination	Lower 3 ft of clay can be in situ if it meets 1×10^{-6} permeability. Top 2 ft of 5-ft liner must be recompacted.	–	–	–
345	ND	LF	Lateral expansion	Combination	Clay for early cells, now composite	–	–	–
203	VA	LF	Lateral expansion	Combination	1.5-ft drainage material, synthetic liner, select fill sub-base	30 mil	–	–
209	WI	LF	New	Combination	GCL/HDPE liner system	60 mil	–	HDPE liner is 60 mil.
253	IL	LF	New	Combination	36 in. of compacted clay, with a geomembrane	60 mil	1×10^{-7}	Double, clay, synthetic, compacted clay, leachate-collection system
201	OH	LF	Lateral expansion	Combination	Composite liner system consisting of 18 in. of recompacted clay and a 30-mil PVC geomembrane	18 in.	$<1 \times 10^{-7}$	–
362	OH	LF	–	Compacted clay	–	–	–	Recompacted clay
221	ND	LF	New	Compacted clay		2 ft	1×10^{-8}	–

TABLE H.1 (Cont.)

ID	State	Unit Type	Is Unit New or an Expansion?	Type of Liner	Description of Combination Liner[a]	Liner Thickness	Liner Hydraulic Conductivity (cm/s)	Comments
220	ND	LF	New	Compacted clay	–	2 ft	1×10^{-8}	–
217	OH	LF	New	Compacted clay	–	3 ft	1×10^{-7}	–
353	OH	LF	–	Compacted clay	–	–	–	Recompacted clay
218	GA	LF	Other	Compacted clay	–	2 ft minimum	1×10^{-5}	10 ft of vertical separation between water table and bottom of 2-ft clay layer. Only the minimum hydraulic conductivity value (1×10^{-5}) acceptable to the State was reported by the Arkwright plant, but no permeability tests were performed on this liner. However, the liner comprises silty to sandy clays and clayey silts; has a Plasticity Index of 39 ('extremely plastic'), Liquid Limit value of 61 and greater than 70% fines passing the # 200 sieve. When compacted to 95%–99% of its maximum dry density, this type of clay would become impervious, with hydraulic conductivity inferred in the 1×10^{-7} to 1×10^{-8} range.
232	FL	LF	New	Double	–	60 mil	–	60-mil HDPE geomembrane
246	IL	LF	New	Double	Synthetic and compacted clay	60 mil	1×10^{-7}	Thickness is for the synthetic liner.
352	OH	LF	–	FML w/leachate collection	–	–	–	–

TABLE H.1 (Cont.)

ID	State	Unit Type	Is Unit New or an Expansion?	Type of Liner	Description of Combination Liner[a]	Liner Thickness	Liner Hydraulic Conductivity (cm/s)	Comments
228	IN	LF	Lateral expansion	Multiple types	One GCL, then 1 ft of compacted clay, then another GCL make up the liner system; with seepage collection system	–	1×10^{-9}	The hydraulic conductivity of the total liner system is equivalent to 1×10^{-9} cm/s. GCL is made with bentonite materials. Total thickness with seepage collection system is about 2 ft 6 in. Clay, synthetic (two GCLs) and combination (one GCL, then 1 ft of compacted clay, then another GCL make up the liner system; with seepage collection system)
230	PA	LF	Other	Multiple types	Phases V through IX primary GM, secondary GM and GCL	60 mil	–	60 mil of smooth and textured HDPE. Single liner: Phases I through IV. Double liner: Phases V through IX.
204	WV	LF	Lateral expansion	Multiple types	–	2 ft	1×10^{-7}	Single, clay and compacted clay
224	MO	LF	New	Multiple types	60-mil HDPE liner over 2 ft of prepared silty-clay subgrade	60 mil		Single, synthetic, combination
226	IN	LF	Lateral expansion	Multiple types	Geomembrane and GCL	–	1×10^{-7}	Double, synthetic, compacted clay, combination of 60 mil of HDPE is underlain by 12 in. of compacted clay (2- to 6-in. lifts). Conductivity is for clay.
202	OH	LF	New	Multiple types	1.5 ft of clay with 30 mil of PVC synthetic liner on top of the clay	–	$\leq 1 \times 10^{-7}$	1.5 ft of clay and 30 mil of PVC. Conductivity is for clay permeability.
205	WV	LF	New	Multiple types	–	2 ft	1×10^{-7}	Single, clay and compacted clay
237	MI	LF	New	Multiple types	Primary is 60 mil of HDPE, secondary is 60 mil of HDPE plus GCL	–	–	Double, synthetic. Leak detection between liners. 60 mil of HDPE plus GCL.

TABLE H.1 (Cont.)

ID	State	Unit Type	Is Unit New or an Expansion?	Type of Liner	Description of Combination Liner[a]	Liner Thickness	Liner Hydraulic Conductivity (cm/s)	Comments
241	VA	LF	New	Multiple types	–	60 mil	–	Single and synthetic. Conductivity, is not known; however, the standard is specified in the Virginia solid waste regulations.
239	PA	LF	Lateral expansion	Multiple types	Stages III and IV, primary GM, secondary GM and GCL	–	–	Single, double, synthetic, combination. Stages I and II are 60 mil. Stages III and IV are 60 mil of textured HDPE.
236	MN	LF	Lateral expansion	Multiple types	–	–	1×10^{-11}	2 ft of clay and 60 mil of HDPE. Double, synthetic, compacted clay.
233	MN	LF	Lateral expansion	Multiple types	–	–	1×10^{-7}	2 ft of clay and 60 mil of HDPE. Double, synthetic, compacted clay.
240	PA	LF	Lateral expansion	Multiple types	–	60 mil (PVC)	–	Single and synthetic
360	ND	LF	–	Not lined — inert waste	–	–	–	Inert waste, bottom ash
229	NH	LF	Lateral expansion	Single	–	60 mil	1×10^{-12}	–
331	NC	LF	New	Synthetic	–	–	–	Unit received a Permit to Construct for the landfill without a liner in 2004. This guidance was based on modeling that suggested that only a synthetic cap and groundwater monitoring would be needed. However, when the company began to model for boron, it determined that a synthetic liner would be needed for groundwater compliance. Unit will also have leachate collection. (E-mail of Oct. 28, 2005, from Paul Pike, AmerenEnergy, St. Louis, MO, to James Roewer, USWAG, Washington, D.C.)

TABLE H.1 (Cont.)

ID	State	Unit Type	Is Unit New or an Expansion?	Type of Liner	Description of Combination Liner[a]	Liner Thickness	Liner Hydraulic Conductivity (cm/s)	Comments
227	NC	LF	Lateral expansion	Synthetic	–	40 mil	1×10^{-7}	A 40-mil textured LLDPE geomembrane is placed over existing ash (former dry-ash landfill). A 1.5-ft-thick layer of bottom ash is placed over the LLDPE geomembrane as the drainage layer for the leachate-collection system.
212	IL	SI	New	Clay	–	4 ft	$<1 \times 10^{-7}$	–
351	OH	SI	New	Combination	1.5-ft clay liner of 1×10^{-7} conductivity that sits on top of 3.5 ft of compacted in situ clay/soil	–	1×10^{-7}	–
216	IL	SI	Other	Combination	12 in. of clay overlain by polypropylene	12 in.	See comments	12 in. of clay, 45 mil of polypropylene. Clay conductivity = 1×10^{-6}. Polypropylene conductivity = 1×10^{-11}.
248	IN	SI	Lateral expansion	Combination	60-mil HDPE liner and 2 in. compacted clay	2.25 ft	1×10^{-8}	–
210	IL	SI	New	Combination	Clay overlain by polypropylene	–	See comments	12 in. of clay, 45 mil of polypropylene. Clay conductivity = 1×10^{-6}. Polypropylene conductivity = 1×10^{-11}.
211	IL	SI	New	Combination	Clay overlain by polypropylene	–	See comments	12 in. of clay, 45 mil of polypropylene. Clay conductivity = 1×10^{-6}. Polypropylene conductivity = 1×10^{-11}.
213	IL	SI	Other	Combination	12 in. of clay overlain by polypropylene	–	See comments	12 in. of clay, 45 mil of polypropylene. Clay conductivity = 1×10^{-6}. Polypropylene conductivity = 1×10^{-11}.

TABLE H.1 (Cont.)

ID	State	Unit Type	Is Unit New or an Expansion?	Type of Liner	Description of Combination Liner[a]	Liner Thickness	Liner Hydraulic Conductivity (cm/s)	Comments
215	IL	SI	Other	Combination	Double clay w/leachate collection	24 in.	$<1 \times 10^{-7}$	Upper clay 12 in., lower clay 24 in.
235	MN	SI	New	Combination	–	–	5×10^{-13}	System uses a GCL with a 60-mil HDPE liner
225	ND	SI	New	Compacted clay	–	–	1×10^{-7}	4 to 10 ft (measured perpendicular to slope)
214	IL	SI	Other	Compacted clay	–	8 ft	$<1 \times 10^{-7}$	–
363	TX	SI	New	HDPE	–	–	–	–
207	NM	SI	Other	Multiple types	–	–	–	Single, double, synthetic, compacted ash. Single liner is 60 mil of electrically conductive HDPE. Double liner is 60 mil of HDPE. Geogrid separation.
245	MO	SI	Other	Single	–	60 mil	1×10^{-7}	40-mil bottom, 60-mil side
247	MO	SI	New	Single	–	60 mil	1×10^{-7}	40-mil bottom, 60-mil side
206	IL	SI	New	Single	–	60 mil	1×10^{-7}	40-mil bottom, 60-mil side
244	MO	SI	Other	Single	–	60 mil	1×10^{-7}	40-mil bottom, 60-mil side
252	ND	SI	New	Synthetic	–	60 mil	1×10^{-8}	–

[a] GCL = geosynthetic clay liner; FML = flexible membrane lining; GM = geomembrane; HDPE = high-density polyethylene; LF = landfill; LLDPE = linear low-density polyethylene; PVC = polyvinyl chloride; SI = surface impoundment.

[b] – = data not available.

APPENDIX I:

GROUNDWATER-MONITORING DATA FOR SURVEYED UNITS AS REPORTED IN THE SURVEYS

TABLE I.1 Groundwater-Monitoring Data for Surveyed Units as Reported in the Surveys[a]

						Wells[b]					
ID	GWM Conducted	Unit Type	State	Constituents Monitored (Comments)	Frequency	Total	In	Out	Up	Down	In Area
232	Yes	LF	FL	In accordance with the FDEP-approved GWMP, the monitoring wells are sampled quarterly for in-situ field measurements (static water levels [before purging], temperature, and turbidity) and for laboratory analyses of the following constituents: fecal coliform bacteria, purgeable halocarbons, purgeable aromatics, molybdenum, strontium, and vanadium (primary and secondary groundwater standards as defined in Florida Administrative Code, Chapter 62-520, which are largely the same as the primary and secondary drinking water standards as defined in Florida Administrative Code, Chapter 62-550.) Leachate monitoring from the two lined impoundments is conducted semiannually. Leachate-monitoring parameters include the following in-situ field measurements: colors and sheens, dissolved oxygen, pH, and specific conductance. Laboratory analyses include NH_4, bicarbonate alkalinity, chlorides, nitrate, TDS, sodium, aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, mercury, selenium, silver, thallium, tin, vanadium, and zinc. Comments: Facility has a sitewide GWMP developed in accordance with FDEP regulations. The slag storage area and leachate-collection ponds are essentially a subset of the GWMP. There are specific well placements upgradient and downgradient of the slag storage pad and leachate-collection ponds and other strategically placed wells to ensure that there are no impacts to groundwater from these double-lined systems. Some monitoring wells must be sampled once every 5 years per the GWMP.	Quarterly	4	–	–	–	–	–
218	Yes	LF	GA	Chloride, cadmium, sulfate, lead, silver, selenium, arsenic, and barium.	Semiannual	9	–	–	5	4	–
246	Yes	LF	IL	pH, nitrate, TDS, tin, arsenic, iron, TOC, vanadium, cadmium, lead, mercury boron, manganese, sulfate, zinc, cyanide, phenols, and specific conductance. Comments: Organics are sampled annually.	Quarterly	7	–	–	2	5	–

TABLE I.1 (Cont.)

						Wells[b]					
ID	GWM Conducted	Unit Type	State	Constituents Monitored (Comments)	Frequency	Total	In	Out	Up	Down	In Area
253	Yes	LF	IL	24 inorganics and 105 organics would be monitored annually; 17 inorganics and 2 organics would be monitored quarterly. Comments: Additional wells to be installed as additional cells are added. Groundwater monitoring is not currently being performed because the landfill is not yet built. The information provided here is based on what is conducted at a similar landfill operated by the same utility in the same state.	Quarterly	9	–	–	1	3	5
223	Yes	LF	IN	Iron, sulfate, hardness, TDS, boron, chlorides, potassium, and molybdenum.	Semiannual	11	9	2	2	3	6
226	Yes	LF	IN	pH (field), conductivity (field), chloride, boron, sodium (diss.), fluoride, sulfate, arsenic (diss.), barium (diss.), cadmium (diss.), chromium (diss.), lead (diss.), mercury (diss.), selenium (diss.), and silver (diss.)	Semiannual	28	4	24	4	24	0
222	Yes	LF	IN	Arsenic, barium, boron, cadmium, chloride, chromium, fluoride, lead, mercury, field pH, selenium, silver, sodium, field-specific conductance, and sulfate. Comments: With the exception of the one upgradient well, all downgradient wells must be within 50 ft of the toe of the slope of the landfill. This means they are on the edge of the perimeter ditch and are affected by water in the perimeter ditch.	Semiannual	6	5	1	1	5	–
228	Yes	LF	IN	pH, specific conductance, temperature, arsenic, barium, boron, cadmium, chloride, chromium, fluoride, lead mercury, selenium, silver, sodium sulfate, TDS, zinc, and copper. Comments: Each of the well clusters has three individual monitoring wells screened at various depths of the aquifer. Additional monitoring of leachate-collection systems is conducted to learn more about the leachability of the waste.	Semiannual	5	–	–	1	4	–

TABLE I.1 (Cont.)

						Wells[b]					
ID	GWM Conducted	Unit Type	State	Constituents Monitored (Comments)	Frequency	Total	In	Out	Up	Down	In Area
237	Yes	LF	MI	Boron, lithium, sulfate, chloride, phenolics, COD, nitrate/nitrite, water level, cobalt, TOC, field conductivity, ammonia, TDS, cyanide, antimony, field pH, potassium, magnesium, arsenic, iron, sodium, manganese, lead, selenium, vanadium, alkalinity (carbonate), and alkalinity (bicarbonate).	Quarterly	8	–	–	1	7	–
236	Yes	LF	MN	Aluminum, ammonia, nitrogen, mercury, molybdenum, nitrite (as nitrogen), phosphorous, vanadium, alkalinity (total as $CaCO_3$), appearance, arsenic, cadmium, calcium, chloride, copper, TDS, iron, magnesium, manganese, nickel, nitrate (as nitrogen), pH, specific conductance, sulfate, TSS, temperature, zinc, dissolved oxygen, Eh (oxidation potential), static water level, barium, boron, chromium VI, lead, potassium, selenium, and sodium.	Quarterly	17	17	0	2	15	–
233	Yes	LF	MN	Antimony, chromium III, mercury, molybdenum, nitrite (as nitrogen), selenium, thallium, vanadium, alkalinity (total as, $CaCO_3$), aluminum, NH_4, appearance, arsenic, cadmium, calcium, chloride, copper, TDS, iron, lead, magnesium, manganese, nickel, nitrate (as nitrogen), pH, potassium, sodium, specific conductance, sulfate, TSS, temperature, zinc, barium, boron, chromium (total) (chromium VI), silver, and tin.	Quarterly	13	13	0	2	11	–
224	Yes	LF	MO	Aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chemical oxygen demand, chloride, chromium, cobalt, copper, fluoride, hardness, magnesium, manganese, mercury, nickel, pH, selenium, silver, sodium, specific conductance, sulfate, temperature, thallium, TDS, TOC, total organic halogens, and zinc. Comments: Quarterly groundwater quality indicator testing, semiannual constituent testing.	Quarterly	6	6	0	2	4	–
227	Yes	LF	NC	Water depth, pH, specific conductance, temperature, arsenic, barium, cadmium, chloride, chromium, copper, fluoride, iron, lead, manganese, mercury, nitrate, selenium, silver, sulfate, zinc, total organic halides, TDS, biochemical oxygen demand, chemical oxygen demand, and TOC.	Semiannual	6	6	0	3	3	–

TABLE I.1 (Cont.)

						Wells[b]					
ID	GWM Conducted	Unit Type	State	Constituents Monitored (Comments)	Frequency	Total	In	Out	Up	Down	In Area
331	Yes	LF	NC	–	–	–	–	–	–	–	–
221	Yes	LF	ND	pH, conductivity, TDS, alkalinity, hardness, nitrate/nitrite, chlorine, sulfate, bicarbonate and carbonate, fluoride, arsenic, boron, barium, cadmium, calcium, chromium, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, and sodium.	Quarterly	10	9	1	1	8	1
358	Yes	LF	ND	–	–	–	–	–	–	–	–
359	Yes	LF	ND	–	–	–	–	–	–	–	–
220	Yes	LF	ND	pH, conductivity, TDS, alkalinity, hardness, nitrate/nitrite, chlorine, sulfate, bicarbonate and carbonate, fluoride, arsenic, boron, barium, cadmium, calcium, chromium, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, and sodium.	Quarterly	8	6	2	4	4	–
361	Yes	LF	ND	–	–	–	–	–	–	–	–
219	Yes	LF	ND	pH, conductivity, TDS, alkalinity, hardness, nitrate/nitrite, chlorine, sulfate, bicarbonate and carbonate, fluoride, arsenic, boron, barium, cadmium, calcium, chromium, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, and sodium. Comments: The locations of up to five new downgradient wells are currently being negotiated.	Quarterly	9	9	0	5	4	–
345	Yes	LF	ND	–	–	–	–	–	–	–	–
229	Yes	LF	NH	Chromium, static water level, nickel, iron, selenium, manganese, pH, sulfate, cadmium, and specific conductivity.	Semiannual	5	0	5	1	4	–
362	Yes	LF	OH	–	–	–	–	–	–	–	–
201	Yes	LF	OH	Temperature, conductivity, pH, alkalinity, TDS, calcium, chloride, sulfate, magnesium, potassium, sodium, arsenic, iron, manganese, selenium, barium, cadmium, chromium, lead, mercury, silver, gross alpha, gross beta, and boron.	Semiannual	28	25	3	12	16	0

TABLE I.1 (Cont.)

						Wells[b]					
ID	GWM Conducted	Unit Type	State	Constituents Monitored (Comments)	Frequency	Total	In	Out	Up	Down	In Area
202	Yes	LF	OH	Static water level, temperature, turbidity, pH, conductivity, TDS, alkalinity, chloride, sulfate, calcium, magnesium, potassium, sodium, arsenic, barium, cadmium, chromium, lead, mercury, selenium, iron, manganese, gross alpha, and gross beta.	Semiannual	41	0	41	12	29	–
217	Yes	LF	OH	Aluminum, arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, copper, iron, manganese, nickel, zinc, vanadium, calcium, magnesium, potassium, sodium, boron, chlorine, SO_4, TDS, alkalinity, pH, and TOC.	Semiannual	–	–	4	–	–	–
353	Yes	LF	OH	–	–	–	–	–	–	–	–
352	Yes	LF	OH	–	–	–	–	–	–	–	–
239	Yes	LF	PA	Quarterly: NH_4, bicarbonate, calcium (diss.), chemical oxygen demand, chloride, fluoride, iron (diss.), magnesium (diss.), manganese (diss.), nitrate-nitrogen, pH, potassium (diss.), sodium (diss.), specific conductance, sulfate, total alkalinity, TDS, TOC, and turbidity. Annual: additional analyses performed on one of the quarterly samples: arsenic (diss.), barium (diss.), cadmium (diss.), chromium (diss.), copper (diss.), lead (diss.), mercury (diss.), selenium (diss.), silver (diss.), and zinc (diss.).	Quarterly	9	9	0	2	7	–
240	Yes	LF	PA	Quarterly: NH_4, bicarbonate, calcium (diss.), chemical oxygen demand, chloride, fluoride, iron (diss.), magnesium (diss.), manganese (diss.), nitrate-nitrogen, pH, potassium (diss.), sodium (diss.), specific conductance, sulfate, total alkalinity, TDS, TOC, and turbidity. Annual: additional analyses performed on one of the quarterly samples: arsenic (diss.), barium (diss.), cadmium (diss.), chromium (diss.), copper (diss.), lead (diss.), mercury (diss.), selenium (diss.), silver (diss.), and zinc (diss.).	Quarterly	6	6	0	3	3	–

TABLE I.1 (Cont.)

						Wells[b]					
ID	GWM Conducted	Unit Type	State	Constituents Monitored (Comments)	Frequency	Total	In	Out	Up	Down	In Area
230	Yes	LF	PA	Quarterly: NH_4, bicarbonate, calcium (diss. and total), COD, chloride, fluoride, iron (diss. and total), magnesium (diss. and total), manganese (diss. and total), pH, potassium (diss. and total), sodium (diss. and total), specific conductance, sulfate, total alkalinity, TDS, TOC, turbidity. Annual: additional analyses performed on one of the quarterly samples: arsenic (diss. and total), barium (diss. and total), cadmium (diss. and total), chromium (diss. and total), copper (diss. and total), lead (diss. and total), mercury (diss. and total), selenium (diss. and total), silver (diss. and total), zinc (diss. and total), and an array of organics.	Quarterly	8	8	0	3	5	–
200	Yes	LF	VA	pH, conductivity, TOC, total organic halogens, Table 5.5 (9 VAC 20-80-300) organics, inorganics, and mercury. Comments: All wells monitored for pH, conductivity, TOC, and total organic halides. Currently one well monitored for Table 5.5 organics, inorganics, and mercury.	Semiannual	14	12	2	3	11	0
203	Yes	LF	VA	pH, conductivity, TOC, total organic halogens, Table 5.5 organics, inorganics, and mercury.	Semiannual	11	0	11	3	8	–
241	Yes	LF	VA	Stage I/II–semiannual for Appendix 5.5 inorganics of the VA solid waste regulations, carbon disulfide, and Appendix 5.1 detects. Stage I/II–every 2 years for all Appendix 5.1 constituents. Stage III–semiannual for all Appendix 5.5 constituents. These are available from the VA solid waste regulations. Comments: Nine wells for Stage I/II, eight wells for Stage III.	Semiannual	17	–	–	6	11	–
209	Yes	LF	WI	Odor, COD, boron, color, pH, selenium, turbidity, alkalinity, temperature, hardness, specific conductance, and sulfate. The leachate is also monitored for the constituents as above, along with chloride, cadmium, lead, manganese, mercury, iron, and acid/base neutral extractable compounds. Comments: The landfill has five side-gradient wells in addition to the three upgradient and six downgradient wells.	Semiannual	14	0	14	3	6	–

TABLE I.1 (Cont.)

						Wells[b]					
ID	GWM Conducted	Unit Type	State	Constituents Monitored (Comments)	Frequency	Total	In	Out	Up	Down	In Area
204	Yes	LF	WV	Lead, barium, sodium, TSS, arsenic, chloride, calcium, manganese, TDS, cadmium, chromium, copper, sulfate, pH, selenium, aluminum, iron, magnesium, temperature, boron, conductivity, nickel, vanadium, zinc, and molybdenum.	Quarterly	11	0	11	3	8	–
205	Yes	LF	WV	pH, barium, sodium arsenic, TSS, chloride, calcium, manganese cadmium, TDS, chromium, copper, sulfate, selenium, aluminum, iron, magnesium, boron, conductivity, lead, vanadium, and molybdenum.	Quarterly	8	0	8	3	5	–
216	Yes	SI	IL	Boron, manganese, pH, sulfate, and TDS.	Quarterly	11	0	11	2	9	–
206	Yes	SI	IL	pH, TDS, boron, calcium, hardness, manganese, sulfate, and alkalinity.	Monthly	13+	–	–	7	6+	–
210	Yes	SI	IL	Boron, sulfates, manganese, magnesium, TDS, and pH.	Quarterly	9	2	7	3	4	–
211	Yes	SI	IL	Boron, sulfates, manganese, magnesium, TDS, and pH.	Quarterly	9	2	7	3	4	–
212	Yes	SI	IL	Boron and pH.	Quarterly	14	6	8	4	4	–
213	Yes	SI	IL	Boron and pH.	Quarterly	14	6	8	4	4	–
215	Yes	SI	IL	Boron, manganese, pH, sulfate, and TDS.	Quarterly	11	0	11	2	9	–
214	Yes	SI	IL	Boron, manganese, sulfate, TDS, and pH.	Quarterly	5	0	5	1	4	–
235	Yes	SI	MN	Alkalinity (total), arsenic (diss.), boron (diss.), cadmium (diss.), calcium (diss.), chloride (total), chromium (total), iron, magnesium, manganese, nickel, nitrate (as nitrogen), pH, specific conductance, temperature, zinc, diss. oxygen, Eh (oxidation potential), static water level, arsenic, barium, boron, cadmium, chromium VI, copper, iron (diss.), manganese (diss.), potassium (diss.), selenium (diss.), sodium (diss.), sulfate (total), TDS, and TSS. Comments: Additional well was to be added in 2005 to expand coverage area.	Quarterly	17	17	0	2	15	–
252	Yes	SI	ND	pH, conductivity, TDS, alkalinity, hardness, nitrate/nitrite, chlorine, sulfate, bicarbonate and carbonate, fluoride, arsenic, boron, barium, cadmium, calcium, chromium, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, and sodium.	Quarterly	10	9	1	1	8	1

TABLE I.1 (Cont.)

						Wells[b]					
ID	GWM Conducted	Unit Type	State	Constituents Monitored (Comments)	Frequency	Total	In	Out	Up	Down	In Area
225	Yes	SI	ND	pH, specific conductance, TSS, alkalinity, bicarbonate, carbonate, hydroxide, TDS, hardness, fluoride, sulfate, chloride, nitrate, ammonia, phosphorus, mercury, calcium, magnesium, sodium, potassium, iron, manganese, molybdenum, boron, arsenic, cadmium, lead, selenium, silver, sodium adsorption ratio, and percent error.	Semiannual	10	10	0	2	8	–
207	Yes	SI	NM	pH, fluorine, calcium, barium, lead, silver, conductivity, SO_2, manganese, cadmium, magnesium, vanadium, TDS, boron, sodium, chromium, mercury, zinc, alkalinity phenolphthatein and total, chlorine, potassium, copper, molybdenum, nitrate-nitrogen, sulfate, arsenic, iron, selenium. Selected wells analyzed for the following parameters: calcium, barium, lead, silver, manganese, cadmium, magnesium, vanadium, sodium, chromium, mercury, zinc, potassium, copper, molybdenum, arsenic, iron, and selenium.	Semiannual	22	0	22	2	20	–
351	Yes	SI	OH	–	–	7	–	–	–	–	–
363	Yes	SI	TX	–	–	–	–	–	–	–	–
360	No	LF	ND	Comments: Inert waste–bottom ash.	–	–	–	–	–	–	–
248	No	SI	IN	–	–	–	–	–	–	–	–
244	No	SI	MO	–	–	–	–	–	–	–	–
247	No	SI	MO	–	–	–	–	–	–	–	–
245	No	SI	MO	–	–	–	–	–	–	–	–

[a] – = data not provided; $CaCO_3$ = calcium carbonate; COD = chemical oxygen demand; diss. = dissolved; FAC = Florida Administrative Code; FDEP = Florida Department of Environmental Protection; GWM = groundwater monitoring; GWMP = groundwater monitoring plan; LF = landfill; NH_4 = ammonia nitrogen; SI = surface impoundment; SO_2 = sulfur dioxide; TDS = total dissolved solids; TOC = total organic carbon; TSS = total suspended solids.

[b] In = wells within unit boundary; out = wells outside unit boundary; up = wells upgradient of unit; down = wells downgradient of unit; in area = wells in disposal management area.

APPENDIX J:

VARIANCE REQUESTS BY STATE AND CATEGORY OF REQUIREMENT

TABLE J.1 Variance Requests by State and Category of Requirement[a]

States with Surveyed Units	Total No. of Variance Requests	Variance Category														
							Other									
		Liners	Groundwater Monitoring	Closure/ Post-Closure	Cover/ Dust Controls	Groundwater-Protection Standards	Landfill Gas	Leachate Collection	Location	Cell Height	Fire Protection	Pre-siting	Signs	Solid Waste Management Plan	Other (Standards for Sewage Works)
FL	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0
GA	6	0	0	1	1	0	1	1	0	0	1	0	1	0	0
IL	4	0	0	0	3	0	0	0	0	0	0	0	0	0	1
IN	8	1	0	2	5	0	0	0	0	0	0	0	0	0	0
MN	4	0	0	0	0	1	2	0	0	0	0	0	0	1	0
OH	5	3	0	0	2	0	0	0	0	0	0	0	0	0	0
VA	8	0	4	0	0	3	0	0	1	0	0	0	0	0	0
WI	4	1	0	0	0	2	0	1	0	0	0	0	0	0	0
WV	11	2	0	0	4	0	2	0	1	1	0	1	0	0	0
Total	52	7	4	3	15	8	5	2	2	1	1	1	1	1	1

[a] No variance requests were identified in the following states: Michigan, Missouri, North Carolina, North Dakota, New Hampshire, New Mexico, and Pennsylvania.

APPENDIX K:

VARIANCE REQUEST DESCRIPTIONS AND REGULATORY SUMMARIES

TABLE K.1 Variance Request Descriptions and Regulatory Summaries

ID	State	Granted	Variance Category	Variance Description	Regulation Summary	Regulation Citation
232	FL	No	Groundwater-protection standards	Variance to allow ambient values for iron and color in groundwater to exceed the secondary drinking water quality standards, rather than comply with the secondary drinking water standards, as the regulations specify.	Class G-I groundwater (potable; total dissolved solids [TDS] <3,000 mg/L) and Class G-II groundwater (potable; TDS <10,000 mg/L) must meet primary and secondary drinking water quality standards, unless the natural background concentration exceeds the applicable standard.	FAC Rule 62-520.420(1) & (2)
232	FL	No	Groundwater-protection standards	Variance to allow concentration of antimony in groundwater to exceed the drinking water quality standard, rather than comply with the drinking water standard, as the regulations specify.	Class G-I groundwater (potable; TDS <3,000 mg/L) and Class G-II groundwater (potable; TDS <10,000 mg/L) must meet primary and secondary drinking water quality standards, unless the natural background concentration exceeds the applicable standard.	FAC Rule 62-520.420(1) & (2)
218	GA	Yes	Closure/ post-closure requirements	Variance waiving the leachate-collection and treatment system otherwise required during the post-closure care period.	The leachate-collection system must be maintained and operated during the post-closure care period, unless the owner/operator demonstrates that leachate no longer poses a threat to human health and the environment.	GDNR Rule 391-3-4-.12(1) and 40 CFR 258.61(a)(2)
218	GA	Yes	Daily cover/ dust controls	Variance waiving the daily cover otherwise required by the regulations.	Solid waste disposal units must apply daily cover, unless they obtain a variance by demonstrating that they are industrial waste monofills and the waste being disposed of would not cause odors or be attractive to disease vectors or birds.	GDNR Rules 391-3-4-.07(3)(e)1 and 391-3-4-.07(4)(a)
218	GA	Yes	Fire protection	Variance waiving the fire protection measures otherwise required by the regulations.	Suitable measures to control fires that may start shall be provided.	GDNR Rule 391-3-4-.07(3)(q)

TABLE K.1 (Cont.)

ID	State	Granted	Variance Category	Variance Description	Regulation Summary	Regulation Citation
218	GA	Yes	Leachate-collection system	Variance waiving the leachate-collection and treatment system otherwise required by the regulations.	Solid waste disposal units must be constructed with leachate-collection systems, unless they obtain a variance by demonstrating that the waste to be disposed of would not cause groundwater or surface water contamination.	GDNR Rules 391-3-4-.07(1)(d) and 391-3-4-.07(4)
218	GA	Yes	Methane gas control	Variance waiving the methane gas monitoring otherwise required by the regulations.	Solid waste disposal units must implement a routine methane monitoring program, unless they obtain a variance by demonstrating that they are industrial waste monofills that would not generate methane gas.	GDNR Rules 391-3-4-.07(3)(h)2 and 391-3-4-.07(4)(a)
218	GA	Yes	Signs	Variance waiving the directional and informational signs otherwise required by the regulations.	Signs shall be posted at the entrance to landfills indicating the days and hours of operation.	GDNR Rule 391-3-4-.07(3)(s)
246	IL	Yes	Daily cover/ dust controls	Variance to allow use of conditioned fly ash as an alternative daily cover, rather than at least 6 in. of clean soil, as the regulations specify.	Six inches of clean soil shall be placed on all exposed waste at the end of each day of operations, or alternative materials or procedures may be used, if they achieve equivalent or superior performance.	35 Ill. Adm. Code 811.106
253	IL	Yes	Daily cover/ dust controls	Variance to allow use of conditioned fly ash as an alternative daily cover, rather than at least 6 in. of clean soil, as the regulations specify.	Six inches of clean soil shall be placed on all exposed waste at the end of each day of operations, or alternative materials or procedures may be used, if they achieve equivalent or superior performance.	35 Ill. Adm. Code 811.106
246	IL	Yes	Intermediate cover	Variance to allow use of conditioned fly ash as an intermediate cover, rather than 1 ft of compacted clean soil material, as required by the regulations.	Intermediate cover shall be equivalent to that provided by 1 ft of compacted clean soil material.	35 Ill. Adm. Code 811.313

TABLE K.1 (Cont.)

ID	State	Granted	Variance Category	Variance Description	Regulation Summary	Regulation Citation
206	IL	Yes	Other (standards for sewage works)	Variance to allow piping that does not comply with the sewage works standards to be installed.	The regulation establishes limiting-value criteria for the design and preparation of plans and specifications for wastewater collection and treatment systems, to promote uniformity of practice throughout the State.	35 Ill. Adm. Code, Subtitle C, Chapter II, Part 370
226	IN	Yes	Closure/ post-closure requirements	Variance to allow use of ash, ash/soil mixture, and 40-mil linear low-density polyethylene (LLDPE) as final cover, rather than compacted soil, as the regulations specify.	Final compacted cover must have 6 in. of topsoil plus 2 ft of compacted clay for slopes less than 15% or 3 ft of compacted clay for slopes greater than 15%.	329 IAC 10-30-2
222	IN	Yes	Cover/dust controls	Variance waiving intermediate cover otherwise required by the regulations.	Must apply and compact no less than 6 in. of cover over all exposed solid waste monthly regardless of weather conditions, or annually, if the solid waste can be demonstrated to have an in-place permeability of less than 1×10^{-6} cm/s.	329 IAC 10-28-12(b) (Type II); 329 IAC 10-36-12 (Type III)
223	IN	Yes	Closure/ post-closure requirements	Variance allowing use of 2.5 ft of fine sandy loam soils for the final cover, rather than 2 ft of soil of Unified Soil Classification ML, CL, MH, CH, or OH and 6 in. of vegetative topsoil, as specified in the regulations.	329 IAC 10-37-2 requires 2 ft of soil as described in 329 IAC 10-36-11, and 6 in. of vegetative topsoil as required by 329 IAC 10-37-4.	329 IAC 10-37-2; 329 IAC 10-36-11; 329 IAC 10-37-4(b)(4)
226	IN	Yes	Cover/dust controls	Variance to allow use of Soil-Sement®, a polymer-based material, as an intermediate cover, rather than 1 ft of clay-type soil, as the regulations specify.	Intermediate cover of not less than 1 ft of compacted clay-type soil must be applied to any area within a Type I restricted waste landfill that has not received waste for 90 days or more.	329 IAC 10-28-12(a)(3)

TABLE K.1 (Cont.)

ID	State	Granted	Variance Category	Variance Description	Regulation Summary	Regulation Citation
228	IN	Yes	Cover/dust controls	Variance waiving the intermediate cover otherwise required by the regulations.	Must apply and compact no less than 6 in. of cover over all exposed solid waste monthly regardless of weather conditions, or annually, if the solid waste can be demonstrated to have an in-place permeability of less than 1×10^{-6} cm/s.	329 IAC 10-28-12(b)
226	IN	Yes	Cover/dust controls	Variance waiving the monthly cover and semiannual permeability testing otherwise required by the regulations.	The regulations waived were not cited in the permit. The regulations at 329 IAC 10-28-12 do require monthly cover for Type II landfills, but the permit is for a Type I landfill.	See Regulation Summary.
223	IN	Yes	Intermediate cover	Variance allowing the use of sandy loam soil, rather than soil of Unified Soil Classification ML, CL, MH, CH, or OH for intermediate cover, as specified in the regulations.	Cover for a Type III restricted waste site must be of a specified United Soil Classification or other suitable material.	329 IAC 10-36-11
223	IN	Yes	Liner requirements	Variance allowing the use of 1 ft of soil and 2 ft of compacted Poz-O-Tec for a liner, rather than 3 ft of soil, as specified in the regulations.	Barriers for Type III restricted waste sites consist of soil and have a minimum thickness of 3 ft between the solid waste and a locally useful aquifer.	329 IAC 10-34-1
233	MN	Yes	Gas monitoring	Variance waiving the methane gas monitoring, collection, and treatment system otherwise required by the regulations.	Decomposition gases must not be allowed to migrate laterally from the facility, but must be vented to prevent explosive concentrations.	Minn. Rule 7035.1700, Item U
236	MN	Yes	Gas monitoring	Variance to exempt the facility from the otherwise applicable requirement to monitor for decomposition gas production in and around the facility.	Decomposition gases must not be allowed to migrate laterally from the facility, but must be vented to prevent explosive concentrations.	Minn. Rule 7035.1700, Item U

TABLE K.1 (Cont.)

ID	State	Granted	Variance Category	Variance Description	Regulation Summary	Regulation Citation
233	MN	Yes	Groundwater-protection standards	Variance establishing analytical limits set forth in the Limits Table in the permit as groundwater-protection standards, rather than the otherwise applicable groundwater-protection standards listed in Minn. Rule 7035.2815, Subpart 4, Item F.	Pollutant concentrations in groundwater must not exceed the standards listed for 73 pollutants at or beyond the compliance boundary and at or below the lower compliance boundary.	Minn. Rule 7035.2815, Subpart 4, Item F
233	MN	Yes	Solid waste management plan	Variance waiving submission of the solid waste management plan otherwise required by the regulations.	A solid waste management facility must manage incoming industrial solid waste according to a plan that specifies procedures for certain specific waste types and specifies waste types that are banned.	Minn. Rule 7035.2535, Subpart 5
202	OH	Yes	Daily cover/ dust controls	Variance allowing the cementitious surface that forms when flue gas desulfurization (FGD) waste is placed in the Phase A area of the landfill to be a substitute for the required intermediate cover consisting of a 12-in.-thick layer of soil.	An intermediate cover consisting of a 12-in.-thick layer of well-compacted soil must be applied to all filled areas of a residual solid waste landfill (SWLF) facility where additional residual solid waste is not to be deposited for at least 180 days.	OAC 3745-30-14(G)(1) and (2). The Director's Final Findings and Orders cited the regulatory requirement as OAC Rule 3745-30-14(V)(2). However, no such section appears in the current OAC. OAC Rule 3745-30-14(G)(1) and (2) are cited herein because they describe a requirement for interim cover that is consistent with the requirement that the Director's Final Findings and Orders attribute to OAC Rule 3745-30-14(V)(2).

TABLE K.1 (Cont.)

ID	State	Granted	Variance Category	Variance Description	Regulation Summary	Regulation Citation
202	OH	Yes	Daily cover/ dust controls	Variance allowing the cementitious surface that forms when FGD waste is placed in the Phase B area of the landfill to be a substitute for the required intermediate cover consisting of a 12-in.-thick layer of soil.	Intermediate cover consisting of a 12-in.-thick layer of well-compacted soil must be applied to all filled areas of a residual SWLF where additional residual solid waste is not to be deposited for at least 180 days.	OAC 3745-30-14(G)(1) and (2). The Director's Final Findings and Orders cited the regulatory requirement as OAC Rule 3745-30-14(V)(2). However, no such section appears in the current OAC. OAC Rule 3745-30-14(G)(1) and (2) are cited herein because they describe a requirement for interim cover that is consistent with the requirement that the Director's Final Findings and Orders attribute to OAC Rule 3745-30-14(V)(2).
201	OH	Yes	Liner requirements	Variance allowing the liner to be constructed using "deep dynamic compaction" of mine spoil without removal.	If a recompacted soil liner is installed, it must be constructed on a prepared surface that is free of deleterious material, will not settle, and has no abrupt changes in grade that could damage the liner.	OAC 3745-30-07
202	OH	No	Liner requirements	Variance to allow use of coarser material to construct the liner rather than 25% retained material particles on a No. 4 sieve, as required by the regulations.	Not available.	GD0202.104, "Aquifer System, Minimum Isolation Distance of the Liner from: Solid Industrial & Residual Waste Siting Criteria" (OAC 3745-30-06(H)(2)(e))
202	OH	No	Liner requirements	Variance allowing the liner to be constructed using "deep dynamic compaction" of mine spoil without removal.	If a recompacted soil liner is installed, it must be constructed on a prepared surface that is free of deleterious material, will not settle, and has no abrupt changes in grade that could damage the liner.	OAC 3745-30-07(C)(1)(i)

TABLE K.1 (Cont.)

ID	State	Granted	Variance Category	Variance Description	Regulation Summary	Regulation Citation
241	VA	Yes	Groundwater monitoring	Variance to exempt the Landfill Stage III from the requirement to monitor groundwater wells for the organic constituents listed in 9 VAC 20-80, Appendix 5.5 (now 9 VAC 20-80-300, Table 5.5), except carbon disulfide, during Phase II monitoring.	A Phase II monitoring program shall include the semiannual analysis for the monitoring parameters shown in Table 5.5 and, if required under the provisions of subdivision 4.e(2) of this subsection, any detected Table 5.1 constituents.	9 VAC 20-80-300 C.4.a
241	VA	Yes	Groundwater monitoring	Variance to exempt Landfill Stages I and II from the requirement to monitor groundwater wells for organic constituents listed in 9 VAC 20-80, Appendix 5.5 (now 9 VAC 20-80-300, Table 5.5), except carbon disulfide, during Phase II monitoring.	A Phase II monitoring program shall include the semiannual analysis for the monitoring parameters shown in Table 5.5 and, if required under the provisions of subdivision 4.e(2) of this subsection, any detected Table 5.1 constituents.	9 VAC 20-80-300 C.4.a
203	VA	Yes	Groundwater monitoring	Variance to exempt groundwater wells in Phase II monitoring from being sampled for the organic constituents listed in 9 VAC 20-80, Appendix 5.5 (now 9 VAC 20-80-300, Table 5.5), as the regulations would otherwise require.	A Phase II monitoring program shall include the semiannual analysis for the monitoring parameters shown in Table 5.5 and, if required under the provisions of subdivision 4.e(2) of this subsection, any detected Table 5.1 constituents.	9 VAC 20-80-300 C.4.a
200	VA	Yes	Groundwater monitoring	Variance to allow monitoring of a subset of wells for Phase I indicator parameters, rather than for constituents listed in 9 VAC 20-80, Appendix 5.5 (now 9 VAC 20-80-300, Table 5.5), even though the facility has entered Phase II monitoring.	If a statistically significant increase in any Table 5.5 constituent is noted in the First Determination report, the owner or operator shall continue Phase II monitoring.	9 VAC 20-80-300 C.4.b(3)(b)
200	VA	Yes	Groundwater-protection standards	Variance to allow alternative concentration limits (ACLs) as groundwater-protection standards for copper, silver, and zinc.	Groundwater-protection standards will be either the maximum contaminant limit (MCL), background concentrations, or ACLs.	9 VAC 20-80-300 C.4.d

TABLE K.1 (Cont.)

ID	State	Granted	Variance Category	Variance Description	Regulation Summary	Regulation Citation
241	VA	Yes	Groundwater-protection standards	Variance to allow Landfill Stage III to use ACLs as groundwater-protection standards (GPSs) for specified constituents that lack background data or an EPA MCL.	The owner or operator may request and the director may establish ACLs as groundwater-protection standards for any constituent for which MCLs have not been established or for which site-specific background data are unavailable.	9 VAC 20-80-300 C.4.d(1)(d)
241	VA	Yes	Groundwater-protection standards	Variance to allow Landfill Stages I and II to use ACLs as groundwater-protection standards for specified constituents that lack background data or an MCL.	The owner or operator may request and the director may establish ACLs as groundwater-protection standards for any constituent for which MCLs have not been established or for which site-specific background data are unavailable.	9 VAC 20-80-300 C.4.d(1)(d)
241	VA	Yes	Location requirements	Variance allowing the facility to be located within 100 ft of a regularly flowing surface water body or river, which the regulations would otherwise prohibit.	No new industrial waste landfill disposal or leachate storage unit or expansion of existing units shall be within 100 ft of any regularly flowing surface water body or river.	9 VAC 20-80-270 A.4.a
209	WI	Yes	Groundwater-protection standards	Variance allowing the development of a landfill in an area where the preventive action limit (PAL) for selenium in groundwater has been attained or exceeded.	A proposed facility cannot be approved at a location where a PAL or enforcement standard has been attained or exceeded, unless an exemption has been granted.	Wis. Adm. Code NR 140.28
209	WI	No	Groundwater-protection standards	Variance allowing the development of a landfill in an area where the PAL for lead in groundwater has been attained or exceeded, rather than prohibiting such development, as the regulations specify.	A proposed facility cannot be approved at a location where a PAL or enforcement standard has been attained or exceeded, unless an exemption has been granted.	Wis. Adm. Code NR 140.28
209	WI	Yes	Leachate-collection requirements	Variance allowing leachate to flow more than 130 ft across the base of the liner before encountering a perforated leachate-collection pipe.	A system is required that routes leachate to the perimeter of the landfill in a manner such that leachate flows no more than 130 ft across the base of the liner before encountering a perforated leachate-collection pipe.	Wis. Adm. Code NR 504.06(5). See variance comments.

TABLE K.1 (Cont.)

ID	State	Granted	Variance Category	Variance Description	Regulation Summary	Regulation Citation
209	WI	Yes	Liner requirements	Variance allowing a penetration through the sideslope of the liner to accommodate gravity drain to the leachate-collection tank.	All composite lined landfills shall be designed and constructed with sumps and sideslope risers as part of their leachate removal system, rather than utilizing systems that penetrate the composite liner sidewall.	Wis. Adm. Code NR 504.06(5)(j)
205	WV	Yes	Cover/dust controls	Variance to waive the requirement in the regulations for 12 in. of compacted intermediate cover material on landfill areas exposed to weather for periods in excess of 30 days.	Solid waste fill surfaces exposed to weather for periods in excess of 30 days must have a minimum of 12 in. of compacted cover material applied within 30 days of completion of the fill surface.	33 CSR 4.6.b.2.B and 33 CSR 4.6.b.2.D.2
204	WV	Yes	Cover/dust controls	Variance to waive the requirement in the regulations for 12 in. of compacted intermediate cover material on landfill areas exposed to weather for periods in excess of 30 days.	Solid waste fill surfaces that remain exposed to weather for periods in excess of 30 days must have a minimum of 12 in. of compacted cover material applied within 30 days of completion of the fill surface.	33 CSR 4.6.b.2.B
205	WV	Yes	Daily cell height	Variance to waive the requirement that daily cell height must not exceed 8 ft in the vertical dimension, other than in the middle, where the vertical dimension can be as high as 11 ft to divert storm water.	Daily cell height must not exceed 8 ft in the vertical dimension, other than in the middle, to divert storm water; that vertical dimension must not exceed 11 ft.	33 CSR 4.6.b.1.B
205	WV	Yes	Daily cover/ dust controls	Variance to waive the requirement for cover with greater than 6 in. of compacted cover material at the end of each operating day.	Exposed solid waste disposal area must be covered with a minimum of 6 in. of compacted cover material at the end of each operating day, or more frequently as needed.	33 CSR 4.6.b.2.A and 33 CSR 4.6.b.2.D.1
204	WV	Yes	Daily cover/ dust controls	Variance to waive the requirement for cover with greater than 6 in. of compacted cover material at the end of each operating day.	All SWLFs must cover the entire exposed solid waste disposal area with a minimum thickness of 6 in. of compacted cover material at the end of each operating day.	33 CSR 33 4.6.b.2.A

TABLE K.1 (Cont.)

ID	State	Granted	Variance Category	Variance Description	Regulation Summary	Regulation Citation
205	WV	Yes	Landfill gas management requirements	Variance to waive the requirement for management of decomposition gases generated within a landfill.	Concentrations of methane or other explosive gases must not exceed 25% of the lower explosive limit for the gas. Gas monitoring programs are required, and the proposed gas monitoring plan must be included in the landfill application.	33 CSR 4.10; 33 CSR 3.10.a.2; 33 CSR 3.10.a.4
204	WV	Yes	Landfill gas management requirements	Variance to waive the requirement for management of decomposition gases generated within a landfill.	Decomposition gases generated within a landfill must be controlled to avoid hazards to health, safety, or property by meeting certain requirements regarding control, monitoring, and reporting the detection of explosive gases such as methane.	33 CSR 4.10
204	WV	Yes	Liner requirements	Variance to waive the requirement for surface impoundments to have double liners and leachate-collection systems.	Double liners required. Top = synthetic > 60 mil; bottom = compacted clay > 2 ft with permeability < 1×10^{-7} overlain by synthetic > 60 mil. Leak detection system required between liners. Existing surface impoundments must be already compliant, retrofitted, or closed.	33 CSR 4.8.c.3.B
205	WV	Yes	Liner requirements	Variance to waive the requirement for surface impoundments to have double liners and leachate-collection systems.	Surface impoundments must have two liners and a leak detection system. Impoundments in use without liners and leak detection systems must close or be retrofitted.	33 CSR 4.8.c.30B
204	WV	Yes	Location requirements	Variance to waive the prohibition on locating a new SWLF above an underground mine.	New SWLFs and lateral expansions cannot be located above underground mine workings or within the critical angle of draw of such workings, unless otherwise approved by the Secretary in writing.	33 CSR 3.2.k

TABLE K.1 (Cont.)

ID	State	Granted	Variance Category	Variance Description	Regulation Summary	Regulation Citation
205	WV	Yes	Pre-siting requirements	Variance to waive the requirement to serve public notice of the intention to consider siting a commercial solid waste facility where none exists and hold a public hearing on the pre-siting notice.	Anyone investigating an area for the purpose of siting a commercial solid waste facility where none exists must make public notification of the proposed site and its size; the State conducts a public meeting on the proposed siting.	33 CSR 3.4

APPENDIX L:

VARIANCE GRANTING RATIONALE, REVOCATION PROVISIONS, AND COMMENTS

TABLE L.1 Variance Granting Rationale, Revocation Provisions, and Comments

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
218	GA	Closure/post-closure requirements	Leachate collection and treatment are not deemed necessary during post-closure care due to the nontoxic, nonhazardous nature of the ash to be disposed of in the monofill.	None specified	The permit does not characterize waiver of the regulatory requirement for post-closure leachate system maintenance and operation as a variance. It is included in this database because the Georgia regulations (40 CFR 258.61) indicate that approval is needed for such a waiver.
218	GA	Daily cover/dust controls	Coal combustion by-products will be loaded, transported, unloaded and placed in a condition at, or near, optimum moisture content. When compacted at, or near, optimum moisture, the by-products will form a surface crust that will prevent blowing dust, thereby eliminating the need for operational cover. Since no blowing trash or disease vectors will be present, a daily cover is not required.	None specified	The permit does not characterize waiver of the regulatory requirement for daily cover as a variance. It is included in this database because the Georgia regulations indicate that a variance is needed, and other States consider waivers of this type to be variances.
218	GA	Fire protection	Fire protection measures are not required for a coal combustion by-products monofill.	None specified	The permit does not characterize waiver of the regulatory requirement for signs as a variance. It is included in this database because some other States consider waivers of nonapplicable regulatory requirements to be variances.
218	GA	Leachate-collection system	Leachate collection and treatment are not deemed necessary due to the nontoxic, nonhazardous nature of the ash to be disposed of in the monofill.	None specified	The permit does not characterize waiver of the regulatory requirement for a leachate-collection system as a variance. It is included in this database because the Georgia regulations indicate that a variance is needed, and other States consider waivers of this type to be variances.
218	GA	Methane gas control	Because fly ash does not produce methane gas, no gas monitoring is required.	None specified	The permit does not characterize waiver of the regulatory requirement for methane gas monitoring as a variance. It is included in this database because the Georgia regulations indicate that a variance is needed, and other States consider waivers of this type to be variances.
218	GA	Signs	Because only Georgia Power Company personnel are to utilize this site and it will not be open or accessible to the general public for disposal, no directional or informational signs are required.	None specified	The permit does not characterize waiver of the regulatory requirement for signs as a variance. It is included in this database because some other States consider waivers of nonapplicable regulatory requirements to be variances.

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
246	IL	Daily cover/dust controls	None specified in the permit. A company representative explained that the daily cover regulations allow alternative materials or procedures as long as they meet the same standards of performance as 6 in. of soil. Data included in the permit application included an analysis of the conditioned fly ash and a description of its properties to demonstrate that, when hardened, it is an even better filter than the standard 6 in. of soil. The permit specifies that the conditioned fly ash must be used as described in the permit application. Note: State regulations allow flexibility in cover design, as long as the alternative can meet the same performance standard as the design specified in the regulations.	None specified	None
253	IL	Daily cover/dust controls	State regulations allow flexibility in cover design, as long as the alternative can meet the same performance standard as the design specified in the regulations.	None specified	None
246	IL	Intermediate cover	None specified in the permit. A company representative explained that data included in the permit application included an analysis of the conditioned fly ash and a description of its properties to demonstrate that, when hardened, it is an even better filter than the standard 12 in. of soil. There have been no modifications to the variance since it was issued. Note: State regulations allow flexibility in cover design, as long as the alternative can meet the same performance standard as the design specified in the regulations.	None specified	None
206	IL	Other (standards for sewage works)	None specified in the permit. A company representative explained that the company's preferred design did not include a separate tank and a valve system that the State indicated were necessary to meet the State sewage works standards. The State agreed to the design based on the company's reasoning that the piping system was not expected to be an integral part of a sewage works system so sewage works standards were not appropriate. The State indicated that if the company proceeded with the preferred design, it could not use problems with the design as a justification for an exceedance of standards. The company installed the design as proposed and has not experienced any problems with it.	None specified	35 Ill. Adm. Code Subtitle C, Chapter II, Part 370 is lengthy. It incorporates standards by reference (American Society for Testing and Materials [ASTM] and other standards) and establishes extensive criteria for topics such as specific design flow, size, depth, cover, bedding, trenching, installation, and slope for wastewater collection and treatment systems. The permit does not specify the elements of the applicant's design that deviated from the regulation.

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
226	IN	Closure/post-closure requirements	None specified in the permit. The permit merely indicates that 329 IAC 10-28-11(a) grants the commissioner the authority to approve an alternative cover if it can be demonstrated that the alternative will provide an adequate level of environmental protection. A company representative explained that the variance was granted because the 40-mil linear low-density polyethylene (LLDPE) geomembrane provides a more protective final cover than would be provided by 2 ft of soil. Fly ash and an ash/soil mixture are used to prepare the subgrade for the 40-mil LLDPE geomembrane. The sideslopes are constructed of 30 in. of compacted clay to eliminate the possibility of a slope failure due to low adhesion between the geomembrane and the vegetative soil cover. This was a change from the original variance request, which specified geomembrane on both the top and the sideslopes. The design also includes engineered storm-water controls, which eliminate both ponding of storm water on the landfill surface and side-slope erosion. The engineering drawings served as the company's justification for the variance request, and the request was granted in a letter from the Indiana Department of Environmental Management (IDEM).	Permittee chooses not to use mixtures described or the mixture cannot be proven to have a permeability of 1×10^{-5} cm/s.	The variances from 329 IAC 10-30-2 are described as "minor modifications" in the permit and were approved on June 14, 2001, and May 26, 1998. Permit FP 37-01 was granted on January 6, 1984, and has been subsequently renewed and modified.

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
222	IN	Cover/dust controls	None specified in the permit. A company representative explained that the company's landfill operating plan, which was the basis for the variance request and has been approved by the regulatory agency, contains the following description of how the landfill surface is managed: "Stabilized sludge is placed in a moist condition with an approximate 25% moisture content. Once placed the sludge is compacted and then the curing process minimizes wind as well as water erosion. The landfill will be developed in a manner that will minimize exposure to stabilized sludge surfaces, thereby minimizing the possibility of fugitive dust generation. Subsequent layers of waste are expected to be placed every two weeks, thereby reducing the chance of fugitive dust emission further. In areas where transport vehicles tread on the surface of the fill and on other on-site haul roads where dust may be expected, plant water trucks will be used to moisten the surfaces on a regular basis. Regular haul roads in fill areas will have an eight inch layer of bottom ash or gravel placed to reduce dust and surface wear of stabilized sludge."	1. Documentation of violation of requirement to maintain sediment control structures and drainage ditches. 2. Documentation that fugitive dust is creating a nuisance.	The landfill to which permit No. 77-3 applies is allowed to receive coal combustion by-products that are classified for disposal in Type II or Type III restricted waste areas.
223	IN	Closure/post-closure requirements	None specified in the permit. The company representative explained that the material being placed into the landfill is Poz-O-Tec, which is produced by a stabilization process. Flue gas desulfurization (FGD) sludges and ash produced by coal combustion power generation facilities are raw materials for this process. Poz-O-Tec is a relatively impermeable material that is not infiltrated significantly by rainwater. Hence, it is important to provide lateral drainage at the interface between the final cover on the landfill and the Poz-O-Tec. The composition of the final cover specified in the variance accomplishes this better than the composition specified in the regulations. In addition, Poz-O-Tec in this coal combustion by-product monofill leaches significantly fewer toxic constituents than materials in a municipal landfill, which is the landfill type to which the regulations were intended to apply.	If vegetation is not established to the satisfaction of the State, soils specified in the regulation will be required.	329 IAC 10-36-11 allows the use of alternative cover material if it can be demonstrated that an alternate cover or site design will provide an adequate level of environmental protection. This variance has been in place since 1992.

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
226	IN	Cover/dust controls	None specified in the permit. The permit merely indicates that 329 IAC 10-28-11(a) grants the commissioner the authority to approve an alternative cover if it can be demonstrated that the alternative will provide an adequate level of environmental protection. A company representative explained that intermediate cover has two purposes: (1) dust control in unused or seldom-used fill areas and (2) rainfall infiltration control to minimize leachate formation. The Soil-Sement® polymer can be shown to fill both of these needs. If properly applied (i.e., multiple coats at effective dilutions), Soil-Sement is more effective at shedding storm water than is the soil cover specified in the regulations. The company representative reported that the manufacturer's specifications for Soil-Sement were provided to regulatory agency personnel, who also observed an area of the landfill treated with this product. Some agency personnel were familiar with use of Soil-Sement at other coal combustion facilities in the State. According to the company representative, all agency personnel have been satisfied that Soil-Sement is an effective alternative to soil cover for this type of facility.	"In the event that the alternative cover material does not perform as intended, or does not appear to be equivalent to one foot of intermediate cover soil, one foot of intermediate cover of clay type soil may be required by 329 IAC 10-28-12(a)(3)."	Information on the variance request to use Soil-Sement was contained in a March 18, 1994, letter.
228	IN	Cover/dust controls	None specified in the permit. A company representative explained that the purposes of requiring intermediate cover at municipal landfills, which is the facility type for which the regulations were originally developed, are to deter vectors and to control fugitive dust. Because coal combustion products are composed of inorganic constituents, vector control is not needed. Also, dusting from coal combustion products can be controlled using compaction techniques and water. Therefore, to require intermediate or daily cover would only add operational expense and take up valuable landfill space with no added environmental benefit. The facility has developed and implemented a fugitive dust control plan, and the company representative indicated that dusting has not been a problem.	Documented violation of requirement to maintain sediment control structures and drainage ditches.	The landfill to which permit No. FP 26-2 applies is allowed to receive coal combustion by-products that are classified for disposal in Type II restricted waste areas.

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
226	IN	Cover/dust controls	None specified in the permit. A company representative explained that this variance applies only to Phase III of the landfill because the Phase III design includes a composite liner constructed with 12 in. of clay having a permeability of 1×10^{-7}, a 60-mil high-density polyethylene (HDPE) geomembrane, and a leachate-collection system. The company representative indicated that the regulatory agency has expressed fewer concerns about leachate formation in the lined Phase III cell than in cells constructed earlier. Accordingly, the State agreed to eliminate the semiannual permeability testing requirement for the lined cell and to lengthen the time period between required application of intermediate cover (from monthly to 90 days in unused areas), provided that adequate dust control measures remain in place.	Dust emissions are not satisfactorily controlled.	The regulations waived were not cited in the permit. The regulations at 329 IAC 10-28-12 do require monthly cover for Type II landfills, but the permit is for a Type I landfill.
223	IN	Intermediate cover	None specified in the permit. A company representative explained that the material being placed into the landfill is Poz-O-Tec, which is produced by a stabilization process. FGD sludges and ash produced by coal combustion power generation facilities are raw materials for this process. Poz-O-Tec is a relatively impermeable material that is not infiltrated significantly by rainwater. Hence, it is important to provide lateral drainage at the interface between the intermediate cover on the landfill and the Poz-O-Tec. The composition of the intermediate cover specified in the variance accomplishes this better than the composition specified in the regulations. In addition, Poz-O-Tec in this coal combustion by-product monofill leaches significantly fewer toxic constituents than materials in a municipal landfill, which is the landfill type to which the regulations were intended to apply.	If vegetation is not established to the satisfaction of the State, soils specified in the regulation will be required.	329 IAC 10-36-11 allows use of covers other than the designated soil types if it can be demonstrated that an alternate cover or site design will provide an adequate level of environmental protection.
223	IN	Liner requirements	None specified in the permit. In support of the variance request, the company submitted permeability data for compacted Poz-O-Tec demonstrating that the permeability of the soil/Poz-O-Tec combination liner would be no greater than the permeability allowed for the 3-ft compacted clay liner specified in the regulations. According to a company representative, this variance applies to an expansion area in the landfill that has not yet been constructed.	None specified	None

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
233	MN	Gas monitoring	Since the waste being disposed of is not putrescible or biodegradable, there is no need for a methane gas management system.	None specified	None
236	MN	Gas monitoring	None specified in the permit. A company representative clarified that methane production and monitoring are moot issues because coal ash loss of ignition is often <1%, indicating there is little organic matter to break down.	If operational records or other reports indicate possible decomposition gas production in or around the facility, the Commissioner reserves the right to require monitoring under Minn. R. 7035.1700, Item U.	None
233	MN	Groundwater-protection standards	The alternative groundwater-performance standards are based on the Minnesota Department of Health's Health Risk Limits. The substitution is made as provided for in Minn. R. 7035.2815, Subp. 4, Item H, which contains descriptions of six circumstances that would justify establishing alternative groundwater-performance standards and intervention limits in the facility permit. A company representative clarified that the analytical limits set forth in the permit do not constitute a variance and provided the following explanation: The Intervention Limits set forth in 7035.2815, Subp. 4, Item F are based upon ¼ of the Minnesota Health Risk Levels (HRLs). Pursuant to 7035.2815, Subp. 4, Item H(5) the HRLs periodically change whenever the Department of Health obtains new information suggesting that the standard is not protective enough. The Minnesota Pollution Control Agency reflects these HRL changes in individual solid waste permits by referencing Item H(5) as the authority for the new, updated standards. Item H(5) is one of the six circumstances under which standards or intervention limits can be changed. Note: The State uses variance provisions in the regulations as the basis for incorporating updated health-based standards into permits in place of the standards specified in the regulations. Apparently this is more efficient that changing the regulations every time health-based standards are updated.	None specified	The permit cites Minn. R. 7035.2815, Subp. 4, Item H, as the authority for the new standards in the regulations that are incorporated into the permit.

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
233	MN	Solid waste management plan	A waste management plan is not necessary because waste disposal operations are restricted to specified waste types.	None specified	None
202	OH	Daily cover/dust controls	This variance would not result in a nuisance or a health hazard and was unlikely to result in a violation of any regulation. A company representative explained that a demonstration was submitted showing that the permeability of the land-filled FGD material would be less than the permeability of the required 1 ft of "low permeability soil." This demonstration supported a conclusion that a 1-ft, compacted layer of FGD material would provide a barrier to rainfall infiltration that is as good as the barrier that the required soil layer would provide. The demonstration also showed that erosion would not be a problem, fugitive dust would be controlled, and the leachate/rainfall runoff collection and treatment ponds would still provide the required level of treatment. To control fugitive dust, vehicles are not allowed to traverse landfill areas subject to the variance. Infrequent erosion areas are repaired as they occur.	None specified	The Director's Final Findings and Orders cited the regulatory requirement as OAC Rule 3745-30-14(V)(2). However, no such section appears in the current OAC. OAC Rule 3745-30-14(G)(1) and (2) are cited herein because they describe a requirement for interim cover that is consistent with the requirement that the Director's Final Findings and Orders attribute to OAC Rule 3745-30-14(V)(2).

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
202	OH	Daily cover/dust controls	The company demonstrated that the FGD waste being disposed of in the landfill can achieve a sufficiently low permeability, is resistant to erosion, and should not create fugitive dust problems. Because the facility has adequate water pollution control mechanisms in place and a composite liner and leachate-collection system, the granting of the variance from the requirement to apply intermediate soil cover on top of Phase B at the landfill will not create a nuisance or a health hazard and is unlikely to result in violation of any regulations.	If the lack of intermediate soil cover proves to be ineffective in minimizing infiltration or otherwise unsatisfactory to the OEPA, or is likely to result in a nuisance or health hazard or violation of any regulations, the variance may be revoked upon written notification of the Director. Upon revocation, the utility must immediately begin placement of intermediate cover in accordance with the requirements of the otherwise applicable OAC rule.	The Director's Final Findings and Orders cited the regulatory requirement as OAC Rule 3745-30-14(V)(2). However, no such section appears in the current OAC. OAC Rule 3745-30-14(G)(1) and (2) are cited herein because they describe a requirement for interim cover that is consistent with the requirement that the Director's Final Findings and Orders attribute to OAC Rule 3745-30-14(V)(2).

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
201	OH	Liner requirements	According to the permit, "deep dynamic compaction" (DDC) is an option as a demonstration project. A company representative explained that the regulatory agency approved use of DDC as an alternative means for densifying the subgrade foundation soils below the liner system prior to construction of the liner system. In this case, the landfill was sited in an unreclaimed mine area. Hence, the subgrade foundation soils consisted of mine spoil material. According to the company, approval of this alternative densification method for subgrade foundation soils was not a variance from any regulatory requirement, including those regarding liner construction. It was simply regulator consent to use an alternative (i.e., unconventional) method for consolidating the subgrade foundation soils. DDC was accomplished by dropping a 20-ton weight from a crane (up to 75 ft in height) approximately 50,000 times over a 25-acre area. This process densified the semiconsolidated mine spoil soils that composed the landfill subgrade, reducing the potential for either total or differential settlement. The DDC method was more cost-effective and time efficient than other subgrade consolidation methods, such as preloading or excavating and recompacting the subgrade soils in controlled lifts. The company reports that the demonstration was completed, and the regulatory agency ultimately certified its acceptance of the prepared subgrade. DDC was found to produce significant densification of the subgrade foundation soils, which assures the integrity of the overlying recompacted soil liner and geomembrane liner. However, the company stated that the regulatory agency expressed concerns related to the lack of documentation on achievement of pre-established performance criteria for certain relatively small areas within the overall project area.	None specified	The permit allows sieving and recompacting mine spoil according to the permit application or the use of dynamic compaction as a demonstration project alternative. Technically, this might not qualify as a variance.

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
241	VA	Groundwater monitoring	None specified in the permit. A company representative explained that the Stage III Landfill did not begin receiving ash until 2002 and that not enough Phase I monitoring data have yet been collected to progress to Phase II monitoring. Even so, the permit Module X, Attachment X-2, Section IV.2(a) states that the variance has been granted for monitoring during Phase II. The company believes the State regulatory agency included the variance language in the permit at the time of the last permit modification for reasons of administrative efficiency, considering that the Phase I monitoring data for the Stage III Landfill so far suggest that support for granting this variance will be available before the permit is due for renewal. After sufficient Phase I monitoring data are available, the company plans to implement the variance during Phase II monitoring based on the current permit language.	None specified. However, for Stages I and II, a parallel variance provides that, if any of the conditions outlined in the variance are violated in any form or manner, the variance will be withdrawn.	Module X, Attachment X-2, Section IV.2(a) of the permit indicates that the facility has been granted this variance for the Stage III landfill. However, Module XI, Section XI.D.3, of the permit suggests that the variance may only apply to Stages I and II.
241	VA	Groundwater monitoring	None specified in the permit. A company representative explained that coal ash has long been generally recognized by industry personnel and State regulators as not presenting an organic pollutant risk. Hence, when the State adopted solid waste landfill regulations in 1988, many coal combustion by-product landfills in the State, including three at power plants owned by the company, requested variances from the section(s) in the regulations requiring testing for organic constituents during Phase II monitoring. Also, groundwater-monitoring data collected after 1988 but before the variance was granted demonstrated that no semivolatile organic compounds, pesticides, polychlorinated biphenyls, or volatile organic compounds other than carbon disulfide, which can occur naturally, were detectable at the landfill site.	If any of the conditions outlined in the variance are violated in any form or manner, the variance will be withdrawn.	None
203	VA	Groundwater monitoring	A company representative provided the following quote from the letter approving the variance: “variance is justified because the facility is a coal ash landfill and not likely to contain and release organic constituents, and because organic constituents have been tested for, but not detected.”	Unknown (the letter granting the variance was not available for review)	None

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
200	VA	Groundwater monitoring	The facility is now in Phase II monitoring, but only one well has shown a statistically significant increase in concentrations during the past few years. That well is excluded from the subset of wells covered by the variance. A company representative explained that Phase I monitoring involves establishing background concentrations for each required indicator constituent (pH, conductivity, total organic carbon [TOC], and total organic halogen [TOX]), and then semiannual monitoring of the four parameters for statistical analysis. Phase II involves a larger parameter list, including metals and organics. The basis for the variance request was that organics should not be found in the coal combustion ash, thus semiannual sampling for a large list of organics was not reasonable. TOC is used as an indicator parameter of organics that might leach into the groundwater. The variance allows the company to sample metals from the list of Phase II parameters for wells that have had some historical statistical exceedences of the Phase I parameters.	If any of the Phase I indicator parameters exceed statistical background limits, impacted wells must implement sampling for Table 5.5 (9 VAC 20-80-300) constituents. If future groundwater-monitoring values exceed groundwater-protection standards, the facility will be required to monitor groundwater per the requirements applicable to Phase II monitoring.	None
200	VA	Groundwater protection standards	None specified. A company representative explained that the Virginia Department of Environmental Quality (VDEQ) did not favor using EPA Region III risk-based concentrations for tap water because the concentrations did not consider a child receptor. The company accepted VDEQ's alternate concentration limits (ACLs) in December 2001/January 2002 correspondence. The company had proposed the EPA risk-based concentrations because VDEQ did not accept secondary maximum contaminant levels (MCLs) as groundwater-protection standards (GPSs) because they are not risk-based. The VDEQ rationale for granting the variances was based on using groundwater as a future potential source of drinking water. It used conservative calculations for the most receptive sensor, a child.	If an MCL is promulgated under Section 1412 of the Safe Drinking Water Act for any of the constituents covered by the variance, the new MCL will be used as the groundwater-protection standard for that respective constituent.	9 VAC 20-80-60A Variance to groundwater-protection standards. "A. Application and conditions. The director may grant a variance to ground water protection standards contained in Part V (9 VAC 20-80-240 et seq.) of this chapter to an owner or operator of a solid waste disposal facility by establishing an alternate concentration limit for a solid waste constituent if the owner or operator shows to the satisfaction of the director that the constituent will not pose a substantial present or potential hazard to human health or the environment as long as the alternate concentration limit is not exceeded."

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
241	VA	Groundwater - protection standards	None specified in the Solid Waste Facility permit. A company representative explained that the Stage III Landfill began receiving ash in 2002, and enough data have not yet been collected to support this variance for Stage III. The permit Module X, Attachment X-2, Section IV.2(d) states that within 60 days of the establishment of Appendix 5.1 (9 VAC 20-80-300) background, the company must propose a groundwater-protection standard for each Appendix 5.1 constituent detected in the groundwater. The company has not yet submitted proposed groundwater-protection standards and does not yet consider itself to have been granted this variance for ACLs and GPSs.	None specified. However, in a parallel variance for Stages I and II landfills, the variance provides that if any of the conditions in the variance are violated in any form or manner, the variance will be immediately withdrawn.	Module I, section I.F.7 states, that Permit Amendment #5 grants a variance for Stage III of the landfill to use alternate concentration limits for groundwater-protection standards. However, unlike a parallel variance for Stages I and II landfills, the permit does not contain an attachment specifying the constituents affected and detailing the nature and conditions of the variance applicable to Stage III.
241	VA	Groundwater-protection standards	None specified in the permit or in the letter dated January 29, 2004, which granted the variance [see Permit Module XI, Attachment XI-2]. In its petition dated April 16, 2002, to obtain the variance, the company requested that ACLs for constituents that do not have MCLs be established at health-based levels derived from the VDEQs "Guidance to Calculate Health-Based Alternate Concentration Limits using REAMS for a Solid Waste Facility," in lieu of using facility background levels. The petition identified 149 of these constituents. The petition indicated that the purpose of the requested variance was to provide for groundwater-monitoring controls that are protective of public health and the environment.	If any of the conditions in the variance are violated in any form or manner, the variance will be immediately withdrawn.	None

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
241	VA	Location requirements	The permit requires the company to mitigate 2.8 acres of affected wetlands by adding emergent wetlands in a 2:1 ratio. The permit also specifies that additional conditions imposed by the Water Division of VDEQ's Piedmont Regional Office must be addressed in the Part B application. A company representative explained that the VDEQ was provided with a copy of the joint permit application for approval of work in waters of the United States, including wetlands, within Virginia. A joint permit application is used to apply for permits from the Norfolk District Army Corps of Engineers, the Virginia Marine Resources Commission, the VDEQ, and local wetlands boards. The application contained information and engineering drawings explaining the need to expand an existing leachate treatment pond to accommodate overflows being rerouted into it from another pond. The information in the drawings made it clear that the only available space into which the leachate treatment pond could be expanded was located within 100 ft of a water body and that a portion of the expanded treatment pond would be in a wetland area. Since no other siting options were available for the treatment pond expansion, the variance allowing the facility to be located within 100 ft of the water body was requested and granted, and mitigation of the impacted wetland area was required.	None specified	This variance is granted in the approval of the Part A Application for the Clover Power Station Stage III permit amendment. [Letter from VDEQ (D. Treacy) to Virginia Power (now Dominion Power) (W. Treacy); November 19, 1999); Permit Attachment V-5].
209	WI	Groundwater-protection standards	Groundwater concentrations for selenium that exceed groundwater standards are attributable to baseline groundwater quality associated with natural hydrogeologic conditions or substances released by other human activity. The proposed facility will not cause the concentration of selenium to exceed the enforcement standard for selenium at the point of standards application because of the landfill's liner and leachate-collection system design. The proposed facility is designed to achieve the lowest possible concentrations for selenium that are technically and economically feasible. Granting the exemption will not inhibit compliance with the Wisconsin solid waste management standards. The company's monitoring well data show only one exceedance of the selenium preventive action permit (PAL) (10 µg/L) since monitoring began in June 2001.	The Department reserves the right to require the submittal of additional information and to modify this approval at any time, if in the Department's opinion, modifications are necessary.	The permittee demonstrated that an exemption to the groundwater standards for selenium and sulfate at an eleventh well (Well Station 6) was warranted. However, the permittee removed Well Station 6 from the groundwater-monitoring plan for the facility. Therefore, an exemption to the groundwater standards for sulfate and selenium at Well Station 6 was not necessary, and an exemption granted on September 10, 2000, for Well Station 6 was rescinded.

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
209	WI	Leachate-collection requirements	Dairyland Power Cooperative (DPC) has demonstrated circumstances that warrant an exemption from the Wisconsin Administrative Code (WAC) requirement whereby leachate flowing across the base of a liner is required to flow into a perforated leachate collection line within 130 ft. A company representative explained that the Wisconsin Department of Natural Resources (WDNR) reviewed the engineering design of the landfill and was satisfied that it would provide adequate drainage, thus protecting human health and the environment. Even though the landfill is located within a natural valley, it is an engineered structure and the drawings reflect that the slopes are adequate to provide the necessary drainage toward the collection pipe. The landfill has base slopes of between 6% and 10%.	The Department reserves the right to require the submittal of additional information and to modify this approval at any time, if in the Department's opinion, modifications are necessary.	Although the permit cites NR 504.05(5) as the section from which a variance is granted, no such section appears in the current regulations. NR 504.06(5) is cited herein because it describes a requirement for the leachate-collection system that is consistent with the requirement that the permit attributes to NR 504.05(5).
209	WI	Liner requirements	DPC has demonstrated circumstances that warrant an exemption from the Wisconsin Administrative Code (WAC) requirement whereby sumps and side-slope risers must be installed as part of the leachate removal system rather than allowing penetration of the composite liner sidewall. A company representative explained that the landfill is located at the head end of a small valley. The leachate tank is located several hundred feet downgradient of the landfill. Hence, natural gravity drainage made sense because the elevation difference between the landfill and the leachate tank would accommodate it. According to the company representative, the area where the liner penetration occurred was inspected and leak tested at the time it was penetrated to verify that no leaks were present. The inspection and leak test data were documented and submitted to the WDNR in the construction report. Since landfill operations began, no means have existed to monitor the penetration area, just as no means exists (other than groundwater monitoring) by which to monitor the landfill liner system. A company representative indicated that data collected from leachate head wells located within the landfill verify that the leachate head on the liner has not exceeded the regulatory limit of 12 in.	The Department reserves the right to require the submittal of additional information and to modify this approval at any time, if in the Department's opinion, modifications are necessary.	None

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
205	WV	Cover/dust controls	None specified in the permit. The rationale for granting the variance was contained in a fact sheet that accompanied the draft permit. As part of the draft permit, the fact sheet was available to the public for comment. It explained the variance rationale as follows: "Requirements for intermediate cover are not necessary for the same reasons as stated for daily cover:" [Note: the reasons stated for daily cover are as follows: "Requirements for cell height and daily cover are not necessary for this facility due to the fact that coal ash should not cause vector problems, windblown litter or other problems associated with municipal waste. In addition, this facility is to be constructed as a structural landfill and does not utilize cells or daily cover."]	None specified	The permit did not specify the terms of the variance.
204	WV	Cover/dust controls	None specified in the permit. The rationale for granting the variance was contained in a fact sheet that accompanied the draft permit. As part of the draft permit, the fact sheet was available to the public for comment. It explained the variance rationale as follows: "Requirements for intermediate cover are not necessary for the same reasons as stated for daily cover:" [Note: the reasons stated for daily cover are as follows: "Requirements for cell height and daily cover are not necessary for this facility due to the fact that coal ash should not cause vector problems, windblown litter or other problems associated with municipal waste. Also, this facility is to be constructed as a structural landfill and does not utilize cells or daily cover."]	None specified	The permit provided no text regarding the variances; it merely stated that "Waiver requests for the following sections of the Solid Waste Management Regulations are granted: Section 3.2k, 3.4, 4.6.b,2,A, 4.6.b.2.D.(1), 4.6.b.2.D.(2), 4.8.c.3.B, 4.10, and gas control and gas monitoring requirements of sections 3.10.a.2, 3.10.a.4, and 3.10.b.3."
205	WV	Daily cell height	None specified in the permit. The rationale for granting the variance was contained in a fact sheet that accompanied the draft permit. As part of the draft permit, the fact sheet was available to the public for comment. It explained the variance rationale as follows: "Requirements for cell height and daily cover are not necessary for this facility due to the fact that coal ash should not cause vector problems, windblown litter or other problems associated with municipal waste. In addition, this facility is to be constructed as a structural landfill and does not utilize cells or daily cover."	None specified	Permit did not specify terms of the variance.

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
205	WV	Daily cover/dust controls	None specified in the permit. The rationale for granting the variance was contained in a fact sheet that accompanied the draft permit. As part of the draft permit, the fact sheet was available to the public for comment. It explained the variance rationale as follows: "Requirements for cell height and daily cover are not necessary for this facility due to the fact that coal ash should not cause vector problems, windblown litter or other problems associated with municipal waste. In addition, this facility is to be constructed as a structural landfill and does not utilize cells or daily cover."	None specified	The permit did not specify the cover/dust control that would apply to the site.
204	WV	Daily cover/dust controls	None specified in the permit. The rationale for granting the variance was contained in a fact sheet that accompanied the draft permit. As part of the draft permit, the fact sheet was available to the public for comment. It explained the variance rationale as follows: "Requirements for cell height and daily cover are not necessary for this facility due to the fact that coal ash should not cause vector problems, windblown litter or other problems associated with municipal waste. Also, this facility is to be constructed as a structural landfill and does not utilize cells or daily cover."	None specified	The permit provided no text regarding the variances; it merely stated that "Waiver requests for the following sections of the Solid Waste Management Regulations are granted: Section 3.2k, 3.4, 4.6.b,2,A, 4.6.b.2.D.(1), 4.6.b.2.D.(2), 4.8.c.3.B, 4.10, and gas control and gas monitoring requirements of sections 3.10.a.2, 3.10.a.4, and 3.10.b.3."
205	WV	Landfill gas management requirements	None specified in the permit. The rationale for granting the variance was contained in a fact sheet that accompanied the draft permit. As part of the draft permit, the fact sheet was available to the public for comment. It explained the variance rationale as follows: "Landfill gas management - The waste disposed at this facility does not produce waste gases."	None specified	The permit did not specify the terms of the variance.
204	WV	Landfill gas management requirements	None specified in the permit. The rationale for granting the variance was contained in a fact sheet that accompanied the draft permit. As part of the draft permit, the fact sheet was available to the public for comment. It explained the variance rationale as follows: "Landfill gas management - The waste disposed at this facility does not produce waste gases."	None specified	The permit provided no text regarding the variances; it merely stated that "Waiver requests for the following sections of the Solid Waste Management Regulations are granted: Section 3.2k, 3.4, 4.6.b,2,A, 4.6.b.2.D.(1), 4.6.b.2.D.(2), 4.8.c.3.B, 4.10, and gas control and gas monitoring requirements of sections 3.10.a.2, 3.10.a.4, and 3.10.b.3."

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
204	WV	Liner requirements	None specified in the permit. The rationale for granting the variance was contained in a fact sheet that accompanied the draft permit. As part of the draft permit, the fact sheet was available to the public for comment. It explained the variance rationale as follows: "Leachate pond liner - waiver is proposed to be granted because this is a Coal Combustion By-product facility and is consistent with the liner required for the landfill." In a telephone conversation, during May 2005, a company representative clarified that Section 5.5.b.1.G of the West Virginia Solid Waste Management Rule allows options for liner systems for surface impoundments receiving leachate. The regulation is as follows: "For surface impoundments receiving leachate, a permittee may elect use of a liner system consisting of either eighteen (18) inches of clay having a permeability no greater than 1×10^{-7} centimeters per second and compacted to a Standard Proctor density of at least ninety-five percent (95%) as determined by ASTM D-698, with a sixty (60) mil synthetic liner installed on top of the clay; two (2) feet of clay with the aforementioned permeability rate and compaction density; or any other alternative liner system approved by the Secretary on a case-by-case basis. Taking into account site-specific conditions, an appropriate groundwater interceptor drainage system, which must also serve as a leachate-detection system, must be installed under all liner systems in such a manner as to avoid groundwater penetration of the liner system and to facilitate detection of leachate penetrating the liner." The company representative stated that a groundwater interceptor drainage system was required but no additional monitoring was required.	None specified	The permit provided no text regarding the variances; it merely stated that "Waiver requests for the following sections of the Solid Waste Management Regulations are granted: Section 3.2k, 3.4, 4.6.b,2,A, 4.6.b.2.D.(1), 4.6.b.2.D.(2), 4.8.c.3.B, 4.10, and gas control and gas monitoring requirements of sections 3.10.a.2, 3.10.a.4, and 3.10.b.3."

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
205	WV	Liner requirements	None specified in the permit. The rationale for granting the variance was contained in a fact sheet that accompanied the draft permit. As part of the draft permit, the fact sheet was available to the public for comment. It explained the variance rationale as follows: "Leachate pond liner - waiver is proposed to be granted because this is a Coal Combustion By-product facility and is consistent with the liner required for the landfill." In a telephone conversation, a company representative clarified that Section 5.5.b.1.G of the West Virginia Solid Waste Management Rule allows options for liner systems for surface impoundments receiving leachate. The regulation is as follows: "For surface impoundments receiving leachate, a permittee may elect use of a liner system consisting of either eighteen (18) inches of clay having a permeability no greater than 1×10^{-7} centimeters per second and compacted to a Standard Proctor density of at least ninety-five percent (95%) as determined by ASTM D-698, with a sixty (60) mil synthetic liner installed on top of the clay; two (2) feet of clay with the aforementioned permeability rate and compaction density; or any other alternative liner system approved by the Secretary on a case-by-case basis. Taking into account site-specific conditions, an appropriate groundwater interceptor drainage system, which must also serve as a leachate detection system, must be installed under all liner systems in such a manner as to avoid groundwater penetration of the liner system and to facilitate detection of leachate penetrating the liner." The company representative stated that a groundwater interceptor drainage system was required but no additional monitoring was required.	None specified	Survey respondent indicated that the landfill has a 2-ft compacted clay liner.

TABLE L.1 (Cont.)

ID	State	Variance Category	Granting Rationale	Revocation Provisions	Variance Comments
204	WV	Location requirements	None specified in the permit. The rationale for granting the variance was contained in a fact sheet that accompanied the draft permit. As part of the draft permit, the fact sheet was available to the public for comment. It explained the variance rationale as follows: "Location standard for facility located over a deep mine – The writer proposes that this waiver be granted based on the Gales Engineering report, Little Broad Run Landfill Mining Subsidence Evaluation, dated November 6, 1992. AEP retained Gales Engineering Company to investigate the structural integrity of the Philip Sporn Number 1 Mine that underlies portions of the landfill. The report indicates that the most significant problem which could occur due to the mine's presence would be failure of the clay liner due to mine subsidence. The mine was constructed utilizing pillars, which according to the report, were never removed. Based on this information, subsidence should be the result of pillar failure. The report utilizes accepted methods for determining pillar failure. The safety factor is 2.3. The report was also reviewed by an engineer of the DEP [Division of Environmental Protection], Office of Mining and Reclamation. He stated that the report utilized appropriate methods and found that based on information in the report, [the site] has an acceptable factor of safety. This waiver was previously granted by DEP's Director via letter dated December 15, 1992 when this permit was originally issued."	None specified	The permit provided no text regarding the variances; it merely stated that "Waiver requests for the following sections of the Solid Waste Management Regulations are granted: Section 3.2k, 3.4, 4.6.b,2,A, 4.6.b.2.D.(1), 4.6.b.2.D.(2), 4.8.c.3.B, 4.10, and gas control and gas monitoring requirements of sections 3.10.a.2, 3.10.a.4, and 3.10.b.3."
205	WV	Pre-siting requirements	None specified in the permit. The rationale for granting the variance was contained in a fact sheet that accompanied the draft permit. As part of the draft permit, the fact sheet was available to the public for comment. It explained the variance rationale as follows: "Pre-siting requirements for commercial solid waste facilities -- This facility is not classified as a commercial solid waste facility since it is a solid waste facility owned and operated by a person for the sole purpose of disposing of solid waste created by a person or such persons on a cost-sharing basis (SWMR Section 2.16)."	None specified	None