Final Report

ESTIMATION OF COSTS FOR REGULATING FOSSIL FUEL COMBUSTION ASH MANAGEMENT AT LARGE ELECTRIC UTILITIES UNDER PART 258

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1.0 INTRODUCTION

In April 2000, the U.S. EPA determined that the regulation of fossil fuel combustion wastes would be under Subtitle D of RCRA. Now, subject to review and final decision by the Administrator, EPA is planning that such regulation be primarily in accordance with Part 258 standards. The regulation will apply to large electric utility plants that burn coal. While many rule options and their costs have been investigated in the past, this report focuses specifically on Part 258 and the requirements thereof. The purpose of this report is to present estimates of cost impacts on large electric utilities for a select number of Part 258 regulatory options under consideration by the Agency for the management of fossil fuel combustion waste. No industry economic impact analysis is presented in this report.

The report is separated into four sections. The first section is the introduction. The second section defines the potential elements of a Part 258 regulation of large coal-burning utility plants that produce electricity and defines the design and performance standard options evaluated in this report. The third section summarizes the ash, FGD, and gypsum generation quantities and management practices for the affected population of plants. The fourth section presents the cost assumptions to be used in the cost model for estimating regulatory cost impacts and the incremental compliance cost estimates for each of the Part 258 regulatory options evaluated.

2.0 DEFINING A PART 258 REGULATORY ALTERNATIVE

2.1 General Approach to Defining Regulatory Alternative

The general approach to defining the regulatory alternative was to identify approaches for mitigating risks identified in damage cases. The primary focus of defining the regulatory alternative is to define the groundwater monitoring, liner, cap, financial assurance, daily cover, dust control, and run-on/run-off control systems that mitigate damages. Insights from similar rulemakings (Cement Kiln Dust and Municipal Solid Waste Landfill), state regulations, and state officials are utilized to identify strategies for mitigating damages.

This analysis focuses on the development of a regulatory approach that fits under the criteria specified in 40 Code of Federal Regulations, Part 258. This analysis does not evaluate non-regulatory alternatives such as placing a tax on coal-fired electricity to create a fund to pay for the cleanup of future damages from ash landfills and impoundments or purchasing of insurance against liability from future damages.

2.2 Insights from Similar Rulemakings and State Regulations

Insights for regulating FFC waste landfills and surface impoundments can be gained from those rules finalized or proposed for municipal solid waste landfills (MSWLFs) under the Subtitle D program (Federal Register, Volume 56, October 9, 1991, and 40 CFR Part 258), the proposed rule for standards for management of cement kiln dust (Federal Register, Volume 64, Friday, August 20, 1999), and state regulations. These rulemakings provide criteria for location restrictions, operation, design, groundwater monitoring and corrective action, closure and post-closure care and financial assurance for landfills. These criteria provide mechanisms that prevent potential damages associated with contaminants traveling via groundwater, air and surface release pathways. Cement kiln dust most likely has similar cementitious and waste characteristic properties to fossil fuel combustion ash implying that similar management practices apply. This analysis does not make this technical comparison. A summary of FFC waste characteristics is provided in Chapter 3.

The above rulemakings provide several criteria to consider for managing FFC wastes. Location restrictions apply to the restriction of siting landfills in floodplains, wetlands, fault areas, seismic impact zones, and unstable areas (e.g., Karst terrains). Operating criteria apply to cover material, dust control, and run-on/run-off control system requirements. Design criteria apply to liner and leachate collection system requirements. Groundwater monitoring criteria apply to monitoring system, sampling and analysis, detection/assessment monitoring, and corrective measure requirements. Closure and post-closure criteria apply to closure (i.e., cap) and post-closure monitoring and maintenance requirements. Financial assurance applies to assuring financial viability for closure, post-closure and/or corrective action. These criteria are described further in the following subsections of this chapter.

Finally, as summarized in the March 1999 Report to Congress:

> "EPA reviewed current state regulations governing management of FFC wastes and found that states currently have more authority to impose controls on utility coal combustion waste management units than in previous years. In addition to regulatory permits, the majority of states are now able to require siting controls, liners, leachate collection systems, ground-water monitoring, closure controls, daily (or other operational) cover, and fugitive dust controls. EPA believes that the use of such controls has the potential to mitigate risks, particularly ground-water pathway risks, from comanaged waste disposal."

Insights on FFC waste management have been gained through a review of the top 34 states that utilize coal for producing electricity. These states account for over 98 percent of the quantity of FGD and ash managed on site and includes every state that manages over 500,000 tons in on-site management units. State regulations were reviewed for Alabama, Arizona, Colorado, Florida, Georgia, Iowa, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Missouri, New Mexico, Mississippi, Montana, New York, Nevada, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Utah, Virginia, West Virginia, Washington, Wisconsin and Wyoming. Exhibits 2-1 and 2-2 present the groundwater monitoring and post-closure monitoring criteria required for FFC landfills and surface impoundments, respectively, in these 34 states. Exhibits 2-3 and 2-4 present the present the liner, cap, financial assurance, daily cover, dust control, and run-on/run-off controls criteria required for FFC landfills and surface impoundments, respectively, in these 34 states.

Exhibit 2-1. Minimum State Groundwater Monitoring Criteria for FFC Waste Landfills for Top 34 Coal Utility States [5]							
State	Date of Regulation	Monitoring Required	Monitoring Location	Minimum Number of Wells	Sampling Parameters	Monitoring Frequency	Post-closure Monitoring
AL	7/26/96	Yes	unit boundary [1]				Yes
AZ [3]	1999	No					No
CO	10/9/93 [4]	Yes	unit boundary [1]				Yes
FL (For new unit construction only.)	1/6/93 [4]	Yes	unit boundary		indicator & Appendix VIII	semi-annual	Yes
GA	7/1/91 [4]	Yes	unit boundary [1]		Appendix VIII	semi-annual	Yes
IA	1971 - 1998 [4] (several amend.)	Yes	unit boundary [1]	1	indicator & Appendix VIII	quarterly (until baseline conditions established) annual (after baseline established)	Yes
IL (For new units replacing units that existed before 10/9/93.)	9/18/90 [4]	Yes	unit boundary [1]	multiple	Appendix VIII	quarterly (first 5 years) annual (after 5 years)	Yes
IN (In compliance by 1/1/98.)	9/1/89 [4] 4/14/96 (for closure)	Yes	unit boundary [1]				No

Exhibit 2-1. Minimum State Groundwater Monitoring Criteria for FFC Waste Landfills for Top 34 Coal Utility States [5]							
State	Date of Regulation	Monitoring Required	Monitoring Location	Minimum Number of Wells	Sampling Parameters	Monitoring Frequency	Post-closure Monitoring
KS	5/79 [4] (amended 5/82 through 5/03)	Yes	unit boundary [1]				Yes
KY	4/28/93	Yes		3	indicator	semi-annual	Yes
LA (For new unit construction only.)	5/03	Yes	unit boundary [1]				Yes
MD	9/16/02	No					Yes
MI (In compliance by 4/19/97)	10/8/93 [4]	Yes	unit boundary [1]		indicator & Appendix VIII	quarterly	Yes
MN	6/95 [4]	Yes	unit boundary [1]				Yes
MS (For new units constructed after 10/9/91)	2/22/96	Yes	unit boundary [1]				Yes
MO (For new units constructed after 10/9/93, except all units must comply with post closure monitoring.)	9/97 [4]	Yes	unit boundary [1]	4	Appendix VIII	semi-annual	Yes

Exhibit 2-1. Minimum State Groundwater Monitoring Criteria for FFC Waste Landfills for Top 34 Coal Utility States [5]							
State	Date of Regulation	Monitoring Required	Monitoring Location	Minimum Number of Wells	Sampling Parameters	Monitoring Frequency	Post-closure Monitoring
MT	6/30/97	Yes	unit boundary [1]				Yes
NC	10/1/95 [4] (effect. date) 1/1/98 (compliance date)	Yes	unit boundary [1]				No
ND	12/1/92 [4] through 11/02	Yes	unit boundary [1]				Yes
NM [2]	11/30/95	No					No
NV (For new units constructed after 12/93.)	12/02	Yes	unit boundary [1]				Yes
NY	11/24/99	Yes	unit boundary [1]				Yes
OH	6/1/94	Yes	unit boundary [1]		indicator & Appendix VIII	semi-annual (for indicators) annual (for metals, TOC, TDS, chloride, sodium and radionuclides)	Yes

Exhibit 2-1. Minimum State Groundwater Monitoring Criteria for FFC Waste Landfills for Top 34 Coal Utility States [5]							
State	Date of Regulation	Monitoring Required	Monitoring Location	Minimum Number of Wells	Sampling Parameters	Monitoring Frequency	Post-closure Monitoring
OK (For new unit construction only.)	6/1/94 [4]	Yes	unit boundary [1]	4	indicator	semi-annual	Yes
PA	7/4/92	Yes	unit boundary		indicator	semi-annual (for indicators) annual (for metals and VOCs)	Yes
SC	10/25/02	Yes	unit boundary [1]				Yes
TN	3/18/90 [4]	Yes	unit boundary [1]	3	indicator & Appendix VIII	semi-annual (for indicators) annual (Appendix VIII constituents)	Yes
TX (For new unit construction only, except for post closure monitoring.)	3/21/00	Yes	unit boundary [1]				Yes
UT	7/15/99	No					No
VA	5/32/01	Yes	unit boundary [1]				Yes
WA	9/8/00	Yes	unit boundary [1]				Yes

Exhibit 2-1. Minimum State Groundwater Monitoring Criteria for FFC Waste Landfills for Top 34 Coal Utility States [5]							
State	Date of Regulation	Monitoring Required	Monitoring Location	Minimum Number of Wells	Sampling Parameters	Monitoring Frequency	Post-closure Monitoring
WI (For new units constructed after 7/1/96).	8/97	Yes	unit boundary [1]		indicator		Yes
WV (For new unit construction only.)	5/1/90 [4]	Yes	unit boundary [1]		indicator & Appendix VIII	semi-annual	Yes
WY	1/1/98	Yes	unit boundary [1]			semi-annual	Yes

Notes:

1. State regulations regarding monitoring were non-specific. In cases where a specific locations for groundwater monitoring was unavailable or given as within a distance from the waste placement (e.g., “within 500 feet”), Unit Boundary Monitoring was assumed as the least cost alternative. The assumption of Unit Boundary Monitoring may increase the estimated post closure remediation costs.

2. The definition for “solid waste” in the regulations indicates that it does not include fly ash waste from coal combustion/energy production (Title 20, Chapter 9, subpart 1, 105(BV)(2)). No regulations were found for fly ash waste from coal combustion/energy production.

3. The definition as stated in Arizona Code, Chapter 4 Solid Waste Management, Article 1 Section 49.701. "Solid waste landfill" means a facility, area of land or excavation in which solid wastes are placed for permanent disposal. Solid waste landfill does not include a land application unit, surface impoundment, injection well, compost pile or waste pile or an area containing ash from the on-site combustion of coal that does not contain household waste, household hazardous waste or conditionally exempt small quantity generator waste.

4. The date of implementation was retained from the review of state regulations prepared by SAIC Incorporated and submitted to the Municipal, Industrial and Solid Waste Division, Office of Solid Waste, on November 15, 2000.

5. Even though a no os specified for a particular environmental control requirement, the State may require the environmental control as a condition under the permit.

Exhibit 2-2. Minimum State Groundwater Monitoring Criteria for FFC Waste Surface Impoundments for Top 34 Coal Utility States							
State	Date of Regulation	Required Monitoring	Monitoring Location	Minimum Number of Wells	Sampling Parameters	Monitoring Frequency	Post-closure Monitoring
AL	None	No					No
AZ	9/27/89 1/1/04 [2]	No					Yes
CO (For new unit construction only.)	8/9/93 [2] 4/4/97	Yes	unit boundary [1]		indicator	quarterly or annual (depending on groundwater classification)	Yes
FL (For new unit construction only.)	7/1/82 1/6/93	Yes	unit boundary [1]	3			No
GA	None	No					No
IA	None	No					No
IL	None	No					No
IN	None	No					No
KS	5/1/75 5/1/87 (amended)	No					No

Exhibit 2-2. Minimum State Groundwater Monitoring Criteria for FFC Waste Surface Impoundments for Top 34 Coal Utility States							
State	Date of Regulation	Required Monitoring	Monitoring Location	Minimum Number of Wells	Sampling Parameters	Monitoring Frequency	Post-closure Monitoring
KY (For new unit construction only.)	8/24/94 [2] through 2003	Yes	unit boundary [1]				Yes
LA	5/03	Yes	unit boundary [1]				Yes
MD	None	No					No
MI (For new unit construction only.)	10/8/93 [2] (monitoring)	Yes (immediate compliance for unlined units only)	unit boundary [1] (if unlined)				Yes
MN	6/74 [2]	Yes	unit boundary [1]				No
MS (For new unit construction only.)	2/22/96	No					No
MO	7/97 [2]	Yes	unit boundary [1]	4	Appendix VIII	semi-annual	Yes
MT	None	No					No

Exhibit 2-2. Minimum State Groundwater Monitoring Criteria for FFC Waste Surface Impoundments for Top 34 Coal Utility States							
State	Date of Regulation	Required Monitoring	Monitoring Location	Minimum Number of Wells	Sampling Parameters	Monitoring Frequency	Post-closure Monitoring
NC (For new unit construction only.)	1/4/94	Yes	unit boundary [1]				Yes
ND	12/1/92 [2]	Yes	unit boundary [1]	3		semi-annual	Yes
NM	6/18/77	No					Yes
NV	12/02	Yes	unit boundary [1]				Yes
NY	11/24/99	Yes	unit boundary [1]				Yes
OH	None	No					No
OK	7/1/95 [2]	Yes	unit boundary [1]	3			Yes
PA (For new unit construction only.)	12/23/00	Yes	unit boundary [1]		indicator & Appendix VIII	semi-annual (for indicators); annual (for metals and VOCs)	No
SC	10/25/02	Yes	unit boundary [1]				Yes
TN	3/18/90 [2]	No					Yes
TX	None	No					No
UT	7/15/99	Yes	unit boundary [1]				Yes

Exhibit 2-2. Minimum State Groundwater Monitoring Criteria for FFC Waste Surface Impoundments for Top 34 Coal Utility States							
State	Date of Regulation	Required Monitoring	Monitoring Location	Minimum Number of Wells	Sampling Parameters	Monitoring Frequency	Post-closure Monitoring
VA	None	No					No
WA	9/8/00	N/A					N/A
WI (For new unit construction only.)	8/97	Yes	unit boundary [1]				Yes
WV (For new unit construction only.)	5/1/90	Yes	unit boundary [1]	3	indicator & Appendix VIII	semi-annual	Yes
WY	1/1/98	No					No

Notes:

1. State regulations regarding monitoring were non-specific. In cases where a specific locations for groundwater monitoring was unavailable or given as within a distance from the waste placement (e.g., "within 500 feet"), Unit Boundary Monitoring was assumed as the least cost alternative. The assumption of Unit Boundary Monitoring may increase the estimated post closure remediation costs.

2. The date of implementation was retained from the review of state regulations prepared by SAIC Incorporated and submitted to the Municipal, Industrial and Solid Waste Division, Office of Solid Waste, on November 15, 2000.

Exhibit 2-3. Minimum State Environmental Control Requirements for FFC Waste Landfills for the Top 34 Coal Utility States								
State	Date of Regulation	Liner	Leachate Collection System	Cap	Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off Controls
AL	7/26/96	composite	Y	synthetic	N	Y	N	Y
AZ [3]	1999	N	N	N	N	N	N	N
CO	10/9/93 [4] 4/9/97 (for financial assurance)	clay or synthetic	Y	clay	Y	N	Y	Y
FL (For new unit construction only.)	1/6/93 [4]	composite or double	Y	synthetic	Y	Y	Y	Y
GA	7/1/91 [4]	composite	Y	soil	Y	Y	Y compaction	Y
IA	1971-1998 [4] (several amend.)	N	N	clay	N	N	Y	Y
IL (For new unit construction after 10/9/93.)	9/18/90 [4]	clay or composite	Y	clay or synthetic	Y	Y	Y (incl. compaction)	Y

Exhibit 2-3. Minimum State Environmental Control Requirements for FFC Waste Landfills for the Top 34 Coal Utility States								
State	Date of Regulation	Liner	Leachate Collection System	Cap	Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off Controls
IN (In compliance by 1/1/98.)	9/1/89 [4] 4/14/96 (for closure)	clay	Y karst only	clay	Y	N	Y	Y
KS	5/79 [4] (amended 5/82 through 5/03)	composite	Y	soil	Y	Y	Y	Y
KY	4/28/93	N	N	Y	Y	Y	N	N
LA (For new unit construction only.)	5/03	composite	Y	clay	Y	Y	Y	Y
MD	9/16/02	N	N	clay	N	Y	N	Y
MI (In compliance by April 19, 1997; new units or expansions need financial assurance for most closure costs.)	10/8/93 [4]	composite	Y	clay or synthetic	Y	Y	Y	N

Exhibit 2-3. Minimum State Environmental Control Requirements for FFC Waste Landfills for the Top 34 Coal Utility States

State	Date of Regulation	Liner	Leachate Collection System	Cap	Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off Controls
MN	6/95 [4]	clay	Y	clay	Y	Y	Y (incl. compac-tion)	Y
MS (For new unit construction after 10/9/91.)	2/22/96	composite	Y	soil	Y	Y	N	Y
MO (For new units constructed after 10/9/93, except all units must comply with cap and FA reqs.)	9/97 [4]	composite	Y	soil	Y	Y	Y	Y
MT	6/30/97	composite	Y	clay	Y	Y	N	Y
NC	10/1/95 [4] (effect. Date) 1/1/98 (compliance date)	composite	Y	soil	Y	Y	N	Y

Exhibit 2-3. Minimum State Environmental Control Requirements for FFC Waste Landfills for the Top 34 Coal Utility States								
State	Date of Regulation	Liner	Leachate Collection System	Cap	Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off Controls
ND	12/1/92 [4] through 11/02	clay or synthetic	Y	clay or synthetic	Y	N	Y (incl. compaction)	N
NM [2]	11/30/95	N	N	N	N	N	N	N
NV (For new unit construction after 12/93.)	12/02	composite	Y	soil	Y	Y	Y	Y
NY	11/24/99	composite	Y	synthetic	Y	Y	Y	Y
OH	6/1/94 (design criteria/ monitoring) 3/1/96 (operating criteria)	composite	Y	synthetic	Y	Y	Y	Y
OK (For new unit construction only.)	6/1/94 [4]	composite	Y	clay	Y	Y	Y	Y
PA	7/4/92	composite	Y	synthetic	N	Y	Y	Y
SC	10/25/02	composite or clay	Y	synthetic	Y	Y	Y	Y

Exhibit 2-3. Minimum State Environmental Control Requirements for FFC Waste Landfills for the Top 34 Coal Utility States								
State	Date of Regulation	Liner	Leachate Collection System	Cap	Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off Controls
TN	3/18/90 [4]	composite	Y	clay	Y	Y site specific	Y	Y
TX (For new unit construction, except existing landfills must meet cap and FA reqs.)	3/21/00	composite	Y	synthetic	Y	Y	N	Y
UT	7/15/99	N	N	N	N	N	N	N
VA	5/23/01	composite	Y	synthetic	Y	Y	Y	Y
WA	9/8/00	composite	Y	synthetic	Y	N	Y	Y
WI (For new units constructed after 7/1/96.)	8/97	composite	Y	clay	Y	Y	Y	Y
WV (For new unit construction, liner permit after 6/2/96.)	5/1/90 [4]	composite	Y	soil/clay	Y	Y	Y	Y

Exhibit 2-3. Minimum State Environmental Control Requirements for FFC Waste Landfills for the Top 34 Coal Utility States

State	Date of Regulation	Liner	Leachate Collection System	Cap	Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off Controls
WY (For new unit construction, except existing units must meet FA, daily, and dust reqs.)	1/1/98	composite	Y	synthetic	Y	N	Y (incl. compac-tion)	Y

Notes:

Y = yes; N = no

1. Not used.

2. The definition for "solid waste" in the regulations indicates that it does not include fly ash waste from coal combustion/energy production (Title 20, Chapter 9, subpart 1, 105(BV)(2)). No regulations were found for fly ash waste from coal combustion/energy production.

3. The definition as stated in Arizona Code, Chapter 4 Solid Waste Management, Article 1 Section 49.701. "Solid waste landfill" means a facility, area of land or excavation in which solid wastes are placed for permanent disposal. Solid waste landfill does not include a land application unit, surface impoundment, injection well, compost pile or waste pile or an area containing ash from the on-site combustion of coal that does not contain household waste, household hazardous waste or conditionally exempt small quantity generator waste.

4. The date of implementation was retained from the review of state regulations prepared by SAIC Incorporated and submitted to the Municipal, Industrial and Solid Waste Division, Office of Solid Waste, on November 15, 2000.

Exhibit 2-4. Minimum State Environmental Control Requirements for FFC Waste Surface Impoundments for the Top 34 Coal Utility States						
State	Date of Regulation	Liner	Leachate Collection System	Cap	Financial Assurance	Run-on/Run-off Controls
AL	None	N	N	N	N	N
AZ	9/27/89 1/1/04 (for new unit construction sites) [1]	N	N	Y synthetic site spec.	Y	N site spec.
CO (For new unit construction only.)	8/9/93 [1] 4/4/97	clay or soil deposit	Y	clay or synthetic	Y	N
FL	7/1/82 1/6/93	composite	Y	N	N	N
GA	None	N	N	N	N	N
IA	None	N	N	N	N	N
IL	None	N	N	N	N	N
IN	None	N	N	N	N	N
KS	5/1/75 5/1/87 (amended)	composite	Y	N	N	N

Exhibit 2-4. Minimum State Environmental Control Requirements for FFC Waste Surface Impoundments for the Top 34 Coal Utility States

State	Date of Regulation	Liner	Leachate Collection System	Cap	Financial Assurance	Run-on/Run-off Controls
KY	8/24/94 [1] through 2003	composite	Y	synthetic	Y	N
LA	5/03	composite	N	N	Y	N
MD	None	N	N	N	N	N
MI (For new unit construction only.)	10/8/93 [1] (monitoring) 8/26/99 (liner requirements)	clay or composite	Y	clay or synthetic	Y	N
MN	6/74 [1]	N (yes if within 4 feet of bedrock)	N	N	Y	N
MS (For new unit construction only.)	2/22/96	N	N	N	N	N
MO	7/97 [1]	composite	Y	soil	Y	N
MT		N	N	N	N	N

Exhibit 2-4. Minimum State Environmental Control Requirements for FFC Waste Surface Impoundments for the Top 34 Coal Utility States						
State	Date of Regulation	Liner	Leachate Collection System	Cap	Financial Assurance	Run-on/Run-off Controls
NC (For new unit construction only.)	1/4/94	composite	Y	soil	Y	N
ND	12/1/92 [1]	clay or synthetic	Y	clay or synthetic	Y	N
NM	6/18/77	N	N	synthetic	Y	N
NV	12/02	composite	Y	N	Y	N
NY	11/24/99	composite	Y	N	N	N
OH	None	N	N	N	N	N
OK	7/1/95 [1]	composite	N	clay or synthetic	Y	N
PA (For new unit construction, except existing units must meet liner reqs.)	12/23/00	composite	Y	N	N	N
SC	10/25/02	N	N	N	N	N
TN	3/18/90 [1]	N	N	synthetic	Y	N
TX	None	N	N	N	N	N
UT	7/15/99	N	N	N	Y	N

Exhibit 2-4. Minimum State Environmental Control Requirements for FFC Waste Surface Impoundments for the Top 34 Coal Utility States						
State	Date of Regulation	Liner	Leachate Collection System	Cap	Financial Assurance	Run-on/Run-off Controls
VA		N	N	N	N	N
WA	9/8/00	N/A	N/A	N/A	N/A	N/A
WI (For new unit construction only.)	8/97	composite, synthetic or clay.	Y	synthetic	Y	N
WV (For new unit construction only.	5/1/1990	composite	Y	N	N	N
WY (For new unit construction only.)	1/1/98	composite	N	N	N	N

Notes:

Y = yes; N = no

1. The date of implementation was retained from the review of state regulations prepared by SAIC Incorporated and submitted to the Municipal, Industrial and Solid Waste Division, Office of Solid Waste, on November 15, 2000.

2.3 Part 258 Requirements

Factors that influence costs need to be identified to evaluate regulatory cost impacts. These cost factors have been identified in context of the planned 40 CFR Part 258 regulation. Specific requirements that derive from Part 258 that pertain to this analysis are listed below. Not all requirements have cost implication in the cost model being developed. They are cited here, for context, in that they are planned to be a part of the rule as currently envisioned. **The items shown in bold are expected to have major cost impacts.**

- Siting requirements for new units;
- Consideration of flood plains, wetlands, seismic impact zones and unstable areas;
- **Surface and ground water protection (to include possible liners);**
- **No disposal below water table for new units;**
- **No wet handling at new units (to include implication of closing wet handling units);**
- **Prohibit use of unlined gravel and sand pits for siting of new disposal units;**
- **Performance standards;**
- **Groundwater monitoring at existing and new units;**
- **Corrective action at new and possibly existing units;**
- Closure and post closure care; and
- Record keeping and financial disclosure.

2.3.1 Groundwater Monitoring Requirements

Groundwater monitoring can be used to assess the performance of the impoundment and landfill unit for preventing contaminants from leaching at concentrations above regulatory standards. The following groundwater monitoring performance controls were specified in the proposed rules for standards for the management of cement kiln dust.

> "With respect to ground-water protection, EPA is proposing that the unit design must ensure that exceedances of a ground-water protection standard not occur at the relevant point of compliance (POC). This standard would apply to metal constituents listed in Appendix VIII of Part 261 (antimony, arsenic, barium, beryllium, cadmium, chromium, (total), lead, mercury. selenium, silver, and thallium). For each constituent the standard should be as follows: (1) if available, the maximum contaminant level (MCL) established under section 1412 of the Safe Drinking Water Act (40 CFR 141); (2) for constituents with concentration levels lower than background, the background level; and (3) for constituents with no MCLs, an alternative risk-based number or, (in

an unauthorized State) other appropriate level established by the EPA Regional Administrator."[1]

"Facilities that wish to propose a design to comply with the performance standard must submit a proposed plan to implement the performance standard for approval by a regulatory agency. EPA will provide such authority in unauthorized States. Authorized States may be more stringent and are not required to adopt today's proposed approach. If a State chooses not to provide such review, compliance with the technology standards would be required (since there is no mechanism for approving an alternative approach)."[2]

"Within 90 days of finding that any of the Part 261 inorganic constituents have been detected at a statistically significant level exceeding ground-water protection standards as defined under 40 CRF 259.45(h), the persons managing the CKD waste must initiate assessment of corrective action measures. ... The Agency is not proposing facility-wide corrective action standards for the management of CKD. Instead, EPA proposes to require corrective action at units which are actively managing CKD."[3]

State regulations for the top 34 coal usage states (for electricity) were reviewed for their monitoring requirements for ash impoundments and landfills to provide additional insights.[4] These requirements are presented below.

2.3.1.1 Point-of Compliance

Two options for point-of-compliance groundwater monitoring include installing monitoring wells at the unit boundary or within 150 meters of the unit boundary. States are tending to require unit boundary monitoring as presented in Exhibits 2-1 and 2-2. The cost estimates presented in Chapter 4 include both monitoring at the unit boundary and within 150 meters from the unit boundary. Placement at the unit boundary is assumed in the cost estimates. Unit boundary point-of-compliance monitoring complies with the within 150 meter point-of-compliance criteria as well. Plants monitoring at the unit boundary will incur no additional costs under the within 150 meter placement criteria.

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[1] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45648. Additional background information provided in 40 CFR 258.50 - Criteria for Municipal Solid Waste Landfills, Ground-Water Monitoring and Corrective Action.

[2] ibid, pp. 45648.

[3] ibid, pp. 45650.

[4] State regulations were reviewed for AL, AZ, CO, FL, GA, IA, IL, IN, KS, KY, LA, MD, MI, MN, MS, MO, MT, NC, ND, NV, NM, NY, OH, OK, PA, SC, TN, TX, UT, VA, WA, WI, WV, and WY.

2.3.1.2 Number of Wells

Certain states specify a minimum number of wells to be installed. Examples of states requiring a minimum number of wells installed include FL (3 wells for impoundments), IA (1 well for landfill), IL (multiple wells for landfills), KY (3 wells for landfills), MO (4 wells for impoundments and landfills), ND (3 wells for impoundments), OK (3 wells for impoundments and 4 wells for landfills), TN (3 wells for landfills) and WV (3 wells for impoundments).

Well spacing design criteria for landfill boundary detection wells for Florida, Iowa, and Kansas were reviewed. Florida requires a minimum of one down-gradient detection well every 500 feet placed within 50 feet of the unit. Iowa requires a minimum of one detection well every 600 feet placed within 50 feet of the unit. Kansas recommends a minimum of one-down-gradient detection well every 500 feet. The Ground Water Technical Enforcement Guidance Document recommends a maximum of 150 feet spacing between down-gradient wells.[5] The Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities recommends a maximum of 250 feet spacing between down-gradient wells.[6] Based on the above information the spacing of the wells was assumed to be 400 feet for this analysis. A "most-likely" approach was applied to the well spacing assumption. Assuming the technical documents are the most stringent and the state regulation minimums are the most lax, a middle ground within the range is anticipated. The assessment will not evaluate the cost differences between the upper and lower bounds of well spacing.

Groundwater monitoring well costs in this analysis assume a minimum of 2 down-gradient wells for the first 800 feet of length along two sides of the landfill or impoundment unit, which is assumed to be square, plus additional wells spaced every additional 400 feet. In addition, one up-gradient well is assumed.

2.3.1.3 Monitoring Parameters

Two options for sampling include testing for indicator parameters and Appendix VIII constituents. Examples of states that currently require indicator parameter monitoring include CO, PA and WV for surface impoundments and IA, FL, KY, MI, OH, OK, PA, TN, WI and WV for landfills. Examples of states requiring Appendix VIII constituent monitoring include MO, PA and WV for surface impoundments and IA, IL, GA, FL, MI, MO, OH, TN and WV for landfills.

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[5] U.S. EPA, Office of Solid Waste and Emergency Response, Ground Water Technical Enforcement Guidance Document, Draft prepared by DPRA Incorporated, March 21, 1985, pp. 2-8 - 2-16.

[6] U.S. EPA, Office of Water & Waste Management, Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities SW-611, prepared December 1980, pp. 40 - 43.

The cost estimates will include monitoring for indicator and metal parameters. Indicator parameters were modeled using the cement kiln dust parameters (pH, conductivity, total dissolved solids, potassium, chloride, sodium, and sulfate) as a cost proxy. Metal parameters were modeled for metals with primary and secondary Maximum Contaminant Levels (MCLs) (Al, Cu, Fe, Mn, Ag, Zn, Sb, As, Ba, Be, Cd, Cr, Pb, Hg, Se, Tl). The combination of indicator and metal parameters represent a reasonable "likely-case" scenario between indicator parameter only and Appendix VIII constituent monitoring which includes the above list of metals. As noted In Exhibit 2-2, for surface impoundments three of the four states with sampling regulations already require sampling for metal parameters (Appendix VIII constituents). For landfills nine of the 13 states with sampling regulations already sample for metal parameters (Appendix VIII constituents). Most states will not incur incremental costs for metals sampling. This assessment will not capture the incremental cost difference between sampling for indicator parameters only and both indicator and MCL parameters.

2.3.1.4 Monitoring Frequency

Three options for groundwater sampling frequency include quarterly, semi-annual and annual. Examples of states that currently require quarterly sampling include CO (depending on the ground-water classification) for surface impoundments and IA (until baseline conditions are established), IL (first 5 years) and MI for landfills. Examples of states requiring semi-annual sampling include MO, ND, PA (indicator parameters) and WV for surface impoundments and GA, FL, KY, MO, OH (indicator parameters), OK, PA (indicator parameters), TN (indicator parameters), WV and WY for landfills. Examples of states requiring annual sampling include CO (depending on the ground-water classification) and PA (metals and VOCs) for surface impoundments and IA (after baseline established), IL (after 5 years), OH (metals, TOC, TDS, chloride, sodium and radionuclides), PA (metals and VOCs) and TN (Appendix VIII constituents) for landfills.

The cost estimates will only include semi-annual sampling (most-likely case) using the cement kiln dust rulemaking and current state regulations as a guideline. The cost assessment will not evaluate the cost differences between quarterly, semi-annual and annual sampling. All costs are estimated assuming semi-annual monitoring even if a state requires sampling on a quarterly or annual basis.

2.3.1.5 Timing of State Regulation Implementation

Under baseline, for certain states groundwater monitoring requirements only apply for newly constructed units. These baseline costs are tracked as future baseline cost streams in the cost model. Examples of states that only require groundwater monitoring at newly constructed surface impoundments include CO, MI, NC, PA, WI, WV, and WY. Examples of states reviewed requiring immediate compliance with monitoring requirements for impoundments include FL, KY, LA, MN, MO, ND, NV, NY, OK, SC, and UT. Examples of a states that only require groundwater monitoring at newly constructed landfills are FL, IL, LA, MS, MO, NV, OK, TX, WV, and WI. Examples of states reviewed requiring immediate compliance with monitoring requirements for landfills include AL, CO, GA, IA, IN, KS, KY, MI, MN, MT, NC, ND, NY, OH, PA, SC, TN, UT, VA, WA, and WY.

The post-regulatory cost estimates will include immediate compliance with monitoring requirements for all surface impoundment and landfill units effective when the proposed rule becomes final, which is estimated to be in 2005. Post closure monitoring is assumed to continue for 30 years after closure of the unit.

2.3.2 Liner and Leachate Collection/Detection System Design Controls

Liners and leachate collection/detection (LCS) system controls can be used to prevent contaminants leaking from the management units into groundwater. The following liner and LCS design controls were specified in the proposed rules for standards for the management of cement kiln dust.

> "EPA proposes that design criteria similar to MSWLFs under the Subtitle D program (Solid Waste Disposal Facility Criteria, 56 FR 50978, October 9, 1991) be adopted with certain modifications for ground-water monitoring (40 CFR 259.40) and remediation. For facilities complying with the technology-based standards for the protection of groundwater, any new CKD waste management unit or lateral expansion of an existing unit must be constructed with a composite liner and a leachate collection system (LCS) [for landfills] that is designed and constructed to maintain less than a 30 cm depth of leachate over the liner. The composite liner must consist of two components: an upper flexible membrane liner (FML) with a minimum thickness of 30-mil, and a lower component consisting of at least two feet of compacted clay with a hydraulic conductivity of no more than 1×10^{-7} cm/sec. In selecting this uniform design, EPA's goal was to identify one that would provide adequate protection in all locations."[7]

> "The Agency believes the technology-based standards proposed in today's rule will be protective of ground-water resources. Liners will prevent leachate from seeping from the landfill entering the aquifer. The FML must have a minimum thickness of 30-mils and be installed in direct and uniform contact with the lower clay component to ensure adequate liner performance, including being able to withstand the stress of construction (see EPA RREL, Lining of Waste Containment and Other Impoundment Facilities EPA/600/2-88/052. September 1988). Compacted clay liners must be at least two feet thick to ensure a high probability of having a hydraulic conductivity of 1×10^{-7} cm/sec. Functionally, both the FML and lower clay component are necessary to retard the migration of contaminants into the subsoil. The FML component would provide a highly

[7] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45648, and 40 CFR 258.40 - Criteria for Municipal Solid Waste Landfills.

impermeable layer to maximize leachate collection and removal. The compacted clay liner would adsorb and attenuate pollutants in the event of FML liner failure."[8]

In the CKD proposed regulation, analyses were conducted concluding that a 4-foot compacted CKD liner could meet performance standards for protection of groundwater resources. The analyses concluded that "if a plant is not located in a karst area, has a "low" net infiltration (i.e., precipitation minus evaporation), and the monofill can be constructed above the natural water table, the monofill requires a compacted CKD liner and final cover."[9]

"A LCS is necessary to relieve the hydraulic pressure within the landfill which could drive leachate migration through the base of the landfill. LCS design normally consists of a permeable material placed on a sloping surface so as to allow leachate to be removed and collected. Sloping the LCS towards a sump minimizes the downward flow, and reduces the amount of leachate leaving te LCS."[10]

It is possible that ash may be a suitable material for use as a liner or cap material because of its "cementitious" properties. Ash can be used as a liner or cap material in the unit design if the person managing FFC waste can demonstrate that the design meets the performance standard for ground water, including establishing that the material will maintain integrity over long periods of time and, therefore, has a low potential for release of contaminants. A 2-foot compacted ash liner is estimated to equal or exceed the performance of a 4-foot compacted CKD liner (having a hydraulic conductivity of 2×10^{-5} cm/sec.[11] The cost estimates presented in Chapter 4 include a composite liner using the MSWLF rulemaking Part 258 as a model for the more stringent design and a 2-foot compacted clay liner, and a 2-foot compacted ash liner for less stringent baseline designs. The cost model is not designed to automatically determine which liner design (e.g., compacted soil, ash or clay, single-synthetic, double-synthetic, and composite, e.g., clay-synthetic, liners) is most cost effective. Liner design selection is a user input.

State regulations for the top 34 coal usage states (for electricity) were reviewed for their liner and LCS requirements for ash impoundments and landfills to provide additional insights. Examples of states that currently require liners for surface impoundments include CO, FL, KS, KY, LA, MI, MO, NC, ND, NV, NY, OK, PA, WI, WV, and WY. Examples of states that

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[8] ibid, pp. 45648-49, and 40 CFR 258.40 - Criteria for Municipal Solid Waste Landfills.

[9] U.S. EPA, Office of Solid Waste, Technical Background Document - Compliance Cost Estimates for the Proposed land Management Regulation of Cement Kiln Dust, prepared by DPRA Incorporated, April 10, 1998, p. 2.

[10] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45649.

[11] "Compacted Ash Surface Impoundment Liner Assumptions (for Economic Analysis)," memorandum from John Vierow and Pat Ransom, SAIC, to Denis Ruddy and Andy Wittner, EPA, and David Frank, ERG, EPA Contract No. 68-W-99-001, WA No. 121, November 20, 2000.

currently require liners for landfills include AL, CO, FL, GA, IL, IN, KS, LA, MI, MN, MS, MO, MT, NC, ND, NV, NY, OH, OK, SC, TN, TX, VA, WA, WI, WV, and WY.

Examples of states that currently require leachate collection/detection systems for surface impoundments include CO, FL, KS, KY, MI, MO, NC, ND, NV, NY, PA, WV, and WI. Examples of states that currently require leachate collection systems for landfills include AL, CO, FL, GA, IL, IN (karst areas only), KS, LA, MI, MN, MS, MO, MT, NC, ND, NV, NY, OH, OK, PA, SC, TN, VA, WA, WI, WV and WY. The cost estimates presented in Chapter 4 only includes an LCS in combination within a composite liner for regulatory alternatives using the MSWLF rulemaking as a proxy. This assessment does not evaluate the cost differences between liner designs with and without a leachate collection/detection system.

Also, given the cost burden of constructing liners, regulatory requirements may only apply to new unit construction, or a landfill/impoundment retirement time schedule could be implemented to help defray costs. Examples of states that require liner and LCS design requirements for new surface impoundment construction only include CO, MI, WI, WV and WY. Examples of states that require immediate compliance with impoundment liner and LCS design requirements include FL, KS, KY, LA, MO, ND, NV, NY, and OK. Examples of states that require liner and LCS design requirements for new landfill construction only include FL, IL, LA, MS, MO, NV, OK, TX, WI, WV and WY. Eighteen states, AL, CO, GA, IN, KS, LA, MI, MN, MT, NC, ND, NY, OH, PA, SC, TN, VA, and WA require immediate compliance with landfill liner and LCS design requirements for all units. The baseline cost estimates include delaying costs for liner and LCS design requirements for new landfill/impoundment construction.

An early retirement regulatory option for surface impoundments is a possibility based on the groundwater modeling results (which are under review) which evaluated the time at which risks were predicted to result from the release of constituents of concern. From the 1999 Report to Congress, for surface impoundments "EPA found that the concentration of arsenic in ground water at the receptor well would not reach the health-based level for arsenic (e.g., achieve a risk level of 1×10^{-6}) for roughly 500 years. For the landfill, the predicted time to reach a risk of 1×10^{-6} or more was found to exceed 3,500 years." Risks from surface impoundments are predicted to occur much sooner than landfills via the groundwater pathway. As of December 2000, more groundwater pathway damage cases were identified for surface impoundments (at least 6) than landfills (at least 2).

Incentives/disincentives vary for liner and LCS options listed above. A disincentive is cost. Liners are costly. Ash liners compared to composite (synthetic-clay) liners are cheaper because of the low cost and availability of ash materials. An incentive is avoided liability. Liners reduce the probability of a release of leachate to groundwater. The higher conductivity/permeability of an ash liner (approximately $1x10^{-5}$ cm/s) compared to a composite liner (approximately $1x10^{-6}$ cm/s) and a leachate collection system increases the probability of release and corrective action costs.

2.3.3 Dust Controls and Run-On/Run-Off Controls and Cover Controls

Dust controls, run-on/run-off controls and daily cover controls can be used to prevent contaminants migrating from the management via above-ground pathways exposing nearby receptors. The following dust, run-on/run-off and daily cover operating controls were specified in either the MSWLF rulemaking or the proposed rules for standards for the management of cement kiln dust. Dust controls, run-on/run-off controls and daily cover are added to the cost of operating landfills.

> For dust controls, "owners and operators of all MSWLFs must ensure that the units not violate any applicable requirements developed under a State Implementation Plan (SIP) approved or promulgated by the Administrator pursuant to Section 110 of the Clean Air Act, as amended."[12] The proposed CKD rulemaking states that "CKD managed in landfills must be emplaced as conditioned CKD. ... conditioned CKD means cement kiln dust that has been compacted in the field at appropriate moisture content using moderate to heavy equipment to attain 95% of the standard Proctor maximum dry density value according to ASTM D 698 or D 1557 test methods. Such conditioning can be achieved by mixing the CKD with water on a continuous or batch basis, such as pugmilling, followed by compaction. ..." "EPA believes that consistent wetting of roads, when used in conjunction with other air control technologies, can reduce releases of fugitive emissions from facilities that manage CKD."[13]

> For run-on/run-off controls, "owners or operators of all MSWLF units must design, construct, and maintain: (1) a run-on control system to prevent flow onto the active portion of the landfill during the peak discharge from a 25-year storm and (2) a run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm."[14]

> For daily cover, "..., the owners or operators of all MSWLF units must cover disposed solid waste with six inches of earthen material at the end of each operating day, or at more frequent intervals if necessary, to control disease vectors, fires, odors, blowing litter, and scavenging."[15] The proposed CKD rulemaking states that "disposed CKD be covered with materials at the end of each operating day sufficient to prevent blowing dust. ... Similarly, EPA is proposing that CKD transported in trucks on or off the facility be covered to minimize fugitive emissions of CKD."[16]

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[12] 40 CFR 258.24 - Criteria for Municipal Solid Waste Landfills.

[13] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45651.

[14] 40 CFR 258.26 - Criteria for Municipal Solid Waste Landfills.

[15] 40 CFR 258.21 - Criteria for Municipal Solid Waste Landfills.

[16] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45651.

State regulations for the top 34 coal usage states (for electricity) were reviewed for their dust, run-on/run-off and daily cover controls to provide additional insights. Examples of states that currently require dust controls (wetting and truck covers and/or compaction) for landfills include CO, FL, GA (compaction only), IA, IL (includes compaction), IN, KS, LA, MI, MN (includes compaction), MO, ND (includes compaction), NM, NY, OH, OK, PA, SC, TN, VA, WA, WI, WV, and WY (includes compaction). Examples of states that currently require cover include AL, FL, GA, IL, KS, KY, LA, MD, MI, MN (6 inches), MS, MO, MT, NC, NV, NY, OH (12 inches twice yearly), OK, PA, SC, TN (site specific), TX, VA, WI, and WV.

Examples of states that currently require run-on/run-off controls include AL, CO, FL, GA, IA, IL, IN, KS, LA, MD, MN, MS, MO, MT, NC, NV, NY, OH, OK, PA, SC, TN, TX, VA, WA, WI, WV and WY.

The incentive for implementing dust, run-on/run-off and daily cover controls is to prevent releases via aboveground pathways and reduce liability from third-party claims. The disincentive (and cost) for implementing daily cover controls is that the application of a soil cover reduces the landfill capacity. Another incentive for implementing dust and daily cover controls, depending on the region of the country, is that it aids in compliance with particulate emission standards under the Clean Air Act.

2.3.4 Closure Controls

Closure controls can be used to prevent contaminants migrating from the management via above-ground pathways exposing nearby receptors. They also are used to prevent rainfall from infiltrating into the landfill or surface impoundment and potentially creating leachate that migrates via the groundwater pathway exposing nearby receptors. The following closure and post-closure controls were specified in either the MSWLF rulemaking or the proposed rules for standards for the management of cement kiln dust.

> For closure, " owners and operators of all MSWLF units must install a final cover system that is design to minimize infiltration and erosion. The final cover system must be designed to: (1) Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than $1x10^{-5}$ cm/sec, whichever is less, and (2) Minimize infiltration through the closed MSWLF by the use of an infiltration layer that contains a minimum of 18 inches of earthen material, and (3) Minimize erosion of the final cover by the use of an erosion layer that contains a minimum 6-inches of earthen material that is capable of sustaining native plant growth." The regulation continues stating the Director of an approved State may design an alternative final cover design that provides equivalent protection to those specified above. In addition, "the owner or operator must prepare a written closure plan that describes the steps necessary to close all the MSWLF units at any point during the active life in

accordance with the cover design requirements ... [as specified above]."[17]

For the CKD proposed rule, "EPA is requiring that new and existing CKD landfill units, including expansions be closed in accordance with specified standards and that units be monitored and maintained after closure. Closure and post-closure plans describing these activities are to be prepared to comply with a minimum set of procedural requirements."[18]

State regulations for the top 34 coal usage states (for electricity) were reviewed for closure controls to provide additional insights. Examples of states that currently require closure controls for landfills include AL (synthetic cap), CO (clay cap), FL (synthetic cap), GA (soil cap), IA (clay cap), IL (clay or synthetic cap), IN (clay cap), KS (soil cap), KY, LA (clay cap), MD (clay cap), MI (clay or synthetic cap), MN (clay cap), MS (soil cap), MO (soil cap), MT (clay cap), NC (soil cap), ND (clay or synthetic cap), NV (soil cap), NY (synthetic cap), OH (synthetic cap), OK (clay cap), PA (synthetic cap), SC (synthetic cap), TN (clay cap), TX (synthetic cap), VA (synthetic cap), WA (synthetic cap), WI (clay cap), WV (soil or clay cap), and WY (synthetic cap). Examples of states that currently require closure controls for surface impoundments include AZ (synthetic cap), CO (clay or synthetic cap), KY (synthetic cap), MI (clay or synthetic cap), MO (soil cap), NC (soil cap), ND (clay or synthetic cap), NM (synthetic cap), OK (clay or synthetic cap), TN (synthetic cap), and WI (synthetic cap). The cost model does not automatically determine which cap design (e.g., compacted soil, ash or clay, single-synthetic, double-synthetic and composite) is most cost effective. Cap design is a user input.

The incentive for implementing closure controls is to prevent long-term liability beyond the operating life of the unit. It increases the likelihood of companies (and their current stockholders) paying site restoration costs.

2.3.5 Post-Closure Monitoring Requirements

Post-closure monitoring requirements can be used to prevent extensive contaminant migration from the management unit via above-ground and below-ground pathways exposing nearby receptors. The following post-closure controls were specified in either the MSWLF rulemaking or the proposed rules for standards for the management of cement kiln dust.

For post-closure controls, "following closure of each MSWLF unit, the owner or operator must conduct post-closure care. Post-closure care must be conducted for 30-years, except as provided under paragraph (b) [40 CFR 258.61(b)] of this section, and consist of at least the following: ... (3) Monitoring the ground water ...." In addition, "the owner or operator of all MSWLF units

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[17] 40 CFR 258.60 - Criteria for Municipal Solid Waste Landfills.

[18] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45652.

must prepare a written post-closure plan ....”[19]

For the CKD proposed rule, “EPA is requiring that new and existing CKD landfill units, including expansions be closed in accordance with specified standards and that units be monitored and maintained after closure. Closure and post-closure plans describing these activities are to be prepared to comply with a minimum set of procedural requirements.”[20]

State regulations for the top 34 coal usage states (for electricity) were reviewed for post-closure groundwater monitoring controls to provide additional insights. States that currently require post-closure groundwater monitoring controls for landfills include the following: AL, CO, FL (new construction), GA, IA, IL (new construction), KS, KY, LA (new construction), MD, MI, MN, MS (new construction), MO, MT, ND, NV (new construction), NY, OH, OK (new construction), PA, SC, TN, TX, VA, WA, WI (new construction), WV (new construction), and WY require post-closure groundwater monitoring.

Eleven states that currently require post-closure groundwater monitoring for surface impoundments include the following: AZ, CO (new construction), KY (new construction), LA, MI (new construction), MO, NC (new construction), ND, NM, NV, NY, OK, SC, TN, UT, WI (new construction), and WV (new construction) require post-closure groundwater monitoring.

The post-closure cost estimates will include monitoring for indicator and metal parameters. Indicator parameters were modeled using the cement kiln dust parameters (pH, conductivity, total dissolved solids, potassium, chloride, sodium, and sulfate) as a cost proxy. Metal parameters were modeled for metals with primary and secondary Maximum Contaminant Levels (MCLs) (Al, Cu, Fe, Mn, Ag, Zn, Sb, As, Ba, Be, Cd, Cr, Pb, Hg, Se, Tl). The combination of indicator and metal parameters represent a reasonable “likely-case” scenario between indicator parameter only and Appendix VIII constituent monitoring which includes the above list of metals. As discussed in Section 2.3.1.3, given the prevalence of sampling for metals (Appendix VIII constituents), this assessment will not evaluate the incremental cost differences between indicator parameters and both indicator and Appendix VIII constituent monitoring.

2.3.6 Financial Assurance

Financial assurance criteria help assure that the owners and operators of the landfill and impoundment units have adequately planned for the future cost of closure, post-closure care, and corrective action for known releases, and to assure that adequate funds will be available when

[19] 40 CFR 258.61 - Criteria for Municipal Solid Waste Landfills.

[20] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45652.

needed to cover the costs if the owner or operator is unwilling or unable to do so. Financial assurance helps protect future generations from paying for damages caused by or the prevention of damages potentially created from today's waste management activities.

> "The owner or operator must have a detailed written estimate in current dollars, of the cost of hiring a third party to close the largest area of all MSWLF units ever requiring a final cover ... at any time during the active life in accordance with the closure plan. ... During the active life of the MSWLF unit, the owner or operator must annually adjust the closure cost estimate for inflation. The owner or operator must increase the closure cost estimate and the amount of financial assurance ... if changes to the closure plan or MSWLF unit increases the maximum cost of closure at any time during the remaining active life. The owner or operator may reduce the closure cost estimate and the amount of financial assurance provided ... if the cost estimate exceeds the maximum cost of closure at any time during the remaining life of the MSWLF unit." Allowable mechanisms used to demonstrate financial assurance include a trust fund, surety bond, letter of credit, insurance, corporate financial test, local government financial test, corporate guarantee, local government guarantee, state assumption of responsibility, or use of multiple mechanisms. These requirements also apply for conducting post-closure care and undertaking a corrective action program.[21]

State regulations for the top 34 coal usage states (for electricity) were reviewed for their financial assurance criteria to provide additional insights. Examples of states that currently require financial assurance for landfills include CO, FL (new construction), GA, IL (new construction), IN, KS, KY, LA (new construction), MI, MN, MS (new construction), MO, MT, NC, ND, NV (new construction), NY, OH, OK (new construction), SC, TN, TX, VA, WA, WI (new construction), WV (new construction), and WY. Examples of states that currently require financial assurance for surface impoundments include AZ, CO (new construction), KY, MI (new construction), MN, MO, NC (new construction), ND, NM, NV, OK, TN, UT, and WI (new construction). The cost estimates in Chapter 4 include costs for selecting a financial mechanism, establishing a financial test and establishing a letter of credit. The difference between financial assurance mechanisms are not assessed.

Financial assurance is a protection mechanism for future generations. Requiring payments into a closure fund during operation of the landfill or impoundment places the cost burden on the current owner and consumer and prevents costs from being passed from the current generation to future generations.

2.3.7 Siting Standards

The following subsections describe various siting restrictions that could be placed on locating FFC waste surface impoundments and landfills. The initial scope of work involved an

[21] 40 CFR 258.71 through 258.74 - Criteria for Municipal Solid Waste Landfills.

evaluation of only the top 25 coal usage states. Subsequent scopes of work did not require the evaluation of the additional 9 states discussed in other areas of this report.

2.3.7.1 Disposal Below Natural Water Table

"Management of CKD wastes in new units located below the natural water table is banned. The natural water table is defined as the natural level at which water stands in a shallow ground-water well open along its length and penetrating the surficial deposits just deeply enough to encounter standing water at the bottom. This level is uninfluenced by ground-water pumping or other engineered activities."[22]

State regulations for only the top 25 coal usage states (for electricity) were reviewed for any siting restrictions below the natural water table to provide additional insights. Examples of states that have siting restrictions below the natural water table for surface impoundments include NC (4 feet above seasonal water table), ND (within aquifer), OK (if less than 15 feet above ground-water table), WV (5 feet above ground-water table) and WY. The percentage of the total waste volume that is currently being regulated by states with siting restrictions below the natural water table for surface impoundments is approximately 16%. Examples of states that have siting restrictions below the natural water table for landfills include FL, IA (5 feet above ground water), MI (4 feet above ground water), MN (5 feet above ground water), NC (4 feet above seasonal water table), ND (within aquifer), OH (5 feet above water table for wastes with higher leachate concentrations), TN (if less than 5 feet above water table). The percentage of the total waste volume that is currently being regulated by states with siting restrictions below the natural water table for landfills is approximately 25%. This assessment does not evaluate the cost of this siting restriction.[23]

For landfills, pile designs (i.e., built above grade), are cheaper than combination fill designs (i.e., built above and below grade). Cost will tend to dictate that landfill units will not be constructed below the natural water table.

2.3.7.2 Floodplains

"New and existing CKD waste landfills and impoundments may not be located in a 100-year floodplain unless a demonstration is made to the EPA Regional Administrator (or the State, in

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[22] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45645.

[23] State siting regulatory information obtained from the review of state regulations for top 25 coal usage states prepared by SAIC Incorporated and submitted to the Municipal, Industrial and Solid Waste Division, Office of Solid Waste, on November 15, 2000.

authorized States), that the landfill has been designed so that it does not restrict flow of the 100-year flood, reduce the temporary water storage capacity of the floodplain, or result in the washout of solid waste so as to pose a hazard to human health and the environment. The Agency's rationale is consistent with the similar rule regarding MSWLFs (53 FR 33314, August 30, 1988). Floodplains, may be adversely impacted by the disposal of solid waste through potential flooding damages including: (1) Rapid transport of hazardous constituents by flood water resulting in degradation of water quality downstream; (2) restriction of flood water flow, causing greater flooding upstream; and (3) reduction of the storage capacity of the floodplain, which may cause more rapid movement of flood water downstream, resulting in higher flood levels and greater flood damages downstream."[24]

"The floodplain is defined using the 100-year flood level (use flood insurance rate maps developed by the Federal Emergency management Agency). ..."[25]

State regulations for only the top 25 coal usage states (for electricity) were reviewed for any siting restrictions in floodplains to provide additional insights. Examples of states that have siting restrictions in floodplains for surface impoundments include KS (under permit), KY, MO (if closed with waste in place), NC, ND, OK (if dike not at least 1 foot above 100-year flood elevation), PA and WV. The percentage of the total waste volume that is currently being regulated by states with siting restrictions in floodplains for surface impoundments is approximately 35%. Examples of states that have siting restrictions in floodplains for landfills include AZ, CO, FL, IL, IN, IA, KS, KY, MI, MN, MO, NC, ND, OH, OK, PA, TN, WV, WI and WY.[26] The percentage of the total waste volume that is currently being regulated by states with siting restrictions in floodplains for landfills is approximately 66%.

This assessment does not evaluate the cost of this siting restriction. Costs will be higher if the construction of a flood berm is necessary. Off-site disposal costs may or may not be higher.

2.3.7.3 Wetlands

"No new CKD waste landfill or impoundment unit may be placed in wetlands (defined by 40 CRF 232.2(r)), unless the person managing the CKD waste makes a specific demonstration to the EPA Regional Administrator (or the State, in authorized States), that the new unit: (1) will

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[24] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45645, and 40 CFR 258.11 - Criteria for Municipal Solid Waste Landfills.

[25] ibid, pp. 45645.

[26] State siting regulatory information obtained from the review of state regulations for top 25 coal usage states prepared by SAIC Incorporated and submitted to the Municipal, Industrial and Solid Waste Division, Office of Solid Waste, on November 15, 2000.

not result in "significant degradation" of the wetland as defined in the Clean Water Act Section 404(b)(1) guidelines, published at 40 CFR Part 230; and (2) will meet other requirements derived from the section 404(b)(1) guidelines. Existing disposal units, including vertical expansions that are located in wetlands would continue to operate."[27]

"The Agency is adopting four major requirements: (1) A practical alternatives test (40 CFR 230.10(a)); (2) the assessment of compliance with other applicable laws (40 CFR 230.10(b)); (3) the assessment of aquatic degradation (40 CFR 230.10(c)); and (4) the assessment of steps taken to minimize the adverse effects of discharge (40 CFR 230.10(d)). These requirements parallel those in the guidelines for wetlands protection under Section 404(b)(1) of the Clean Water Act. The guiding principle is that discharges should not be allowed unless the persons managing CKD waste can demonstrate that such discharges are unavoidable and will not cause or contribute to significant degradation of wetlands."[28]

State regulations for only the top 25 coal usage states (for electricity) were reviewed for any siting restrictions in (or near) wetlands to provide additional insights. Examples of states that have siting restrictions in wetlands for surface impoundments include KY, MO (if closed with waste in place), ND, PA, and WV. The percentage of the total waste volume that is currently being regulated by states with siting restrictions in wetlands for surface impoundments is approximately 30%. Examples of states that have siting restrictions in wetlands for landfills include AZ, CO, FL, IL, IN, IA, KY, MI, MN, MO, ND, OK, PA, TN, WV, WI and WY.[29] The percentage of the total waste volume that is currently being regulated by states with siting restrictions in wetlands for landfills is approximately 53%.

This assessment does not evaluate the cost of this siting restriction. Transportation costs will be higher if construction cannot be conducted in nearby wetlands.

2.3.7.4 Fault Areas

"No new CKD waste landfill or impoundment unit may be sited within 60 meters (200 feet) of a fault that has had displacement in Holocene time, unless demonstration is made to the EPA Regional Administrator (or the State in authorized States), that an alternative setback distance of less than 60 meters will prevent damage to the structural integrity of the unit, and will be

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[27] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45645, and 40 CFR 258.1 - Criteria for Municipal Solid Waste Landfills.

[28] ibid, pp. 45646.

[29] State siting regulatory information obtained from the review of state regulations for top 25 coal usage states prepared by SAIC Incorporated and submitted to the Municipal, Industrial and Solid Waste Division, Office of Solid Waste, on November 15, 2000.

protective of human health and the environment. ... Regional geologic maps of Holocene age faults are published by the U.S. Geological Survey. ..."[30]

"Available information collected in support of the MSWLF rule suggests that structural damage resulting from earthquakes is most severe for structures located within 60 meters of the fault trace, and decrease with increasing distance from the fault. ..."[31]

State regulations for only the top 25 coal usage states (for electricity) were reviewed for any siting restrictions in fault areas to provide additional insights. Examples of states that have siting restrictions in fault areas for surface impoundments include MO (if closed with waste in place) and WV. The percentage of the total waste volume that is currently being regulated by states with siting restrictions in fault areas for surface impoundments is approximately 11%. Examples of states that have siting restrictions in fault areas for landfills include AZ, CO, MO, OH, TN, WV and WI.[32] The percentage of the total waste volume that is currently being regulated by states with siting restrictions in fault areas for landfills is approximately 24%.

This assessment does not evaluate the cost of this siting restriction. Transportation costs will be slightly higher if construction cannot occur within 60 meters of a fault area.

2.3.7.5 Seismic Impact Zones

"Any new CKD waste landfill and impoundment unit located in a seismic impact zone must be designed to resist the maximum horizontal acceleration in lithified material for the site. The design features affected include all containment structures (i.e., liners, leachate collection systems, and surface water control systems). Seismic impact zones are defined as areas having a ten percent or greater probability that the maximum expected horizontal acceleration in lithified material for the site, expressed as a percent of the Earth's gravitational pull (g), will exceed 0.10g (i.e., 98.0 centimeters per second per second) in 250 years. The term "lithified material" refers to any consolidated or coherent, relatively hard, naturally occurring aggregate composed of one or more minerals (e.g., granite, shale, marble, sandstone, limestone, etc.). ..."[33]

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[30] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45646, and 40 CFR 258.13 - Criteria for Municipal Solid Waste Landfills.

[31] ibid, pp. 45646.

[32] State siting regulatory information obtained from the review of state regulations for top 25 coal usage states prepared by SAIC Incorporated and submitted to the Municipal, Industrial and Solid Waste Division, Office of Solid Waste, on November 15, 2000.

[33] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45646, and 40 CFR 258.14 - Criteria for Municipal Solid Waste Landfills.

"The process of determining earthquake-resistant components may be divided into three steps: (1) Determining expected peak ground acceleration at the site due to maximum quake, based on regional studies and site-specific risk analysis; (2) determining site-specific seismic hazards (e.g., soil liquefaction); and (3) designing the facility to withstand peak ground accelerations. Various methods for accomplishing the above tasks appropriate to individual CKD waste units should be selected by the person managing CKD waste, subject to regulatory agency approval."[34]

State regulations for only the top 25 coal usage states (for electricity) were reviewed for any siting restrictions in seismic impact areas to provide additional insights. Examples of states that have siting restrictions in seismic impact areas for surface impoundments include MO (if closed with waste in place) and WV. The percentage of the total waste volume that is currently being regulated by states with siting restrictions in seismic impact areas for surface impoundments is approximately 11%. Examples of states that have siting restrictions in seismic impact areas for landfills include AZ, CO, IL, MO, OK (if within 5 miles of epicenter of 4.0 earthquake), TN, WV and WI.[35] The percentage of the total waste volume that is currently being regulated by states with siting restrictions in seismic impact areas for landfills is approximately 16%.

This assessment does not evaluate the cost of this siting restriction. Transportation costs will be higher if construction cannot occur in seismic impact zones.

2.3.7.6 Unstable Areas

"Persons managing CKD wastes in new and existing landfills and impoundments must demonstrate the structural integrity of the unit to the EPA Regional Administrator (or the State, in authorized States). This demonstration must show that engineering measures have been incorporated in the unit's design to mitigate the potential adverse structural impacts on the structural components of the unit that may result in subsidence, slope failure, or other mass movements in unstable areas. Structural components include liners leachate collection systems, and final covers."[36]

"EPA is particularly concerned with landfill and impoundment units located in areas of karst terrain, Karst terrain means an area where karst landscape, with its characteristic hydrogeology and/or landforms is developed. In karst terrain, ground-water flow generally occurs through an

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[34] ibid, pp. 45647.

[35] State siting regulatory information obtained from the review of state regulations for top 25 coal usage states prepared by SAIC Incorporated and submitted to the Municipal, Industrial and Solid Waste Division, Office of Solid Waste, on November 15, 2000.

[36] **Federal Register**, Vol. 64, No. 161, Friday, August 20, 1999, Proposed Rules for Standards for the Management of Cement Kiln Dust, pp. 45647, and 40 CFR 258.15 - Criteria for Municipal Solid Waste Landfills.

open system with both diffuse and conduit flow end member components, and typically has rapid ground-water velocities which exceed Darcian flow velocities. Composed of limestone, dolomite, gypsum and other soluble rock, karst terrain typically has well developed secondary porosity enhanced by dissolution. Landforms found in karst terrain include, but are not limited to, sinkholes, sinking streams, caves, springs and blind valleys. Karst terrains always include one or more springs for each ground-water basin, and underground streams except where ground-water flow is diffuse or the host rock has megaporosity."[37]

"... a karst ground-water investigation must be conducted to define the direction of ground-water flow, and points of discharge for the karst ground-water basin(s) the facility may affect. The karst ground-water investigation shall include a dye-tracer study to identify springs which are hydrologically related to the karst ground-water basin potentially affected by the unit. The verification of a karst terrain may include, but not necessarily be limited to, a review of the available literature. If the literature fails to provide conclusive evidence that the facility does not overlie a karst terrain, a basin-wide field study should be implemented, even if the discharge points of the basin exist beyond the facility boundary, to identify all springs from which groundwater passing beneath the unit may discharge. Certification may be obtained from an independent professional ground-water scientist, from the EPA Regional Administrator, or from the State, in authorized States."[38]

"After verification, the person managing CKD waste must located background and intermediate sampling locations, and downgradient springs or ground-water monitoring wells for detection monitoring pursuant to 40 CFR 259(a) and 259.45(b) for assessment monitoring. The person managing CKD waste must establish a ground-water monitoring system pursuant to 40 CFR 259.41(a) that incorporates spring monitoring. The Agency believes that this will generally necessitate: (1) a field study to conduct an inventory of karst features and locate springs; (2) quantitative tracer studies to verify flow path, time-of-travel, and duration of the dye plume; (3) the regular monitoring of chemographs and hydrographs of springs and monitoring wells; and (4) the development of a sampling strategy based on the unique fate and transport characteristics of the toxic constituents in CKD waste and hydrology of the karst aquifer, that is capable of detecting releases from the landfill or impoundment unit."[39]

State regulations for only the top 25 coal usage states (for electricity) were reviewed for any siting restrictions in unstable areas to provide additional insights. Examples of states that have siting restrictions in unstable areas for surface impoundments include KY, MO (if closed with waste in place), ND, PA, and WV (1,000 feet away). The percentage of the total waste volume that is currently being regulated by states with siting restrictions in unstable areas for surface

[37] ibid, pp. 45647.

[38] ibid, pp. 45647.

[39] ibid, pp. 45647.

impoundments is approximately 30%. Examples of states that have siting restrictions in unstable areas for landfills include AZ, CO, IN, IA, KY, MN, MO, ND, PA, TN, WV (1,000 feet away) and WI.[40] The percentage of the total waste volume that is currently being regulated by states with siting restrictions in unstable areas for landfills is approximately 43%.

The cost model can be used to assess costs for off-site disposal and full Subtitle D design requirements for landfills and surface impoundments located in karst terrain. Cost estimates are presented later in this report for this siting restriction.

2.3.8 Corrective Action

State regulations for the top 25 coal usage states (for electricity) were reviewed for correction action requirements.[41] Corrective action requirements were identified in 21 of these states. The proposed rule would not create additional compliance cost impacts in these states. The following list is a summary of correction action requirements for surface impoundments in these states:

- AZ, IN, and IA establish a corrective action alert level and response action in site-specific state permits;
- CO requires corrective action for new units;
- FL, GA, KY, MI, NC, ND, PA, UT, and WI require corrective action;
- IL, MN, TX, WV, and WY do not allow groundwater degradation, but, specific enforcement mechanisms are not specified in state regulations;
- MO requires corrective action if the unit is closed with waste in place, otherwise, corrective action requirements may be established under a permit; and
- NM requires an abatement plan.

The percentage of the total waste volume that is currently being regulated by states with corrective action requirements for surface impoundments is approximately 64%.

The following list is a summary of correction action requirements for landfills in these states:

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[40] State siting regulatory information obtained from the review of state regulations for top 25 coal usage states prepared by SAIC Incorporated and submitted to the Municipal, Industrial and Solid Waste Division, Office of Solid Waste, on November 15, 2000.

[41] State corrective action information obtained from the review of state regulations for top 25 coal usage states prepared by SAIC Incorporated and submitted to the Municipal, Industrial and Solid Waste Division, Office of Solid Waste, on November 15, 2000.

- AZ establishes corrective action alert level and response action in site-specific state permits;
- CO, FL, GA, IL, KY, MI, NC, ND, OH, OK, PA, UT, WV, WI, and WY require corrective action;
- MN, TX do not allow groundwater degradation, but, specific enforcement mechanisms are not specified in state regulations;
- MO, TN require assessment only;
- NM requires an abatement plan.

The percentage of the total waste volume that is currently being regulated by states with corrective action requirements for landfills is approximately 78%.

Examples of potential corrective action costs including investigation, capping only, capping plus a slurry wall, and capping plus a groundwater pump and treat system are presented in Chapter 4.

2.4 Packaging Part 258 Requirements into Regulatory Options

The list of typical 40 CFR Part 258 requirements have just been presented. These requirements may be packaged into a single design standard that must be met at all FFC waste landfills and impoundments across the United States or into performance based standards where the design varies dependent upon the performance of various environmental controls (liners, caps, etc.) under given site-specific conditions (i.e., unstable areas, disposal below natural water table, flood plains, wetlands, fault areas, or seismic impact zones). These requirements are presented in Exhibit 2-5. A check mark indicates which requirements are included in each regulatory option.

This report evaluates the incremental cost impacts associated with four design standard options and one performance based option. These options are discussed on the following page..

Table 2-5. List of Part 258 Requirements Included in Each Regulatory Option					
Part 258 Requirement	**Regulatory Option**				
	Design Standard Option 1	**Design Standard Option 2**	**Design Standard Option 3**	**Design Standard Option 4**	**Performance Standard Option 1**
Groundwater Monitoring	✔	✔	✔	✔	✔
Post-Closure Groundwater Monitoring	✔	✔	✔	✔	✔
Cap Controls		✔	✔	✔	✔
Financial Assurance			✔	✔	Karst Areas Only
Liner and Leachate Collection/Detection System Design Controls				✔	Karst Areas Only
Dust Controls, Run-On/Run-Off and Daily Cover Controls					
Siting Standard - Unstable Areas					✔
Siting Standard - Disposal Below Natural Water Table					
Siting Standard - Flood plains					
Siting Standard - Wetlands					
Siting Standard - Fault Areas					
Siting Standard - Seismic Impact Zones					
Corrective Action					

2.4.1 Design Standard Option 1 - Groundwater Monitoring and Post-Closure Groundwater Monitoring

The Agency at a minimum plans to require groundwater monitoring at FFC waste impoundments and landfills to monitor the release of leachate to groundwater. For the groundwater monitoring alternative, groundwater monitoring within 150 meters of the unit boundary is assumed. Groundwater monitoring is required during the operating life of the impoundment/landfill unit and for at least 30 years post closure of the unit. The cost analysis presents two suboptions where groundwater monitoring requirements are effective for all units in 2006 (i.e., currently operating/existing units and newly constructed units) or only for newly constructed units. The design assumptions used in the cost estimates are presented in Section 4.

Benefits from this option are that ground-water monitoring provides a short-term avoided cost benefit of detecting and preventing (with corrective action) contaminant migration via a ground-water pathway exposing nearby receptors and creating third party damages during life of unit operation. Post-closure groundwater monitoring provides an additional 30-year long-term avoided cost benefit of detecting and preventing (through corrective action) contaminant migration via a ground-water pathway exposing nearby receptors and creating third party damages beyond the operating life of the unit. In addition, post-closure groundwater monitoring provides a mechanism to assure that companies (and stockholders) pay site restoration and corrective action costs avoiding inter-generational cost impacts.

2.4.2 Design Standard Option 2 - Cap Controls, Groundwater Monitoring, and Post-Closure Groundwater Monitoring

In addition to the Design Standard Option 1 groundwater monitoring and post-closure monitoring requirements described above, the installation of a synthetic/clay cap is required upon closure of all management units. The cost analysis presents two suboptions where cap requirements are effective for all units in 2006 (i.e., currently operating/existing units and newly constructed units) or only for newly constructed units. The design assumptions used in the cost estimates are presented in Section 4.

Benefits from this option are that caps provide long-term avoided cost benefit of physically preventing rain infiltrating through the ash creating leachate that migrates via a ground-water pathway exposing nearby receptors and creating third party damages beyond the operating life of the unit. Capping requirements increase the likelihood of companies (and stockholders) paying site restoration costs avoiding inter-generational cost impacts.

2.4.3 Design Standard Option 3 - Financial Assurance, Cap Controls, Groundwater Monitoring, and Post-Closure Groundwater Monitoring

In addition to the Design Standard Options 1 and 2 groundwater monitoring, post-closure monitoring, and capping requirements described above, financial assurance is necessary to help assure adequate planning for the future cost of closure and post-closure care. It is an assurance that adequate funds will be available when needed to cover the costs if the owner or operator is unwilling to do so. The cost analysis presents one option where financial assurance requirements are effective only for newly constructed units. The design assumptions used in the cost estimates are presented in Section 4.

Financial assurance provides an additional mechanism to assure that companies (and stockholders) pay site restoration and corrective action costs avoiding inter-generational cost impacts.

2.4.4 Design Standard Option 4 - Liner and Leachate Collection/Detection Controls, Financial Assurance, Cap Controls, Groundwater Monitoring, and Post-Closure Groundwater Monitoring

This option assumes full Subtitle D type municipal sold waste landfill requirements for landfills and similar Subtitle D-like requirements for surface impoundments to control the release of leachate to groundwater. The option assumes groundwater monitoring (within 150 meters), cap (synthetic), liner (synthetic-clay composite), leachate collection system, post-closure monitoring, and financial assurance. These design and operating requirements for landfills and impoundments only apply to new construction. However, compliance with groundwater monitoring and post-closure monitoring are effective the date the rule becomes final. The cost analysis assumes that groundwater monitoring compliance will begin in 2006.

The addition of a liner provides added short- and long-term avoided cost benefits by physically preventing leachate leakage and migration via a groundwater pathway exposing nearby receptors and creating third-party damages. A leachate collection system provides additional physical prevention of short-term and long-term leachate leakage and migration via groundwater pathway exposing nearby receptors and creating third party damage.

2.4.5 Performance Based Option 1 - Siting Restrictions in Karst Terrains

Another option is to tailor technical and management standards to unstable geologic conditions. This alternative is referred to as Performance Based Option 1. Under this approach, standards are most stringent on plants located in mature karst geologic regions. It is slightly less stringent on plants located in non-mature karst terrains. It is even less stringent for plants located in non-karst terrains (see Exhibit 2-6).

In unstable karst terrains groundwater flow generally occurs through an open system with both diffuse and conduit flow end member components, and typically have rapid ground-water flow velocities which exceed Darcian flow velocities. Karst is typically composed of limestone, dolomite, gypsum and other soluble rock. The karst terrain typically has well developed secondary porosity enhanced by dissolution. Land forms found in karst terrains include, but are not limited to, sinkholes, sinking streams, caves, springs and blind valleys. Karst terrains always include one or more springs for each ground-water basin, and underground streams except where ground-water flow is diffuse or the host rock has megaporosity. Based on a general mapping of plants to karst terrains, 53 plants are located in major karst geologic terrain and 84 plants are located in these other less-developed forms of karst classified as moderate, minor or pseudo. Of the total surface impoundment and landfill waste volumes, 30 percent and 43 percent, respectively, are managed in the 25 states reviewed with existing siting restriction in regards to construction in unstable areas. Existing state siting restrictions for constructing units in unstable areas have yet to be mapped into the baseline cost estimate presented later in the report.

2.4.5.1 Mature Karst

As noted previously, some states currently regulate the siting of landfills and surface impoundments in unstable areas (e.g., karst), more so for landfills that impoundments. Twelve states out of a review of 25 state regulations currently restrict the siting of landfills in unstable areas (AZ, CO, IN, IA, KY, MN, MO, ND, PA, TN, WV and WI). Five of these states also restrict the siting of impoundments in unstable areas (KY, MO, ND, PA and WV). Of these 12 states, only one does not have karst terrains (North Dakota). Other states that were reviewed and have some level of karst terrain and no siting restrictions include AL, GA, FL, IL, KS, MI, NC, NM, NY, OH, OK, and TX. Only one state whose regulations were reviewed has no identified karst terrain and that is Utah. Other states whose siting regulations were not reviewed and have some level of karst terrain include AR, MD, MS, NE, NJ, NV, SC, SD, and VA.

Mature karst is found in 18 states (AL, AR, AZ, CO, FL, GA, IA, IL, KY, MD, MN, MO, TN, PA, SD, VA, WI, and WV). To protect these terrains, off-site disposal at landfills meeting full Subtitle D type municipal solid waste (MSW) landfill design requirements is assumed to be more appropriate than on-site disposal. For surface impoundments, their discontinued use seems appropriate replaced by off-site disposal at landfills meeting full Subtitle D type MSW landfill design requirements. Both of these requirements are assumed to be implemented for new units constructed at the end of the projected closure date of the unit.

2.4.5.2 Other Karst Regions

This region is defined as those areas of moderate, minor and pseudo karst. For this region, a full Subtitle D type landfill design is required, but, on-site construction is allowed. It requires a synthetic-clay composite liner. Several states currently regulate the design criteria for landfills and impoundments to include full or close to full Subtitle D requirements for landfills and similar requirements for surface impoundments.

2.4.5.3 Non-Karst Regions

This region is defined as those areas having no karst terrains. For this region, a synthetic/clay cap is the assumed design requirement.

Exhibit 2-6. Proposed Controls for Performance Based Option 1

Design Component	Regions with Mature Karst [1]	Regions with Other Karst [1]	Regions with No Karst
Location	Off-site	Off-site/On-site (economic decision)	Off-site/On-site (economic decision)
Cap	composite (synthetic & 2' soil)	composite (synthetic & 2' soil)	synthetic or clay cap
Liner	composite (synthetic & 2' clay)	composite (synthetic & 2' clay)	No
Leachate Collection/ Detection System	Yes	Yes	No
Ground-water Monitoring and Post-Closure Monitoring	Yes (within 150 meters)	Yes (within 150 meters)	Yes (within 150 meters)
Financial Assurance	Yes	Yes	No

[1] Full Subtitle D type MSW landfill design and similar design for impoundments.

3.0 BASELINE GENERATION AND MANAGEMENT

3.1 Annual Waste Generation

While coal combustion continues to increase, so does the generation of the associated wastes. Coal-fired utilities represent the largest single category of fossil fuel combustion, and likewise generate the greatest proportion of FFC wastes. Currently, utilities burn approximately 900-million tons of coal per year using a variety of conventional combustion technologies. Utility coal usage results in the generation of roughly 100-million tons of large-volume FFC wastes: fly ash, bottom, ash, boiler slag, flue gas desulfurization (FGD) sludge, and gypsum. These wastes may be managed in landfills and surface impoundments, or, increasingly, may be applied to a variety of beneficial uses.

3.2 Waste Management Unit Types and Locations

Waste management units common at utility coal combustion facilities include landfills and surface impoundments. Wastes at a facility may be managed together in the same waste management unit, or different FFC waste may be disposed in separate units. For example, fly ash may be sluiced to one surface impoundment, while bottom ash is managed in another. Also, different waste management units may service separate combustion units at an individual facility. Finally, as described above, FFC wastes initially may be managed in a surface impoundment (or series of impoundments) and then dredged for placement in a landfill. As a result of these practices, a given combustion facility may have more than one waste management unit. The 1993 DOE study found 618 management units at 450 U.S. coal-fired power plants. The EEI Power Statistics database reports 561 units serving 440 plants. Responses to the EPRI comanagement survey cover 323 FFC waste management units serving 238 power plants.

The three data sources show nearly equal numbers of surface impoundments and landfills. While slightly more than half of the units in the DOE study and EEI database are surface impoundments, just under half of the EPRI survey units are surface impoundments. Although each source shows a similar proportion of unit types, there appears to be a general trend toward the increasing use of landfills.

Analyses presented in Chapter 4 (Exhibit 4-1) combining EIA 767/759 databases and EPRI comanagement survey identified 470 management units at 452 plants. Of this total, 382 management units were specifically reported in the data sources reviewed. An additional 88 units are assumed to exist at plants where management data were not available. Management data were not available for most of these plants because they were not required to report by-product disposition (disposal/use) in the EIA 767 database. Plants with capacities between 10 and 100 megawatts were not required to report these data. The reported 382 management units show nearly equal numbers of surface impoundments and landfills. The assumed 88 units are included in the economic analysis for purposes of assessing potential maximum cost impacts of the proposed rule. The 88 units are assumed to be landfills (either on-site of off-site, whichever is more economical) because they are cheaper to construct than surface impoundments.

Units opened since 1970 are more likely to be landfills than surface impoundments. Three factors may contribute to the trend toward the increasing use of landfills. First, space constraints at existing utility facilities favor the use of landfilling when new units are required. As discussed below, because of their greater height and material compaction, landfills can provide greater FFC waste management capacity in smaller areas than surface impoundments. Furthermore, when space constraints are extreme, utilities must locate new FFC waste management units off site. When located off site, landfills may be the preferred unit type because of the lower cost of transporting dry FFC waste as opposed to wet FFC waste. Second, New Source Performance Standards (NSPS) under the Clean Water Act require zero discharge of fly ash handling water. These requirements encourage the use of dry ash handling systems and, therefore, landfilling for new generating units. Third, there is an increasing trend toward dry ash handling in general due to a steady increase in beneficial use applications, which favor dry ash collection and management.

Geographically the greatest number of units are located in the upper Midwest and fewer units in the far west and New England. This is consistent with geographic distribution of coal-fired utilities. Of more significance, surface impoundments outnumber landfills in the Southeast and some Midwestern states, while landfills outnumber surface impoundments in Texas and some Rocky Mountain states.

Exhibit 3-1 Geographic Distribution of Plants and Management Units

State by EPA Region	No. of Plants	No. of Landfills	No. of Surface Impoundments
EPA Region 1			
Connecticut	2	1	0
Maine	0	0	0
Massachusetts	2	0	0
New Hampshire	2	1	0
Rhode Island	0	0	0
Vermont	0	0	0
Region Total	**6**	**2**	**0**

Exhibit 3-1 Geographic Distribution of Plants and Management Units			
State by EPA Region	**No. of Plants**	**No. of Landfills**	**No. of Surface Impoundments**
EPA Region 2			
New Jersey	5	1	1
New York	12	10	0
Region Total	**17**	**11**	**1**
EPA Region 3			
Delaware	2	1	0
Maryland	8	6	1
Pennsylvania	23	17	5
Virginia	11	6	4
West Virginia	14	11	6
District of Columbia	0	0	0
Region Total	**58**	**41**	**16**
EPA Region 4			
Alabama	9	5	8
Florida	12	9	4
Georgia	12	4	10
Kentucky	17	10	13
Mississippi	5	5	2
North Carolina	14	3	13
South Carolina	13	6	8
Tennessee	7	6	7
Region Total	**89**	**48**	**65**
EPA Region 5			
Illinois	26	12	16
Indiana	25	13	16
Michigan	22	12	7
Minnesota	17	13	1
Ohio	27	15	11

Exhibit 3-1 Geographic Distribution of Plants and Management Units			
State by EPA Region	**No. of Plants**	**No. of Landfills**	**No. of Surface Impoundments**
Wisconsin	18	16	0
Region Total	**135**	**81**	**51**
EPA Region 6			
Arkansas	3	3	1
Louisiana	5	3	3
New Mexico	4	2	2
Oklahoma	6	4	2
Texas	19	14	7
Region Total	**37**	**26**	**15**
EPA Region 7			
Iowa	20	12	5
Kansas	8	5	4
Missouri	20	10	9
Nebraska	4	4	1
Region Total	**52**	**31**	**19**
EPA Region 8			
Colorado	15	12	1
Montana	3	2	0
North Dakota	9	9	3
South Dakota	2	2	0
Utah	5	5	2
Wyoming	8	8	3
Region Total	**42**	**38**	**9**
EPA Region 9			
Arizona	6	3	3
California	2	2	0
Hawaii	0	0	0

Exhibit 3-1 Geographic Distribution of Plants and Management Units			
State by EPA Region	**No. of Plants**	**No. of Landfills**	**No. of Surface Impoundments**
Nevada	4	4	1
Region Total	**12**	**9**	**4**
EPA Region 10			
Alaska	1	1	0
Idaho	0	0	0
Oregon	1	1	0
Washington	2	1	0
Region Total	**4**	**3**	**0**
Totals	**452**	**290**	**180**

Based on data from the DOE study and EEI, the majority of FFC waste management units are located at the generating site. Surface impoundments are almost exclusively found at the generating site (94 to 95 percent), while approximately half of landfills (49 to 59 percent) are on-site units. The extensive use of on-site management units likely is due to the large volume of waste generated. Off-site transportation costs can make onsite disposal more economical.

Power plants with the smallest generating capacity are more likely to use off-site units for FFC waste disposal than are the largest power plants. As discussed above, the majority of off-site units are landfills. Thus, smaller generating facilities tend to favor off-site landfilling.

3.3 Waste Characteristics

Coal-fired utilities represent the largest single category of fossil fuel combustion, and likewise generate the greatest proportion of Fossil Fuel Combustion (FFC) wastes. Each year, utilities burn approximately 900-million tons of coal using a variety of conventional combustion technologies.[42] Three types of wastes generated from the FCC of coal fired utilities include large volume wastes, low volume wastes, and comanaged wastes. Comanaged wastes are a

[42] Report to Congress: Wastes from the Combustion of Fossil Fuels-Volume 1-Executive Summary, US EPA Office of Solid Waste and Emergency Response, March 1999, Chapter 3 pages 1 and 2.

combination of one or more low volume wastes with one or more large volume wastes.[43] The following text lists and describes each type of waste highlighting its chemical composition.

3.3.1 Large Volume Wastes

Utility coal usage results in the generation of roughly 100-million tons of large-volume FFC wastes: fly ash, bottom, ash, boiler slag, and flue gas desulfurization (FGD) sludge. These wastes may be managed in landfills and surface impoundments, or, increasingly, may be applied to a variety of beneficial uses.

Each of the large-volume wastes can exist as a dry solid or wet slurry, depending on collection and management technology. Other physical characteristics vary from waste type to waste type. Fly ash is typically generated and collected as a solid but may be transported by sluicing. This type of waste consists primarily of particles between 5 and 100 microns.[44] Fly ash typically has a round shape resulting from the high temperatures used in a pulverized coal boiler. Bottom ash and slag can be generated from a wet-bottom or dry-bottom pulverized-coal boiler. The bottom ash collected from a dry-bottom system can be transported in a dry state or sluiced. Bottom ash and boiler slag consist of larger particles than fly ash, ranging from 0.1 millimeter (100 microns) to 10 millimeters in diameter.[45] Bottom ash has a coarse angular structure, while boiler slag consists of angular particles with a glassy appearance. FGD waste can be generated from a dry sorbent system or a wet scrubber system. Wet systems generate waste with slightly smaller particle size (0.001 to 0.05 millimeters) than dry systems (0.002 to 0.074 millimeters). Wet systems also generate a filter cake or similar wet solid (16 to 43 percent moisture), while waste from dry systems contains no liquids.[46]

Oxides of silicon, iron, aluminum, and calcium compose 95 percent of the weight of both bottom and fly ash. These constituents also are present in significant quantities in boiler slag. Calcium sulfate is the principal constituent of limestone-based FGD waste. Large-volume wastes also contain trace metals. Mean concentrations of arsenic, barium, beryllium, boron, copper, and vanadium are highest in fly ash. Bottom ash has mean contaminant levels lower than fly ash for most constituents. Mean concentrations of antimony, lead, mercury, selenium, and zinc are highest in FGD waste. Several studies have included testing of organic constituents in large-volume UCCWs, including polynuclear aromatic hydrocarbons (PAHs) and dioxins. Although

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[43] Report to Congress: Wastes from the Combustion of Fossil Fuels-Volume 2- Methods, Findings, and Recommendations, US EPA Office of Solid Waste and Emergency Response, March 1999, Section 3.2 Waste Characteristics pages 12-17.

[44] EPA. 1988. *Report to Congress: Wastes from the Combustion of Coal by Electric Utility Power Plant*s. EPA/530-SW-88-002. February.

[45] ibid.

[46] ibid.

an exhaustive review of organic constituent data has not been conducted, based on available information, total and leachable organic concentrations are generally reported to be at or below analytical detection limits.[47]

3.3.2 Low Volume Wastes

In addition to large volume wastes, utilities generate a variety of low-volume wastes that result from supporting processes that are ancillary to the combustion and power generation processes.[48] Low-volume wastes 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 washwater
- Boiler chemical cleaning waste
- Floor and yard drains and sumps
- Laboratory wastes
- Wastewater treatment sludge

Because low-volume wastes are generated throughout the combustion process and its ancillary activities, the characteristics of these wastes are extremely variable. EPA does not have comprehensive data characterizing every type of low-volume waste that might be comanaged with large-volume coal combustion wastes. Exhibit 3-2 presents the principal physical and chemical characteristics of several major types of low-volume waste.[49]

EPA has identified coal mill rejects (and particularly their pyrite component) as a low-volume waste of particular concern. If mismanaged, these materials have the potential to oxidize and generate acids that could leach metals from surrounding materials to ground and surface waters. The industry has developed a guidance document for managing coal mill rejects.

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[47] ibid.

[48] Report to Congress: Wastes from the Combustion of Fossil Fuels-Volume 1-Executive Summary, US EPA Office of Solid Waste and Emergency Response, March 1999.

[49] ibid.

Exhibit 3-2 General Composition of Selected Low-Volume Wastes	
Coal Pile Runoff	Acidic or alkaline solution (depending on coal type) with uncombusted coal particles. May contain calcium, metals, silica, chloride, sulfate, and dissolved and suspended solids.
Coal Mill Rejects	Hard coal, quartz, and iron sulfides (pyrites) that cannot be ground by mills.
Boiler Blowdown	Alkaline solution of boiler feed water with low dissolved solids. May contain chlorides, sulfates, calcium and magnesium salts, precipitated solids, corrosion products, and chemical additives, such as phosphates, sodium hydroxide, sodium sulfite, hydrazine, and chelating agents.
Cooling Tower Blowdown and Sludge	Similar to makeup water, with biocides, anti-corrosives, and other additives. Sludge contains settled solids. Contaminants may include calcium and magnesium salts, metal oxides, asbestos, biofouling inhibitors, zinc, phosphonates, sulfuric acid, chlorine, wood preservatives, suspended solids, carbonates, nitrates, and sulfates.
Water Treatment Sludge	Sludge from the treatment of makeup water.
Regeneration Waste Streams and Other Water Treatment Wastes	Strong acid and base regeneration solutions, with concentrated makeup water contaminants. May contain calcium, metals, sodium, chlorides, sulfates, and organic constituents.
Air Heater and Precipitator Washwater	Aqueous solution with suspended ash from fireside cleaning. May include a source of alkalinity for pH control. May contain metals, dissolved or suspended solids, and polynuclear hydrocarbons from soot deposits.
Boiler Chemical Cleaning Waste	Aqueous weak acid or base solution containing residual cooling system additives. May contain ammonium sulfate, ammonium carbonate, oxidizing agents, metals, hydrochloric or other acids, phosphates, fluorides, organic compounds, caustics, and silica.
Floor and Yard Drains and Runoff	Low solids aqueous waste with soil, ash, some uncombusted coal, oil and grease, and phosphates and surfactants.
Laboratory Wastes	Miscellaneous aqueous wastes expected to be represented by above. May be acidic or alkaline and may contain methylene chloride, phthalates, silica, phosphorous, hydrazine, and sodium.
Wastewater Treatment Sludge	Sludge from management of several of the above wastes.
Sources: EPA, 1988, 1996; EPRI, 1991, 1992, 1994a, 1994b, 1996a, 1996b, 1997b, 1997c, 1997d, 1997e, 1997f, 1997g, 1997h, 1997i, 1997j, 1997k, 1997l, and 1999	

3.3.3 Comanaged Wastes

Comanaged wastes consist of one or more low-volume wastes in combination with one or more large-volume UCCWs. EPA estimates that there are roughly 470 FFC waste management units operated at approximately 452 coal-fired utility power plants. Recent trends suggest increasing preference for landfills. Nearly all of the surface impoundments are located onsite, while landfills may be onsite or offsite. Based on utility survey data, EPA estimates that more than 80 percent of these operations comanage large- and low-volume wastes.[50]

Individual surface impoundments and landfills may comanage as many as 15 different low-volume waste streams. Surface impoundments typically comanage more different waste types (a median of eight) than do landfills (a median of four). Coal mill rejects are among the most common wastes to be comanaged in landfill and impoundments, while floor drain wastes, coal pile runoff, and water treatment wastes are also commonly disposed in comanaged waste impoundments. The total quantity of low-volume wastes managed in landfills will generally be small compared with the large-volume wastes. In surface impoundments, however, the low-volume wastes may be very large compared with the quantity of ash disposed. This relative measure largely reflects the volume of water and not the solids content of the low-volume waste.[51]

The size of comanaged waste units ranges from modest to very large, with some surface impoundments covering 1,500 acres or more. Median landfill and surface impoundment capacities are 3.8 and 3.4 million cubic yards, respectively.[52]

From a physical standpoint, comanaged wastes are similar to large-volume UCCWs, especially in cases where the UCCWs are managed with low-volume aqueous wastes or only small quantities of low-volume solid wastes. For example, a solid sample of comanaged ash managed under these conditions has a similar particle size and gross physical characteristics (e.g., oxides of aluminum, silicon, iron, and calcium) as the ash when generated.

Differences in physical properties between comanaged wastes and high-volume wastes can be apparent in localized areas of a waste management unit. Comanaged wastes generally show properties of each material. For example, comanagement of fly ash in a section of a pond receiving coal pile runoff results in a mixture resembling combusted and uncombusted coal particles, while comanagement of coal mill rejects and bottom ash results in a mixture

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[50] Report to Congress: Wastes from the Combustion of Fossil Fuels-Volume 1-Executive Summary, US EPA Office of Solid Waste and Emergency Response, March 1999.

[51] ibid.

[52] ibid.

resembling a coarse angular and glassy material with oxidized iron.[53]

The chemical characteristics of comanaged wastes are dependent on the type and quantity of low- and large-volume wastes present. EPA has characterized comanaged waste using "as managed" samples from 17 comanaging utility sites. The Agency has compared the comanagement practices at these facilities to industry-wide practices as described by EPRI comanagement survey results. Based on this comparison, EPA concluded that comanagement practices at sampled sites are similar to industry-wide practices or reflect a greater degree of comanagement than at the sites in the general population.[54]

Exhibit 3-3 presents waste characterization data for comanaged wastes in impoundments and landfills. Of constituents of potential concern, barium, strontium, and manganese are present in the highest concentrations. These findings are similar to the characteristics of large-volume UCCWs as presented in the 1988 Report to Congress. Additionally, Exhibit 3-2 shows that the characteristics of comanaged wastes collected from landfills and impoundments are generally within an order of magnitude of each other. A much smaller number of landfills are represented in the data, which may contribute to uncertainty in those results.

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[53] EPRI. 1997. *Field Evaluation of the Comanagement of Utility Low-Volume Wastes with High-Volume Combustion By-Products: Various sit*es.

[54] Report to Congress: Wastes from the Combustion of Fossil Fuels-Volume 1-Executive Summary, US EPA Office of Solid Waste and Emergency Response, March 1999.

Exhibit 3-3. Facility Average Concentrations of Trace Constituents in Comanaged Wastes (parts per million)				
Constituent	**Managed in Surface Impoundments**		**Managed in Landfills**	
	Mean	**Range**	**Mean**	**Range**
Arsenic	40	6.7-150	20	6.2-38
Barium	1600	150-8,400	2,900	1,800-3,800
Beryllium	8.4	.88-16	n/a	n/a
Boron	190	.03-420	n/a	n/a
Cadmium	6	.20-24	n/a	n/a
Chromium	85	5.7-290	50	35-78
Cobalt	29	4.7-42	n/a	n/a
Copper	78	2.2-150	150	97-120
Lead	42	5-150	17	6.5-29
Manganese	280	55-660	460	200-820
Nickel	68	1.5-160	51	33-65
Selenium	37	.025-320	14	.8-32
Silver	5.2	.03-14	n/a	n/a
Thallium	27	10.6-48	n/a	n/a
Strontium	1040	1-4,800	2,100	1,100-2,650
Vanadium	120	20-350	86	23-160
Zinc	150	17-860	84	35

** All measurements identified as below detection limit were assigned a value equal to one-half the detection limit for use in the calculations. All concentrations are facility-averaged; i.e., multiple measurements from a single site are averaged, and the resulting population of facility averages used to generate the statistics in this exhibit.*

n/a = data not available

Sources: EPRI, 1991, 1992, 1994a,1994b, 1996a, 1996b, 1997c, 1997d, 1997e, 1997f, 1997g, 1997h, 1997i, 1997j, 1997k, and 1997l

EPRI has provided a limited quantity of data on organic constituents in comanaged wastes. The data generally indicate that these constituents are not present at levels above detection limits. EPA evaluated the data available on the presence of dioxins and furans in comanaged wastes. Very few samples had concentrations of individual compounds above detection limits. The most toxic compound, 2,3,7,8-TCDD, was not detected in any of the 17 samples from 11 sites. Compositing the concentrations of all compounds of interest using their respective 2,3,7,8-TCDD equivalency factors, the samples displayed 2,3,7,8-TCDD equivalent concentrations from below detection to 2.1 ng/kg (approximately one order of magnitude above typical detection limits). By comparison, a reference sample of municipal waste incinerator fly ash had a 2,3,7,8-TCDD equivalent concentration of 1,460 ng/kg (parts per trillion).[55]

Coal contains and emits low levels of naturally occurring radiation. Concentrations of radionuclides in coal vary with coal rank and origin. For example, uranium and thorium concentrations in U.S. coals range from below 0.01 parts per million (ppm) to roughly 75 ppm, based on analyses of more than 6,000 samples (EPA, 1995c). However, the geometric mean concentrations of uranium and thorium for the same sample population are 1.2 ppm and 2.2 ppm, respectively. These concentrations correspond to activities of roughly 0.41 pCi/g and 0.24 pCi/g, respectively. Because they do not volatilize, these elements generally concentrate in coal ash, such that activity levels in the ash increase relative to the radioactivity in source coal. EPA estimates an average increase of roughly 10×, such that average activity levels for uranium and thorium are 4 pCi/g and 2.4 pCi/g, respectively.[56]

3.4 Technologies Used to Manage FFC Waste and Life Expectancy of Units

Based on the 1998 EIA 767 database and 1995 EPRI Comanagement Survey, FFC wastes are disposed in surface impoundments, landfills, or minefills or sold for beneficial purposes. Exhibit 4-1 in the next chapter presents a frequency distribution of the number of plants managing their waste by the above practices. From the March 1999 Report to Congress, the following is a brief summary of current environmental controls used for surface impoundments and landfills:

> “The utility sector in recent years has increasingly installed more environmental controls for comanaged waste facilities. Today more than one-half of the landfills and one quarter of the impoundments are lined. Other examples of in-place controls include leachate collection, ground-water monitoring, and operation under regulatory permits, each of which has a high rate of implementation at landfill management units, and significant implementation at surface impoundment management units.”

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55 Report to Congress: Wastes from the Combustion of Fossil Fuels-Volume 2- Methods, Findings, and Recommendations, US EPA Office of Solid Waste and Emergency Response, March 1999.

56 ibid.

The Agency asked utility industry representatives what a typical life of an ash landfill and surface impoundment would be. They provided a 40-year estimate for both. This is supported by data provided by industry in the 1995 EPRI Comanagement Survey. In the EPRI Survey, data were provided for six landfills for the year the unit was opened and the estimated date of closure. The average life expectancy is 34 years and the median life expectancy is 38 years. Similarly, data were provided for 18 surface impoundments. The average life expectancy is 45 years and the median life expectancy is 46 years. Therefore, a 40-year life expectancy for ash landfills and surface impoundments is assumed.

4.0 REGULATORY COSTS

4.1 Costing Methodology

Costs are developed using secondary data on costs for groundwater well installation, monitoring, and reporting. Where acceptable data are not available, costs are estimated using cost engineering models and algorithms. Costs are developed in three different forms: capital costs for well installation, annual operating and maintenance costs for groundwater sampling, well maintenance and replacement and reporting, and annual post-closure monitoring costs. These costs are then combined into an annualized before-tax compliance cost to approximate the overall economic impact of complying with the proposed regulation. Standard annualizing procedures are used which incorporate accepted discount rates.

The cost of potential regulations can be viewed in two contexts, economic and financial. The two perspectives consider regulatory costs in two different ways for different purposes. The economic context considers impacts on resource allocation for the economy as a whole, which considers potential effects on supply and demand, shifts to substitute products, and the structure, conduct, and performance of industries as a whole. The financial context evaluates private sector effects on plants, firms, and other discrete entities. This study focuses on the financial context (i.e., impacts on plants). Future analyses, outside the scope of this assessment, will infer general economic effects based on an aggregate level of costs incurred by plants and market conditions that will control how much costs can be shifted to consumers.

Consequently, this study employs data and cost accounting assumptions consistent with the perspective of plant operators. Thus, impacts look at effects on cost of production and returns. Where discounting of investment or future costs are needed, a general cost of capital real discount rate for obtaining financing of seven percent is assumed, rather than a lower “social” discount rate. While financial impacts are usually assessed on an after-tax basis, this assumption is somewhat complicated for this study as many “public” plants may be considered “non-profit” and thus should have a zero tax rate. In this study, all costs are annualized on a before-tax basis. Before-tax compliance costs are used because they represent a resource cost of the alternative management practices considered, measured before any business expense tax deductions available to affected companies. The savings attributable to corporate tax deductions or depreciation on capital expenditures for pollution control equipment are not considered in calculating before-tax costs.

4.2 Overview of Costing Approach

Annual before-tax baseline and compliance costs are estimated for each facility using derived engineering cost estimates and reported and estimated waste quantities. Annual incremental compliance costs are estimated by subtracting the annual baseline cost estimate from the annual compliance cost estimate. In reformulating the costs of compliance, EPA used a discount rate of seven percent and assumed a 40-year operating life (borrowing period) based on industry data for landfill and impoundment operational periods when annualizing capital and post-closure costs for newly constructed units. For existing waste management units, the remaining years of the unit's operating life is assumed as the borrowing period for application of new environmental controls (e.g., groundwater monitoring or cap).

The following formulas were used to calculate the before-tax annualized baseline and compliance costs and estimate annual incremental compliance costs for the proposed groundwater monitoring regulation:

Annual Before-Tax Costs =

(Initial Capital One Time Costs)(CRF_n) +

(Annual O&M Costs)($SPWF_n$)(CRF_n) +

(Post Closure O&M Costs)($SPWF_{30}$)(PWF_n)(CRF_n)

Where: CRF_n = Capital recovery factor (i.e., the amount of each future annuity payment required to accumulate a given present value) based on a 7 percent real rate of return (i) and a specified borrowing period/operating life (n) is calculated as follows:

$$\frac{(1+i)^n(i)}{(1+i)^n-1} = 0.07501 \quad \text{when } n = 40$$

Where: PWF_n = Present worth factor (i.e., the present value of a sum N periods in the future) based on a 7 percent real rate of return (i) and sums occurring 40-years and 45-years (n) in the future as follows:

$$\frac{1}{(1+i)^n} = 0.06678 \quad \text{when } n = 40$$

Where: $SPWF_n$ = Series present worth factor (i.e., the present value of a series of uniform end-of-period payments) based on a 7 percent real rate of return (i) and a 30-year (post-closure monitoring) and 40-year (operating life) payment period (n) is calculated as follows:

$$\frac{1}{\underline{(1+i)^n(i)}}$$

$$(1 + i)^n - 1 = 13.331 \quad \text{when } n = 40$$
$$= 12.409 \quad \text{when } n = 30$$

Annual Incremental Compliance Cost = Annual Compliance Cost - Annual Baseline Cost

After the above costs have been allocated across years (a 50-year time period is modeled), the total net present worth incremental compliance costs were calculated using the following formula:

$$PW = \sum_{1}^{n} (F_n)(PWF_n)$$

Where: PW = Present worth (i.e., the present value of n sums (F) made over n periods in the future) based on a 7 percent real rate of return (i) and sums occurring over the next 50 periods into the future.

F = Future worth of sum (i.e., incremental compliance cost) to be paid in year n.

The total net present value cost estimate (PW) for each plant is calculated based on the next 50 years of variable annualized cost streams and assuming a seven percent discount rate. The PW is calculated based on cost incurred at the beginning of the period. A constant annualized compliance cost for each plant is estimated by annualizing the total net present value cost estimate over a 50-year time horizon assuming a seven percent discount rate. A 50-year time horizon was chosen because new construction for replacement of all disposal units is estimated to have occurred by that time. The annualized 50-year before tax cost is calculated using the following formula:

$$\text{Annualized 50-year Cost} = CRF_{50} * PW$$

4.3 Approach for Establishing Costing Baseline

The baseline cost estimate is based on current design and operating conditions using information obtained from the 1995 EPRI Comanagement Survey, 1994-2004 USWAG/DOE/EPA New Unit Survey, and current state regulatory requirements (based on a review of the regulations for the 34 states that use the most coal to produce electricity). Several states have already established certain FFC waste disposal unit design and operating requirements that are a required to be implemented either upon the effective date of the regulation (e.g., groundwater monitoring), upon retirement of the disposal unit (e.g., post-closure monitoring), or for newly constructed units only. As a result, future cost streams for some states are part of the baseline. Future cost streams associated with FFC waste management post-closure monitoring and new unit construction groundwater and post-closure monitoring costs are already a requirement under existing state regulations.

The data sources used for estimating costs include those used to profile and develop alternative management practices, waste quantities and characteristics, and unit cost estimates or cost estimating models. Primary data sources include:

- The Department of Energy (DOE) Energy Information Administration (EIA) 767 Database (1998 and 2003; 2003 for the two CA sites only) and 759 Database (1999),
- Electric Power Research Institute (EPRI) Comanagement Survey (published in 1997, but contains 1995 data),
- 1994-2004 Utility Solid Waste Activities Group/Department of Energy/Environmental Protection Agency (USWAG/DOE/EPA) New Unit Survey (June 24, 2005 version), and
- Remedial Action Cost Engineering and Requirements (RACER) cost estimating software (2002) with costs based on the R.S. Means, Environmental Cost Handling Options and Solutions (ECHOS), Environmental Remediation Cost Data (2002).

If coal usage, percent ash content, and ash generation quantity data were not available in the 1998 EIA 767 database or 1995 EPRI Comanagement Survey it was estimated using other sources. For 16 plants coal usage and ash generation were estimated based on the boiler nameplate rating. For 9 plants data were obtained from the 1999 EIA 759 database. Three additional plants were added to the population based on the 1999 database, and two additional plants were added to the population based on the 2003 database. For 11 plants an average nameplate rating was assumed determined from the 16 plants discussed above. Appendix B lists the EIA plant codes and the assumptions used to estimate coal usage and ash generation quantities.

4.3.1 Baseline Population

For each of the 452 coal-fired utility plants identified using the 1998 and 2003 EIA 767 and 1999 EIA 759 databases, baseline FFC waste disposal practices (types) were assigned using the methodology presented below. The results from applying this methodology are presented in Exhibit 4-1. Cost impacts on plants operating 290 on-site landfills and 180 on-site surface impoundments are evaluated in this regulatory cost assessment. Out of the 290 on-site landfills, 202 were identified through actual reporting in the EIA and EPRI data sources. The USWAG/DOE/EPA data source identified newly constructed units between 1994 and 2004. All the units identified were constructed at sites with pre-existing landfills or impoundments. The remaining 88 on-site landfills are conservatively included in the analysis for plants that provided no disposal practice data in order to assess the maximum potential impacts of the proposed regulation. This analysis assumes that the proposed regulation does not impact off-site beneficial uses and off-site landfill practices. Off-site disposal facilities (landfills) commercially receiving FFC wastes are assumed to already be in compliance with the proposed regulation and operate in accordance with Subtitle D guidance.

1) If the plant reported either on-site landfill, on-site impoundment, sold for beneficial use, or off-site landfill/minefill disposal of fly ash, bottom ash, gypsum or fluegas desulfurization (FGD) sludge in the 1998 and 2003 EIA 767 databases these disposal practices are assumed for the baseline. A total of 174 on-site landfill units and 170 on-site surface impoundment units were specifically reported in the EIA 767 database.

2) Given no data in the 1998 and 2003 EIA 767 databases, the disposal practices of landfill (either on-site or off-site depending which is more economical), impoundment, and minefill as reported in the 1995 EPRI Comanagement Survey are the assumed disposal practices for the baseline. An additional 14 on-site landfill units and 10 on-site surface impoundment units were identified using the EPRI Comanagement Survey.

3) Based on 1998 and 2003 EIA 767 data, if the plant reported "on-site use and storage" quantities and no on-site landfill or on-site disposal practice, landfill (either on-site or off-site depending which is more economical) is the assumed FFC disposal practice if the reported storage quantity is greater then twice the reported quantities sold for beneficial use or off-site landfill. It was assumed that too much quantity was unaccounted for in the reported on-site storage quantity to remove from the analysis. An additional 14 on-site landfill units are assumed based on this assumption.

4) If total FFC waste generation quantities are greater than twice the reported beneficial use and off site disposal quantity, landfill (either on-site or off-site depending which is more economical) is the assumed disposal practice. Landfills are cheaper to construct than surface impoundments. An additional 3 on-site landfill units are assumed.

5) Finally, if no data on FFC disposal practices are available in the 1998 and 2003 EIA 767 databases and 1995 EPRI Comanagement Survey, landfill (either on-site or off-site whichever is more economical) is the assumed FFC disposal practice. Landfills are cheaper to construct than surface impoundments. An additional 85 on-site landfill units are assumed. It should be noted that plants with capacities between 10 and 100 megawatts are not required to report their disposal practices in the EIA 767 Steam-Electric Plant Operation and Design Report. This likely explains why no management data exists for these 85 plants.

EXHIBIT 4-1. BASELINE FREQUENCY DISTRIBUTION OF FFC DISPOSAL PRACTICES BY DATA SOURCE (NUMBER OF PLANTS OUT OF 452)					
Data Source	**On-Site Landfill**	**On-Site Impound-ment**	**Sold for Beneficial Use**	**Off-Site Disposal (Landfill/ Minefill)**	**Comments**
1998 and 2003 EIA Databases: Number of plants reporting FFC disposal practice	174	170	257	83	3 of the 172 plants with on-site landfills reported "on-site use and storage" quantities. These quantities were assumed to be landfilled, in addition to the reported quantities of landfilled waste.
1995 EPRI Comanagement Survey: Number of additional plants identified using these FFC disposal practices	14	10	1	1	
1998 and 2003 EIA Databases: Number of plants reporting "on-site use and storage" quantities assumed to landfill because reported storage quantity is more than twice the reported beneficial use and off-site landfill/minefill quantities.	14	0	---	---	A total of 14 plants were identified reporting "on-site use and storage" quantities that were more than twice the reported beneficial use and off-site landfill/minefill quantities and reported no on-site landfill activity. The following is a further breakdown of the 14 plants: - 6 plants did not report off-site beneficial use or off-site disposal. - 8 plants have storage quantities that are at least two times greater than the reported beneficial use and off-site disposal quantities.

EXHIBIT 4-1. BASELINE FREQUENCY DISTRIBUTION OF FFC DISPOSAL PRACTICES BY DATA SOURCE (NUMBER OF PLANTS OUT OF 452)

Data Source	On-Site Landfill	On-Site Impound-ment	Sold for Beneficial Use	Off-Site Disposal (Landfill/ Minefill)	Comments
1998, 1999, and 2003 EIA Databases and 1995 EPRI Comanagement Survey: Number of plants with assumed landfill units (either on-site or off-site whichever is more economical) because no beneficial use or off-site disposal/minefill quantity is reported or the "total ash generation quantity" is more than twice the reported beneficial use and off-site landfill/minefill quantities.	88	0	---	— (included in 88)	A total of 150 plants were identified reporting no on-site landfills. (It should be noted that plants between 10 and 100 megawatts are not required to report their disposal practices in the 1998 and 1999 EIA 767 databases.) The following is a further breakdown of the 150 plants: 1) 85 plants reported no beneficial use or off-site disposal quantities. 2) 65 plants reported quantities of beneficial use or off-site disposal in either the 1998 or 2003 EIA Database or the 1995 EPRI survey. - 62 of the 65 plants have total generation quantities that are less than twice the total reported beneficial use or off-site disposal quantities. These plants are not assumed to possibly have on-site landfills. - 3 of the 65 plants have total generation quantities that are greater than twice the total reported beneficial use and off site disposal mass. This is too much quantity unaccounted for to remove from the analysis. These plants are assumed to landfill the excess generated waste.
TOTAL	290	180	258	84	
Number of plants with both on-site landfill and surface impoundment units	80		---	---	

Note: Several plants use more than one on-site or off-site disposal practice. Total number of plants with coal-fired boilers is 452.

For each of the 452 coal-fired utility plants identified, baseline FFC waste disposal practices were assigned controls using the following methodology. The results of this methodology are presented in Exhibit 4-2 for on-site landfills and Exhibit 4-3 for on-site surface impoundments.

1) If the plant reported controls in the 1995 EPRI Comanagement Survey or the 1994-2004 USWAG/DOE/EPA Survey, the stricter of these controls or state-specified controls are assumed for the baseline. The design and operation of commercial special waste, industrial, and municipal solid waste (MSW) are assumed to meet Subtitle D MSW landfill requirements.
2) Controls specified under state regulations are assumed for all other plants for the baseline if no 1995 EPRI Comanagement data or 1994-2004 USWAG/DOE/EPA data are available for that plant.
3) Finally, if no state-regulatory data on controls have been collected, no controls are assumed under baseline for on-site landfills and impoundments as a worse case assumption.

For 452 coal-fired utility plants, an estimated annualized baseline cost for the Baseline is estimated assuming a seven percent discount rate over a 50-year time horizon. Cost estimate assumptions are presented in Section 4.1.3.

As presented in Exhibit 4-4, the following controls were most commonly assumed in the baseline scenarios assigned to facilities utilizing landfills; capping (92% for new units, 79% for existing units), groundwater monitoring (94% for new units, 77% for existing units), and post closure monitoring (86% for new units, 75% for existing units). Exhibit 4-5 presents the distribution of baseline scenarios assigned to facilities utilizing surface impoundments. The most commonly assumed controls for surface impoundment facilities are groundwater monitoring (58% for new units, 46% for existing units), liner (54% for new units, 46% for existing units), and capping (43% for new units, 41% for existing units). Appendix D presents the environmental controls assumed for each landfill and surface impoundment included in the cost model.

EXHIBIT 4-2. BASELINE DISTRIBUTION OF FFC ON-SITE LANDFILL ENVIRONMENTAL CONTROLS (NUMBER OF PLANTS AND QUANTITY IN SHORT TONS)				
Current or State Regulated Environmental Controls	**New Unit Construction**		**Existing Units**	
	No. of Plants	**Quantity**	**No. of Plants**	**Quantity**
No Controls	14	1,542,433	40	2,947,897
150 Meter Groundwater Monitoring	4	1,591,426	4	1,591,426
Unit Boundary Groundwater Monitoring	0	0	5	1,177,444
Synthetic Liner, Unit Boundary Monitoring	1	10,500	0	0
Clay Liner, Soil Cap, 150 Meter Groundwater Monitoring	1	31,200	1	31,200
Clay/Soil Cap (Uncompacted)	1	111,100	1	111,100
Daily Cover, Dust Controls, 150 Meter Groundwater Monitoring	3	82,664	3	82,664
Daily Cover, Dust Controls, Run-on/Run-off Controls, Clay Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring	2	96,800	2	96,800
Daily Cover, Dust Controls, Run-on/Run-off Controls, Clay Liner, Leachate Collection System, Clay Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	12	1,510,013	12	1,510,013
Daily Cover, Dust Controls, Run-on/Run-off Controls, Clay Liner, Leachate Collection System, Synthetic Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	0	0	2	375,205
Daily Cover, Dust Controls, Run-on/Run-off Controls, Synthetic Liner, Leachate Collection System, Clay Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	27	1,851,876	19	1,401,902

Exhibit 4-2. Baseline Distribution of FFC On-Site Landfill Environmental Controls (Number of Plants and Quantity in Short Tons)				
Current or State Regulated Environmental Controls	**New Unit Construction**		**Existing Units**	
	No. of Plants	**Quantity**	**No. of Plants**	**Quantity**
Daily Cover, Dust Controls, Run-on/Run-off Controls, Synthetic Liner, Leachate Collection System, Soil Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	22	1,821,724	11	1,233,035
Daily Cover, Dust Controls, Run-on/Run-off Controls, Synthetic Liner, Leachate Collection System, Soil/Clay Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	9	3,152,914	5	2,721,531
Daily Cover, Dust Controls, Run-on/Run-off Controls, Synthetic Liner, Leachate Collection System, Synthetic Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring	8	371,645	7	316,245
Daily Cover, Dust Controls, Run-on/Run-off Controls, Synthetic Liner, Leachate Collection System, Synthetic Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	81	16,047,399	68	14,331,505
Daily Cover, Dust Controls, Synthetic Liner, Leachate Collection System, Synthetic Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	9	263,876	9	263,876
Daily Cover, Run-on/Run-off Controls, Clay Cap, 150 Meter Groundwater Monitoring, Post Closure Groundwater Monitoring	5	958,788	5	958,788
Daily Cover, Run-on/Run-off Controls, Clay Cap, Post Closure Groundwater Monitoring, Unit Boundary Groundwater Monitoring	1	8,128	1	8,128
Daily Cover, Run-on/Run-off Controls, Synthetic Liner, Leachate Collection System, Clay Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	2	1,015,773	2	1,015,773

Exhibit 4-2. Baseline Distribution of FFC On-Site Landfill Environmental Controls (Number of Plants and Quantity in Short Tons)				
Current or State Regulated Environmental Controls	**New Unit Construction**		**Existing Units**	
	No. of Plants	**Quantity**	**No. of Plants**	**Quantity**
Daily Cover, Run-on/Run-off Controls, Synthetic Liner, Leachate Collection System, Soil Cap, Unit Boundary Groundwater Monitoring, Financial Assurance	3	762,200	3	762,200
Daily Cover, Run-on/Run-off Controls, Synthetic Liner, Leachate Collection System, Soil Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	4	99,724	0	0
Daily Cover, Run-on/Run-off Controls, Synthetic Liner, Leachate Collection System, Synthetic Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring	5	817,200	5	817,200
Daily Cover, Run-on/Run-off Controls, Synthetic Liner, Leachate Collection System, Synthetic Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	14	8,119,619	4	2,622,481
Daily Cover, Synthetic Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	10	3,273,715	10	3,273,715
Dust Controls, Run-on/Run-off Controls, Clay Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring	10	231,303	10	231,303
Dust Controls, Run-on/Run-off Controls, Clay Liner, Leachate Collection System, Clay Cap, Unit Boundary Groundwater Monitoring, Financial Assurance	13	3,473,061	13	3,473,061
Dust Controls, Run-on/Run-off Controls, Synthetic Liner, Leachate Collection System, Clay Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	11	407,016	11	407,016
Dust Controls, Run-on/Run-off Controls, Synthetic Liner, Leachate Collection System, Synthetic Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	6	604,590	1	616

EXHIBIT 4-2. BASELINE DISTRIBUTION OF FFC ON-SITE LANDFILL ENVIRONMENTAL CONTROLS (NUMBER OF PLANTS AND QUANTITY IN SHORT TONS)				
Current or State Regulated Environmental Controls	**New Unit Construction**		**Existing Units**	
	No. of Plants	**Quantity**	**No. of Plants**	**Quantity**
Dust Controls, Synthetic Liner, Leachate Collection System, Synthetic Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	9	1,986,780	9	1,986,780
Dust Controls, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	0	0	5	603,974
Soil Cap, Post Closure Groundwater Monitoring, Financial Assurance	0	0	9	393,451
Synthetic Cap (Compacted), 150 Meter Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	1	666,511	1	666,511
Synthetic Cap, Post Closure Groundwater Monitoring, Financial Assurance	0	0	10	5,497,138
Total	288	50,909,978	288	50,909,978
Note: Several plants use both landfill and surface impoundment disposal practices. Volumes reported separately for off-site disposal and beneficial use are not included in this table.				

Exhibit 4-3. Baseline Distribution of FFC On-Site Surface Impoundment Environmental Controls (Number of Plants and Quantity in Short Tons)				
Current or State Regulated Environmental Controls	**New Unit Construction**		**Existing Units**	
	No. of Plants	**Quantity**	**No. of Plants**	**Quantity**
No Controls	61	7,184,900	76	10,316,999
150 Meter Groundwater Monitoring	3	2,261,601	3	2,261,601
Unit Boundary Groundwater Monitoring	2	329,300	2	99,500
Unit Boundary Groundwater Monitoring, Financial Assurance	1	16,500	1	16,500
Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring	8	649,500	8	649,500
Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	2	222,061	2	222,061
Clay Liner, Clay/Soil Cap, 150 Meter Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	1	102,000	1	102,000
Clay Liner, Leachate Collection System, Synthetic Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	1	7,300	0	0
Clay Liner, Soil Cap	5	942,400	5	942,400
Clay Liner, Soil Cap, 150 Meter Groundwater Monitoring	4	1,028,898	4	1,028,898
Clay Liner, Soil Cap, Unit Boundary Groundwater Monitoring	2	35,700	2	35,700
Synthetic Cap, Post Closure Groundwater Monitoring, Financial Assurance	5	941,700	5	941,700
Synthetic Liner	1	45,100	0	0
Synthetic Liner, 150 Meter Groundwater Monitoring	3	492,246	3	492,246

EXHIBIT 4-3. BASELINE DISTRIBUTION OF FFC ON-SITE SURFACE IMPOUNDMENT ENVIRONMENTAL CONTROLS (NUMBER OF PLANTS AND QUANTITY IN SHORT TONS)				
Current or State Regulated Environmental Controls	**New Unit Construction**		**Existing Units**	
	No. of Plants	**Quantity**	**No. of Plants**	**Quantity**
Synthetic Liner, Unit Boundary Groundwater Monitoring	5	385,600	0	0
Synthetic Liner, Leachate Collection System	4	345,600	4	345,600
Synthetic Liner, Leachate Collection System, Soil Cap, Post Closure Groundwater Monitoring, Financial Assurance	0	0	8	720,600
Synthetic Liner, Leachate Collection System, Soil Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	19	1,700,700	10	917,400
Synthetic Liner, Leachate Collection System, Synthetic Cap, 150 Meter Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	7	2,734,143	7	2,734,143
Synthetic Liner, Leachate Collection System, Synthetic Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	28	6,332,172	28	6,332,172
Synthetic Liner, Leachate Collection System, Unit Boundary Groundwater Monitoring	9	2,006,100	4	185,300
Synthetic Liner, Leachate Collection System, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring	3	706,900	1	126,100
Synthetic Liner, Leachate Collection System, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	1	59,200	1	59,200
Synthetic Liner, Soil Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	2	139,600	2	139,600
Synthetic Liner, Synthetic Cap, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	2	57,300	2	57,300

EXHIBIT 4-3. BASELINE DISTRIBUTION OF FFC ON-SITE SURFACE IMPOUNDMENT ENVIRONMENTAL CONTROLS (NUMBER OF PLANTS AND QUANTITY IN SHORT TONS)				
Current or State Regulated Environmental Controls	**New Unit Construction**		**Existing Units**	
	No. of Plants	**Quantity**	**No. of Plants**	**Quantity**
Synthetic Liner, Unit Boundary Groundwater Monitoring, Post Closure Groundwater Monitoring, Financial Assurance	1	49,100	1	49,100
Total	180	28,775,621	180	28,775,620
Note: Several plants use both landfill and surface impoundment disposal practices. Volumes reported separately for off-site disposal and beneficial use are not included in this table.				

EXHIBIT 4-4. BASELINE DISTRIBUTION OF FFC ON-SITE LANDFILL ENVIRONMENTAL CONTROLS (BY CONTROL)					
Current or State Regulated Environmental Control		**New Unit Construction**		**Existing Units**	
		No. of Plants	**Percent of Total Based on 290 LF Facilities**	**No. of Plants**	**Percent of Total Based on 290 LF Facilities**
No Controls		16	6%	42	14%
Groundwater Monitoring		272	94%	222	77%
Liner		237	82%	182	63%
Leachate Collection System		235	81%	181	62%
Cap	Synthetic or Clay	226	78%	201	69%
	Soil	30	10%	24	8%
	Clay/Soil	10	3%	6	2%
Financial Assurance		232	80%	211	73%
Daily Cover		217	75%	169	58%
Dust Controls		222	77%	182	63%
Run-on/Run-off Controls		235	81%	181	62%
Post Closure Monitoring		248	86%	218	75%

EXHIBIT 4-5. BASELINE DISTRIBUTION OF FFC ON-SITE SURFACE IMPOUNDMENTS ENVIRONMENTAL CONTROLS (BY CONTROL)					
Current or State Regulated Environmental Control		**New Unit Construction**		**Existing Units**	
		No. of Plants	**Percent of Total** **Based on 180 SI Facilities**	**No. of Plants**	**Percent of Total** **Based on 180 SI Facilities**
No Controls		61	34%	76	42%
Groundwater Monitoring		104	58%	82	46%
Liner		98	54%	83	46%
Leachate Collection System		72	40%	63	35%
Cap	Synthetic	43	24%	42	23%
	Soil	32	18%	31	17%
	Clay/Soil	1	1%	1	1%
Financial Assurance		70	39%	68	38%
Post Closure Monitoring		80	44%	76	42%

4.4 Cost Estimating Assumptions

The following subsections provide information regarding the assumptions used to derive cost estimates for the proposed regulation. Remedial Action Cost Engineering and Requirements (RACER) cost estimating software was utilized to estimate the costs.

4.4.1 Waste Management Unit Sizing Assumptions

Baseline and compliance cost estimates were developed utilizing unit cost data from engineering cost literature for five different landfill and impoundment sizes which represent the range of FFC waste management unit capacities. The tables below present the ash generation and area sizes assumed for the five different management unit sizes. Of note are the large impoundment areas because they are constructed below grade. Landfills can be constructed above grade in a combination fill or a pile design creating a smaller foot print area.

Landfill (Combination Fill Design) Model Sizes (50% of Capacity Below Grade)			
Bulk Tons/Year	Uncompacted No Daily Cover	Compacted No Daily Cover	Compacted With Daily Cover
10,000	14 acres	12 acres	12 acres
50,000	68 acres	55 acres	56 acres
200,000	264 acres	212 acres	217 acres
500,000	655 acres	525 acres	535 acres
2,000,000	2,597 acres	2,080 acres	2,122 acres

Landfill (Pile Design) Model Sizes (5% of Capacity Below Grade)			
Bulk Tons/Year	Uncompacted No Daily Cover	Compacted No Daily Cover	Compacted With Daily Cover
10,000	19 acres	16 acres	16 acres
50,000	97 acres	78 acres	79 acres
200,000	387 acres	310 acres	316 acres
500,000	967 acres	773 acres	789 acres
2,000,000	3,865 acres	3,092 acres	3,155 acres

Surface Impoundment Model Sizes (100% of Capacity Below Grade)	
Bulk Tons/Year	In-Situ Wet No Daily Cover
10,000	30 acres
50,000	141 acres
200,000	555 acres
500,000	1,378 acres
2,000,000	5,480 acres

In sizing the excavation, ash is assumed to be disposed 300 days per year. The unit operating life is assumed to be 40 years for both landfills and impoundments (based on available data reported by industry). The compacted dry waste density is assumed to be 1,190 kg/m^3; the in-situ wet waste density is assumed to be 900 kg/m^3; and a compaction factor of 1.25 to convert bulk waste volumes to compacted waste volumes is assumed. The depth of fill below grade is assumed to be 15 feet for combination fill landfills and surface impoundments and 1 foot for pile-design landfills. The amount of fill below grade is assumed to be 50% for combination fill landfills, 5% for pile-design landfills, and 100% for surface impoundments. A below grade side slope of 3:1 (rise:run) is assumed.

As a simplifying assumption to the cost estimating methodology and given that costs are being developed by adapting the Monofill Cost model developed to support proposed cement kiln dust rulemakings, the unit is assumed to have one construction phase (i.e., one large cell or monofill). Technically, the landfill unit controls (as opposed to a surface impoundment unit) likely are constructed in several phases (e.g., one cell per year).

4.4.2 Groundwater and Surface Water Sampling Design Assumptions

Immediate compliance of monitoring requirements for all surface impoundment and landfill units is assumed to be effective when the proposed rule becomes final in 2006. Post closure monitoring is assumed to continue for 30 years.

In the cost model, all groundwater monitoring wells are sampled semi-annually for indicator (pH, conductivity, total dissolved solids, potassium, chloride, sodium, and sulfate) and primary and secondary MCL metal (Al, Cu, Fe, Mn, Ag, Zn, Sb, As, Ba, Be, Cd, Cr, Pb, Hg, Se, Tl) parameters, $1,150/sample (2005$)[57].

For *Unit Boundary Monitoring,* two wells are assumed for the first 800 feet plus additional wells spaced 400 feet apart along two sides of unit, which is assumed to be square. In addition, one upgradient well is assumed. $[(2 \times (\text{acres} \times 43{,}560\ \text{sf/acre})^{0.5} - 800)/400 + 3]$

For *150 Meter Monitoring*, two wells are assumed for the first 800 feet plus additional wells spaced 400 feet apart, 150 meters away from two sides of unit, which is assumed to be square. In addition, one upgradient well is assumed. $[(2 \times [(\text{acres} \times 43{,}560\ \text{sf/acre})^{0.5} + (2)(150\ \text{m})/(0.3048\ \text{m/ft})] - 800)/400 + 3]$

Surface water sampling is assumed to be conducted semi-annually at two locations for indicator

[57] Costs were inflated from 2002$ using the Department of Energy Departmental Price Change Index FY 2003 Guidance.

and metal parameters, $1,150/sample (2005$)[58].

Groundwater monitoring results are assumed to be reported to a state regulatory agency after each sampling event, once every six months. Reporting is assumed to include review, reduction, and graphic presentation of the analytical data. Reporting cost is composed of labor for a project scientist, a field technician, CADD professional, and clerical assistance. For each sample, one hour of project scientist labor and 0.5 hours each of field technician, CADD professional, and clerical assistance time is estimated for a total cost of $200/sample (2005$)[59].

Theoretically, monitoring wells do not experience degradation or require upkeep and maintenance; however, damage can occur from outside sources such as earth shifts and heavy equipment. Wells damaged to a significant degree that render them unusable will require the removal of the casing and concrete pad, and grouting of the boring to prevent preferential drainage or contaminant access to the water table. A new monitoring well is assumed to be constructed in a nearby location to the previously removed monitoring well. To account for potential damage to monitoring wells, 25 percent of the total number of wells for the unit are assumed to be replaced every 20 years. For example, a 10,000 ton per year pile landfill design consists of 12 wells in a unit boundary point-of-compliance scenario. Of the 12 wells, 3 wells will be replace over a 20 year period. A minimum of one well is assumed replaced at a time. A cost of $870/well (2005$)[60] is estimated, including costs for field labor, demolition and disposal of the well pad, and grouting of the boring.

The list below presents a summary of cost estimate assumptions. Exhibit 4-6 list the unit costs used to develop the cost estimate.

- The unit is assumed to be square.
- One well is installed upgradient of the unit.
- Monitoring wells are assumed to be installed along the length of two down-gradient sides of the unit. Two wells are assumed to be installed for the first 800 feet of length. Additional wells are added with each additional 400 feet of length.
- The wells are assumed to be installed 150 meters from the unit boundary.
- The sampling and analytical costs for the parameters selected in the Cement Kiln Dust

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[58] Costs were inflated from 2002$ using the Department of Energy Departmental Price Change Index FY 2003 Guidance.

[59] Costs were inflated from 2002$ using the Department of Energy Departmental Price Change Index FY 2003 Guidance.

[60] Costs were inflated from 2002$ using the Department of Energy Departmental Price Change Index FY 2003 Guidance.

proposed rule and metal parameters from the National Primary and Secondary Drinking Water Standards are used for FFC sampling, until final specifications are determined. Analytical costs were estimated using 2003 RACER cost estimating software and inflated to 2005$. Groundwater monitoring wells are sampled semi-annually for pH, conductivity, total dissolved solids, potassium, chloride, sodium, sulfate, primary and secondary MCL metals.

- Surface water sampling is assumed to be conducted semi-annually at two locations for the above specified parameters.
- For new unit construction, the most economical choice between on-site landfill (pile-design or combination fill design), off-site commercial Subtitle D type landfill, or on-site surface impoundment is selected.
- Well replacement is assumed for 25% of the unit total well count every 20 years.

Exhibit 4-6. Groundwater Monitoring Unit Costs

Unit Cost Description	Unit Cost ($2005)
Groundwater Monitoring Well Installation	$5,433/well + $6,332 for equipment mobilization
Groundwater Monitoring Well Removal	$870/well
Monitoring: Groundwater Surface Water	$1,150/per sample ($947 sampling and analysis, $204 reporting)
Engineering Fee	10% (< $1 million DCC) 7.5% ($1 to $5 million DCC) 5% (> $5 million DCC)
Inspection and Testing Fee	5%
Contingency	10%
RACER Markups	
General Conditions (professional labor, craft labor, materials, and equipment markups)	<$10,000: 25%, 25%, 17%, 40% $10,000 to $25,000: 15%, 20%, 12%, 30% $25,000 to $50,000: 10%, 17.5%, 10%, 20% $50,000 to $100,000: 7.5%, 15%, 8%, 15% $100,000 to $250,000: 5%, 12%, 6.5%, 10% $250,000 to $500,000: 5%, 10%, 5%, 8% >$500,000: 5%, 8%, 5%, 6%
Overhead (professional labor, craft labor, materials, and equipment markups)	160%, 30%, 8%, 8%
Profit (sub profit and prime profit)	8.5%

Exhibit 4-6. Groundwater Monitoring Unit Costs	
Unit Cost Description	**Unit Cost ($2005)**
Prime Markup	3.5%
Owner Costs	5%
Discount Rate	7%
Debt Life	40 years
Interest Rate	7%

DCC: Total Direct Capital Costs

4.4.3 Liner Design Assumptions

A synthetic liner for a *landfill or pile* is comprised of 2 feet of off-site clay, a 60 mil HDPE synthetic liner, 1 foot sand (leachate collection), and filter fabric. Liner costs would be lower if on-site clay is available.

A synthetic liner for a *surface impoundment* is comprised of 2 feet off-site clay, 1 foot sand (leachate detection/collection), and 60 mil HDPE synthetic liner. Liner costs would be lower if on-site clay is available.

A clay liner for a *landfill, pile, or surface impoundment* is comprised of 2 feet of off-site clay. Liner costs would be lower if on-site clay is available.

An ash liner for a *landfill, pile, or surface impoundment* is comprised of 2 feet of ash available on site. The ash is assumed to be available on site.

4.4.4 Leachate Collection System and Treatment Design Assumptions

A leachate collection system for a *landfill or pile* is assumed to collect three inches of leachate per year (based on the Subtitle D Municipal Landfill Cost Model default value) in perforated collection pipes spaced approximately 300 feet apart along the base of the unit. It includes a wet well for leachate collection. Leachate is shipped off site by truck for off-site treatment. A leachate detection system is not included. The leachate collection system is designed to maintain a leachate level less than 30 centimeters above the liner. The leachate is treated using carbon dioxide neutralization and discharged to the local sewer system under a NPDES permit. The leachate treatment system includes a carbon dioxide storage vessel, vaporization unit, controls systems, and operational labor. The leachate collection treatment system is operated for a period of thirty years after unit closure.

A leachate collection/detection system for a *surface impoundment* is comprised of perforated collection pipes spaced approximately 300 feet apart along the base of the unit. It includes a wet well for leachate collection. No leachate is assumed to be collected below the 60 mil HDPE synthetic liner.

4.4.5 Cap Design Assumptions

A synthetic cap with drainage layer is comprised of a 60 mil HDPE synthetic liner, 1 foot sand, filter fabric, 1.5 foot slope and earth fill, 0.5 foot topsoil, and vegetation. It includes a perforated pipe for drainage collection.

A synthetic cap without drainage layer is comprised of a 60 mil HDPE synthetic liner, 1.5 foot slope and earth fill, 0.5 foot topsoil, and vegetation.

A clay cap is comprised of 2 feet of off-site clay, 0.5 foot topsoil, and vegetation. Cover costs would be lower if on-site clay is available.

A soil/clay cover is comprised of 0.5 foot clay, 0.5 foot earthfill, and 0.5 foot topsoil, and vegetation. Cover costs would be lower if on-site clay is available.

A soil cap is comprised of a 1.5 foot slope and earth fill, 0.5 foot topsoil, and vegetation.

The slope of the cap is assumed to be 0.02:1 (rise:run) with a cover toe slope of 4:1 (run:rise).

4.4.6 Surface and Dust Control Design Assumptions

No visual berm or flood protection berm is assumed. Stormwater control is comprised of a ditch surrounding active area of landfill and an excavated bermed basin for water collection.

Daily cover for landfills and piles is comprised of slope and earth fill assumed to be 2 percent of the unit volume (Subtitle D Municipal Landfill Cost Model default value).

Dust controls for landfills and piles with compaction equipment, water trucks, and covers on trucks are based on cost equations developed for Cement Kiln Dust rule, with modified waste density (see Appendix A for additional assumptions).

4.4.7 Post-Closure Groundwater Monitoring Assumptions

Post-closure is comprised of 30 years of groundwater monitoring and surface water monitoring on a semi-annual basis. The unit costs assumptions are the same as those presented above.

Post-closure monitoring costs are estimated assuming an annual sum is placed in a fund during the 40-year operating life of the disposal unit. At the time of closure sufficient monies will be available in the fund to cover post-closure monitoring for the next 30 years assuming an interest rate of seven percent.

4.4.8 Waste Handling

Waste handling is comprised of conveyance, storage, conditioning (e.g., addition of water or dewatering for handling), filling, grading, loading, and hauling. Conveyance, storage, and conditioning include capital and operation costs for wet or dry conveyors, silo storage, water towers, pelletizing, and dewatering. The costs included are dependent on the form (i.e., wet or dry) of the fly ash, bottom ash, and FGD. Compaction includes costs for, at a minimum, one self-propelled sheepsfoot roller and a water truck. Loading and hauling ash an estimated distance of one mile for disposal. Costs include vehicle, equipment, and labor.

4.4.9 Financial Assurance Assumptions

Capital cost includes selection of financial assurance mechanism, establishment of financial test, and establishment of letter of credit. The letter of credit is assumed to be the most available to the utilities will be utilized in most circumstances. Annual cost includes maintenance of financial test and maintenance of letter of credit.[61] The establishment and annual maintenance of the letter of credit is estimated to be 1.5 percent of the nominal value of the letter of credit. The implementation costs are estimated on the assumption that an outside consulting firm and legal assistance will be retained to assist in obtaining and maintaining the letter of credit.

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[61] Cost estimates obtained from U.S. EPA, Estimating Costs for the Economic Benefits of RCRA Noncompliance, September 1997.

4.4.10 Off-Site Landfill Disposal Assumptions

Off-site landfill disposal unit costs are from the March 2000 Remedial Market Report published by Chartwell. Average unit costs are listed for each state and include costs from disposal of contaminated soil in landfills and dumps. The Rhode Island unit cost is based on the average of Connecticut and Massachusetts. The Washington D.C. unit cost is based on the average of Virginia and Maryland. These costs reflect March 2000 landfill market conditions.

Off-site disposal unit costs also include transportation and loading costs of $27.82 per load based on a 20 cubic yard load and a 200 mile round trip. The cost is based on an Racer 2000 software estimate inflated to 2005$ using the Department of Energy Departmental Price Change Index FY 2003 Guidance. Regional factors, discussed below, are applied to the loading and hauling cost.

4.4.11 Limitations

The following costs are not included:

- Preconstruction studies, designs, and plans;
- Permitting, legal, and siting expenses (e.g., EIS preparation, public participation, etc.);
- Closure/post-closure plans;
- Closure certification;
- No taxes/trans-state fees are included in off-site disposal costs;
- Off-site disposal costs are assumed not to be effected by this rule and remain constant; and
- Cost savings for sale or beneficial use of FFC wastes.

The data used in the cost model were obtained from sources with data from the mid to late 1990's. Coal usage, percent ash content, and ash, flue gas desulfurization sludge, and gypsum quantity data were obtained from the 1998 EIA 767 and 1999 EIA 759 databases. Disposal practices primarily were identified using the 1998 EIA 767 database supplemented by the 1997 EPRI Comanagement Survey (that contains 1995 data). New generation data through 2003 is available. The model assumes an annual generation increase of 1 percent per year to approximate the increase of generation capacity over time; however, the cost model is currently programmed to only increase generation starting in year 2005.

Many of the cost model costs are based on unit costs developed in 1995. The cost model utilizes cost equations generated from the Agency’s cost model to develop Subtitle D landfill design requirements. These costs are inflated 10 years using inflation factors developed by the Department of Energy; however, inflation of these unit costs does not fully account for changes in market conditions for equipment and labor.

Only 34 State regulatory environments were reviewed to determine controls regarding landfilling or surface impoundment units. The remaining states may have regulatory controls that are not captured in the cost model.

The assignment of controls in karst areas for Performance Standard Option 1 was completed using general areas rather than facility or site specific data for the disposal units. Facilities may be located in general karst regions but not have karst features near the disposal unit.

4.4.12 Cost Accounting Assumptions

Costs are annualized on a before-tax basis assuming a discount rate of 7 percent. Curve-fit equations were calculated based on the annualized, discounted costs for five model facility sizes for each environmental control option. Appendix E presents the annualized cost equation developed for each environmental control option.

Regional cost adjustment factors are applied to each plant cost estimate involving on-site construction. These regional factors account for the variability between states in site work and landscape construction costs. Cost adjustment factors are derived from the Means Building Construction Costs Year 2003 city factors. All the cities for each state were averaged together to derive a state average.

4.5 Corrective Action Cost Estimates

Plants may potentially be required to address releases of constituents from FFC waste landfills and surface impoundments. The 11 damage cases identified as of December 2000 involve both aboveground and below ground releases. Remedial action information collected for these damage cases include:

- The Faulkner Landfill, Basin Electric Surface Impoundment and Don Frame Trucking Landfill sites involved early closure and capping.
- The Chisman Creek site involved capping, groundwater remediation, and provision of alternative water supplies.
- The Possum Point Pond involved separation of wastes.
- The Old E.J. Stoneman site included early closure of the site and provision of alternative water supplies.
- The Clinch River site involved relying upon natural attenuation.

- The Cedar Sauk Landfill involved installation of a clay cap and groundwater remediation.
- The Coal Creek Station Impoundment involved relining the ponds.
- The Nelson Dewey Impoundment resulted in early closure of the impoundment and conversion to dry ash disposal.
- The WEPCO landfill involved extensive groundwater monitoring.

4.5.1 Debt Payments on Closed Landfill and Surface Impoundment Units

Based on the above damage case, corrective action cost estimates were developed for early closure and construction of a synthetic cap, slurry wall, and/or groundwater remediation system. As a result of early closure, the plant loses the benefits gained from capital expenses sunk into the construction of the landfill or surface impoundment. The plant may need to continue paying all or a portion (if the unit was construction in phases) of its annual payments on the borrowed capital (debt) over the remainder of the borrowing period. The borrowing period is assumed to be 40 years based on the typical life of these units.

Assuming an average-sized on-site landfill of 176,771 tons per year with uncompacted ash and unit boundary monitoring, the annualized before-tax capital cost for early closure is estimated at $4.5 million per year using linear interpolation of the estimates presented in Exhibit 4-5a. The total net present value capital cost is $42.9 million. Similarly, assuming an average-sized on-site surface impoundment of 159,865 tons per year with unit boundary monitoring, the annualized before-tax capital cost for early closure is estimated at $8.6 million per year or a total present value capital cost of $81.9 million (Exhibit 4-5b).

4.5.2 Corrective Action - Remediation Costs

The three corrective action cost estimates below include costs for conducting a hydrogeologic study and a corrective measures study:

1.) One corrective action option is to *construct a cap* over the unit to prevent further releases along above ground pathways and further infiltration through the ash to groundwater. Corrective action cost estimates were developed for constructing a synthetic cap. The number of monitoring wells is assumed to be equivalent to the calculated number of unit boundary monitoring wells. Some of these wells will be pre-existing and some will be newly constructed during the hydrogeologic study and part of the cost of the study. The well depth is assumed to be 30 feet. Semi-annual sampling for metals for 30 years is assumed.

Assuming an average-sized on-site landfill of 176,771 tons per year with uncompacted ash and unit boundary monitoring, the annualized before-tax capital cost for a synthetic cap is estimated at $3.7 million per year over a 30-year remediation (borrowing) period using linear interpolation of the estimates presented in Exhibit 4-5a. The total net present value is $33.8 million. Similarly, assuming an average-sized on-site surface impoundment of 159,865 tons per year with unit boundary monitoring, the annualized before-tax capital cost for a cap is estimated at $6.8 million per year or total present value cost of $63.6 million (Exhibit 4-5b).

2.) A second corrective action option is to *construct a slurry wall surrounding the unit in addition to the cap* to prevent any further migration of contaminants via groundwater. Corrective action cost estimates were developed for constructing a synthetic cap and a bentonite slurry wall encircling the unit. A 70 percent probability was assigned to a 20-foot deep slurry wall and a 30 percent probability was assigned to a 50-foot deep wall. The groundwater monitoring assumptions are the same as those described above in the first corrective action option.

Assuming an average-sized on-site landfill of 176,771 tons per year with uncompacted ash and unit boundary monitoring, the annualized before-tax capital cost a cap and slurry wall is estimated at $4.0 million per year over a 30-year remediation (borrowing) period using linear interpolation of the estimates presented in Exhibit 4-5a. The total net present value is $35.4 million. Similarly, assuming an average-sized on-site surface impoundment of 159,865 tons per year with unit boundary monitoring, the annualized before-tax capital cost for a cap and slurry wall is estimated at $7.2 million per year or total present value cost of $65.7 million (Exhibit 4-5b).

3.) A third corrective action option is to *install groundwater remediation (pump and treat) in addition to the cap* to prevent any further migration of contaminants via groundwater. Corrective action cost estimates were developed for constructing a synthetic cap and a groundwater pump and treat system. A 70 percent probability was assigned to a 20-foot deep collection well, a 10 percent probability was assigned to a 100-foot deep collection well and a 20 percent probability of installing a shallow french drain system. The number of extraction wells is assumed to be equal the half the number of estimated unit boundary monitoring wells. The french drain system is assumed to be operated on two sides of the disposal unit. A 50 percent probability is assigned to a 5 gallon per minute (gpm) per well collection rate and a 50 percent probability is assigned to a 10 gpm per well collection rate. Metals precipitation is the assumed groundwater treatment technology. It is assumed that 5 percent of the flow rate entering the metals precipitation unit will exit as precipitant and go to a dewatering unit. It is assumed that 20 percent of the quantity being dewatered will become sludge to be transported 200 miles off site to a non-hazardous Subtitle D landfill for industrial waste. The operating duration of the pump and treat system is assumed to be 30 years. The groundwater monitoring assumptions are the same as those described above in the first corrective action option.

> Assuming an average-sized on-site landfill of 176,771 tons per year with uncompacted ash and unit boundary monitoring, the annualized before-tax capital cost is estimate at $4.2 million per year over a 30-year remediation (borrowing) period using linear interpolation of the estimates presented in Exhibit 4-5a. The total net present value is $34.2 million. Similarly, assuming an average-sized on-site surface impoundment of 159,865 tons per year with unit boundary monitoring, the annualized before-tax capital cost is estimated at $7.5 million per year or total present value cost of $64.2 million (Exhibit 4-5b).

Annualized before-tax present value corrective action costs are presented in Exhibit 4-5c. Annualized corrective action costs for an average-sized on-site landfill are anticipated to range between $8.2 and $8.7 million per year depending on the corrective action remedy and including the lost benefit from the sunk capital costs expended constructing the landfill. Annualized costs reduce to between $4.2 million and $5.3 million per year after the sunk capital costs have been paid off for the construction of the closed landfill.

Annualized before-tax present value corrective action costs for an average-sized on-site surface impoundment are anticipated to range between $15.4 and $16.1 million per year depending on the corrective action remedy and including the lost benefit from the sunk capital costs expended constructing the surface impoundment. Annualized costs reduce to between $6.8 million and $7.8 million per year after the sunk capital costs have been paid off for construction of the impoundment.

Total present value corrective action costs are presented in Exhibit 4-5d for four different closure dates (6, 16, 26, and 36 years from today) to reflect potential retirement schedules. Corrective action costs for an average-sized on-site landfill are anticipated to range between $53.5 and $99.5 million depending on the date of closure and corrective action remedy and including the lost benefit from the sunk capital costs (debt payments) expended from constructing the landfill.

Total present value corrective action costs for an average-sized on-site surface impoundment are anticipated to range between $100.7 and $184.0 million depending on the closure date and corrective action remedy and including the lost benefit from the sunk capital costs expended constructing the landfill.

An estimate of the number of future corrective actions has yet to be predicted by the Agency. Total corrective action costs cannot be calculated until this estimate is established.

Exhibit 4-7a. Corrective Action Cost Estimates for Landfills (2004 dollars)

tons/year	10,000	50,000	200,000	500,000	2,000,000
acres	14.45	67.87	264.47	654.77	2597.1
Continue payment of bank loan for early closure: uncompacted landfill with unit boundary monitoring (1a)					
Total Capital Cost	$2,689,098	$124,630,310	$48,896,458	$121,453,437	$483,241,186
Annualized Before-Tax Capital Cost (40 yr life)	$281,753	$1,305,543	$5,123,183	$12,725,423	$50,632,150
Present Value Capital Cost, Closure in Year 6	$3,648,050	$16,903,747	$66,333,289	$164,764,610	$655,568,483
Present Value Capital Cost, Closure in Year 16	$3,283,436	$15,214,258	$59,703,434	$148,296,778	$590,045,969
Present Value Capital Cost, Closure in Year 26	$2,566,185	$11,890,776	$46,661,506	$115,902,060	$461,153,266
Present Value Capital Cost, Closure in Year 36	$1,155,244	$5,352,985	$21,006,060	$52,176,748	$207,601,811
Corrective Action: Synthetic Cap (CA1)					
Total Capital Cost	$2,351,941	$10,144,546	$38,795,636	$95,373,376	$374,686,042
Annual Cost	$28,027	$64,292	$153,869	$290,950	$850,011
Annualized Before-Tax PV Cost (30 yrs O&M)	$277,537	$1,134,271	$4,235,652	$10,315,809	$40,201,672
Present Value Cost (30 yrs O&M)	$2,699,726	$10,942,347	$40,705,004	$98,983,785	$385,233,864
Corrective Action: Synthetic Cap and Slurry Wall (CA2)					
Total Capital Cost	$3,013,435	$11,557,623	$41,567,927	$99,725,382	$383,336,010
Annual Cost	$76,835	$170,071	$362,678	$619,502	$1,504,353
Annualized Before-Tax PV Cost (30 yrs O&M)	$401,023	$1,399,742	$4,757,900	$11,136,489	$41,834,302
Present Value Cost (30 yrs O&M)	$3,966,885	$13,668,039	$46,068,410	$107,412,811	$402,003,585
Corrective Action: Synthetic Cap and Pump & Treat (CA3)					
Total Capital Cost	$2,895,321	$10,897,549	$39,948,955	$96,960,659	$377,426,117
Annual Cost	$279,815	$513,298	$991,230	$1,547,823	$3,223,332
Annualized Before-Tax PV Cost (30 yrs O&M)	$613,955	$1,711,564	$5,285,963	$11,877,248	$43,123,153
Present Value Cost (30 yrs O&M)	$6,367,553	$17,267,084	$52,249,171	$116,167,664	$417,424,579

Exhibit 4-7b. Corrective Action Cost Estimates for Surface Impoundments (2004 dollars)					
tons/yr	10,000	50,000	200,000	500,000	2,000,000
acres	29.52	141.26	554.89	1377.93	5479.82
Costs for Continued Payment of Bank Loan Associated with Early Closure: Design is a surface impoundment with unit boundary monitoring (1a)					
Total Capital Cost	$5,502,663	$26,040,265	$102,874,120	$256,083,211	$1,020,678,434
Annualized Before-Tax Capital Cost (40 yr life)	$579,548	$2,728,399	$10,778,754	$26,831,412	$106,942,754
Present Value Capital Cost, Closure in Year 6	$7,464,953	$35,326,411	$139,559,775	$347,404,334	$1,384,659,737
Present Value Capital Cost, Closure in Year 16	$6,718,848	$31,795,620	$125,611,106	$312,682,095	$1,246,266,282
Present Value Capital Cost, Closure in Year 26	$5,251,148	$24,850,020	$98,171,965	$244,378,196	$974,025,409
Present Value Capital Cost, Closure in Year 36	$2,363,960	$11,186,973	$44,195,020	$110,014,088	$438,486,407
Corrective Action Costs for Design 1: Synthetic Cap (CA1)					
Total Capital Cost	$4,554,761	$20,665,388	$80,335,253	$198,758,952	$786,660,746
Annual Cost	$40,809	$98,858	$241,870	$473,140	$1,444,396
Annualized Before-Tax PV Cost (30 yrs O&M)	$522,528	$2,273,925	$8,685,695	$21,350,383	$84,026,562
Total Present Value Cost (30 yrs O&M)	$5,061,157	$21,882,123	$83,336,634	$204,630,169	$804,584,316
Corrective Action Costs for Design 2: Synthetic Cap and Slurry Wall (CA2)					
Total Capital Cost	$5,492,685	$22,686,220	$84,342,998	$205,064,356	$799,217,518
Annual Cost	$110,571	$251,464	$544,328	$949,762	$2,394,877
Annualized Before-Tax PV Cost (30 yrs O&M)	$698,236	$2,656,099	$9,441,338	$22,540,089	$86,397,246
Total Present Value Cost (30 yrs O&M)	$6,864,759	$25,806,642	$91,097,580	$216,849,992	$828,935,645
Corrective Action Costs for Design 3: Synthetic Cap and Pump & Treat (CA3)					
Total Capital Cost	$5,199,286	$21,606,188	$81,823,133	$200,874,845	$790,445,633
Annual Cost	$393,164	$742,153	$1,400,628	$2,241,992	$4,835,747
Annualized Before-Tax PV Cost (30 yrs O&M)	$981,173	$3,087,603	$10,127,810	$23,535,504	$88,187,528
Total Present Value Cost (30 yrs O&M)	$10,078,070	$30,815,599	$99,203,585	$228,695,817	$850,452,617

Exhibit 4-7c. Average Annualized Corrective Action Cost Estimates per Facility (2004 dollars)				
		Cap	**Cap + Slurry Wall**	**Cap + Pump & Treat**
Total On-Site Landfill Disposal (tons/yr)	50,909,978			
Baseline Facilities (Number of Landfills)	288			
Average On-Site Landfill Disposal (tons/yr)	176,771	$8,153,870	$8,456,474	$8,711,308
Total On-Site Impoundment Disposal (tons/yr)	28,775,620			
Baseline Facilities (Number of Impoundments)	180			
Average On-Site Impoundment Disposal (tons/yr)	159,865	$15,413,208	$15,811,238	$16,082,973
Number of Baseline Facilities Operating Both a Landfill and Impoundment	78			

Note: Cost estimates include continuing payment of bank loan for disposal unit capital costs assuming 40 years of remaining life.

Exhibit 4-7d. Average Present Value Corrective Action Cost Estimates for Landfills and Surface Impoundments with Early Closure

Average Present Value Corrective Action Cost Estimates per Facility (2004 dollars), Closure in Year 6 of 40 Years

		Cap	Cap + Slurry Wall	Cap + Pump & Treat
Total On-Site Landfill Disposal (tons/yr)	50,909,978			
Baseline Facilities (Number of Landfills)	288			
Average On-Site Landfill Disposal (tons/yr)	176,771	$93,325,765	$96,434,238	$99,476,716
Total On-Site Impoundment Disposal (tons/yr)	28,775,620			
Baseline Facilities (Number of Impoundments)	180			
Average On-Site Impoundment Disposal (tons/yr)	159,865	$176,584,123	$180,672,848	$183,973,570
Baseline Facilities with Landfill and Impoundment				

Average Present Value Corrective Action Cost Estimates per Facility (2004 dollars), Closure in Year 16 of 40 Years

		Cap	Cap + Slurry Wall	Cap + Pump & Treat
Total On-Site Landfill Disposal (tons/yr)	50,909,978			
Baseline Facilities (Number of Landfills)	288			
Average On-Site Landfill Disposal (tons/yr)	176,771	$87,503,685	$90,612,157	$93,654,635
Total On-Site Impoundment Disposal (tons/yr)	28,775,620			
Baseline Facilities (Number of Impoundments)	180			
Average On-Site Impoundment Disposal (tons/yr)	159,865	$165,481,127	$169,569,852	$172,870,574
Baseline Facilities with Landfill and Impoundment	78			

Exhibit 4-7d. Average Present Value Corrective Action Cost Estimates for Landfills and Surface Impoundments with Early Closure (Continued)

Average Present Value Corrective Action Cost Estimates per Facility (2004 dollars), Closure in Year 26 of 40 Years

		Cap	Cap + Slurry Wall	Cap + Pump & Treat
Total On-Site Landfill Disposal (tons/yr)	50,909,978			
Baseline Facilities (Number of Landfills)	288			
Average On-Site Landfill Disposal (tons/yr)	176,771	$76,050,770	$79,159,243	$82,201,721
Total On-Site Impoundment Disposal (tons/yr)	28775620			
Baseline Facilities (Number of Impoundments)	180			
Average On-Site Impoundment Disposal (tons/yr)	159865	$143,639,854	$147,728,579	$151,029,302
Baseline Facilities with Landfill and Impoundment	78			

Average Present Value Corrective Action Cost Estimates per Facility (2004 dollars), Closure in Year 36 of 40 Years

		Cap	Cap + Slurry Wall	Cap + Pump & Treat
Total On-Site Landfill Disposal (tons/yr)	50,909,978			
Baseline Facilities (Number of Landfills)	288			
Average On-Site Landfill Disposal (tons/yr)	176,771	$53,521,154	$56,629,627	$59,672,105
Total On-Site Impoundment Disposal (tons/yr)	28,775,620			
Baseline Facilities (Number of Impoundments)	180			
Average On-Site Impoundment Disposal (tons/yr)	159,865	$100,674,765	$104,763,490	$108,064,212
Baseline Facilities with Landfill and Impoundment	78			

Note: Cost estimates include continuing payment of bank loan for disposal unit capital costs assuming four different closure dates (and durations of remaining disposal unit life).

4.6 Cost Model Assumptions

Estimated annual incremental compliance costs are allocated across a 50-year time horizon in the cost model developed for this analysis. The timing of when baseline state regulatory requirements for newly constructed units begin to be incurred depends on the installation and closure date the disposal units. Baseline state regulatory cost requirements are incurred at the closure date of the disposal unit when new unit construction occurs. For example, if a plant's disposal unit closes in 2019, new unit construction costs required under state regulations are incurred from 2020 to 2049. A total net present value cost estimate for each plant is calculated for the 50 years of costs assuming a seven percent discount rate. Subsequently, an annual compliance cost for each plant is estimated by annualizing the total net present value cost estimate over a 50-year time horizon assuming a seven percent discount rate. A 50-year time horizon was chosen because new construction for replacement of all disposal units is estimated to have occurred by that time.

One set of years for the opening and closure of disposal units are assumed for each facility. If data for initial year of operation were provided for the facility disposal units in the 1995 EPRI Comanagement Survey or 1994-2004 USWAG/DOE/EPA Survey, these data were used. If the plant had more than one disposal unit and more than one reported date for initial year of operation, the dates were averaged. For example, if a facility had three disposal units (2 landfills and 1 surface impoundment) with installation dates of 1970, 1980, and 1990, the model assumed the installation date of all the units was 1980. This assumption was used as a simplifying procedure, to perform the cost calculations on a per facility basis instead of a per disposal unit basis. If no disposal unit installation data were available, the installation date is assumed to be equal to the earliest boiler installation date reported in the 1998 EIA 767 database for that plant. If no disposal unit or boiler installation year data were available, an installation year of 1980 was assumed reflecting a disposal unit being half-way through its expected 40-year life.

If a closure date of the unit was provided in the 1995 EPRI Comanagement Survey, this date was used for when a new unit will be installed. Otherwise, if no closure year is provided, closure is assumed to occur 40 years after the year of installation.

The baseline design for the facilities is the current or future state regulatory controls or, if more stringent, the current regulatory controls in place by the facility. The incremental cost is the federal regulatory controls cost above the baseline. The incremental cost is set to zero in the cost model if the baseline cost is greater than the assumed federal regulation.

For landfills, the most economic of three landfill options, dug (i.e., combination landfill with 50% of waste below ground and 50% above ground), pile (i.e., 5 % of waste below ground and 95% above ground), or offsite is determined within the cost model. The cost for the most economical approach is assigned to that plant unless available data specify otherwise. The economic choice is dependent upon on the level of controls and the annual disposal rate.

If a surface impoundment is currently used as a disposal unit, a landfill is assumed to be used as the future disposal unit because they are more economical to construct if no pre-existing depressions are available to use and excavation is necessary. If beneficial use (sale) and off-site disposal are reported in the baseline, this practice is assumed to continue in the future.

Gypsum, bottom ash, and fly ash quantities, are assumed to be disposed in the same landfill or surface impoundment unit within the cost model. Unit cost estimates are based on the summed quantity.

Cost estimates are increased one percent per year across the 50-year time horizon to reflect a one-percent annual growth in coal consumption.

4.7 Incremental Compliance Costs

Incremental compliance cost estimates were developed for the four Part 258 design standard options and a single Part 258 performance standard over a 50-year time horizon. Depending on the regulatory option annual incremental compliance costs are estimated to range between $4 million to $521 million per year (2005 dollars) assuming a seven percent discount rate, 40-year waste management unit operating life, and a coal consumption increase of one percent per year.

Design Standard Option 1 requires the installation of a groundwater and post-closure monitoring system within 150 meters of the management unit boundary. One alternative would require the implementation of a groundwater monitoring program in 2006 for all units currently operating (i.e., existing units) and all new construction (i.e., new units). Incremental compliance costs are estimated at $15.4 million per year. A second alternative would be to require the installation of groundwater monitoring programs for new unit construction beginning in 2006. The incremental compliance costs are estimated to be $4.3 million per year for this alternative. Requiring groundwater monitoring programs at existing units adds $11.1 million per year to the incremental compliance cost estimate.

Design Standard Option 2 requires the installation of a synthetic cap upon closure of the unit in addition to the installation of a groundwater and post-closure monitoring system within 150 meters of the management unit boundary. One alternative would require the implementation of a cap requirement and groundwater monitoring program in 2006 for both existing and new units. Incremental compliance costs are estimated at $244 million per year. If a cap requirement and groundwater monitoring program are only required for new units beginning in 2006 the incremental compliance costs are estimated to be $40 million per year. Requiring caps and groundwater monitoring programs at existing units adds $204 million per year to the incremental compliance cost estimate.[62]

Design Standard Option 3 requires that a financial assurance mechanism be in place to cover closure and post-closure costs. Costs for a letter of credit are assumed in the estimate. This cost is added to the cost of installing a synthetic cap and implementing a groundwater and post-closure monitoring system within 150 meters of the management unit boundary. One alternative would require the implementation of a cap requirement, financial assurance, and groundwater monitoring program in 2006 for both existing and new units. Incremental compliance costs are estimated at $267 million per year. If these controls are required for all new unit construction beginning in 2006, the incremental compliance costs are estimated to be $50 million per year. Requiring caps, financial assurance, and groundwater monitoring programs at existing units adds $217 million per year to the incremental compliance cost estimate.

Design Standard Option 4 requires a full municipal waste landfill type design under Subtitle D, excluding daily cover and run-on/run-off controls. In addition to the above mentioned controls installation of a composite liner (synthetic and clay) and leachate collection system are required for new unit construction This cost is added to the cost of installing a synthetic cap and implementing a groundwater and post-closure monitoring system within 150 meters of the management unit boundary. One alternative would require the implementation of a cap requirement, financial assurance, and groundwater monitoring program in 2006 for existing units in addition to the above controls for new units. Incremental compliance costs are estimated at $521 million per year. If these controls are required for new unit construction beginning in 2006, the incremental compliance costs are estimated to be over $304 million per year. Requiring caps, financial assurance, and groundwater monitoring programs at existing units adds $217 million per year to the incremental compliance cost estimate.

Performance Standard Option 1 is an option that varies design requirements based on the performance of landfill and impoundment units in unstable areas (i.e., karst terrains). Controlling and cleaning up releases from units sited in major karst terrains are known to be difficult. Under this option, plants sited in major karst are required to ship their waste off site to a commercial Subtitle D type landfill that would not be located in an unstable area. Plants sited in karst terrains that are not fully developed are required to manage wastes in on-site units that meet the requirements of Design Standard 4. Plants sited in non-karst terrains are required to

[62] For existing units, the cost methodology used spread costs over the "remaining life" of the unit. Under this methodology, current utility customers are paying the cost for capping the waste they generated through their demand for electricity. Current rate payers are not likely to accept a one-year (or couple-year) spike in their rates. To minimize spikes in rates a second cost methodology could be used that would spread the cost over a "30-year loan period" linked to the duration of the post-closure period. This methodology would reduce the incremental cost estimate. The problem with this methodology is that future utility customers are paying for capping waste they did not generate (i.e., they received no electricity/benefit for this cost). Recovery of these costs likely will be accepted by Public Utility Commissions in future rate negotiations. However, it is unclear how deregulation of the utility industry will impact future rate negotiations.

manage wastes in on-site units that meet the requirements of Design Standard 2. One alternative would require the implementation of a cap requirement, financial assurance, and groundwater monitoring program in 2006 for existing units in addition to the above controls for new units. Incremental compliance costs are estimated at $459 million per year. If these controls are required for new unit construction beginning in 2006, the incremental compliance costs are estimated to be over $242 million per year.[63] For controls implemented with new units constructed at plants located in major karst terrains account for $183 million per year of the total incremental cost, plants located in other karst terrains account for $22 million per year of the total incremental cost, and all other plants account for $36 million per year of the total incremental cost. If capping, financial assurance, and groundwater monitoring controls are implemented with existing units in addition to the above controls for new units constructed at plants located in major karst terrains account for $216 million per year of the total incremental cost, plants located in other karst terrains account for $190 million per year of the total incremental cost, and all other plants account for $53 million per year of the total incremental cost. By varying the design requirements based on the performance of landfills and impoundments in karst terrains the incremental compliance cost estimate are reduced by approximately $62 million per year ($304 - $242 million per year or $521 - $459 million per year) compared to a full municipal waste Subtitle D type standard (Design Standard Option 4). Costs associated with the performance of these units under other site-specific conditions have yet to be estimated (i.e., climate, disposal below natural water table, floodplains, wetlands, fault areas, seismic and impact zones).

If damages are identified, corrective action costs are estimated to range between $8.2 million (capping a new landfill unit) and $16 million (capping and installing a groundwater remediation system at a new surface impoundment unit) per year per damage case for an average-sized disposal unit. Over half the cost is for paying off the debt on the landfill being closed. The plant will lose the benefits gained from the capital costs sunk into its construction. The incremental compliance cost model is set up to construct units with 40-year capacities. Many facilities are likely to construct the unit in phases or lateral expansions. To be consistent with the incremental compliance cost model, the 40-year capacity assumption is incorporated into the sunk (lost benefit) construction costs incorporated into the corrective action cost estimates. After sunk capital costs have been paid off for the construction of the landfill, corrective action costs range between $4.2 million and $6.8 million per year. Costs vary depending on the unit type (landfill or surface impoundment), age of the unit, and type of corrective action. In terms over total net present value, corrective action costs are estimated to range between $54 million (capping an old landfill unit) and $184 million (capping and installing a groundwater remediation system at a

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[63] Based on a review of the regulations for the top 25 coal usage states (for electricity) certain states already restrict construction of landfill and surface impoundment units in unstable areas. States that have siting restrictions in unstable areas for surface impoundments include KY, MO (if closed with waste in place), ND, PA, and WV (1,000 feet away). Examples of states that have siting restrictions in unstable areas for landfills include AZ, CO, IN, IA, KY, MN, MO, ND, PA, TN, WV (1,000 feet away) and WI. These existing state regulations have yet to be mapped into the baseline cost estimates. The incremental compliance cost will be lower than $223 million/year after accounting for these existing state regulations in the baseline cost estimate.

new surface impoundment unit) per damage case including continued debt payments for the closed landfill.[64]

[64] All costs presented in this paragraph are in 2004 dollars.

Exhibit 4-8. Pre-Tax Annual Incremental Compliance Costs for Four Part 258 Design Standard Options and One Part 258 Performance Standard Option (year 2005 dollars, millions/year)		
Landfill and Surface Impoundment Design/Performance Standards	**Newly Constructed Units**	**All Units /a/**
DESIGN STANDARD OPTION 1: (Nationwide) Groundwater Monitoring within 150 meters of unit and Post-Closure Mon. for 30 years	$4.3 /a/	$15.4
DESIGN STANDARD OPTION 2: (Nationwide) Synthetic Cap , GW Mon. within 150 meters of unit, and Post-Closure Mon. for 30 years	$40 /a/	$244
DESIGN STANDARD OPTION 3: (Nationwide) Synthetic Cap , GW Mon. within 150 meters of unit, Post-Closure Mon. for 30 years, and Financial Assurance	$50.1 /a/	$267
DESIGN STANDARD OPTION 4: (Nationwide) Full Municipal Subtitle D Type Design (excluding Daily Cover and Run-on/Run-Off Controls) - Composite Liner, Leachate Collection System, Synthetic Cap, GW Mon. within 150 meters of unit, Dust Controls, Post-Closure Care for 30 years, and Financial Assurance	$304 /a/	$521
PERFORMANCE STANDARD OPTION 1: (Unstable Areas) /b, c/ *Major Karst Unstable Areas:* Off-site Commercial Subtitle D Type Landfill *Other (Moderate, Minor or Pseudo) Karst Unstable Areas:* Use Design Standard 4 *Non-Karst Areas:* Use Design Standard 2	$242 total /a/ $183 for major karst plants $22 for other karst plants $36 for non-karst plants	$459 $216 for major karst plants $190 for other karst plants $53 for non-karst plants

/a/ Options require a groundwater monitoring program to be implemented in 2006.

/b/ Design standards vary depending on the presence of unstable areas beneath the plant. Of the 452 coal-fired utility plants greater than 10 MW, 53 plants are located in major karst unstable areas, 84 plants are located in moderate, minor or pseudo karst unstable areas, and 315 plants are located in non-karst areas.

/c/ Based on a review of the regulations for the top 25 coal usage states (for electricity) certain states already restrict construction of landfill and surface impoundment units in unstable areas. States that have siting restrictions in unstable areas for surface impoundments include KY, MO (if closed with waste in place), ND, PA, and WV (1,000 feet away). Examples of states that have siting restrictions in unstable areas for landfills include AZ, CO, IN, IA, KY, MN, MO, ND, PA, TN, WV (1,000 feet away) and WI. <u>These existing state regulations have yet to be mapped into the baseline cost estimates. The incremental compliance cost will be lower than $242 and $459 million/year after accounting for these existing state regulations in the baseline cost estimate.</u>

APPENDIX A

EQUIPMENT ASSUMPTIONS FOR THE FFC MONOFILL COST MODEL INCLUDING FUGITIVE DUST CONTROL TECHNOLOGIES

Compaction Equipment

Ash is assumed to be compacted in the waste management area by self-propelled sheepsfoot rollers for regulatory scenarios including dust controls. A model cost assumption is that four passes are made by the roller in 6-inch lifts. With these assumptions, the roller can compact approximately 1,300 cy of ash per day.

The operating life of purchased compaction equipment is assumed to be five years. The number of sheepsfoot rollers required is estimated as follows:

$$\text{Rollers} = \frac{(\text{tons/yr})(2{,}000\ \text{lb/ton})(16.02\ \text{kg/m}^3\ /\ \text{lb/cf})}{(1{,}190\ \text{kg/m}^3)(27\ \text{cf/cy})(1{,}300\ \text{cy/day})(300\ \text{days/yr})}$$

The cost of a sheepsfoot roller is assumed to be $75,000 in 1995 dollars.

Plants will incur annual costs for equipment operation ($0.63/cy) and maintenance. Maintenance costs are assumed to be 5 percent of capital costs. Annual costs for compaction are estimated as follows:

$$\text{Annual Cost} = \frac{(\text{tons/yr})(2{,}000\ \text{lb/ton})(16.02\ \text{kg/m}^3\ /\ \text{lb/cf})(\$0.63/\text{cy})}{(1{,}190\ \text{kg/m}^3)(27\ \text{cf/cy})} + \$75{,}000*0.05*\text{Rollers}$$

Water Truck for Compaction

Ash is assumed to be wetted in the waste management area by water trucks to facilitate compaction and to control dust. A model assumption is that FFC plants currently use water trucks 50 percent of the operational day to control dust on roads (see Water Spray on Roads). It is reasonable to assume that the same water trucks will be used for the roads and the ash management unit. Therefore, it is assumed that an existing water truck is available for compaction 50 percent of the operational day. Additional water trucks are assumed to be necessary to facilitate compaction for large facilities.

A model assumption is that a water truck will be necessary for compaction 50 percent of the time required by the compaction equipment. The water truck time for compaction is estimated as follows:

$$\text{Water Truck Time for Compaction} = \frac{(\text{tons/yr})(2{,}000\ \text{lb/ton})(16.02\ \text{kg/m}^3\ /\ \text{lb/cf})(8\ \text{hr/day})(0.5)}{(1{,}190\ \text{kg/m}^3)(27\ \text{cf/cy})(1{,}300\ \text{cy/day})}$$

One existing water truck for compaction and water spray on roads is estimated to be sufficient for plants managing less than 391,000 tons per year of ash. Facilities managing between 391,000 and 1,173,000 tons per year are assumed to purchase one additional water truck. Facilities managing between 1,173,000 and 1,955,000 tons per year are assumed to purchase two additional water trucks. Facilities managing more than 1,955,000 tons per year to the maximum facility size modeled of 2,000,000 tons per year are assumed to purchase three additional water trucks. The cost of a water truck is assumed to be $101,000 in 1995 dollars. The water truck operating life is assumed to be five years.

The operating costs for water spray for compaction are estimated assuming that the truck travels approximately five miles per day, for each day used, with a fuel consumption of five miles per gallon at a fuel cost of $1.15 per gallon. The truck is assumed to operate 50 percent of the hours required for compaction. The daily water volume used is assumed to be 10,000 gallons, at a cost of $2 per 1,000 gallons. The annual cost associated with ash management is estimated as follows:

$$\text{Annual Cost} = \frac{(\text{tons/yr})(2{,}000\ \text{lb/MT})(16.02\ \text{kg/m}^3\ /\ \text{lb/cf})(0.5)}{(1{,}190\ \text{kg/m}^3)(27\ \text{cf/cy})(1{,}300\ \text{cy/day})} * [(8\text{hr/day})(\$31.50/\text{hr}) + (5\ \text{mi/day})(\$1.15/\text{gal})/(5\ \text{mi/gal}) + (10{,}000\ \text{gal/day})(\$2/1{,}000\ \text{gal})]$$

Covers on Trucks[65]

Covers on hauling trucks as a fugitive dust control technology is an option for the compliance scenarios. Capital costs for this dust control technology include the cost of the roll-on tarp mechanism and the installation of this mechanism. Capital costs for covers on trucks are estimated as follows:

$$\text{Capital Cost} = \text{Round Up}[\underline{(\text{tons/yr})(2{,}000\ \text{lb/ton})(16.02\ \text{kg/m}^3\ /\ \text{lb/cf})(0.65\ \text{hr/load})}] * (\$4{,}800)$$

[65] The cost of tarps, tarp mechanisms, and installation of the mechanisms, as well as the life of each tarp were estimated by ICF in *Cost Functions for Alternative CKD Control Technologies (Draft)*, dated July 19, 1996.

$$(1{,}190\ kg/m^3)(0.80)(27\ cf/cy)(9\ cy/load)(2{,}400\ hr/yr)$$

Annual costs for this dust control technology include the cost of the tarps and the cost to replace the tarps. Tarps are estimated to be replaced every 150 loads. Replacement of a tarp is estimated to require 15 minutes. Annual costs for covers on trucks are estimated as follows:

$$\text{Annual Cost} = \frac{(tons/yr)(2{,}000\ lb/ton)(16.02\ kg/m^3\ /\ lb/cf)(\$155/tarp + 0.25hr/tarp*\$19/hr)}{(1{,}190\ kg/m^3)(0.80)(27\ cf/cy)(9\ cy/load)(150\ load/tarp)}$$

Water Spray on Roads[66]

Water spray on roads is required as a fugitive dust control technology for the compliance scenarios. A model assumption is that FFC plants currently have water trucks and use water spray on roads as a baseline management practice.

A model assumption is that dust control is required for a road length of 1.5 miles (3 miles round-trip), with a road width of 10 meters. The water truck capacity is assumed to be 5,000 gallons and requires approximately one hour to fill. The water truck can spray a width of five meters at an assumed speed of 10 miles per hour.

For the baseline scenario, a model assumption is that the entire water volume (5,000 gallons) will be sprayed on each pass of the truck along one side of the road (i.e., 1.5 miles x 5 meters). The resulting water volume per road area, averaged over the 1.25 hours required to spray the road and refill the truck, is approximately 2.5 times that of the average hourly daytime evaporation rate. Therefore, water spray on roads will be required 3 times per day.

The water volume sprayed per road area is estimated as follows:

$$\text{Water per Area} = (1.5\ mi)(5{,}280\ ft/mi)(0.3048\ m/ft)(10\ m)(5{,}000\ gal)(3.785\ L/gal)$$
$$= 0.784\ L/m^2$$

The time required for the water truck to be filled, spray along both sides of the road, and return for refilling is estimated as follows:

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[66] Water truck capacity, refill time, and spray width were estimated by ICF in *Cost Functions for Alternative CKD Control Technologies (Draft)*, dated July 19, 1996.

$$\text{Time} = (1 \text{ hour}) + (3 \text{ miles})/(10 \text{ miles/hour}) = 1.3 \text{ hour}$$

Therefore, the total time for one pass is assumed to be 1 hour and 15 minutes. The average rate of water spray is estimated as follows:

$$\text{Spray Rate} = \frac{(0.784 \text{ L/m}^2)(1{,}000 \text{ ml/L})(\text{cm}^3/\text{ml})(1{,}000 \text{ mm/m})}{(100 \text{ cm/m})^3(1.25 \text{ hr})} = 0.6272 \text{ mm/hr}$$

The average hourly daytime evaporation rate is approximately 0.25 mm/hr. Therefore, the water spray rate is approximately 2.5 times the evaporation rate. Since the total time required for water spray (1.25 hour) times 2.5 is approximately 3, a model assumption is that water spray on roads is required approximately every 3 hours. In order to coordinate the water truck use for road spray and ash compaction, it is assumed that the truck alternates between these two requirements during the day. Therefore, over a nine-hour day (eight working hours plus one hour for lunch), roads are sprayed 3 times, requiring a total of approximately 4 hours, or 50 percent of the operational day. Because it is assumed that FFC facilities currently spray water on roads for dust control, the incremental cost from the baseline to the compliance scenarios is zero.

APPENDIX B

COAL USAGE ESTIMATES FOR PLANT CODES WITH NO DATA REPORTED IN THE 1998 EIA 767 DATABASE OR 1995 EPRI COMANAGEMENT SURVEY

Plant Code	Available Coal Usage or Nameplate Rating Data	Assumption
6205	Nameplate rating = 12,000 kW	Note 1
511	Nameplate rating = 3,750 kW	Note 1
563	Nameplate rating = 90,000 kW	Note 1
7242	1999 Data 624,313 tons of coal per year	Note 2
1065	Nameplate rating = 4,000 kW	Note 1
1083	Nameplate rating = 243,636 kW	Note 1
1166	Nameplate rating = 3,000 kW	Note 1
934	Nameplate rating = 2,750 kW	Note 1
961	Active, organic facility less than 100 MW, Natural Gas usage. Nameplate rating = 11,500 kW	Note 1
7363	Nameplate rating = 614,600 kW	Note 1
1445	No coal boiler data identified in 1998 and 1999.	Eliminate from list. No coal boiler identified.
1581	Nameplate rating = 35,000 kW	Note 1
1819	Nameplate rating = 11,000 kW	Note 1
1726	Nameplate rating = 8,000 kW	Note 1
1859	Active, organic facility. Nameplate rating = 7,500 kW	Note 1
1772	Active, organic facility, Natural Gas usage. Nameplate rating = 18,750 kW	Note 1
1888	Nameplate rating = 81,600 kW	Note 1
2016	No coal boiler data identified in 1998 and 1999.	Note 3
2062	1999 Data 1,218 tons of coal per year	Note 2
2063	1999 Data 140 tons of coal per year	Note 2
7672	No coal boiler data identified in 1998 and 1999.	Note 3
7674	No coal boiler data identified in 1998 and 1999.	Note 3
7419	No coal boiler data identified in 1998 and 1999.	Note 3
2908	Nameplate rating = 160,000 kW	Note 1
2847	No coal boiler data identified in 1998 and 1999.	Note 3
2954	No coal boiler data identified in 1998 and 1999.	Note 3
7652	1999 Data 171,549 tons of coal per year.	Note 2
7678	No coal boiler data identified in 1998 and 1999.	Note 3
3805	No coal boiler data identified in 1998 and 1999.	Note 3
3807	No coal boiler data identified in 1998 and 1999.	Note 3

7549	No coal boiler data identified in 1998 and 1999.	Note 3
7537	1999 Data 134,975 tons of coal per year.	Note 2
1822	No coal boiler data identified in 1998 and 1999.	Note 3
1077	1999 Facility 584,023 tons of coal/year	Note 2
1393	1999 Facility 2,284,878 tons of coal/year	Note 2
1859	1999 Facility 833 tons of coal/year	Note 2
4057	1999 Facility 150,991 tons of coal/year	Note 2

Notes:

1. Estimate ash generation assuming average utilization of 80% for coal plants, average of 266 days of operation per year, conversion of 2001.224 kWh per short ton of coal and average of 9.1 percent ash content in coal.

2. Estimate ash generation assuming average of 9.1 percent ash content in coal.

3. Assumed these plants are smaller, similar to those identified in the exhibit above. Therefore, assumed an average nameplate rating based on those specified above (77,240 kW).

APPENDIX C

COMPARISON OF LANDFILL AND SURFACE IMPOUNDMENT INFORMATION IN THE ECONOMIC AND RISK ANALYSIS DATABASES

The risk analysis is apparently only analyzing a subset of the population, given the economic analysis database includes 452 plants and the risk analysis database includes 179 plants. Apparently, the risk analysis database only includes management units where landfill and surface impoundment capacities are known. The economic analysis database includes the total known/estimated population of landfills and surface impoundments in order to assess the total economic impacts of a proposed Subtitle D rule.

The risk analysis database includes two plants (i.e., landfills) that are not currently included in the economic analysis database. These plants will be added to the economic analysis database after future research on their ash generation rates are conducted.

Exhibit C-1. Comparison of Landfill Information in the Economic and Risk Analysis Databases			
Data Source	**Economic Analysis**	**Risk Analysis**	**Comments**
Number of coal combustion plants	452	179	273 econ sites not included in risk sites; 2 California sites were identified in the risk analysis. These two sites have been included in the economic analysis.
Evaluation of EIA On-Site Disposal Quantities			
1998 and 2003 EIA Database: Number of plants reporting on-site landfill quantities	174	106	2 California sites were identified in the risk analysis. These two sites have been included in the economic analysis. 3 of the 172 plants with on-site landfills in the economic analysis reported "on-site use and storage" quantities. These quantities were assumed to be landfilled, in addition to the reported quantities of landfilled waste.

Exhibit C-1. Comparison of Landfill Information in the Economic and Risk Analysis Databases			
Data Source	**Economic Analysis**	**Risk Analysis**	**Comments**
Evaluation of EPRI On-Site Disposal Quantities			
1995 EPRI Comanagement Survey: Number of additional plants reporting on-site landfill quantities	14	0	The risk sites are included in the plant total of 106, above.
Evaluation of EIA On-Site Use and Storage Quantities			
1998 and 2003 EIA Database: Number of plants reporting "on-site use and storage" quantities assumed to landfill because reported storage quantity is more than twice the reported beneficial use and off-site landfill/minefill quantities.	14	0	A total of 14 plants were identified reporting "on-site use and storage" quantities that were more than twice the reported beneficial use and off-site landfill/minefill quantities and reported no on-site landfill activity. The following is a further breakdown of the 14 plants: - 6 plants did not report off-site beneficial use or off-site disposal. - 8 plants have storage quantities that are at least two times greater than the reported beneficial use and off-site disposal quantities.

Exhibit C-1. Comparison of Landfill Information in the Economic and Risk Analysis Databases			
Data Source	**Economic Analysis**	**Risk Analysis**	**Comments**
Evaluation of EIA and EPRI Beneficial Use and Off-Site Disposal/Minefill Quantities			
1998, 1999 and 2003 EIA Databases and 1995 EPRI Comanagement Survey: Number of plants with assumed landfill units (either on-site or off-site whichever is more economical) because no beneficial use or off-site disposal/minefill quantity is reported or the "total ash generation quantity" is more than twice the reported beneficial use and off-site landfill/minefill quantities.	88	0	A total of 150 plants were identified reporting no on-site landfills. (It should be noted that plants between 10 and 100 megawatts are not required to report their disposal practices in the 1998 and 1999 EIA 767 databases.) The following is a further breakdown of the 150 plants: 1.) 85 plants reported no beneficial use or off-site disposal quantities. 2.) 65 plants reported quantities of beneficial use or off-site disposal in either the 1998 EIA Database or the 1995 EPRI survey. - 62 of the 65 plants have total generation quantities that are less than twice the total reported beneficial use or off-site disposal quantities. These plants are not assumed to possibly have on-site landfills. - 3 of the 65 plants have total generation quantities that are greater than twice the total reported beneficial use and off site disposal mass. This is too much quantity unaccounted for to remove from the analysis. These plants are assumed to landfill the excess generated waste.
Total Number of Plants With On-Site Landfills	290	106	
Note: Several plants use more than one on-site or off-site disposal practice. Total number of plants with coal-fired boilers is 452.			

Exhibit C-2. Comparison of Surface Impoundment Information in the Economic and Risk Analysis Databases			
Data Source	**Economic Analysis**	**Risk Analysis**	**Comments**
Number of coal combustion plants	452	179	273 econ sites not included in risk sites; 2 California sites were identified in the risk analysis. These two sites have been included in the economic analysis.
Evaluation of EIA On-Site Disposal Quantities			
1998 and 2003 EIA Database: Number of plants reporting on-site surface impoundment quantities	170	96	
Evaluation of EPRI On-Site Disposal Quantities			
1995 EPRI Comanagement Survey: Number of additional plants reporting on-site surface impoundment quantities	10	0	
Total Number of Plants With On-Site Surface Impoundments	180	96	
Note: Several plants use more than one on-site or off-site disposal practice. Total number of plants with coal-fired boilers is 452.			

APPENDIX D

LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 290 LANDFILLS AND 180 SURFACE IMPOUNDMENTS

EXHIBIT D-1. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 290 LANDFILLS (NEW UNIT CONSTRUCTION)

			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
7353	6288	AK	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
195	10	AL	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	N	Y	Y
195	26	AL	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	N	Y	Y
18642	47	AL	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	N	Y	Y
18642	50	AL	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	N	Y	Y
189	56	AL	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	N	Y	Y
814	6009	AR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17698	6138	AR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
814	6641	AR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
16572	4941	AZ	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
16572	6177	AZ	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
24211	8223	AZ	N	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Y
52	10002	CA	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
353	10640	CA	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3285	462	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15466	468	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15466	470	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15466	477	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
3989	492	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
19204	511	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15466	525	CO	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
30151	527	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15466	6205	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15466	6248	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15143	6761	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
3989	8219	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y

Exhibit D-1. List of Environmental Controls for each of the 290 Landfills (New Unit Construction)																			
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
4176	563	CT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
5027	594	DE	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
21554	136	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
9617	207	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14610	564	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
6455	628	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
7801	641	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
7801	642	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
6909	663	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
10623	676	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
18454	7242	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
7140	699	GA	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
7140	703	GA	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
7140	728	GA	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
4538	753	GA	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
9392	1046	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
9162	1058	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
9162	1065	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
9162	1077	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
12341	1083	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
12341	1091	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	Y	Y	Y	Y
13038	1166	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
14645	1175	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
4303	1217	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
3258	1218	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
12341	6664	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
12341	7343	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	Y	Y	Y	Y
4110	874	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4110	879	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4110	883	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4110	886	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
2188	934	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
16179	961	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17828	963	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17828	964	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y

Exhibit D-1. List of Environmental Controls for each of the 290 Landfills (New Unit Construction)																		
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
17632	976	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3252	6016	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3253	6017	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
40307	6238	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
9269	983	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
9273	992	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
9273	994	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
13756	996	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
15470	1004	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
4508	1024	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
14839	1037	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
13756	6085	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
15470	6113	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
17633	6137	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
9324	6166	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
9267	6213	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
9667	6225	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
18315	108	KS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
5860	1239	KS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
10000	1241	KS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
10015	1250	KS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
10015	1252	KS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
22053	1353	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
10171	1356	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
10171	1360	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
11249	1363	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
11249	1364	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
8449	1372	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
18642	1379	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
5580	1384	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
3542	6018	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
5580	6041	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
3265	51	LA	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
7806	1393	LA	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
7806	7363	LA	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y

EXHIBIT D-1. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 290 LANDFILLS (NEW UNIT CONSTRUCTION)

			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
1167	602	MD	N	Y	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y
1167	1552	MD	N	Y	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y
15270	1571	MD	N	Y	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y
15270	1572	MD	N	Y	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y
15270	1573	MD	N	Y	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y
7908	1581	MD	N	N	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y
4254	1702	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
4254	1710	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
4254	1720	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
5109	1726	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
5109	1733	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
20847	1769	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
19578	1771	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
19578	1772	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
3915	1819	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
10704	1831	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
19125	1859	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
12807	4259	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
9392	1888	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
12647	1891	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
12647	1893	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
13781	1915	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
13781	1918	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
14232	1943	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
1009	1961	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
8543	1979	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
16181	2008	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
19321	2016	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
19883	2018	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20737	2022	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
13781	6090	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
10000	2080	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
3486	2122	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
4045	2123	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
11732	2144	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y

EXHIBIT D-1. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 290 LANDFILLS (NEW UNIT CONSTRUCTION)																		
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
17833	2161	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
924	2167	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
924	2168	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
3242	2169	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
9231	2171	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
17833	6195	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
12686	2049	MS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	N	Y	Y
7651	2062	MS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	N	Y	Y
7651	2063	MS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	N	Y	Y
17568	6061	MS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	N	Y	Y
12686	6073	MS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
12825	6076	MT	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	N	Y	Y
12819	6089	MT	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	N	Y	Y
3046	2712	NC	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	N	Y	N
5416	2727	NC	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	N	Y	N
5416	8042	NC	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	N	Y	N
12819	2790	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
1307	2817	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
12658	2823	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
19514	2824	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
4322	6030	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
1307	6469	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
12658	7672	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
12658	7674	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
14232	8222	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
13337	2277	NE	N	Y	N	Y	N	N	N	N	N	Y	N	N	N	N	N	N
14127	2291	NE	N	Y	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
13337	6077	NE	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14127	6096	NE	N	Y	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
15472	2364	NH	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
19856	2434	NJ	Y	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
15129	87	NM	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15698	2468	NM	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
13407	2324	NV	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
17609	2341	NV	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y

EXHIBIT D-1. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 290 LANDFILLS (NEW UNIT CONSTRUCTION)																			
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
17166	7419	NV	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
17166	8224	NV	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
3249	2480	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13511	2526	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13511	2527	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13511	2529	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13511	2531	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13511	2535	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13573	2549	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13573	2554	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
16183	2640	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13511	6082	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3006	2828	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3542	2830	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3542	2832	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4062	2840	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4922	2847	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4922	2848	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4922	2850	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
18997	2878	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3762	2908	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
5330	2914	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17891	2942	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17043	2943	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3542	6019	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
40577	7286	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14006	8102	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14063	2952	OK	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14063	2954	OK	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
15474	2963	OK	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
20447	6772	OK	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
15248	6106	OR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12390	3113	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
12390	3115	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
21683	3118	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y

EXHIBIT D-1. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 290 LANDFILLS (NEW UNIT CONSTRUCTION)

			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
21683	3122	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
21683	3130	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
21683	3131	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
21683	3132	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
21683	3136	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14716	3138	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14715	3145	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
14715	3148	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
14715	3149	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
19390	3176	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
20387	3178	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
20387	3179	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
20387	3181	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
5487	8226	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
17543	130	SC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17539	3287	SC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17539	3295	SC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17554	3298	SC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17539	7210	SC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17539	7652	SC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
19545	3325	SD	N	Y	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
14232	6098	SD	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N
18642	3396	TN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
18642	3399	TN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
18642	3403	TN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
18642	3405	TN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
18642	3406	TN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
18642	3407	TN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
8901	298	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
8901	3470	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
44372	3497	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
18715	6136	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
17698	6139	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
44372	6146	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
44372	6147	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y

Exhibit D-1. List of Environmental Controls for each of the 290 Landfills (New Unit Construction)																		
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
11269	6179	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
16604	6181	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
44372	6648	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
40051	7030	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
16604	7097	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
17718	7678	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
17698	7902	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
14354	3644	UT	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14354	6165	UT	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
11208	6481	UT	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
40230	7790	UT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14354	8069	UT	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
733	3775	VA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
733	3776	VA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
15270	3788	VA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
19876	3805	VA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
19876	3807	VA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
19876	7213	VA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
18429	3920	WA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	Y	Y
13781	3982	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20847	4040	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20847	4041	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20847	4042	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20856	4050	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20856	4054	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20856	4057	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20860	4078	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
11571	4125	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
12298	4127	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
4716	4140	WI	Y	N	Y	N	N	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y
4716	4143	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
4716	4271	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20847	6170	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20847	7549	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20856	8023	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y

EXHIBIT D-1. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 290 LANDFILLS (NEW UNIT CONSTRUCTION)																			
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
733	3935	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3277	3938	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
12796	3942	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
12796	3943	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
12796	3944	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
12796	3945	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
12796	3946	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
19876	3954	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
12796	6004	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
733	6264	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
19876	7537	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
19545	4150	WY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	Y	Y
19545	4151	WY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	Y	Y
14354	4158	WY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14354	4162	WY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	Y	Y
14354	6101	WY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
1307	6204	WY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	Y	Y
19545	7504	WY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	Y	Y
14354	8066	WY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y

Notes:

UB = unit boundary

m = meters

Mon = monitoring

Y = Yes

N = No

EXHIBIT D-2. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 290 LANDFILLS (EXISTING UNITS)																		
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
7353	6288	AK	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
195	10	AL	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	N	Y	Y
195	26	AL	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	N	Y	Y
18642	47	AL	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	N	Y	Y
18642	50	AL	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	N	Y	Y
189	56	AL	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	N	Y	Y
814	6009	AR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17698	6138	AR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
814	6641	AR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
16572	4941	AZ	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
16572	6177	AZ	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
24211	8223	AZ	N	Y	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Y
52	10002	CA	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
353	10640	CA	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3285	462	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15466	468	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15466	470	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15466	477	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
3989	492	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
19204	511	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15466	525	CO	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
30151	527	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15466	6205	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15466	6248	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
15143	6761	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
3989	8219	CO	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	N	Y	Y	Y
4176	563	CT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
5027	594	DE	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
21554	136	FL	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9617	207	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14610	564	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
6455	628	FL	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7801	641	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
7801	642	FL	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
6909	663	FL	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Exhibit D-2. List of Environmental Controls for each of the 290 Landfills (Existing Units)																		
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
10623	676	FL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
18454	7242	FL	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	699	GA	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
7140	703	GA	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
7140	728	GA	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
4538	753	GA	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
9392	1046	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
9162	1058	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
9162	1065	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
9162	1077	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
12341	1083	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
12341	1091	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	Y	Y	Y	Y
13038	1166	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
14645	1175	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
4303	1217	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
3258	1218	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
12341	6664	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	N	Y	Y	Y
12341	7343	IA	Y	N	N	N	N	N	N	Y	N	N	N	N	Y	Y	Y	Y
4110	874	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4110	879	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4110	883	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4110	886	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
2188	934	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
16179	961	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17828	963	IL	Y	N	N	Y	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17828	964	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17632	976	IL	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3252	6016	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3253	6017	IL	Y	N	N	Y	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
40307	6238	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9269	983	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
9273	992	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
9273	994	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
13756	996	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
15470	1004	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N

EXHIBIT D-2. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 290 LANDFILLS (EXISTING UNITS)																		
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
4508	1024	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
14839	1037	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
13756	6085	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
15470	6113	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
17633	6137	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
9324	6166	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
9267	6213	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
9667	6225	IN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	N	Y	Y	N
18315	108	KS	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
5860	1239	KS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
10000	1241	KS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
10015	1250	KS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
10015	1252	KS	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
22053	1353	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
10171	1356	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
10171	1360	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
11249	1363	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
11249	1364	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
8449	1372	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
18642	1379	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
5580	1384	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
3542	6018	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
5580	6041	KY	Y	N	N	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y
3265	51	LA	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
7806	1393	LA	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7806	7363	LA	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
1167	602	MD	N	Y	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y
1167	1552	MD	N	Y	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y
15270	1571	MD	N	Y	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y
15270	1572	MD	N	Y	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y
15270	1573	MD	N	Y	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y
7908	1581	MD	N	N	N	N	N	N	N	Y	N	N	N	N	Y	N	Y	Y
4254	1702	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
4254	1710	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
4254	1720	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y

Exhibit D-2. List of Environmental Controls for each of the 290 Landfills (Existing Units)																		
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
5109	1726	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
5109	1733	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
20847	1769	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
19578	1771	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
19578	1772	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
3915	1819	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
10704	1831	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
19125	1859	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
12807	4259	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	N	Y
9392	1888	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
12647	1891	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
12647	1893	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
13781	1915	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
13781	1918	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
14232	1943	MN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
1009	1961	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
8543	1979	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
16181	2008	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
19321	2016	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
19883	2018	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20737	2022	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
13781	6090	MN	Y	N	N	Y	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
10000	2080	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
3486	2122	MO	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Y
4045	2123	MO	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Y
11732	2144	MO	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Y
17833	2161	MO	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Y
924	2167	MO	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Y
924	2168	MO	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Y
3242	2169	MO	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Y
9231	2171	MO	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Y
17833	6195	MO	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	Y
12686	2049	MS	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7651	2062	MS	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7651	2063	MS	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

EXHIBIT D-2. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 290 LANDFILLS (EXISTING UNITS)																		
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
17568	6061	MS	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12686	6073	MS	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
12825	6076	MT	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	N	Y	Y
12819	6089	MT	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	N	Y	Y
3046	2712	NC	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	N	Y	N
5416	2727	NC	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	N	Y	N
5416	8042	NC	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	N	Y	N
12819	2790	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
1307	2817	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
12658	2823	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
19514	2824	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
4322	6030	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
1307	6469	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
12658	7672	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
12658	7674	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
14232	8222	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	N	Y
13337	2277	NE	N	Y	N	Y	N	N	N	N	N	Y	N	N	N	N	N	N
14127	2291	NE	N	Y	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
13337	6077	NE	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14127	6096	NE	N	Y	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
15472	2364	NH	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
19856	2434	NJ	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15129	87	NM	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15698	2468	NM	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
13407	2324	NV	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
17609	2341	NV	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	Y	Y	Y	Y
17166	7419	NV	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17166	8224	NV	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3249	2480	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13511	2526	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13511	2527	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13511	2529	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13511	2531	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13511	2535	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13573	2549	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y

EXHIBIT D-2. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 290 LANDFILLS (EXISTING UNITS)																		
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
13573	2554	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
16183	2640	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
13511	6082	NY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3006	2828	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3542	2830	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3542	2832	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4062	2840	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4922	2847	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4922	2848	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4922	2850	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
18997	2878	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3762	2908	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
5330	2914	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17891	2942	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17043	2943	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3542	6019	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
40577	7286	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14006	8102	OH	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14063	2952	OK	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
14063	2954	OK	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15474	2963	OK	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
20447	6772	OK	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
15248	6106	OR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12390	3113	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
12390	3115	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
21683	3118	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
21683	3122	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
21683	3130	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
21683	3131	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
21683	3132	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
21683	3136	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14716	3138	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14715	3145	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
14715	3148	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
14715	3149	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y

Exhibit D-2. List of Environmental Controls for each of the 290 Landfills (Existing Units)																		
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
19390	3176	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
20387	3178	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
20387	3179	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
20387	3181	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
5487	8226	PA	Y	N	Y	N	N	Y	Y	N	N	N	N	N	Y	Y	Y	Y
17543	130	SC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17539	3287	SC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17539	3295	SC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17554	3298	SC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17539	7210	SC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
17539	7652	SC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
19545	3325	SD	N	Y	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
14232	6098	SD	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N
18642	3396	TN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
18642	3399	TN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
18642	3403	TN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
18642	3405	TN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
18642	3406	TN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
18642	3407	TN	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
8901	298	TX	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Y
8901	3470	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
44372	3497	TX	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Y
18715	6136	TX	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Y
17698	6139	TX	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Y
44372	6146	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
44372	6147	TX	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Y
11269	6179	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
16604	6181	TX	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Y
44372	6648	TX	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	N	Y	Y
40051	7030	TX	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Y
16604	7097	TX	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Y
17718	7678	TX	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Y
17698	7902	TX	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	Y
14354	3644	UT	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14354	6165	UT	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N

EXHIBIT D-2. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 290 LANDFILLS (EXISTING UNITS)																		
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
11208	6481	UT	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
40230	7790	UT	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14354	8069	UT	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
733	3775	VA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
733	3776	VA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
15270	3788	VA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
19876	3805	VA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
19876	3807	VA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
19876	7213	VA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
18429	3920	WA	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y	Y	Y
13781	3982	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20847	4040	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20847	4041	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20847	4042	WI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
20856	4050	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20856	4054	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20856	4057	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20860	4078	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
11571	4125	WI	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12298	4127	WI	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4716	4140	WI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
4716	4143	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
4716	4271	WI	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
20847	6170	WI	Y	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
20847	7549	WI	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
20856	8023	WI	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
733	3935	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
3277	3938	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
12796	3942	WV	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12796	3943	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
12796	3944	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
12796	3945	WV	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12796	3946	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
19876	3954	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
12796	6004	WV	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Exhibit D-2. List of Environmental Controls for each of the 290 Landfills (Existing Units)																			
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Daily Cover	Dust Controls	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil					
733	6264	WV	Y	N	Y	N	N	Y	N	N	N	N	Y	Y	Y	Y	Y	Y
19876	7537	WV	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
19545	4150	WY	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N	Y
19545	4151	WY	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N	Y
14354	4158	WY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
14354	4162	WY	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N	Y
14354	6101	WY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y
1307	6204	WY	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N	Y
19545	7504	WY	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N	Y
14354	8066	WY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y

Notes:

UB = unit boundary

m = meters

Mon = monitoring

Y = Yes

N = No

EXHIBIT D-3. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 180 SURFACE IMPOUNDMENTS (NEW UNIT CONSTRUCTION)

			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil			
195	3	AL	N	Y	N	N	N	N	N	N	N	N	N	N	N	N
195	7	AL	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N
195	8	AL	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N
195	10	AL	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N
18642	47	AL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
18642	50	AL	N	Y	N	N	N	N	N	N	N	N	N	N	N	N
189	56	AL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
195	6002	AL	N	Y	N	Y	N	N	N	N	N	Y	N	N	N	N
17698	6138	AR	N	N	N	N	N	N	N	N	N	N	N	N	N	N
803	113	AZ	N	N	N	N	N	N	Y	N	N	N	N	Y	N	Y
796	160	AZ	N	N	N	N	N	N	Y	N	N	N	N	Y	N	Y
16572	6177	AZ	N	N	N	N	N	N	Y	N	N	N	N	Y	N	Y
15143	6761	CO	Y	N	N	Y	N	Y	Y	N	N	N	N	Y	N	Y
7801	643	FL	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N
18454	645	FL	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N
18454	646	FL	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N
6909	663	FL	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N
7140	703	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	708	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	709	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	710	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	727	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	728	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
16687	733	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	6052	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
16687	6124	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	6257	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9392	1047	IA	Y	N	N	Y	N	N	N	N	N	Y	N	N	N	N
12341	1081	IA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12341	1082	IA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12341	1091	IA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12341	6664	IA	Y	N	N	Y	N	N	N	N	N	Y	N	N	N	N
4110	384	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3252	856	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3253	862	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N

EXHIBIT D-3. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 180 SURFACE IMPOUNDMENTS (NEW UNIT CONSTRUCTION)

			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil			
3253	863	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3253	864	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4110	867	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4110	874	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4110	884	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9208	889	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9208	891	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9208	892	IL	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
9208	897	IL	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
9208	898	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17828	963	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3252	6016	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3253	6017	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9269	983	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9324	988	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9273	990	IN	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N
9273	991	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9273	994	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15470	1001	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15470	1004	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15470	1007	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15470	1008	IN	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N
15470	1010	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17633	1012	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9267	1043	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
13756	6085	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15470	6113	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17633	6137	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17633	6705	IN	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N
10000	1241	KS	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N
9996	1295	KS	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N
9996	6064	KS	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N
10015	6068	KS	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N
22053	1353	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
10171	1355	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y

EXHIBIT D-3. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 180 SURFACE IMPOUNDMENTS (NEW UNIT CONSTRUCTION)

			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil			
10171	1356	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
10171	1357	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
10171	1361	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
11249	1363	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
11249	1364	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	1378	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	1379	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
5580	1385	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
3542	6018	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
5580	6041	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
11249	6071	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
3265	51	LA	Y	N	Y	N	N	N	N	N	N	N	N	Y	N	Y
2777	6055	LA	Y	N	Y	N	N	N	N	N	N	Y	N	Y	N	Y
3265	6190	LA	Y	N	Y	N	N	N	N	N	N	Y	N	Y	N	Y
15263	1570	MD	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4254	1702	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
4254	1710	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
4254	1720	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
4254	1723	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
5109	1733	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
10704	1831	MI	Y	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
10704	1832	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
12647	1891	MN	Y	N	N	N	N	N	N	N	N	N	N	Y	N	N
5860	2076	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
10000	2079	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
19430	2103	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
19430	2104	MO	Y	N	Y	N	N	Y	Y	N	N	Y	N	Y	N	Y
19430	2107	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
9231	2132	MO	Y	N	Y	N	N	Y	Y	N	N	Y	N	Y	N	Y
924	2167	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
10000	6065	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
19430	6155	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
12686	2049	MS	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12686	6073	MS	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3046	2706	NC	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y

EXHIBIT D-3. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 180 SURFACE IMPOUNDMENTS (NEW UNIT CONSTRUCTION)

			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil			
3046	2708	NC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
3046	2709	NC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
3046	2713	NC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
3046	2716	NC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
5416	2718	NC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
5416	2720	NC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
5416	2721	NC	N	Y	N	Y	N	Y	Y	N	N	N	Y	Y	N	Y
5416	2723	NC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
5416	2727	NC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
5416	2732	NC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
3046	6250	NC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
5416	8042	NC	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
1307	2817	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
12658	2823	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
4322	6030	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
13337	6077	NE	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15477	2403	NJ	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15129	87	NM	N	N	N	N	N	N	Y	N	N	N	N	Y	N	Y
803	2442	NM	N	N	N	N	N	N	Y	N	N	N	N	Y	N	Y
13407	2324	NV	Y	N	Y	N	N	Y	N	N	N	N	N	Y	N	Y
3006	2828	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3542	2830	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3542	2832	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4062	2840	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4062	2843	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4922	2850	OH	N	Y	N	N	N	N	N	N	N	N	N	N	N	N
13998	2861	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14006	2872	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14015	2876	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4922	6031	OH	N	Y	N	Y	N	N	N	N	N	Y	N	N	N	N
14006	8102	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15474	2963	OK	Y	N	Y	N	N	N	Y	N	N	N	N	Y	N	Y
20447	6772	OK	Y	N	Y	N	N	N	Y	N	N	N	N	Y	N	Y
14715	3148	PA	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N
14715	3149	PA	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N

Exhibit D-3. List of Environmental Controls for each of the 180 Surface Impoundments (New Unit Construction)																
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil			
14715	3152	PA	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N
14716	6094	PA	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N
5487	8226	PA	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N
17543	130	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
3046	3251	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
5416	3264	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
17539	3280	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
17539	3297	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
17543	3317	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
17543	3319	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
17543	6249	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
18642	3393	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	3396	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	3399	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	3403	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	3405	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	3406	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	3407	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
20404	127	TX	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17698	6139	TX	N	N	N	N	N	N	N	N	N	N	N	N	N	N
44372	6147	TX	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3278	6178	TX	N	Y	N	Y	N	N	N	N	N	Y	N	N	N	N
11269	6179	TX	N	Y	N	Y	N	N	N	N	N	Y	N	N	N	N
44372	6648	TX	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17698	7902	TX	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14354	6165	UT	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y
11208	6481	UT	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y
19876	3796	VA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
19876	3797	VA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
19876	3803	VA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
19876	3804	VA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
733	3935	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
3277	3938	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	N	N	Y
12796	3944	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
14006	3947	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	N	N	Y

EXHIBIT D-3. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 180 SURFACE IMPOUNDMENTS (NEW UNIT CONSTRUCTION)																
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil			
14006	3948	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
12796	6004	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	N	N	Y
14354	4162	WY	N	N	Y	N	N	N	N	N	N	N	N	N	N	N
1307	6204	WY	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N
14354	8066	WY	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N

Notes:

UB = unit boundary

m = meters

Mon = monitoring

Y = Yes

N = No

Exhibit D-4. List of Environmental Controls for each of the 180 Surface Impoundments (Existing Units)																
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil			
195	3	AL	N	Y	N	N	N	N	N	N	N	N	N	N	N	N
195	7	AL	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N
195	8	AL	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N
195	10	AL	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N
18642	47	AL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
18642	50	AL	N	Y	N	N	N	N	N	N	N	N	N	N	N	N
189	56	AL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
195	6002	AL	N	Y	N	Y	N	N	N	N	N	Y	N	N	N	N
17698	6138	AR	N	N	N	N	N	N	N	N	N	N	N	N	N	N
803	113	AZ	N	N	N	N	N	N	Y	N	N	N	N	Y	N	Y
796	160	AZ	N	N	N	N	N	N	Y	N	N	N	N	Y	N	Y
16572	6177	AZ	N	N	N	N	N	N	Y	N	N	N	N	Y	N	Y
15143	6761	CO	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7801	643	FL	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N
18454	645	FL	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N
18454	646	FL	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N
6909	663	FL	Y	N	Y	N	N	Y	N	N	N	N	N	N	N	N
7140	703	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	708	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	709	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	710	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	727	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	728	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
16687	733	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	6052	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
16687	6124	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
7140	6257	GA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9392	1047	IA	Y	N	N	Y	N	N	N	N	N	Y	N	N	N	N
12341	1081	IA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12341	1082	IA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12341	1091	IA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12341	6664	IA	Y	N	N	Y	N	N	N	N	N	Y	N	N	N	N
4110	384	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3252	856	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3253	862	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N

EXHIBIT D-4. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 180 SURFACE IMPOUNDMENTS (EXISTING UNITS)

			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil			
3253	863	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3253	864	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4110	867	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4110	874	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4110	884	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9208	889	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9208	891	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9208	892	IL	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
9208	897	IL	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
9208	898	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17828	963	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3252	6016	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3253	6017	IL	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9269	983	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9324	988	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9273	990	IN	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N
9273	991	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9273	994	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15470	1001	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15470	1004	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15470	1007	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15470	1008	IN	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N
15470	1010	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17633	1012	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
9267	1043	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
13756	6085	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15470	6113	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17633	6137	IN	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17633	6705	IN	N	N	N	Y	N	N	N	N	N	Y	N	N	N	N
10000	1241	KS	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N
9996	1295	KS	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N
9996	6064	KS	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N
10015	6068	KS	N	N	Y	N	N	Y	N	N	N	N	N	N	N	N
22053	1353	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
10171	1355	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y

EXHIBIT D-4. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 180 SURFACE IMPOUNDMENTS (EXISTING UNITS)																
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil			
10171	1356	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
10171	1357	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
10171	1361	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
11249	1363	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
11249	1364	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	1378	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	1379	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
5580	1385	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
3542	6018	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
5580	6041	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
11249	6071	KY	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
3265	51	LA	Y	N	Y	N	N	N	N	N	N	N	N	Y	N	Y
2777	6055	LA	Y	N	Y	N	N	N	N	N	N	Y	N	Y	N	Y
3265	6190	LA	Y	N	Y	N	N	N	N	N	N	Y	N	Y	N	Y
15263	1570	MD	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4254	1702	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
4254	1710	MI	Y	Y	Y	Y	N	Y	Y	N	N	N	N	Y	N	Y
4254	1720	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
4254	1723	MI	Y	Y	Y	Y	N	Y	Y	N	N	N	N	Y	N	Y
5109	1733	MI	Y	Y	Y	Y	N	Y	Y	N	N	N	N	Y	N	Y
10704	1831	MI	Y	Y	Y	Y	N	Y	Y	N	N	N	N	Y	N	Y
10704	1832	MI	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
12647	1891	MN	Y	N	N	N	N	N	N	N	N	N	N	Y	N	N
5860	2076	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
10000	2079	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
19430	2103	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
19430	2104	MO	Y	N	Y	N	N	Y	Y	N	N	Y	N	Y	N	Y
19430	2107	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
9231	2132	MO	Y	N	Y	N	N	Y	Y	N	N	Y	N	Y	N	Y
924	2167	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
10000	6065	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
19430	6155	MO	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
12686	2049	MS	N	N	N	N	N	N	N	N	N	N	N	N	N	N
12686	6073	MS	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3046	2706	NC	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y

EXHIBIT D-4. LIST OF ENVIRONMENTAL CONTROLS FOR EACH OF THE 180 SURFACE IMPOUNDMENTS (EXISTING UNITS)

			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil			
3046	2708	NC	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
3046	2709	NC	Y	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
3046	2713	NC	N	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
3046	2716	NC	N	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
5416	2718	NC	N	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
5416	2720	NC	N	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
5416	2721	NC	N	Y	N	Y	N	N	N	N	N	N	Y	Y	N	Y
5416	2723	NC	N	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
5416	2727	NC	N	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
5416	2732	NC	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3046	6250	NC	N	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
5416	8042	NC	N	N	Y	N	N	Y	N	N	N	Y	N	Y	N	Y
1307	2817	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
12658	2823	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
4322	6030	ND	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
13337	6077	NE	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15477	2403	NJ	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15129	87	NM	N	N	N	N	N	N	Y	N	N	N	N	Y	N	Y
803	2442	NM	N	N	N	N	N	N	Y	N	N	N	N	Y	N	Y
13407	2324	NV	Y	N	Y	N	N	Y	N	N	N	N	N	Y	N	Y
3006	2828	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3542	2830	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3542	2832	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4062	2840	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4062	2843	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4922	2850	OH	N	Y	N	N	N	N	N	N	N	N	N	N	N	N
13998	2861	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14006	2872	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14015	2876	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
4922	6031	OH	N	Y	N	Y	N	N	N	N	N	Y	N	N	N	N
14006	8102	OH	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15474	2963	OK	Y	N	Y	N	N	N	Y	N	N	N	N	Y	N	Y
20447	6772	OK	Y	N	Y	N	N	N	Y	N	N	Y	N	Y	N	Y
14715	3148	PA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14715	3149	PA	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Exhibit D-4. List of Environmental Controls for each of the 180 Surface Impoundments (Existing Units)																
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil			
14715	3152	PA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14716	6094	PA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
5487	8226	PA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17543	130	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
3046	3251	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
5416	3264	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
17539	3280	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
17539	3297	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
17543	3317	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
17543	3319	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
17543	6249	SC	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y
18642	3393	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	3396	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	3399	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	3403	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	3405	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	3406	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
18642	3407	TN	N	Y	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
20404	127	TX	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17698	6139	TX	N	N	N	N	N	N	N	N	N	N	N	N	N	N
44372	6147	TX	N	N	N	N	N	N	N	N	N	N	N	N	N	N
3278	6178	TX	N	Y	N	Y	N	N	N	N	N	Y	N	N	N	N
11269	6179	TX	N	Y	N	Y	N	N	N	N	N	Y	N	N	N	N
44372	6648	TX	N	N	N	N	N	N	N	N	N	N	N	N	N	N
17698	7902	TX	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14354	6165	UT	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y
11208	6481	UT	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y
19876	3796	VA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
19876	3797	VA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
19876	3803	VA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
19876	3804	VA	N	N	N	N	N	N	N	N	N	N	N	N	N	N
733	3935	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
3277	3938	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
12796	3944	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
14006	3947	WV	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Exhibit D-4. List of Environmental Controls for each of the 180 Surface Impoundments (Existing Units)																	
			Groundwater Monitoring		Liner			Leachate Collection System	Cap					Financial Assurance	Run-on/ Run-off	Post Closure Monitoring
Utility Code	Plant Code	State	UB Mon	150m Mon	Synthetic	Clay	Ash		Synthetic	Clay	Ash	Soil	Clay/ Soil			
14006	3948	WV	Y	N	Y	N	N	Y	Y	N	N	N	N	Y	N	Y
12796	6004	WV	N	N	N	N	N	N	N	N	N	N	N	N	N	N
14354	4162	WY	N	N	N	N	N	N	N	N	N	N	N	N	N	N
1307	6204	WY	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N
14354	8066	WY	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N

Notes:

UB = unit boundary

m = meters

Mon = monitoring

Y = Yes

N = No

APPENDIX E

Annualized Before-Tax Cost Equations Developed for Each FFC Disposal Control Combinations and Early Implementation Scenarios (2005$)

Exhibit E -1

Annualized Before-Tax Cost Equations Developed for Each FFC Disposal Control Combinations Assuming a 40-Year Life (2005$)

Cost Equation Reference Number	Environmental Controls	Cost Equation			
	Dug Landfills - 40 year life				
1	Daily Cover, Run-On-Off, Liner, LCS, Cap, UB Mon, PCM	$ =		(tons/year) +	246,748
2	Dust Controls, Run-On/Off, Clay liner, LCS, Clay Cap, UB Mon, PCM, FA	$ =	44.40	(tons/year) +	234,829
3	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Cap, UB Mon, PC Mon, Fin Ass	$ =	40.49	(tons/year) +	229,158
4	Dust Controls, Run-On/Off, Clay Cap, UB Mon, PCM	$ =	40.92	(tons/year) +	114,374
5	Daily Cover, Dust Controls, Run-On/Off, Clay liner, LCS, Cap, UB Mon, PCM, FA	$ =	18.91	(tons/year) +	238,968
6	Dust Controls, Run-On/Off, Clay liner, LCS, Clay Cap, UB Mon, FA	$ =	41.67	(tons/year) +	230,442
7	Daily Cover, Dust Controls, Run-on/Off, Liner, LCS, Soil Cap, UB Mon, PCM, FA	$ =	40.46	(tons/year) +	249,841
8	Daily Cover, Dust Controls, Run-On/Off, Liner, LCS, Clay Cap, UB Mon, PCM, FA	$ =	44.38	(tons/year) +	257,380
9	Daily cover, Run-On/Off, Clay Cap, PCM	$ =	46.45	(tons/year) +	73,785
10	No Controls	$ =	19.16	(tons/year) +	59,690
11	Daily Cover, Dust, Liner, LCS, Cap, UB Mon, PC Mon, FA	$ =	17.17	(tons/year) +	248,176
12	150 m Monitoring	$ =	45.37	(tons/year) +	118,584
13	Daily Cover, Run-on/Off, Liner, LCS, Soil Cap, UB Mon, PCM, FA	$ =	17.25	(tons/year) +	249,677
14	Daily Cover, Run-On/Off, Liner, LCS, Clay Cap, UB mon, PCM, FA	$ =	44.18	(tons/year) +	257,216
15	Composite Liner, LCS, Cap, Unit Boundary Monitoring	$ =	46.24	(tons/year) +	212,539
16	Composite Liner, LCS, Cap, 150 m Monitoring	$ =	39.00	(tons/year) +	228,833
17	Daily Cover, Run-on/Off, Liner, LCS, Soil Cap, UB mon, FA	$ =	39.00	(tons/year) +	245,389
18	Liner, LCS, Cap, 150 m Mon., Post-Closure Mon., Financial Ass.	$ =	44.17	(tons/year) +	239,165
19	Dust Controls, Clay Liner, LCS, Cap, UB Mon, PCM, FA	$ =	39.72	(tons/year) +	230,950
20	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Cap, UB Mon, PC Mon	$ =	40.71	(tons/year) +	246,912
21	Daily Cover, Run-On-Off, Liner, LCS, Cap, UB Mon, PCM, FA	$ =	44.61	(tons/year) +	254,202
22	Dust, Run-On/Run-Off, Liner, LCS, Cap, UB Mon, PC Mon, Fin Ass	$ =	45.21	(tons/year) +	226,456
23	Daily Cover, Dust Controls, Run-On/Off, Liner, LCS, Soil/Clay Cap, UB Mon, PCM, FA	$ =	39.95	(tons/year) +	253,611
24	Daily Cover, Run-On/Run-Off, Clay Cap, Unit Boundary Monitoring, PC Mon	$ =	45.43	(tons/year) +	111,479
25	Soil Cap, PCM, FA	$ =	18.34	(tons/year) +	69,632
			18.13		

Exhibit E -1

Annualized Before-Tax Cost Equations Developed for Each FFC Disposal Control Combinations Assuming a 40-Year Life (2005$)

Cost Equation Reference Number	Environmental Controls	Cost Equation			
26	Daily cover, Run-On/Off, Clay Cap, 150 m Mon, PCM	$ =	19.24	(tons/year) +	133,951
27	Dust, Liner, LCS, Cap, UB Mon, PC Mon, Fin Ass	$ =	44.29	(tons/year) +	245,686
28	Daily Cover, Dust Controls, UB Mon, PCM, FA	$ =	17.99	(tons/year) +	106,806
29	Unit Boundary Monitoring	$ =	17.25	(tons/year) +	100,498
30	Daily Cover, Dust Controls, 150 m Monitoring	$ =	16.20	(tons/year) +	107,510
31	UB Mon, PCM	$ =	17.25	(tons/year) +	102,791
32	Cap, UB Mon, PCM, FA	$ =	18.90	(tons/year) +	113,970
33	Soil Cap, UB Mon, PCM, FA	$ =	18.21	(tons/year) +	110,440
34	Clay Liner, Soil Cap, 150 m Mon, PCM	$ =	33.80	(tons/year) +	190,728
35	Daily Cover, Dust, 150m Mon, PCM	$ =	17.99	(tons/year) +	122,614
36	Liner, LCS, Cap, UB Mon., PCM	$ =	43.30	(tons/year) +	238,129
37	Clay Cap, PC Monitoring, Financial Assurance	$ =	18.13	(tons/year) +	69,632
38	150 m Monitoring, PCM	$ =	17.27	(tons/year) +	122,283
39	Liner, LCS, Cap, 150m Mon., PCM	$ =	43.30	(tons/year) +	257,184
40	Uncompacted, Clay/Soil Cap, UB Mon, PCM	$ =	21.04	(tons/year) +	84,810
41	Clay Liner, Clay Cap	$ =	37.61	(tons/year) +	103,968
42	Uncompacted, Clay/Soil Cap, 150 m Mon, PCM	$ =	21.04	(tons/year) +	103,865
43	Daily Cover, Run-On/Off, Liner, LCS, Clay Cap, UB mon, PCM	$ =	44.94	(tons/year) +	248,314
44	Daily Cover, Dust Controls, Run-On/Run-Off, Clay Cap, UBM, PC Mon	$ =	18.54	(tons/year) +	111,642
45	Daily Cover, Liner, LCS, Cap, 150m Mon, PCM, FA	$ =	45.17	(tons/year) +	270,385
46	Daily Cover, Cap, PCM, FA	$ =	19.39	(tons/year) +	75,436
47	Liner, LCS, Cap, Unit Boundary Mon., Post-Closure Mon., Fin. Ass.	$ =	39.72	(tons/year) +	221,191
48	Dust Controls, Run-On/Run-Off Controls, UB Monitoring, PC Mon	$ =	17.51	(tons/year) +	108,635
49	Cap, 150 m Monitoring, PC Mon, Financial Assurance, Compacted	$ =	18.90	(tons/year) +	133,921
50	Daily Cover, Dust Controls, Run-On/Off, Clay liner, LCS, Clay Cap, UB Mon, PCM, FA	$ =	40.97	(tons/year) +	235,403
51	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Soil Cap, 150 m Monitoring	$ =	44.06	(tons/year) +	259,684

Exhibit E -1

Annualized Before-Tax Cost Equations Developed for Each FFC Disposal Control Combinations Assuming a 40-Year Life (2005$)

Cost Equation Reference Number	Environmental Controls	Cost Equation			
52	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Soil Cap, 150m Mon, PC Mon, Fin Ass	$ =		(tons/year) +	269,377
53	Uncompacted, Clay/Soil Cap	$ =	44.39	(tons/year) +	38,004
54	Daily Cover, Cap, UB Mon, PCM, FA	$ =	20.95	(tons/year) +	114,682
55	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Cap, PCM	$ =	19.46	(tons/year) +	203,573
56	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Cap, Unit Boundary Mon.	$ =	44.53	(tons/year) +	220,436
57	Daily Cover, Run-On/Run-Off, Liner, LCS, Cap, 150m Mon, PC Mon, Fin Ass	$ =	40.18	(tons/year) +	274,153
58	Daily Cover, Cap, 150 m Monitoring, PC Monitoring, Financial Assurance	$ =	45.21	(tons/year) +	134,633
59	Cap, PCM, FA	$ =	19.46 18.82513	(tons/year) +	73162.23
60	UB Mon, Dust, Run-On/Run-Off, Liner, LCS, Clay Cap,PCM	$ =		(tons/year) +	220,727
61	UB Mon, Dust, FA, PCM	$ =	39.48	(tons/year) +	106,186
62	Clay liner, soil cap, UB mon (29b+1b-0b)	$ =	17.46	(tons/year) +	156,712
63	Clay liner, Clay Cap, 150 m Mon (31b+2b-0b)	$ =	30.46	(tons/year) +	177,802
64	Clay liner, Soil Cap, 150 m Mon (29b+2b-0b)	$ =	31.18	(tons/year) +	174,799
65	Clay/Soil cap, 150 m MonND+2a-0a	$ =	30.46	(tons/year) +	100,415
66	Liner, LCS, Cap (6b-(2b-0b))	$ =	21.04	(tons/year) +	169,939
67	Liner, LCS, 150 m Mon (6b-4b+2b)	$ =	38.93	(tons/year) +	224,623
68	Daily Cover, Dust, Run on/Run off, UB mon (27-7b+1b)	$ =	38.15	(tons/year) +	108,464
69	Daily Cover, Dust, Run on/Run off, Cap UB mon, FA, PC (27-5b+3b)	$ =	18.44	(tons/year) +	121,327
70	Dust, Run on/Run off, Cap, 150 mon, PC, FA (18-6b+4b)	$ =	20.02	(tons/year) +	138,392
71	Daily Cover, Dust, Run on/Run off, Cap 150 m Mon, PC, FA (28-6b+4b)	$ =	19.05	(tons/year) +	141,093
72	Daily Cover, Liner, LCS, Cap, UB Mon, PCM, FA	$ =	20.02	(tons/year) +	250,434
73	Daily Cover, Dust, Liner, LCS, Cap, 150m Mon, PCM, FA	$ =	45.17	(tons/year) +	270,548
74	Cap, UB Mon, PCM	$ =	45.38	(tons/year) +	106,919
75	Clay Liner, Cap, 150m Mon, PCM	$ =	18.11	(tons/year) +	153,215
76	Daily Cover, Dust, Cap, 150m Mon, PCM	$ =	30.20	(tons/year) +	126,790
77	Cap, 150m Mon, PCM	$ =	18.86	(tons/year) +	125,974
			18.11		

Exhibit E -1

Annualized Before-Tax Cost Equations Developed for Each FFC Disposal Control Combinations Assuming a 40-Year Life (2005$)

Cost Equation Reference Number	Environmental Controls	Cost Equation			
78	Dust, Run-On/Run-Off, Liner, LCS, Clay Cap, UB Mon, PCM, FA	$ =	40.43	(tons/year) +	228,248
79	Dust Controls, Run-On/Off, Clay Cap, UB Mon, PCM, FA	$ =	20.21	(tons/year) +	122,915
80	Daily Cover, Dust Controls, Run-On/Run-Off, Clay Cap, UB Mon, PCM, FA	$ =	19.01	(tons/year) +	117,039
81	Daily cover, Run-On/Off, Clay Cap, 150m Mon, PCM, FA	$ =	20.54	(tons/year) +	143,407
82	Daily Cover, Run-On/Run-Off, Clay Cap, UB Mon, PCM, FA	$ =	18.81	(tons/year) +	116,876
83	Clay Liner, Cap, 150m Mon, PCM, FA	$ =	31.16	(tons/year) +	178,544
84	Daily Cover, Dust, Cap, 150m Mon, PCM, FA	$ =	19.67	(tons/year) +	134,797
85	Liner, UB Mon	$ =	37.18	(tons/year) +	185,627
86	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Cap, UB Mon., PCM	$ =	40.19	(tons/year) +	222,443
87	Liner, UB Mon, PCM	$ =	37.19	(tons/year) +	187,693
	Piles Landfills - 40 year life				
101	Daily Cover, Run-On-Off, Liner, LCS, Cap, UB Mon, PCM	$ =	44.25	(tons/year) +	173,543
102	Dust Controls, Run-On/Off, Clay liner, LCS, Clay Cap, UB Mon, PCM, FA	$ =	39.92	(tons/year) +	174,565
103	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Cap, UB Mon, PC Mon, Fin Ass	$ =	45.65	(tons/year) +	179,195
104	Dust Controls, Run-On/Off, Clay Cap, UB Mon, PCM	$ =	6.38	(tons/year) +	120,640
105	Daily Cover, Dust Controls, Run-On/Off, Clay liner, LCS, Cap, UB Mon, PCM, FA	$ =	40.09	(tons/year) +	175,623
106	Dust Controls, Run-On/Off, Clay liner, LCS, Clay Cap, UB Mon, FA	$ =	39.91	(tons/year) +	169,699
107	Daily Cover, Dust Controls, Run-on/Off, Liner, LCS, Soil Cap, UB Mon, PCM, FA	$ =	44.12	(tons/year) +	177,991
108	Daily Cover, Dust Controls, Run-On/Off, Liner, LCS, Clay Cap, UB Mon, PCM, FA	$ =	46.40	(tons/year) +	180,299
109	Daily cover, Run-On/Off, Clay Cap, PCM	$ =	6.35	(tons/year) +	74,120
110	No Controls	$ =	4.33	(tons/year) +	61,544
111	Daily Cover, Dust, Liner, LCS, Cap, UB Mon, PC Mon, Fin Ass	$ =	45.59	(tons/year) +	171,940
112	150 m Monitoring	$ =	4.42	(tons/year) +	126,454
113	Daily Cover, Run-on/Off, Liner, LCS, Soil Cap, UB Mon, PCM, FA	$ =	43.91	(tons/year) +	177,828
114	Daily Cover, Run-On/Off, Liner, LCS, Clay Cap, UB mon, PCM, FA	$ =	46.20	(tons/year) +	180,136
115	Composite Liner, LCS, Cap, Unit Boundary Monitoring	$ =	43.12	(tons/year) +	161,656

Exhibit E -1

Annualized Before-Tax Cost Equations Developed for Each FFC Disposal Control Combinations Assuming a 40-Year Life (2005$)

Cost Equation Reference Number	Environmental Controls	Cost Equation			
116	Composite Liner, LCS, Cap, 150 m Monitoring	$ =	43.12	(tons/year) +	179,742
117	Daily Cover, Run-on/Off, Liner, LCS, Soil Cap, UB mon, FA	$ =	43.90	(tons/year) +	172,923
118	Liner, LCS, Cap, 150 m Mon., Post-Closure Mon., Financial Ass.	$ =	44.30	(tons/year) +	189,588
119	Dust Controls, Clay Liner, LCS, Cap, UB Mon, PCM, FA	$ =	39.05	(tons/year) +	166,268
120	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Cap, UB Mon, PC Mon	$ =	44.45	(tons/year) +	173,707
121	Daily Cover, Run-On-Off, Liner, LCS, Cap, UB Mon, PCM, FA	$ =	45.45	(tons/year) +	179,032
122	Dust, Run-On/Run-Off, Liner, LCS, Cap, UB Mon, PC Mon, Fin Ass	$ =	44.58	(tons/year) +	176,987
123	Daily Cover, Dust Controls, Run-On/Off, Liner, LCS, Soil/Clay Cap, UB Mon, PCM, FA	$ =	45.67	(tons/year) +	178,806
124	Daily Cover, Run-On/Run-Off, Clay Cap, Unit Boundary Monitoring, PC Mon.	$ =	5.51	(tons/year) +	120,111
125	Soil Cap, PCM, FA	$ =	5.75	(tons/year) +	69,779
126	Daily cover, Run-On/Off, Clay Cap, 150 m MonPCM	$ =	6.44	(tons/year) +	140,370
127	Dust, Liner, LCS, Cap, UB Mon, PC Mon, Fin Ass	$ =	44.51	(tons/year) +	169,801
128	Daily Cover, Dust Controls, UB Mon, PCM, FA	$ =	4.90	(tons/year) +	115,417
129	Unit Boundary Monitoring	$ =	4.42	(tons/year) +	108,336
130	Daily Cover, Dust Controls, 150 m Monitoring	$ =	4.89	(tons/year) +	127,312
131	UB Mon, PCM	$ =	4.42	(tons/year) +	110,972
132	Cap, UB Mon, PCM, FA	$ =	6.87	(tons/year) +	117,722
133	Soil Cap, UB Mon, PCM, FA	$ =	5.84	(tons/year) +	116,571
134	Clay Liner, Soil Cap, 150 m Mon, PCM	$ =	29.01	(tons/year) +	144,813
135	Daily Cover, Dust, UB Mon, PCM	$ =	4.89	(tons/year) +	130,936
136	Liner, LCS, Cap, UB Mon., PCM	$ =	43.13	(tons/year) +	164,183
137	Clay Cap, PC Monitoring, Financial Assurance	$ =	5.75	(tons/year) +	69,779
138	150 m Monitoring, PCM	$ =	4.44	(tons/year) +	130,097
139	Liner, LCS, Cap, 150m Mon., PCM	$ =	43.13	(tons/year) +	183,238
140	Uncompacted, Clay/Soil Cap, UB Mon, PCM	$ =	5.45	(tons/year) +	91,741
141	Clay Liner, Clay Cap	$ =	36.24	(tons/year) +	54,779

Exhibit E -1

Annualized Before-Tax Cost Equations Developed for Each FFC Disposal Control Combinations Assuming a 40-Year Life (2005$)

Cost Equation Reference Number	Environmental Controls	Cost Equation			
142	Uncompacted, Clay/Soil Cap, 150 m Mon, PCM	$ =	5.45	(tons/year) +	110,828
143	Daily Cover, Run-On/Off, Liner, LCS, Clay Cap, UB mon, PCM	$ =	44.64	(tons/year) +	174,117
144	Daily Cover, Dust Controls, Run-On/Run-Off, Clay Cap, UBM, PC Mon	$ =	5.71	(tons/year) +	120,286
145	Daily Cover, Liner, LCS, Cap, 150m Mon, PCM, FA	$ =	45.40	(tons/year) +	194,198
146	Daily Cover, Cap, PCM, FA	$ =	7.10	(tons/year) +	73,173
147	Liner, LCS, Cap, Unit Boundary Mon., Post-Closure Mon., Fin. Ass.	$ =	44.30	(tons/year) +	169,638
148	Dust Controls, Run-On/Run-Off Controls, UB Monitoring, PC Mon	$ =	4.69	(tons/year) +	118,400
149	Cap, 150 m Monitoring, PC Mon, Financial Assurance, Compacted	$ =	6.87	(tons/year) +	137,704
150	Daily Cover, Dust Controls, Run-On/Off, Clay liner, LCS, Clay Cap, UB Mon, PCM, FA	$ =	39.03	(tons/year) +	174,470
151	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Soil Cap, 150 m Monitoring	$ =	43.66	(tons/year) +	188,621
152	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Soil Cap, 150m Mon, PC Mon, Fin Ass	$ =	44.14	(tons/year) +	197,943
153	Uncompacted, Clay/Soil Cap	$ =	5.34	(tons/year) +	37,880
154	Daily Cover, Cap, UB Mon, PCM, FA	$ =	7.19	(tons/year) +	118,472
155	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Cap, PCM	$ =	44.35	(tons/year) +	124,053
156	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Cap, Unit Boundary Mon.	$ =	44.45	(tons/year) +	171,159
157	Daily Cover, Run-On/Run-Off, Liner, LCS, Cap, 150m Mon, PC Mon, Fin Ass	$ =	45.45	(tons/year) +	198,982
158	Daily Cover, Cap, 150 m Monitoring, PC Monitoring, Financial Assurance	$ =	7.19	(tons/year) +	138,454
159	Cap, PC Monitoring, Financial Assurance	$ =	6.78	(tons/year) +	70,930
160	UB Mon, Dust, Run-On/Run-Off, Liner, LCS, Clay Cap,PCM	$ =	43.81	(tons/year) +	172,116
161	UB Mon, Dust, FA, PCM	$ =	4.63	(tons/year) +	114,695
162	Clay liner, soil cap, UB mon (29b+1b-0b)	$ =	29.00	(tons/year) +	123,287
163	Clay liner, Clay Cap, 150 m Mon (31b+2b-0b)	$ =	30.19	(tons/year) +	142,599
164	Clay liner, Soil Cap, 150 m Mon (29b+2b-0b)	$ =	29.00	(tons/year) +	141,406
165	Clay/Soil cap, 150 m MonND+2a-0a	$ =	5.45	(tons/year) +	107,102
166	Liner, LCS, Cap (6b-(2b-0b))	$ =	43.03	(tons/year) +	114,832

Exhibit E -1

Annualized Before-Tax Cost Equations Developed for Each FFC Disposal Control Combinations Assuming a 40-Year Life (2005$)

Cost Equation Reference Number	Environmental Controls	Cost Equation			
167	Liner, LCS, 150 m Mon (6b-4b+2b)	$ =		(tons/year) +	177,971
168	Daily Cover, Dust, Run on/Run off, UB mon (27-7b+1b)	$ =	41.85	(tons/year) +	117,893
169	Daily Cover, Dust, Run on/Run off, Cap UB mon, FA, PC (27-5b+3b)	$ =	5.77	(tons/year) +	127,646
170	Dust, Run on/Run off, Cap, 150 mon, PC, FA (18-6b+4b)	$ =	8.22	(tons/year) +	145,420
171	Daily Cover, Dust, Run on/Run off, Cap 150 m Mon, PC, FA (28-6b+4b)	$ =	7.14	(tons/year) +	147,628
172	Daily Cover, Liner, LCS, Cap, UB Mon, PCM, FA	$ =	8.22	(tons/year) +	174,247
173	Daily Cover, Dust, Liner, LCS, Cap, 150m Mon, PCM, FA	$ =	45.40	(tons/year) +	194,361
174	Cap, UB Mon, PCM	$ =	45.60	(tons/year) +	112,635
175	Clay Liner, Cap, 150m Mon, PCM	$ =	5.69	(tons/year) +	150,576
176	Daily Cover, Dust, Cap, 150m Mon, PCM	$ =	30.17	(tons/year) +	132,614
177	Cap, 150m Mon, PCM	$ =	6.19	(tons/year) +	131,721
178	Dust, Run-On/Run-Off, Liner, LCS, Clay Cap, UB Mon, PCM, FA	$ =	5.69	(tons/year) +	178,111
179	Dust Controls, Run-On/Off, Clay Cap, UB Mon, PCM, FA	$ =	45.37	(tons/year) +	126,261
180	Daily Cover, Dust Controls, Run-On/Run-Off, Clay Cap, UB Mon, PCM, FA	$ =	7.94	(tons/year) +	124,851
181	Daily cover, Run-On/Off, Clay Cap, 150m Mon, PCM, FA	$ =	6.41	(tons/year) +	146,915
182	Daily Cover, Run-On/Run-Off, Clay Cap, UB Mon, PCM, FA	$ =	8.01	(tons/year) +	124,851
183	Clay Liner, Cap, 150m Mon, PCM, FA	$ =	6.41	(tons/year) +	150,576
184	Daily Cover, Dust, Cap, 150m Mon, PCM, FA	$ =	30.17	(tons/year) +	138,629
185	Liner, UB Mon	$ =	7.39	(tons/year) +	136,895
186	Daily Cover, Dust, Run-On/Run-Off, Liner, LCS, Cap, UB mon, PCM	$ =	40.14	(tons/year) +	173,707
187	Liner, UB Mon, PCM	$ =	44.45	(tons/year) +	139,531
			40.14		
	Surface Impoundments - 40 year life				
1	No Controls	$ =		(tons/year) +	
2	Unit Boundary Monitoring	$ =	42.45	(tons/year) +	49,176 108,637
3	150 m Monitoring	$ =	42.57	(tons/year) +	126,750
4	Cap, 150m Mon, PCM, FA	$ =	42.57	(tons/year) +	227,181
			88.23		

Exhibit E -1

Annualized Before-Tax Cost Equations Developed for Each FFC Disposal Control Combinations Assuming a 40-Year Life (2005$)

Cost Equation Reference Number	Environmental Controls	Cost Equation			
5	Composite Liner, LCS, UB Mon	$ =	106.47	(tons/year) +	289,331
6	Composite Liner, LCS	$ =	106.35	(tons/year) +	229,895
7	Clay Liner, Cap, UB Mon, PCM, FA	$ =		(tons/year) +	273,150
8	Liner, LCS, Cap, Unit Boundary Mon., Post-Closure Mon., Fin. Ass.	$ =	99.24 110.80	(tons/year) +	308,444
9	Liner, UB Mon, PCM, FA	$ =		(tons/year) +	243,179
10	Clay Liner, Soil Cap	$ =	95.01	(tons/year) +	156,199
11	Clay Liner, LCS, Cap, Unit Boundary Mon., Post-Closure Mon., Fin. Ass.	$ =	86.04 101.14	(tons/year) +	287,043
12	Unit Boundary Monitoring, FA	$ =		(tons/year) +	109,746
13	Liner, LCS, Soil Cap, UB Mon., Post-Closure Mon., Financial Ass.	$ =	42.57 108.17	(tons/year) +	301,849
14	Liner, LCS, UB Mon., PCM, FA	$ =	106.49	(tons/year) +	296,967
15	Liner, LCS, UB Mon, PCM	$ =	106.48	(tons/year) +	292,507
16	Unit Boundary Monitoring, PCM	$ =		(tons/year) +	111,813
17	Liner, Cap, 150m Mon, PCM, FA	$ =	42.58	(tons/year) +	243,641
18	Liner, 150 m Monitoring	$ =	97.16	(tons/year) +	252,601
19	Unit Boundary Monitoring, PCM, FA	$ =	94.91	(tons/year) +	115,862
20	Liner	$ =	42.58	(tons/year) +	175,068
21	Cap, PC Monitoring, Financial Assurance	$ =	94.78	(tons/year) +	
22	Liner, LCS, Cap, 150 m Mon., Post-Closure Mon., Financial Ass.	$ =	46.77 110.80	(tons/year) +	61,762 328,389
23	Cap, 150m Mon, PCM	$ =		(tons/year) +	219,837
24	Clay Liner, Cap, UB Mon, PCM	$ =	86.82	(tons/year) +	238,894
25	Clay Liner, Cap, 150m Mon, PCM	$ =	86.82 108.72	(tons/year) +	298,468
26	Composite Liner, LCS, Cap, UB Mon, PCM	$ =		(tons/year) +	262,698
27	Liner, Cap, 150m Mon, PCM	$ =	97.16	(tons/year) +	247,125
28	Liner, Cap, UB Mon., Post-Closure Mon., Financial Ass.	$ =	88.23	(tons/year) +	253,205
29	Liner, Soil Cap, UB Mon., Post-Closure Mon., Financial Ass.	$ =	99.24	(tons/year) +	248,023
30	Cap, Unit Boundary Monitoring, PCM	$ =	97.41	(tons/year) +	117,774
31	Clay Liner, Clay/Soil Cap, 150 m Monitoring, PC Monitoring, Financial Assurance	$ =	44.82	(tons/year) +	
			92.08		266,943

Exhibit E -1

Annualized Before-Tax Cost Equations Developed for Each FFC Disposal Control Combinations Assuming a 40-Year Life (2005$)

Cost Equation Reference Number	Environmental Controls	Cost Equation			
32	150 m Monitoring, PCM	$ =	42.58	(tons/year) +	130,886
33	Clay Liner, Soil Cap, UB Mon, PCM	$ =	86.17	(tons/year) +	218,811
34	Clay Liner, Soil Cap, 150m Mon, PCM	$ =	86.17	(tons/year) +	237,868
35	Clay Liner, Cap, 150m Mon, PCM, FA	$ =	46.90	(tons/year) +	147,299
36	Liner, 150 m Mon, PCM	$ =	94.91	(tons/year) +	256,737
37	Liner, UB Mon, PCM	$ =	94.91	(tons/year) +	237,680
38	Liner, Cap, UB Mon, PCM	$ =	94.91	(tons/year) +	234,504
39	Cap, Unit Boundary Monitoring, PCM, FA	$ =	46.00	(tons/year) +	127,338
40	Liner, LCS, Soil Cap, PCM, FA	$ =	106.04	(tons/year) +	244,261
41	Liner, UB Mon	$ =	44.82	(tons/year) +	136,847
44	29+2-0 (Clay Liner, Soil Cap, 150 m Monitoring), former 126	$ =	86.17	(tons/year) +	233,773
46	29+1-0 (Clay Liner, Soil Cap, UB Monitoring), former 128	$ =	86.17	(tons/year) +	215,660

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls									
	Early Implementation Groundwater and PCM Cost Equation Controls									
	Pile Landfill Units									
Years Until Closure	**UB Mon, PCM Only**					**150 m Mon, PCM Only**				
1	$ =	$ 0.41	(tons/year) +	$	198,634	$ =	$0.41	(tons/year) +	$	270,233
2	$ =	$ 0.30	(tons/year) +	$	145,375	$ =	$0.30	(tons/year) +	$	197,336
3	$ =	$ 0.25	(tons/year) +	$	125,953	$ =	$0.25	(tons/year) +	$	170,805
4	$ =	$ 0.23	(tons/year) +	$	115,116	$ =	$0.23	(tons/year) +	$	156,034
5	$ =	$ 0.22	(tons/year) +	$	107,805	$ =	$0.22	(tons/year) +	$	146,090
6	$ =	$ 0.21	(tons/year) +	$	102,327	$ =	$0.21	(tons/year) +	$	138,653
7	$ =	$ 0.20	(tons/year) +	$	97,951	$ =	$0.20	(tons/year) +	$	132,721
8	$ =	$ 0.19	(tons/year) +	$	94,307	$ =	$0.19	(tons/year) +	$	127,790
9	$ =	$ 0.18	(tons/year) +	$	91,187	$ =	$0.18	(tons/year) +	$	123,571
10	$ =	$ 0.18	(tons/year) +	$	88,462	$ =	$0.18	(tons/year) +	$	119,890
11	$ =	$ 0.17	(tons/year) +	$	86,048	$ =	$0.17	(tons/year) +	$	116,632
12	$ =	$ 0.17	(tons/year) +	$	83,887	$ =	$0.17	(tons/year) +	$	113,718
13	$ =	$ 0.17	(tons/year) +	$	81,938	$ =	$0.17	(tons/year) +	$	111,090
14	$ =	$ 0.16	(tons/year) +	$	80,168	$ =	$0.16	(tons/year) +	$	108,706
15	$ =	$ 0.16	(tons/year) +	$	78,554	$ =	$0.16	(tons/year) +	$	106,532
16	$ =	$ 0.16	(tons/year) +	$	77,076	$ =	$0.16	(tons/year) +	$	104,543
17	$ =	$ 0.15	(tons/year) +	$	75,719	$ =	$0.15	(tons/year) +	$	102,717
18	$ =	$ 0.15	(tons/year) +	$	74,470	$ =	$0.15	(tons/year) +	$	101,036
19	$ =	$ 0.15	(tons/year) +	$	73,318	$ =	$0.15	(tons/year) +	$	99,487
20	$ =	$ 0.15	(tons/year) +	$	72,254	$ =	$0.15	(tons/year) +	$	98,055
21	$ =	$ 0.14	(tons/year) +	$	71,269	$ =	$0.14	(tons/year) +	$	96,731
22	$ =	$ 0.14	(tons/year) +	$	70,356	$ =	$0.14	(tons/year) +	$	95,504
23	$ =	$ 0.14	(tons/year) +	$	69,510	$ =	$0.14	(tons/year) +	$	94,367

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls							
	Early Implementation Groundwater and PCM Cost Equation Controls							
24	$ =	$ 0.14	(tons/year) +	$ 68,725	$ =	$0.14	(tons/year) +	$ 93,312
25	$ =	$ 0.14	(tons/year) +	$ 67,996	$ =	$0.14	(tons/year) +	$ 92,332
26	$ =	$ 0.14	(tons/year) +	$ 67,318	$ =	$0.14	(tons/year) +	$ 91,421
27	$ =	$ 0.14	(tons/year) +	$ 66,688	$ =	$0.14	(tons/year) +	$ 90,574
28	$ =	$ 0.13	(tons/year) +	$ 66,101	$ =	$0.13	(tons/year) +	$ 89,786
29	$ =	$ 0.13	(tons/year) +	$ 65,555	$ =	$0.13	(tons/year) +	$ 89,053
30	$ =	$ 0.13	(tons/year) +	$ 65,047	$ =	$0.13	(tons/year) +	$ 88,371
31	$ =	$ 0.13	(tons/year) +	$ 64,574	$ =	$0.13	(tons/year) +	$ 87,735
32	$ =	$ 0.13	(tons/year) +	$ 64,133	$ =	$0.13	(tons/year) +	$ 87,143
33	$ =	$ 0.13	(tons/year) +	$ 63,722	$ =	$0.13	(tons/year) +	$ 86,591
34	$ =	$ 0.13	(tons/year) +	$ 63,339	$ =	$0.13	(tons/year) +	$ 86,076
35	$ =	$ 0.13	(tons/year) +	$ 62,981	$ =	$0.13	(tons/year) +	$ 85,596
36	$ =	$ 0.13	(tons/year) +	$ 62,648	$ =	$0.13	(tons/year) +	$ 85,149
37	$ =	$ 0.13	(tons/year) +	$ 62,337	$ =	$0.13	(tons/year) +	$ 84,732
38	$ =	$ 0.13	(tons/year) +	$ 62,047	$ =	$0.13	(tons/year) +	$ 84,343
39	$ =	$ 0.13	(tons/year) +	$ 61,777	$ =	$0.13	(tons/year) +	$ 83,979
40	$ =	$ 0.13	(tons/year) +	$ 61,524	$ =	$0.13	(tons/year) +	$ 83,640
	UB Mon PCM Only				**150 m Mon PCM Only**			
1	$ =	$ 0.08	(tons/year) +	$ 43,100	$ =	$0.08	(tons/year) +	$ 57,655
2	$ =	$ 0.08	(tons/year) +	$ 40,281	$ =	$0.08	(tons/year) +	$ 53,883
3	$ =	$ 0.07	(tons/year) +	$ 37,645	$ =	$0.07	(tons/year) +	$ 50,358
4	$ =	$ 0.07	(tons/year) +	$ 35,183	$ =	$0.07	(tons/year) +	$ 47,064
5	$ =	$ 0.06	(tons/year) +	$ 32,881	$ =	$0.06	(tons/year) +	$ 43,985
6	$ =	$ 0.06	(tons/year) +	$ 30,730	$ =	$0.06	(tons/year) +	$ 41,107
7	$ =	$ 0.06	(tons/year) +	$ 28,719	$ =	$0.06	(tons/year) +	$ 38,418
8	$ =	$ 0.05	(tons/year) +	$ 26,841	$ =	$0.05	(tons/year) +	$ 35,905

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls									
	Early Implementation Groundwater and PCM Cost Equation Controls									
9	$ =	$	0.05	(tons/year) +	$	25,085	$ =	$0.05	(tons/year) +	$ 33,556
10	$ =	$	0.04	(tons/year) +	$	23,444	$ =	$0.04	(tons/year) +	$ 31,361
11	$ =	$	0.04	(tons/year) +	$	21,910	$ =	$0.04	(tons/year) +	$ 29,309
12	$ =	$	0.04	(tons/year) +	$	20,477	$ =	$0.04	(tons/year) +	$ 27,392
13	$ =	$	0.04	(tons/year) +	$	19,137	$ =	$0.04	(tons/year) +	$ 25,600
14	$ =	$	0.03	(tons/year) +	$	17,885	$ =	$0.03	(tons/year) +	$ 23,925
15	$ =	$	0.03	(tons/year) +	$	16,715	$ =	$0.03	(tons/year) +	$ 22,360
16	$ =	$	0.03	(tons/year) +	$	15,621	$ =	$0.03	(tons/year) +	$ 20,897
17	$ =	$	0.03	(tons/year) +	$	14,600	$ =	$0.03	(tons/year) +	$ 19,530
18	$ =	$	0.03	(tons/year) +	$	13,644	$ =	$0.03	(tons/year) +	$ 18,252
19	$ =	$	0.02	(tons/year) +	$	12,752	$ =	$0.02	(tons/year) +	$ 17,058
20	$ =	$	0.02	(tons/year) +	$	11,918	$ =	$0.02	(tons/year) +	$ 15,942
21	$ =	$	0.02	(tons/year) +	$	11,138	$ =	$0.02	(tons/year) +	$ 14,899
22	$ =	$	0.02	(tons/year) +	$	10,409	$ =	$0.02	(tons/year) +	$ 13,924
23	$ =	$	0.02	(tons/year) +	$	9,728	$ =	$0.02	(tons/year) +	$ 13,014
24	$ =	$	0.02	(tons/year) +	$	9,092	$ =	$0.02	(tons/year) +	$ 12,162
25	$ =	$	0.02	(tons/year) +	$	8,497	$ =	$0.02	(tons/year) +	$ 11,367
26	$ =	$	0.02	(tons/year) +	$	7,941	$ =	$0.02	(tons/year) +	$ 10,623
27	$ =	$	0.01	(tons/year) +	$	7,422	$ =	$0.01	(tons/year) +	$ 9,928
28	$ =	$	0.01	(tons/year) +	$	6,936	$ =	$0.01	(tons/year) +	$ 9,278
29	$ =	$	0.01	(tons/year) +	$	6,482	$ =	$0.01	(tons/year) +	$ 8,671
30	$ =	$	0.01	(tons/year) +	$	6,058	$ =	$0.01	(tons/year) +	$ 8,104
31	$ =	$	0.01	(tons/year) +	$	5,662	$ =	$0.01	(tons/year) +	$ 7,574
32	$ =	$	0.01	(tons/year) +	$	5,292	$ =	$0.01	(tons/year) +	$ 7,078
33	$ =	$	0.01	(tons/year) +	$	4,945	$ =	$0.01	(tons/year) +	$ 6,615
34	$ =	$	0.01	(tons/year) +	$	4,622	$ =	$0.01	(tons/year) +	$ 6,183
35	$ =	$	0.01	(tons/year) +	$	4,319	$ =	$0.01	(tons/year) +	$ 5,778

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls									
	Early Implementation Groundwater and PCM Cost Equation Controls									
36	$ =	$	0.01	(tons/year) +	$	4,037	$ =	$0.01	(tons/year) +	$ 5,400
37	$ =	$	0.01	(tons/year) +	$	3,773	$ =	$0.01	(tons/year) +	$ 5,047
38	$ =	$	0.01	(tons/year) +	$	3,526	$ =	$0.01	(tons/year) +	$ 4,717
39	$ =	$	0.01	(tons/year) +	$	3,295	$ =	$0.01	(tons/year) +	$ 4,408
40	$ =	$	0.01	(tons/year) +	$	3,080	$ =	$0.01	(tons/year) +	$ 4,120
	UB Mon Only						**150 m Mon Only**			
1	$ =	$	0.32	(tons/year) +	$	155,533.55	$ =	$0.32	(tons/year) +	$ 212,577.68
2	$ =	$	0.22	(tons/year) +	$	105,094.86	$ =	$0.22	(tons/year) +	$ 143,453.18
3	$ =	$	0.18	(tons/year) +	$	88,307.59	$ =	$0.18	(tons/year) +	$ 120,446.81
4	$ =	$	0.16	(tons/year) +	$	79,933.13	$ =	$0.16	(tons/year) +	$ 108,969.90
5	$ =	$	0.15	(tons/year) +	$	74,923.74	$ =	$0.15	(tons/year) +	$ 102,104.70
6	$ =	$	0.15	(tons/year) +	$	71,596.84	$ =	$0.15	(tons/year) +	$ 97,545.30
7	$ =	$	0.14	(tons/year) +	$	69,231.31	$ =	$0.14	(tons/year) +	$ 94,303.42
8	$ =	$	0.14	(tons/year) +	$	67,466.57	$ =	$0.14	(tons/year) +	$ 91,884.91
9	$ =	$	0.14	(tons/year) +	$	66,102.31	$ =	$0.14	(tons/year) +	$ 90,015.24
10	$ =	$	0.13	(tons/year) +	$	65,018.33	$ =	$0.13	(tons/year) +	$ 88,529.67
11	$ =	$	0.13	(tons/year) +	$	64,138.12	$ =	$0.13	(tons/year) +	$ 87,323.37
12	$ =	$	0.13	(tons/year) +	$	63,410.68	$ =	$0.13	(tons/year) +	$ 86,326.45
13	$ =	$	0.13	(tons/year) +	$	62,800.71	$ =	$0.13	(tons/year) +	$ 85,490.50
14	$ =	$	0.13	(tons/year) +	$	62,282.97	$ =	$0.13	(tons/year) +	$ 84,780.96
15	$ =	$	0.13	(tons/year) +	$	61,838.96	$ =	$0.13	(tons/year) +	$ 84,172.46
16	$ =	$	0.13	(tons/year) +	$	61,454.80	$ =	$0.13	(tons/year) +	$ 83,645.98
17	$ =	$	0.13	(tons/year) +	$	61,119.87	$ =	$0.13	(tons/year) +	$ 83,186.97
18	$ =	$	0.12	(tons/year) +	$	60,825.91	$ =	$0.12	(tons/year) +	$ 82,784.11
19	$ =	$	0.12	(tons/year) +	$	60,566.40	$ =	$0.12	(tons/year) +	$ 82,428.45
20	$ =	$	0.12	(tons/year) +	$	60,336.10	$ =	$0.12	(tons/year) +	$ 82,112.84

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls										
	Early Implementation Groundwater and PCM Cost Equation Controls										
21	$ =	$	0.12	(tons/year) +	$	60,130.81	$ =	$0.12	(tons/year) +	$	81,831.49
22	$ =	$	0.12	(tons/year) +	$	59,947.05	$ =	$0.12	(tons/year) +	$	81,579.65
23	$ =	$	0.12	(tons/year) +	$	59,781.96	$ =	$0.12	(tons/year) +	$	81,353.41
24	$ =	$	0.12	(tons/year) +	$	59,633.16	$ =	$0.12	(tons/year) +	$	81,149.49
25	$ =	$	0.12	(tons/year) +	$	59,498.65	$ =	$0.12	(tons/year) +	$	80,965.14
26	$ =	$	0.12	(tons/year) +	$	59,376.73	$ =	$0.12	(tons/year) +	$	80,798.05
27	$ =	$	0.12	(tons/year) +	$	59,265.95	$ =	$0.12	(tons/year) +	$	80,646.24
28	$ =	$	0.12	(tons/year) +	$	59,165.07	$ =	$0.12	(tons/year) +	$	80,507.99
29	$ =	$	0.12	(tons/year) +	$	59,073.03	$ =	$0.12	(tons/year) +	$	80,381.85
30	$ =	$	0.12	(tons/year) +	$	58,988.90	$ =	$0.12	(tons/year) +	$	80,266.54
31	$ =	$	0.12	(tons/year) +	$	58,911.86	$ =	$0.12	(tons/year) +	$	80,160.96
32	$ =	$	0.12	(tons/year) +	$	58,841.21	$ =	$0.12	(tons/year) +	$	80,064.15
33	$ =	$	0.12	(tons/year) +	$	58,776.34	$ =	$0.12	(tons/year) +	$	79,975.24
34	$ =	$	0.12	(tons/year) +	$	58,716.69	$ =	$0.12	(tons/year) +	$	79,893.49
35	$ =	$	0.12	(tons/year) +	$	58,661.77	$ =	$0.12	(tons/year) +	$	79,818.23
36	$ =	$	0.12	(tons/year) +	$	58,611.16	$ =	$0.12	(tons/year) +	$	79,748.87
37	$ =	$	0.12	(tons/year) +	$	58,564.48	$ =	$0.12	(tons/year) +	$	79,684.89
38	$ =	$	0.12	(tons/year) +	$	58,521.37	$ =	$0.12	(tons/year) +	$	79,625.81
39	$ =	$	0.12	(tons/year) +	$	58,481.53	$ =	$0.12	(tons/year) +	$	79,571.21
40	$ =	$	0.12	(tons/year) +	$	58,444.68	$ =	$0.12	(tons/year) +	$	79,520.71
	Excavated Landfill Units										
	UB Mon, PCM Only						**150 m Mon, PCM Only**				
1	$ =	$	0.30	(tons/year) +	$	157,719.73	$ =	$0.30	(tons/year) +	$	229,324.49
2	$ =	$	0.22	(tons/year) +	$	115,603.67	$ =	$0.22	(tons/year) +	$	167,570.07
3	$ =	$	0.19	(tons/year) +	$	100,229.02	$ =	$0.19	(tons/year) +	$	145,086.06
4	$ =	$	0.17	(tons/year) +	$	91,640.70	$ =	$0.17	(tons/year) +	$	132,563.28

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls									
	Early Implementation Groundwater and PCM Cost Equation Controls									
5	$ =	$ 0.16	(tons/year) +	$ 85,840.61		$ =	$0.16	(tons/year) +	$ 124,129.81	
6	$ =	$ 0.15	(tons/year) +	$ 81,490.60		$ =	$0.15	(tons/year) +	$ 117,820.59	
7	$ =	$ 0.14	(tons/year) +	$ 78,012.91		$ =	$0.14	(tons/year) +	$ 112,787.38	
8	$ =	$ 0.14	(tons/year) +	$ 75,115.22		$ =	$0.14	(tons/year) +	$ 108,601.19	
9	$ =	$ 0.13	(tons/year) +	$ 72,632.36		$ =	$0.13	(tons/year) +	$ 105,019.70	
10	$ =	$ 0.13	(tons/year) +	$ 70,462.88		$ =	$0.13	(tons/year) +	$ 101,894.25	
11	$ =	$ 0.13	(tons/year) +	$ 68,540.33		$ =	$0.13	(tons/year) +	$ 99,127.48	
12	$ =	$ 0.12	(tons/year) +	$ 66,818.79		$ =	$0.12	(tons/year) +	$ 96,652.21	
13	$ =	$ 0.12	(tons/year) +	$ 65,265.08		$ =	$0.12	(tons/year) +	$ 94,419.97	
14	$ =	$ 0.12	(tons/year) +	$ 63,854.38		$ =	$0.12	(tons/year) +	$ 92,394.51	
15	$ =	$ 0.12	(tons/year) +	$ 62,567.46		$ =	$0.12	(tons/year) +	$ 90,547.83	
16	$ =	$ 0.11	(tons/year) +	$ 61,389.08		$ =	$0.11	(tons/year) +	$ 88,857.70	
17	$ =	$ 0.11	(tons/year) +	$ 60,306.83		$ =	$0.11	(tons/year) +	$ 87,306.12	
18	$ =	$ 0.11	(tons/year) +	$ 59,310.44		$ =	$0.11	(tons/year) +	$ 85,878.16	
19	$ =	$ 0.11	(tons/year) +	$ 58,391.26		$ =	$0.11	(tons/year) +	$ 84,561.28	
20	$ =	$ 0.11	(tons/year) +	$ 57,541.89		$ =	$0.11	(tons/year) +	$ 83,344.77	
21	$ =	$ 0.11	(tons/year) +	$ 56,755.93		$ =	$0.11	(tons/year) +	$ 82,219.36	
22	$ =	$ 0.10	(tons/year) +	$ 56,027.80		$ =	$0.10	(tons/year) +	$ 81,176.99	
23	$ =	$ 0.10	(tons/year) +	$ 55,352.56		$ =	$0.10	(tons/year) +	$ 80,210.54	
24	$ =	$ 0.10	(tons/year) +	$ 54,725.83		$ =	$0.10	(tons/year) +	$ 79,313.68	
25	$ =	$ 0.10	(tons/year) +	$ 54,143.70		$ =	$0.10	(tons/year) +	$ 78,480.78	
26	$ =	$ 0.10	(tons/year) +	$ 53,602.65		$ =	$0.10	(tons/year) +	$ 77,706.76	
27	$ =	$ 0.10	(tons/year) +	$ 53,099.50		$ =	$0.10	(tons/year) +	$ 76,987.06	
28	$ =	$ 0.10	(tons/year) +	$ 52,631.36		$ =	$0.10	(tons/year) +	$ 76,317.52	
29	$ =	$ 0.10	(tons/year) +	$ 52,195.61		$ =	$0.10	(tons/year) +	$ 75,694.38	
30	$ =	$ 0.10	(tons/year) +	$ 51,789.86		$ =	$0.10	(tons/year) +	$ 75,114.19	
31	$ =	$ 0.10	(tons/year) +	$ 51,411.92		$ =	$0.10	(tons/year) +	$ 74,573.81	

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls									
	Early Implementation Groundwater and PCM Cost Equation Controls									
32	$ =	$	0.10	(tons/year) +	$	51,059.76	$ =	$0.10	(tons/year) +	$ 74,070.35
33	$ =	$	0.09	(tons/year) +	$	50,731.56	$ =	$0.09	(tons/year) +	$ 73,601.16
34	$ =	$	0.09	(tons/year) +	$	50,425.60	$ =	$0.09	(tons/year) +	$ 73,163.80
35	$ =	$	0.09	(tons/year) +	$	50,140.31	$ =	$0.09	(tons/year) +	$ 72,756.03
36	$ =	$	0.09	(tons/year) +	$	49,874.25	$ =	$0.09	(tons/year) +	$ 72,375.76
37	$ =	$	0.09	(tons/year) +	$	49,626.09	$ =	$0.09	(tons/year) +	$ 72,021.07
38	$ =	$	0.09	(tons/year) +	$	49,394.56	$ =	$0.09	(tons/year) +	$ 71,690.20
39	$ =	$	0.09	(tons/year) +	$	49,178.55	$ =	$0.09	(tons/year) +	$ 71,381.49
40	$ =	$	0.09	(tons/year) +	$	48,976.96	$ =	$0.09	(tons/year) +	$ 71,093.43
	UB Mon PCM Only						**150 m Mon PCM Only**			
1	$ =	$	0.06	(tons/year) +	$	34,479.73	$ =	$0.06	(tons/year) +	$ 49,040.37
2	$ =	$	0.06	(tons/year) +	$	32,224.05	$ =	$0.06	(tons/year) +	$ 45,832.12
3	$ =	$	0.05	(tons/year) +	$	30,115.93	$ =	$0.05	(tons/year) +	$ 42,833.75
4	$ =	$	0.05	(tons/year) +	$	28,145.73	$ =	$0.05	(tons/year) +	$ 40,031.55
5	$ =	$	0.05	(tons/year) +	$	26,304.42	$ =	$0.05	(tons/year) +	$ 37,412.66
6	$ =	$	0.04	(tons/year) +	$	24,583.57	$ =	$0.04	(tons/year) +	$ 34,965.10
7	$ =	$	0.04	(tons/year) +	$	22,975.30	$ =	$0.04	(tons/year) +	$ 32,677.67
8	$ =	$	0.04	(tons/year) +	$	21,472.24	$ =	$0.04	(tons/year) +	$ 30,539.87
9	$ =	$	0.04	(tons/year) +	$	20,067.52	$ =	$0.04	(tons/year) +	$ 28,541.94
10	$ =	$	0.03	(tons/year) +	$	18,754.69	$ =	$0.03	(tons/year) +	$ 26,674.71
11	$ =	$	0.03	(tons/year) +	$	17,527.75	$ =	$0.03	(tons/year) +	$ 24,929.63
12	$ =	$	0.03	(tons/year) +	$	16,381.07	$ =	$0.03	(tons/year) +	$ 23,298.72
13	$ =	$	0.03	(tons/year) +	$	15,309.41	$ =	$0.03	(tons/year) +	$ 21,774.51
14	$ =	$	0.03	(tons/year) +	$	14,307.86	$ =	$0.03	(tons/year) +	$ 20,350.01
15	$ =	$	0.02	(tons/year) +	$	13,371.83	$ =	$0.02	(tons/year) +	$ 19,018.70
16	$ =	$	0.02	(tons/year) +	$	12,497.04	$ =	$0.02	(tons/year) +	$ 17,774.49

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls									
	Early Implementation Groundwater and PCM Cost Equation Controls									
17	$ =	$	0.02	(tons/year) +	$	11,679.48	$ =	$0.02	(tons/year) +	$ 16,611.67
18	$ =	$	0.02	(tons/year) +	$	10,915.40	$ =	$0.02	(tons/year) +	$ 15,524.92
19	$ =	$	0.02	(tons/year) +	$	10,201.31	$ =	$0.02	(tons/year) +	$ 14,509.27
20	$ =	$	0.02	(tons/year) +	$	9,533.93	$ =	$0.02	(tons/year) +	$ 13,560.07
21	$ =	$	0.02	(tons/year) +	$	8,910.22	$ =	$0.02	(tons/year) +	$ 12,672.96
22	$ =	$	0.01	(tons/year) +	$	8,327.31	$ =	$0.01	(tons/year) +	$ 11,843.89
23	$ =	$	0.01	(tons/year) +	$	7,782.53	$ =	$0.01	(tons/year) +	$ 11,069.06
24	$ =	$	0.01	(tons/year) +	$	7,273.39	$ =	$0.01	(tons/year) +	$ 10,344.91
25	$ =	$	0.01	(tons/year) +	$	6,797.56	$ =	$0.01	(tons/year) +	$ 9,668.14
26	$ =	$	0.01	(tons/year) +	$	6,352.86	$ =	$0.01	(tons/year) +	$ 9,035.65
27	$ =	$	0.01	(tons/year) +	$	5,937.25	$ =	$0.01	(tons/year) +	$ 8,444.53
28	$ =	$	0.01	(tons/year) +	$	5,548.84	$ =	$0.01	(tons/year) +	$ 7,892.08
29	$ =	$	0.01	(tons/year) +	$	5,185.83	$ =	$0.01	(tons/year) +	$ 7,375.78
30	$ =	$	0.01	(tons/year) +	$	4,846.57	$ =	$0.01	(tons/year) +	$ 6,893.25
31	$ =	$	0.01	(tons/year) +	$	4,529.50	$ =	$0.01	(tons/year) +	$ 6,442.29
32	$ =	$	0.01	(tons/year) +	$	4,233.18	$ =	$0.01	(tons/year) +	$ 6,020.83
33	$ =	$	0.01	(tons/year) +	$	3,956.24	$ =	$0.01	(tons/year) +	$ 5,626.95
34	$ =	$	0.01	(tons/year) +	$	3,697.42	$ =	$0.01	(tons/year) +	$ 5,258.83
35	$ =	$	0.01	(tons/year) +	$	3,455.54	$ =	$0.01	(tons/year) +	$ 4,914.79
36	$ =	$	0.01	(tons/year) +	$	3,229.47	$ =	$0.01	(tons/year) +	$ 4,593.26
37	$ =	$	0.01	(tons/year) +	$	3,018.20	$ =	$0.01	(tons/year) +	$ 4,292.77
38	$ =	$	0.00	(tons/year) +	$	2,820.75	$ =	$0.00	(tons/year) +	$ 4,011.94
39	$ =	$	0.00	(tons/year) +	$	2,636.21	$ =	$0.00	(tons/year) +	$ 3,749.47
40	$ =	$	0.00	(tons/year) +	$	2,463.75	$ =	$0.00	(tons/year) +	$ 3,504.18
	UB Mon Only						**150 m Mon**			
1	$ =	$	0.24	(tons/year) +	$	123,240.00	$ =	$0.24	(tons/year) +	$ 180,284

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls									
	Early Implementation Groundwater and PCM Cost Equation Controls									
2	$ =	$	0.16	(tons/year) +	$	83,379.63	$ =	$0.16	(tons/year) +	$ 121,738
3	$ =	$	0.13	(tons/year) +	$	70,113.09	$ =	$0.13	(tons/year) +	$ 102,252
4	$ =	$	0.12	(tons/year) +	$	63,494.97	$ =	$0.12	(tons/year) +	$ 92,532
5	$ =	$	0.11	(tons/year) +	$	59,536.19	$ =	$0.11	(tons/year) +	$ 86,717
6	$ =	$	0.11	(tons/year) +	$	56,907.02	$ =	$0.11	(tons/year) +	$ 82,855
7	$ =	$	0.10	(tons/year) +	$	55,037.61	$ =	$0.10	(tons/year) +	$ 80,110
8	$ =	$	0.10	(tons/year) +	$	53,642.98	$ =	$0.10	(tons/year) +	$ 78,061
9	$ =	$	0.10	(tons/year) +	$	52,564.84	$ =	$0.10	(tons/year) +	$ 76,478
10	$ =	$	0.10	(tons/year) +	$	51,708.19	$ =	$0.10	(tons/year) +	$ 75,220
11	$ =	$	0.10	(tons/year) +	$	51,012.59	$ =	$0.10	(tons/year) +	$ 74,198
12	$ =	$	0.10	(tons/year) +	$	50,437.72	$ =	$0.10	(tons/year) +	$ 73,353
13	$ =	$	0.09	(tons/year) +	$	49,955.67	$ =	$0.09	(tons/year) +	$ 72,645
14	$ =	$	0.09	(tons/year) +	$	49,546.52	$ =	$0.09	(tons/year) +	$ 72,045
15	$ =	$	0.09	(tons/year) +	$	49,195.63	$ =	$0.09	(tons/year) +	$ 71,529
16	$ =	$	0.09	(tons/year) +	$	48,892.04	$ =	$0.09	(tons/year) +	$ 71,083
17	$ =	$	0.09	(tons/year) +	$	48,627.35	$ =	$0.09	(tons/year) +	$ 70,694
18	$ =	$	0.09	(tons/year) +	$	48,395.04	$ =	$0.09	(tons/year) +	$ 70,353
19	$ =	$	0.09	(tons/year) +	$	48,189.95	$ =	$0.09	(tons/year) +	$ 70,052
20	$ =	$	0.09	(tons/year) +	$	48,007.96	$ =	$0.09	(tons/year) +	$ 69,785
21	$ =	$	0.09	(tons/year) +	$	47,845.72	$ =	$0.09	(tons/year) +	$ 69,546
22	$ =	$	0.09	(tons/year) +	$	47,700.50	$ =	$0.09	(tons/year) +	$ 69,333
23	$ =	$	0.09	(tons/year) +	$	47,570.03	$ =	$0.09	(tons/year) +	$ 69,141
24	$ =	$	0.09	(tons/year) +	$	47,452.44	$ =	$0.09	(tons/year) +	$ 68,969
25	$ =	$	0.09	(tons/year) +	$	47,346.14	$ =	$0.09	(tons/year) +	$ 68,813
26	$ =	$	0.09	(tons/year) +	$	47,249.79	$ =	$0.09	(tons/year) +	$ 68,671
27	$ =	$	0.09	(tons/year) +	$	47,162.24	$ =	$0.09	(tons/year) +	$ 68,543
28	$ =	$	0.09	(tons/year) +	$	47,082.52	$ =	$0.09	(tons/year) +	$ 68,425

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls										
	Early Implementation Groundwater and PCM Cost Equation Controls										
29	$ =	$	0.09	(tons/year) +	$	47,009.78	$ =	$0.09	(tons/year) +	$	68,319
30	$ =	$	0.09	(tons/year) +	$	46,943.29	$ =	$0.09	(tons/year) +	$	68,221
31	$ =	$	0.09	(tons/year) +	$	46,882.41	$ =	$0.09	(tons/year) +	$	68,132
32	$ =	$	0.09	(tons/year) +	$	46,826.58	$ =	$0.09	(tons/year) +	$	68,050
33	$ =	$	0.09	(tons/year) +	$	46,775.32	$ =	$0.09	(tons/year) +	$	67,974
34	$ =	$	0.09	(tons/year) +	$	46,728.17	$ =	$0.09	(tons/year) +	$	67,905
35	$ =	$	0.09	(tons/year) +	$	46,684.78	$ =	$0.09	(tons/year) +	$	67,841
36	$ =	$	0.09	(tons/year) +	$	46,644.78	$ =	$0.09	(tons/year) +	$	67,782
37	$ =	$	0.09	(tons/year) +	$	46,607.89	$ =	$0.09	(tons/year) +	$	67,728
38	$ =	$	0.09	(tons/year) +	$	46,573.82	$ =	$0.09	(tons/year) +	$	67,678
39	$ =	$	0.09	(tons/year) +	$	46,542.33	$ =	$0.09	(tons/year) +	$	67,632
40	$ =	$	0.09	(tons/year) +	$	46,513.21	$ =	$0.09	(tons/year) +	$	67,589
	Surface Impoundment Units										
	UB Mon, PCM Only						**150 m Mon, PCM Only**				
1	$ =	$	0.48	(tons/year) +	$	229,860	$ =	$0.48	(tons/year) +	$	301,440
2	$ =	$	0.35	(tons/year) +	$	167,594	$ =	$0.35	(tons/year) +	$	219,545
3	$ =	$	0.30	(tons/year) +	$	144,990	$ =	$0.30	(tons/year) +	$	189,840
4	$ =	$	0.28	(tons/year) +	$	132,442	$ =	$0.27	(tons/year) +	$	173,365
5	$ =	$	0.26	(tons/year) +	$	124,018	$ =	$0.26	(tons/year) +	$	162,314
6	$ =	$	0.24	(tons/year) +	$	117,733	$ =	$0.24	(tons/year) +	$	154,077
7	$ =	$	0.23	(tons/year) +	$	112,732	$ =	$0.23	(tons/year) +	$	147,527
8	$ =	$	0.23	(tons/year) +	$	108,581	$ =	$0.22	(tons/year) +	$	142,093
9	$ =	$	0.22	(tons/year) +	$	105,035	$ =	$0.22	(tons/year) +	$	137,454
10	$ =	$	0.21	(tons/year) +	$	101,946	$ =	$0.21	(tons/year) +	$	133,414
11	$ =	$	0.21	(tons/year) +	$	99,214	$ =	$0.21	(tons/year) +	$	129,843
12	$ =	$	0.20	(tons/year) +	$	96,773	$ =	$0.20	(tons/year) +	$	126,653

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls									
	Early Implementation Groundwater and PCM Cost Equation Controls									
13	$ =	$	0.20	(tons/year) +	$	94,574	$ =	$0.20	(tons/year) +	$	123,779
14	$ =	$	0.19	(tons/year) +	$	92,579	$ =	$0.19	(tons/year) +	$	121,174
15	$ =	$	0.19	(tons/year) +	$	90,762	$ =	$0.19	(tons/year) +	$	118,800
16	$ =	$	0.18	(tons/year) +	$	89,100	$ =	$0.18	(tons/year) +	$	116,630
17	$ =	$	0.18	(tons/year) +	$	87,575	$ =	$0.18	(tons/year) +	$	114,639
18	$ =	$	0.18	(tons/year) +	$	86,172	$ =	$0.18	(tons/year) +	$	112,807
19	$ =	$	0.18	(tons/year) +	$	84,879	$ =	$0.18	(tons/year) +	$	111,119
20	$ =	$	0.17	(tons/year) +	$	83,684	$ =	$0.17	(tons/year) +	$	109,560
21	$ =	$	0.17	(tons/year) +	$	82,579	$ =	$0.17	(tons/year) +	$	108,118
22	$ =	$	0.17	(tons/year) +	$	81,557	$ =	$0.17	(tons/year) +	$	106,783
23	$ =	$	0.17	(tons/year) +	$	80,608	$ =	$0.17	(tons/year) +	$	105,546
24	$ =	$	0.17	(tons/year) +	$	79,729	$ =	$0.16	(tons/year) +	$	104,398
25	$ =	$	0.16	(tons/year) +	$	78,912	$ =	$0.16	(tons/year) +	$	103,332
26	$ =	$	0.16	(tons/year) +	$	78,153	$ =	$0.16	(tons/year) +	$	102,342
27	$ =	$	0.16	(tons/year) +	$	77,448	$ =	$0.16	(tons/year) +	$	101,422
28	$ =	$	0.16	(tons/year) +	$	76,791	$ =	$0.16	(tons/year) +	$	100,566
29	$ =	$	0.16	(tons/year) +	$	76,181	$ =	$0.16	(tons/year) +	$	99,769
30	$ =	$	0.16	(tons/year) +	$	75,612	$ =	$0.16	(tons/year) +	$	99,027
31	$ =	$	0.16	(tons/year) +	$	75,082	$ =	$0.16	(tons/year) +	$	98,337
32	$ =	$	0.16	(tons/year) +	$	74,589	$ =	$0.15	(tons/year) +	$	97,693
33	$ =	$	0.15	(tons/year) +	$	74,130	$ =	$0.15	(tons/year) +	$	97,094
34	$ =	$	0.15	(tons/year) +	$	73,701	$ =	$0.15	(tons/year) +	$	96,535
35	$ =	$	0.15	(tons/year) +	$	73,302	$ =	$0.15	(tons/year) +	$	96,014
36	$ =	$	0.15	(tons/year) +	$	72,929	$ =	$0.15	(tons/year) +	$	95,528
37	$ =	$	0.15	(tons/year) +	$	72,582	$ =	$0.15	(tons/year) +	$	95,075
38	$ =	$	0.15	(tons/year) +	$	72,258	$ =	$0.15	(tons/year) +	$	94,652
39	$ =	$	0.15	(tons/year) +	$	71,955	$ =	$0.15	(tons/year) +	$	94,258

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls								
	Early Implementation Groundwater and PCM Cost Equation Controls								
40	$ =	$ 0.15	(tons/year) +	$	71,673	$ =	$0.15	(tons/year) +	$ 93,890
	UB Mon PCM Only					**150 m Mon PCM Only**			
1	$ =	$ 0.10	(tons/year) +	$	47,758.10	$ =	$0.10	(tons/year) +	$ 62,185
2	$ =	$ 0.09	(tons/year) +	$	44,633.74	$ =	$0.09	(tons/year) +	$ 58,116
3	$ =	$ 0.08	(tons/year) +	$	41,713.77	$ =	$0.08	(tons/year) +	$ 54,314
4	$ =	$ 0.08	(tons/year) +	$	38,984.83	$ =	$0.08	(tons/year) +	$ 50,761
5	$ =	$ 0.07	(tons/year) +	$	36,434.42	$ =	$0.07	(tons/year) +	$ 47,440
6	$ =	$ 0.07	(tons/year) +	$	34,050.86	$ =	$0.07	(tons/year) +	$ 44,337
7	$ =	$ 0.06	(tons/year) +	$	31,823.24	$ =	$0.06	(tons/year) +	$ 41,436
8	$ =	$ 0.06	(tons/year) +	$	29,741.34	$ =	$0.06	(tons/year) +	$ 38,725
9	$ =	$ 0.06	(tons/year) +	$	27,795.65	$ =	$0.06	(tons/year) +	$ 36,192
10	$ =	$ 0.05	(tons/year) +	$	25,977.24	$ =	$0.05	(tons/year) +	$ 33,824
11	$ =	$ 0.05	(tons/year) +	$	24,277.79	$ =	$0.05	(tons/year) +	$ 31,611
12	$ =	$ 0.05	(tons/year) +	$	22,689.53	$ =	$0.05	(tons/year) +	$ 29,543
13	$ =	$ 0.04	(tons/year) +	$	21,205.17	$ =	$0.04	(tons/year) +	$ 27,611
14	$ =	$ 0.04	(tons/year) +	$	19,817.91	$ =	$0.04	(tons/year) +	$ 25,804
15	$ =	$ 0.04	(tons/year) +	$	18,521.41	$ =	$0.04	(tons/year) +	$ 24,116
16	$ =	$ 0.04	(tons/year) +	$	17,309.73	$ =	$0.04	(tons/year) +	$ 22,539
17	$ =	$ 0.03	(tons/year) +	$	16,177.32	$ =	$0.03	(tons/year) +	$ 21,064
18	$ =	$ 0.03	(tons/year) +	$	15,118.99	$ =	$0.03	(tons/year) +	$ 19,686
19	$ =	$ 0.03	(tons/year) +	$	14,129.90	$ =	$0.03	(tons/year) +	$ 18,398
20	$ =	$ 0.03	(tons/year) +	$	13,205.51	$ =	$0.03	(tons/year) +	$ 17,195
21	$ =	$ 0.03	(tons/year) +	$	12,341.60	$ =	$0.03	(tons/year) +	$ 16,070
22	$ =	$ 0.02	(tons/year) +	$	11,534.21	$ =	$0.02	(tons/year) +	$ 15,018
23	$ =	$ 0.02	(tons/year) +	$	10,779.63	$ =	$0.02	(tons/year) +	$ 14,036
24	$ =	$ 0.02	(tons/year) +	$	10,074.42	$ =	$0.02	(tons/year) +	$ 13,118

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls											
	Early Implementation Groundwater and PCM Cost Equation Controls											
25	$ =	$	0.02	(tons/year) +	$	9,415.35	$ =	$0.02	(tons/year) +	$	12,259
26	$ =	$	0.02	(tons/year) +	$	8,799.39	$ =	$0.02	(tons/year) +	$	11,457
27	$ =	$	0.02	(tons/year) +	$	8,223.73	$ =	$0.02	(tons/year) +	$	10,708
28	$ =	$	0.02	(tons/year) +	$	7,685.73	$ =	$0.02	(tons/year) +	$	10,007
29	$ =	$	0.01	(tons/year) +	$	7,182.92	$ =	$0.01	(tons/year) +	$	9,353
30	$ =	$	0.01	(tons/year) +	$	6,713.01	$ =	$0.01	(tons/year) +	$	8,741
31	$ =	$	0.01	(tons/year) +	$	6,273.84	$ =	$0.01	(tons/year) +	$	8,169
32	$ =	$	0.01	(tons/year) +	$	5,863.41	$ =	$0.01	(tons/year) +	$	7,635
33	$ =	$	0.01	(tons/year) +	$	5,479.82	$ =	$0.01	(tons/year) +	$	7,135
34	$ =	$	0.01	(tons/year) +	$	5,121.33	$ =	$0.01	(tons/year) +	$	6,668
35	$ =	$	0.01	(tons/year) +	$	4,786.29	$ =	$0.01	(tons/year) +	$	6,232
36	$ =	$	0.01	(tons/year) +	$	4,473.16	$ =	$0.01	(tons/year) +	$	5,824
37	$ =	$	0.01	(tons/year) +	$	4,180.53	$ =	$0.01	(tons/year) +	$	5,443
38	$ =	$	0.01	(tons/year) +	$	3,907.03	$ =	$0.01	(tons/year) +	$	5,087
39	$ =	$	0.01	(tons/year) +	$	3,651.43	$ =	$0.01	(tons/year) +	$	4,754
40	$ =	$	0.01	(tons/year) +	$	3,412.56	$ =	$0.01	(tons/year) +	$	4,443
	UB Mon Only						**150 m Mon**				
1	$ =	$	0.38	(tons/year) +	$	182,102	$ =	$0.38	(tons/year) +	$	239,256
2	$ =	$	0.26	(tons/year) +	$	122,960	$ =	$0.26	(tons/year) +	$	161,428
3	$ =	$	0.22	(tons/year) +	$	103,276	$ =	$0.22	(tons/year) +	$	135,525
4	$ =	$	0.20	(tons/year) +	$	93,457	$ =	$0.20	(tons/year) +	$	122,604
5	$ =	$	0.18	(tons/year) +	$	87,583	$ =	$0.18	(tons/year) +	$	114,874
6	$ =	$	0.17	(tons/year) +	$	83,682	$ =	$0.17	(tons/year) +	$	109,741
7	$ =	$	0.17	(tons/year) +	$	80,909	$ =	$0.17	(tons/year) +	$	106,091
8	$ =	$	0.16	(tons/year) +	$	78,839	$ =	$0.16	(tons/year) +	$	103,368
9	$ =	$	0.16	(tons/year) +	$	77,240	$ =	$0.16	(tons/year) +	$	101,263

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls									
	Early Implementation Groundwater and PCM Cost Equation Controls									
10	$ =	$	0.16	(tons/year) +	$	75,969	$ =	$0.16	(tons/year) +	$	99,590
11	$ =	$	0.16	(tons/year) +	$	74,937	$ =	$0.16	(tons/year) +	$	98,232
12	$ =	$	0.15	(tons/year) +	$	74,084	$ =	$0.15	(tons/year) +	$	97,109
13	$ =	$	0.15	(tons/year) +	$	73,368	$ =	$0.15	(tons/year) +	$	96,168
14	$ =	$	0.15	(tons/year) +	$	72,761	$ =	$0.15	(tons/year) +	$	95,369
15	$ =	$	0.15	(tons/year) +	$	72,241	$ =	$0.15	(tons/year) +	$	94,684
16	$ =	$	0.15	(tons/year) +	$	71,790	$ =	$0.15	(tons/year) +	$	94,091
17	$ =	$	0.15	(tons/year) +	$	71,398	$ =	$0.15	(tons/year) +	$	93,575
18	$ =	$	0.15	(tons/year) +	$	71,053	$ =	$0.15	(tons/year) +	$	93,121
19	$ =	$	0.15	(tons/year) +	$	70,749	$ =	$0.15	(tons/year) +	$	92,721
20	$ =	$	0.15	(tons/year) +	$	70,479	$ =	$0.15	(tons/year) +	$	92,365
21	$ =	$	0.15	(tons/year) +	$	70,238	$ =	$0.15	(tons/year) +	$	92,048
22	$ =	$	0.15	(tons/year) +	$	70,022	$ =	$0.15	(tons/year) +	$	91,765
23	$ =	$	0.15	(tons/year) +	$	69,829	$ =	$0.14	(tons/year) +	$	91,510
24	$ =	$	0.15	(tons/year) +	$	69,654	$ =	$0.14	(tons/year) +	$	91,281
25	$ =	$	0.14	(tons/year) +	$	69,497	$ =	$0.14	(tons/year) +	$	91,073
26	$ =	$	0.14	(tons/year) +	$	69,354	$ =	$0.14	(tons/year) +	$	90,885
27	$ =	$	0.14	(tons/year) +	$	69,224	$ =	$0.14	(tons/year) +	$	90,714
28	$ =	$	0.14	(tons/year) +	$	69,106	$ =	$0.14	(tons/year) +	$	90,558
29	$ =	$	0.14	(tons/year) +	$	68,998	$ =	$0.14	(tons/year) +	$	90,416
30	$ =	$	0.14	(tons/year) +	$	68,899	$ =	$0.14	(tons/year) +	$	90,286
31	$ =	$	0.14	(tons/year) +	$	68,809	$ =	$0.14	(tons/year) +	$	90,168
32	$ =	$	0.14	(tons/year) +	$	68,726	$ =	$0.14	(tons/year) +	$	90,059
33	$ =	$	0.14	(tons/year) +	$	68,650	$ =	$0.14	(tons/year) +	$	89,958
34	$ =	$	0.14	(tons/year) +	$	68,580	$ =	$0.14	(tons/year) +	$	89,866
35	$ =	$	0.14	(tons/year) +	$	68,515	$ =	$0.14	(tons/year) +	$	89,782
36	$ =	$	0.14	(tons/year) +	$	68,456	$ =	$0.14	(tons/year) +	$	89,704

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls									
	Early Implementation Groundwater and PCM Cost Equation Controls									
37	$ =	$ 0.14	(tons/year) +	$	68,401	$ =	$0.14	(tons/year) +	$	89,632
38	$ =	$ 0.14	(tons/year) +	$	68,351	$ =	$0.14	(tons/year) +	$	89,565
39	$ =	$ 0.14	(tons/year) +	$	68,304	$ =	$0.14	(tons/year) +	$	89,504
40	$ =	$ 0.14	(tons/year) +	$	68,261	$ =	$0.14	(tons/year) +	$	89,447

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls							
	Early Implementation of Synthetic Cap Cost Equation Controls							
	Pile Landfills							
Years Until Closure	**With out Daily Cover**				**With Daily Cover**			
1$ =	$ 249.45	(tons/year) +	$ 326,343	$ =	$ 254.53	(tons/year) +	$ 329,211	
2$ =	$ 120.65	(tons/year) +	$ 158,656	$ =	$ 123.11	(tons/year) +	$ 160,044	
3$ =	$ 77.77	(tons/year) +	$ 102,758	$ =	$ 79.36	(tons/year) +	$ 103,653	
4$ =	$ 56.37	(tons/year) +	$ 74,814	$ =	$ 57.52	(tons/year) +	$ 75,463	
5$ =	$ 43.56	(tons/year) +	$ 58,056	$ =	$ 44.45	(tons/year) +	$ 58,557	
6$ =	$ 35.05	(tons/year) +	$ 46,894	$ =	$ 35.77	(tons/year) +	$ 47,298	
7$ =	$ 29.00	(tons/year) +	$ 38,933	$ =	$ 29.59	(tons/year) +	$ 39,267	
8$ =	$ 24.48	(tons/year) +	$ 32,974	$ =	$ 24.98	(tons/year) +	$ 33,256	
9$ =	$ 20.98	(tons/year) +	$ 28,352	$ =	$ 21.41	(tons/year) +	$ 28,594	
10$ =	$ 18.20	(tons/year) +	$ 24,667	$ =	$ 18.58	(tons/year) +	$ 24,877	
11$ =	$ 15.95	(tons/year) +	$ 21,664	$ =	$ 16.27	(tons/year) +	$ 21,848	
12$ =	$ 14.08	(tons/year) +	$ 19,174	$ =	$ 14.36	(tons/year) +	$ 19,336	
13$ =	$ 12.51	(tons/year) +	$ 17,079	$ =	$ 12.77	(tons/year) +	$ 17,223	
14$ =	$ 11.18	(tons/year) +	$ 15,294	$ =	$ 11.41	(tons/year) +	$ 15,424	
15$ =	$ 10.04	(tons/year) +	$ 13,759	$ =	$ 10.24	(tons/year) +	$ 13,875	
16$ =	$ 9.05	(tons/year) +	$ 12,427	$ =	$ 9.23	(tons/year) +	$ 12,531	
17$ =	$ 8.19	(tons/year) +	$ 11,262	$ =	$ 8.35	(tons/year) +	$ 11,356	
18$ =	$ 7.43	(tons/year) +	$ 10,236	$ =	$ 7.58	(tons/year) +	$ 10,322	
19$ =	$ 6.76	(tons/year) +	$ 9,328	$ =	$ 6.90	(tons/year) +	$ 9,406	
20$ =	$ 6.17	(tons/year) +	$ 8,520	$ =	$ 6.29	(tons/year) +	$ 8,591	
21$ =	$ 5.64	(tons/year) +	$ 7,798	$ =	$ 5.75	(tons/year) +	$ 7,863	
22$ =	$ 5.16	(tons/year) +	$ 7,150	$ =	$ 5.27	(tons/year) +	$ 7,210	
23$ =	$ 4.73	(tons/year) +	$ 6,567	$ =	$ 4.83	(tons/year) +	$ 6,621	

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls								
	Early Implementation of Synthetic Cap Cost Equation Controls								
24$ =	$	4.35	(tons/year) +	$	6,040	$ =	$	4.44	(tons/year) +	$	6,090
25$ =	$	4.00	(tons/year) +	$	5,562	$ =	$	4.08	(tons/year) +	$	5,609
26$ =	$	3.69	(tons/year) +	$	5,129	$ =	$	3.76	(tons/year) +	$	5,171
27$ =	$	3.40	(tons/year) +	$	4,734	$ =	$	3.47	(tons/year) +	$	4,773
28$ =	$	3.14	(tons/year) +	$	4,374	$ =	$	3.20	(tons/year) +	$	4,410
29$ =	$	2.90	(tons/year) +	$	4,045	$ =	$	2.96	(tons/year) +	$	4,078
30$ =	$	2.68	(tons/year) +	$	3,743	$ =	$	2.74	(tons/year) +	$	3,774
31$ =	$	2.48	(tons/year) +	$	3,467	$ =	$	2.53	(tons/year) +	$	3,496
32$ =	$	2.30	(tons/year) +	$	3,213	$ =	$	2.35	(tons/year) +	$	3,240
33$ =	$	2.13	(tons/year) +	$	2,980	$ =	$	2.17	(tons/year) +	$	3,005
34$ =	$	1.98	(tons/year) +	$	2,765	$ =	$	2.02	(tons/year) +	$	2,788
35$ =	$	1.83	(tons/year) +	$	2,567	$ =	$	1.87	(tons/year) +	$	2,588
36$ =	$	1.70	(tons/year) +	$	2,385	$ =	$	1.74	(tons/year) +	$	2,404
37$ =	$	1.58	(tons/year) +	$	2,216	$ =	$	1.61	(tons/year) +	$	2,234
38$ =	$	1.47	(tons/year) +	$	2,060	$ =	$	1.50	(tons/year) +	$	2,077
39$ =	$	1.37	(tons/year) +	$	1,916	$ =	$	1.39	(tons/year) +	$	1,932
40$ =	$	1.27	(tons/year) +	$	1,782	$ =	$	1.30	(tons/year) +	$	1,797
	Excavated Landiflls										
	With out Daily Cover						**With Daily Cover**				
1 $ =	$	167.64	(tons/year) +	$	812,887	$ =	$	171.04	(tons/year) +	$	822,350
2 $ =	$	81.09	(tons/year) +	$	393,716	$ =	$	82.74	(tons/year) +	$	398,291
3 $ =	$	52.28	(tons/year) +	$	254,116	$ =	$	53.34	(tons/year) +	$	257,065
4 $ =	$	37.90	(tons/year) +	$	184,416	$ =	$	38.66	(tons/year) +	$	186,553
5 $ =	$	29.29	(tons/year) +	$	142,680	$ =	$	29.88	(tons/year) +	$	144,331
6 $ =	$	23.57	(tons/year) +	$	114,929	$ =	$	24.05	(tons/year) +	$	116,257
7 $ =	$	19.50	(tons/year) +	$	95,172	$ =	$	19.90	(tons/year) +	$	96,271

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls										
	Early Implementation of Synthetic Cap Cost Equation Controls										
8	$ =	$	16.46	(tons/year) +	$	80,413	$ =	$	16.80	(tons/year) +	$ 81,340
9	$ =	$	14.11	(tons/year) +	$	68,988	$ =	$	14.40	(tons/year) +	$ 69,782
10	$ =	$	12.24	(tons/year) +	$	59,897	$ =	$	12.49	(tons/year) +	$ 60,586
11	$ =	$	10.73	(tons/year) +	$	52,504	$ =	$	10.94	(tons/year) +	$ 53,108
12	$ =	$	9.47	(tons/year) +	$	46,386	$ =	$	9.66	(tons/year) +	$ 46,919
13	$ =	$	8.42	(tons/year) +	$	41,249	$ =	$	8.59	(tons/year) +	$ 41,722
14	$ =	$	7.52	(tons/year) +	$	36,882	$ =	$	7.67	(tons/year) +	$ 37,305
15	$ =	$	6.75	(tons/year) +	$	33,132	$ =	$	6.89	(tons/year) +	$ 33,512
16	$ =	$	6.09	(tons/year) +	$	29,884	$ =	$	6.21	(tons/year) +	$ 30,226
17	$ =	$	5.51	(tons/year) +	$	27,048	$ =	$	5.62	(tons/year) +	$ 27,357
18	$ =	$	5.00	(tons/year) +	$	24,556	$ =	$	5.10	(tons/year) +	$ 24,837
19	$ =	$	4.55	(tons/year) +	$	22,353	$ =	$	4.64	(tons/year) +	$ 22,609
20	$ =	$	4.15	(tons/year) +	$	20,396	$ =	$	4.23	(tons/year) +	$ 20,630
21	$ =	$	3.79	(tons/year) +	$	18,650	$ =	$	3.87	(tons/year) +	$ 18,863
22	$ =	$	3.47	(tons/year) +	$	17,085	$ =	$	3.54	(tons/year) +	$ 17,281
23	$ =	$	3.19	(tons/year) +	$	15,678	$ =	$	3.25	(tons/year) +	$ 15,857
24	$ =	$	2.93	(tons/year) +	$	14,409	$ =	$	2.99	(tons/year) +	$ 14,573
25	$ =	$	2.69	(tons/year) +	$	13,260	$ =	$	2.75	(tons/year) +	$ 13,412
26	$ =	$	2.48	(tons/year) +	$	12,219	$ =	$	2.53	(tons/year) +	$ 12,358
27	$ =	$	2.29	(tons/year) +	$	11,271	$ =	$	2.33	(tons/year) +	$ 11,400
28	$ =	$	2.11	(tons/year) +	$	10,408	$ =	$	2.15	(tons/year) +	$ 10,526
29	$ =	$	1.95	(tons/year) +	$	9,619	$ =	$	1.99	(tons/year) +	$ 9,729
30	$ =	$	1.81	(tons/year) +	$	8,898	$ =	$	1.84	(tons/year) +	$ 9,000
31	$ =	$	1.67	(tons/year) +	$	8,238	$ =	$	1.70	(tons/year) +	$ 8,331
32	$ =	$	1.55	(tons/year) +	$	7,631	$ =	$	1.58	(tons/year) +	$ 7,718
33	$ =	$	1.43	(tons/year) +	$	7,074	$ =	$	1.46	(tons/year) +	$ 7,155
34	$ =	$	1.33	(tons/year) +	$	6,562	$ =	$	1.36	(tons/year) +	$ 6,636

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls										
	Early Implementation of Synthetic Cap Cost Equation Controls										
35	$ =	$	1.23	(tons/year) +	$	6,090	$ =	$	1.26	(tons/year) +	$ 6,159
36	$ =	$	1.15	(tons/year) +	$	5,655	$ =	$	1.17	(tons/year) +	$ 5,719
37	$ =	$	1.06	(tons/year) +	$	5,253	$ =	$	1.09	(tons/year) +	$ 5,313
38	$ =	$	0.99	(tons/year) +	$	4,882	$ =	$	1.01	(tons/year) +	$ 4,937
39	$ =	$	0.92	(tons/year) +	$	4,539	$ =	$	0.94	(tons/year) +	$ 4,591
40	$ =	$	0.86	(tons/year) +	$	4,221	$ =	$	0.87	(tons/year) +	$ 4,270
	Surface Impoundment										
1	$ =	$	441.22	(tons/year) +	$	1,171,647					
2	$ =	$	213.39	(tons/year) +	$	566,690					
3	$ =	$	137.54	(tons/year) +	$	365,286					
4	$ =	$	99.69	(tons/year) +	$	264,774					
5	$ =	$	77.04	(tons/year) +	$	204,622					
6	$ =	$	61.99	(tons/year) +	$	164,651					
7	$ =	$	51.28	(tons/year) +	$	136,213					
8	$ =	$	43.28	(tons/year) +	$	114,985					
9	$ =	$	37.10	(tons/year) +	$	98,564					
10	$ =	$	32.19	(tons/year) +	$	85,508					
11	$ =	$	28.19	(tons/year) +	$	74,899					
12	$ =	$	24.89	(tons/year) +	$	66,126					
13	$ =	$	22.12	(tons/year) +	$	58,764					
14	$ =	$	19.76	(tons/year) +	$	52,512					
15	$ =	$	17.74	(tons/year) +	$	47,147					
16	$ =	$	15.99	(tons/year) +	$	42,502					

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls				
	Early Implementation of Synthetic Cap Cost Equation Controls				
17 $ =	$	14.47	(tons/year) +	$	38,450
18 $ =	$	13.13	(tons/year) +	$	34,892
19 $ =	$	11.95	(tons/year) +	$	31,749
20 $ =	$	10.90	(tons/year) +	$	28,958
21 $ =	$	9.96	(tons/year) +	$	26,469
22 $ =	$	9.12	(tons/year) +	$	24,240
23 $ =	$	8.37	(tons/year) +	$	22,236
24 $ =	$	7.69	(tons/year) +	$	20,430
25 $ =	$	7.07	(tons/year) +	$	18,796
26 $ =	$	6.51	(tons/year) +	$	17,315
27 $ =	$	6.01	(tons/year) +	$	15,968
28 $ =	$	5.55	(tons/year) +	$	14,742
29 $ =	$	5.13	(tons/year) +	$	13,622
30 $ =	$	4.74	(tons/year) +	$	12,598
31 $ =	$	4.39	(tons/year) +	$	11,661
32 $ =	$	4.06	(tons/year) +	$	10,801
33 $ =	$	3.77	(tons/year) +	$	10,011
34 $ =	$	3.49	(tons/year) +	$	9,284
35 $ =	$	3.24	(tons/year) +	$	8,615
36 $ =	$	3.01	(tons/year) +	$	7,998
37 $ =	$	2.80	(tons/year) +	$	7,429
38 $ =	$	2.60	(tons/year) +	$	6,904

Exhibit E -2 Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)				
Years Until Closure of Unit	**Environmental Controls**			
Early Implementation of Synthetic Cap Cost Equation Controls				
39 $ =	$	2.41 (tons/year) +	$	6,418
40 $ =	$	2.25 (tons/year) +	$	5,969

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls											
	Early Implementation Financial Assurance Cost Equation Controls											
	Pile Landfills											
Years Until Closure	**With out Daily Cover**						**With Daily Cover**					
1	$ =	$	1.18	(tons/year) +	$	5,883	$ =	$	1.20	(tons/year) +	$	5,897
2	$ =	$	1.17	(tons/year) +	$	4,250	$ =	$	1.20	(tons/year) +	$	4,263
3	$ =	$	1.16	(tons/year) +	$	3,692	$ =	$	1.18	(tons/year) +	$	3,705
4	$ =	$	1.14	(tons/year) +	$	3,398	$ =	$	1.17	(tons/year) +	$	3,411
5	$ =	$	1.12	(tons/year) +	$	3,206	$ =	$	1.14	(tons/year) +	$	3,219
6	$ =	$	1.10	(tons/year) +	$	3,064	$ =	$	1.12	(tons/year) +	$	3,076
7	$ =	$	1.07	(tons/year) +	$	2,948	$ =	$	1.09	(tons/year) +	$	2,960
8	$ =	$	1.04	(tons/year) +	$	2,848	$ =	$	1.06	(tons/year) +	$	2,860
9	$ =	$	1.00	(tons/year) +	$	2,757	$ =	$	1.02	(tons/year) +	$	2,769
10	$ =	$	0.97	(tons/year) +	$	2,674	$ =	$	0.99	(tons/year) +	$	2,685
11	$ =	$	0.93	(tons/year) +	$	2,595	$ =	$	0.95	(tons/year) +	$	2,606
12	$ =	$	0.90	(tons/year) +	$	2,519	$ =	$	0.91	(tons/year) +	$	2,530
13	$ =	$	0.86	(tons/year) +	$	2,447	$ =	$	0.88	(tons/year) +	$	2,457
14	$ =	$	0.82	(tons/year) +	$	2,377	$ =	$	0.84	(tons/year) +	$	2,386
15	$ =	$	0.78	(tons/year) +	$	2,308	$ =	$	0.80	(tons/year) +	$	2,317
16	$ =	$	0.74	(tons/year) +	$	2,242	$ =	$	0.76	(tons/year) +	$	2,250
17	$ =	$	0.70	(tons/year) +	$	2,177	$ =	$	0.72	(tons/year) +	$	2,185
18	$ =	$	0.66	(tons/year) +	$	2,114	$ =	$	0.68	(tons/year) +	$	2,122
19	$ =	$	0.63	(tons/year) +	$	2,053	$ =	$	0.64	(tons/year) +	$	2,060
20	$ =	$	0.59	(tons/year) +	$	1,993	$ =	$	0.60	(tons/year) +	$	2,000
21	$ =	$	0.55	(tons/year) +	$	1,935	$ =	$	0.56	(tons/year) +	$	1,941
22	$ =	$	0.52	(tons/year) +	$	1,879	$ =	$	0.53	(tons/year) +	$	1,885
23	$ =	$	0.48	(tons/year) +	$	1,824	$ =	$	0.49	(tons/year) +	$	1,830

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls							
	Early Implementation Financial Assurance Cost Equation Controls							
24	$ =	$ 0.45	(tons/year) +	$ 1,771	$ =	$ 0.46	(tons/year) +	$ 1,776
25	$ =	$ 0.41	(tons/year) +	$ 1,720	$ =	$ 0.42	(tons/year) +	$ 1,724
26	$ =	$ 0.38	(tons/year) +	$ 1,670	$ =	$ 0.39	(tons/year) +	$ 1,674
27	$ =	$ 0.35	(tons/year) +	$ 1,622	$ =	$ 0.35	(tons/year) +	$ 1,626
28	$ =	$ 0.32	(tons/year) +	$ 1,575	$ =	$ 0.32	(tons/year) +	$ 1,579
29	$ =	$ 0.29	(tons/year) +	$ 1,530	$ =	$ 0.29	(tons/year) +	$ 1,534
30	$ =	$ 0.26	(tons/year) +	$ 1,487	$ =	$ 0.26	(tons/year) +	$ 1,490
31	$ =	$ 0.23	(tons/year) +	$ 1,446	$ =	$ 0.23	(tons/year) +	$ 1,448
32	$ =	$ 0.20	(tons/year) +	$ 1,405	$ =	$ 0.21	(tons/year) +	$ 1,408
33	$ =	$ 0.18	(tons/year) +	$ 1,367	$ =	$ 0.18	(tons/year) +	$ 1,369
34	$ =	$ 0.15	(tons/year) +	$ 1,330	$ =	$ 0.15	(tons/year) +	$ 1,331
35	$ =	$ 0.13	(tons/year) +	$ 1,294	$ =	$ 0.13	(tons/year) +	$ 1,295
36	$ =	$ 0.10	(tons/year) +	$ 1,260	$ =	$ 0.11	(tons/year) +	$ 1,261
37	$ =	$ 0.08	(tons/year) +	$ 1,227	$ =	$ 0.08	(tons/year) +	$ 1,228
38	$ =	$ 0.06	(tons/year) +	$ 1,195	$ =	$ 0.06	(tons/year) +	$ 1,196
39	$ =	$ 0.06	(tons/year) +	$ 1,194	$ =	$ 0.06	(tons/year) +	$ 1,195
40	$ =	$ 0.04	(tons/year) +	$ 1,164	$ =	$ 0.04	(tons/year) +	$ 1,165
	Excavated Landiflls							
	With out Daily Cover				**With Daily Cover**			
1	$ =	$ 0.79	(tons/year) +	$ 8,152	$ =	$ 0.81	(tons/year) +	$ 8,196
2	$ =	$ 0.79	(tons/year) +	$ 6,505	$ =	$ 0.81	(tons/year) +	$ 6,550
3	$ =	$ 0.78	(tons/year) +	$ 5,924	$ =	$ 0.80	(tons/year) +	$ 5,968
4	$ =	$ 0.77	(tons/year) +	$ 5,596	$ =	$ 0.79	(tons/year) +	$ 5,639
5	$ =	$ 0.76	(tons/year) +	$ 5,363	$ =	$ 0.77	(tons/year) +	$ 5,405
6	$ =	$ 0.74	(tons/year) +	$ 5,171	$ =	$ 0.75	(tons/year) +	$ 5,213
7	$ =	$ 0.72	(tons/year) +	$ 5,001	$ =	$ 0.73	(tons/year) +	$ 5,041

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls							
	Early Implementation Financial Assurance Cost Equation Controls							
8	$ =	$ 0.70	(tons/year) +	$ 4,841	$ =	$ 0.71	(tons/year) +	$ 4,880
9	$ =	$ 0.68	(tons/year) +	$ 4,687	$ =	$ 0.69	(tons/year) +	$ 4,725
10	$ =	$ 0.65	(tons/year) +	$ 4,536	$ =	$ 0.67	(tons/year) +	$ 4,573
11	$ =	$ 0.63	(tons/year) +	$ 4,388	$ =	$ 0.64	(tons/year) +	$ 4,423
12	$ =	$ 0.60	(tons/year) +	$ 4,241	$ =	$ 0.61	(tons/year) +	$ 4,274
13	$ =	$ 0.58	(tons/year) +	$ 4,095	$ =	$ 0.59	(tons/year) +	$ 4,127
14	$ =	$ 0.55	(tons/year) +	$ 3,951	$ =	$ 0.56	(tons/year) +	$ 3,982
15	$ =	$ 0.53	(tons/year) +	$ 3,808	$ =	$ 0.54	(tons/year) +	$ 3,838
16	$ =	$ 0.50	(tons/year) +	$ 3,667	$ =	$ 0.51	(tons/year) +	$ 3,695
17	$ =	$ 0.47	(tons/year) +	$ 3,528	$ =	$ 0.48	(tons/year) +	$ 3,555
18	$ =	$ 0.45	(tons/year) +	$ 3,392	$ =	$ 0.46	(tons/year) +	$ 3,417
19	$ =	$ 0.42	(tons/year) +	$ 3,257	$ =	$ 0.43	(tons/year) +	$ 3,281
20	$ =	$ 0.40	(tons/year) +	$ 3,126	$ =	$ 0.40	(tons/year) +	$ 3,148
21	$ =	$ 0.37	(tons/year) +	$ 2,997	$ =	$ 0.38	(tons/year) +	$ 3,018
22	$ =	$ 0.35	(tons/year) +	$ 2,871	$ =	$ 0.35	(tons/year) +	$ 2,891
23	$ =	$ 0.32	(tons/year) +	$ 2,748	$ =	$ 0.33	(tons/year) +	$ 2,767
24	$ =	$ 0.30	(tons/year) +	$ 2,629	$ =	$ 0.31	(tons/year) +	$ 2,646
25	$ =	$ 0.28	(tons/year) +	$ 2,513	$ =	$ 0.28	(tons/year) +	$ 2,528
26	$ =	$ 0.26	(tons/year) +	$ 2,400	$ =	$ 0.26	(tons/year) +	$ 2,414
27	$ =	$ 0.23	(tons/year) +	$ 2,290	$ =	$ 0.24	(tons/year) +	$ 2,304
28	$ =	$ 0.21	(tons/year) +	$ 2,184	$ =	$ 0.22	(tons/year) +	$ 2,196
29	$ =	$ 0.19	(tons/year) +	$ 2,082	$ =	$ 0.20	(tons/year) +	$ 2,093
30	$ =	$ 0.17	(tons/year) +	$ 1,983	$ =	$ 0.18	(tons/year) +	$ 1,993
31	$ =	$ 0.15	(tons/year) +	$ 1,887	$ =	$ 0.16	(tons/year) +	$ 1,896
32	$ =	$ 0.14	(tons/year) +	$ 1,795	$ =	$ 0.14	(tons/year) +	$ 1,803
33	$ =	$ 0.12	(tons/year) +	$ 1,706	$ =	$ 0.12	(tons/year) +	$ 1,713
34	$ =	$ 0.10	(tons/year) +	$ 1,620	$ =	$ 0.10	(tons/year) +	$ 1,626

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls										
	Early Implementation Financial Assurance Cost Equation Controls										
35	$ =	$	0.09	(tons/year) +	$	1,538	$ =	$	0.09	(tons/year) +	$ 1,543
36	$ =	$	0.07	(tons/year) +	$	1,459	$ =	$	0.07	(tons/year) +	$ 1,463
37	$ =	$	0.05	(tons/year) +	$	1,383	$ =	$	0.06	(tons/year) +	$ 1,386
38	$ =	$	0.04	(tons/year) +	$	1,310	$ =	$	0.04	(tons/year) +	$ 1,312
39	$ =	$	0.04	(tons/year) +	$	1,309	$ =	$	0.04	(tons/year) +	$ 1,311
40	$ =	$	0.03	(tons/year) +	$	1,239	$ =	$	0.03	(tons/year) +	$ 1,240
	Surface Impoundment										
1	$ =	$	2.09	(tons/year) +	$	9,780					
2	$ =	$	2.07	(tons/year) +	$	8,125					
3	$ =	$	2.05	(tons/year) +	$	7,526					
4	$ =	$	2.02	(tons/year) +	$	7,174					
5	$ =	$	1.98	(tons/year) +	$	6,911					
6	$ =	$	1.94	(tons/year) +	$	6,684					
7	$ =	$	1.89	(tons/year) +	$	6,474					
8	$ =	$	1.83	(tons/year) +	$	6,271					
9	$ =	$	1.77	(tons/year) +	$	6,072					
10	$ =	$	1.71	(tons/year) +	$	5,873					
11	$ =	$	1.65	(tons/year) +	$	5,674					
12	$ =	$	1.58	(tons/year) +	$	5,476					
13	$ =	$	1.52	(tons/year) +	$	5,278					
14	$ =	$	1.45	(tons/year) +	$	5,081					
15	$ =	$	1.38	(tons/year) +	$	4,885					
16	$ =	$	1.31	(tons/year) +	$	4,690					

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls				
	Early Implementation Financial Assurance Cost Equation Controls				
17	$ =	$ 1.24	(tons/year) +	$	4,498
18	$ =	$ 1.17	(tons/year) +	$	4,309
19	$ =	$ 1.11	(tons/year) +	$	4,122
20	$ =	$ 1.04	(tons/year) +	$	3,939
21	$ =	$ 0.98	(tons/year) +	$	3,759
22	$ =	$ 0.91	(tons/year) +	$	3,583
23	$ =	$ 0.85	(tons/year) +	$	3,412
24	$ =	$ 0.79	(tons/year) +	$	3,245
25	$ =	$ 0.73	(tons/year) +	$	3,082
26	$ =	$ 0.67	(tons/year) +	$	2,924
27	$ =	$ 0.61	(tons/year) +	$	2,770
28	$ =	$ 0.56	(tons/year) +	$	2,622
29	$ =	$ 0.51	(tons/year) +	$	2,478
30	$ =	$ 0.46	(tons/year) +	$	2,339
31	$ =	$ 0.41	(tons/year) +	$	2,204
32	$ =	$ 0.36	(tons/year) +	$	2,074
33	$ =	$ 0.31	(tons/year) +	$	1,949
34	$ =	$ 0.27	(tons/year) +	$	1,829
35	$ =	$ 0.22	(tons/year) +	$	1,713
36	$ =	$ 0.18	(tons/year) +	$	1,602
37	$ =	$ 0.14	(tons/year) +	$	1,495
38	$ =	$ 0.11	(tons/year) +	$	1,392

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls				
	Early Implementation Financial Assurance Cost Equation Controls				
39	$ =	$ 0.11	(tons/year) +	$	1,391
40	$ =	$ 0.07	(tons/year) +	$	1,292

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls							
Early Implementation of Synthetic Cap and Financial Assurance Cost Equation Controls								
Pile Landfills								
Years Until Closure	**With out Daily Cover**				**With Daily Cover**			
1	$ =	$ 250.63	(tons/year) +	$ 332,227	$ =	$ 255.74	(tons/year) +	$ 335,108
2	$ =	$ 121.81	(tons/year) +	$ 162,893	$ =	$ 124.30	(tons/year) +	$ 164,295
3	$ =	$ 78.92	(tons/year) +	$ 106,429	$ =	$ 80.52	(tons/year) +	$ 107,337
4	$ =	$ 57.50	(tons/year) +	$ 78,184	$ =	$ 58.67	(tons/year) +	$ 78,846
5	$ =	$ 44.66	(tons/year) +	$ 61,229	$ =	$ 45.57	(tons/year) +	$ 61,743
6	$ =	$ 36.12	(tons/year) +	$ 49,920	$ =	$ 36.86	(tons/year) +	$ 50,336
7	$ =	$ 30.04	(tons/year) +	$ 41,839	$ =	$ 30.65	(tons/year) +	$ 42,185
8	$ =	$ 25.49	(tons/year) +	$ 35,777	$ =	$ 26.00	(tons/year) +	$ 36,071
9	$ =	$ 21.95	(tons/year) +	$ 31,062	$ =	$ 22.40	(tons/year) +	$ 31,315
10	$ =	$ 19.14	(tons/year) +	$ 27,291	$ =	$ 19.53	(tons/year) +	$ 27,512
11	$ =	$ 16.84	(tons/year) +	$ 24,208	$ =	$ 17.19	(tons/year) +	$ 24,403
12	$ =	$ 14.94	(tons/year) +	$ 21,642	$ =	$ 15.24	(tons/year) +	$ 21,814
13	$ =	$ 13.33	(tons/year) +	$ 19,473	$ =	$ 13.60	(tons/year) +	$ 19,627
14	$ =	$ 11.96	(tons/year) +	$ 17,618	$ =	$ 12.20	(tons/year) +	$ 17,756
15	$ =	$ 10.78	(tons/year) +	$ 16,015	$ =	$ 11.00	(tons/year) +	$ 16,139
16	$ =	$ 9.75	(tons/year) +	$ 14,616	$ =	$ 9.95	(tons/year) +	$ 14,728
17	$ =	$ 8.85	(tons/year) +	$ 13,386	$ =	$ 9.03	(tons/year) +	$ 13,489
18	$ =	$ 8.06	(tons/year) +	$ 12,298	$ =	$ 8.22	(tons/year) +	$ 12,391
19	$ =	$ 7.39	(tons/year) +	$ 11,382	$ =	$ 7.54	(tons/year) +	$ 11,467
20	$ =	$ 6.76	(tons/year) +	$ 10,514	$ =	$ 6.89	(tons/year) +	$ 10,592
21	$ =	$ 6.19	(tons/year) +	$ 9,734	$ =	$ 6.31	(tons/year) +	$ 9,806
22	$ =	$ 5.68	(tons/year) +	$ 9,030	$ =	$ 5.79	(tons/year) +	$ 9,095
23	$ =	$ 5.22	(tons/year) +	$ 8,392	$ =	$ 5.32	(tons/year) +	$ 8,452

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls								
	Early Implementation of Synthetic Cap and Financial Assurance Cost Equation Controls								
24	$ =	$ 4.80	(tons/year) +	$ 7,811	$ =	$ 4.89	(tons/year) +	$ 7,867
25	$ =	$ 4.42	(tons/year) +	$ 7,283	$ =	$ 4.50	(tons/year) +	$ 7,334
26	$ =	$ 4.07	(tons/year) +	$ 6,799	$ =	$ 4.15	(tons/year) +	$ 6,846
27	$ =	$ 3.75	(tons/year) +	$ 6,356	$ =	$ 3.82	(tons/year) +	$ 6,400
28	$ =	$ 3.46	(tons/year) +	$ 5,950	$ =	$ 3.53	(tons/year) +	$ 5,990
29	$ =	$ 3.19	(tons/year) +	$ 5,576	$ =	$ 3.25	(tons/year) +	$ 5,613
30	$ =	$ 2.94	(tons/year) +	$ 5,231	$ =	$ 3.00	(tons/year) +	$ 5,265
31	$ =	$ 2.71	(tons/year) +	$ 4,913	$ =	$ 2.77	(tons/year) +	$ 4,945
32	$ =	$ 2.50	(tons/year) +	$ 4,619	$ =	$ 2.55	(tons/year) +	$ 4,648
33	$ =	$ 2.33	(tons/year) +	$ 4,384	$ =	$ 2.38	(tons/year) +	$ 4,411
34	$ =	$ 2.15	(tons/year) +	$ 4,131	$ =	$ 2.20	(tons/year) +	$ 4,156
35	$ =	$ 1.99	(tons/year) +	$ 3,896	$ =	$ 2.03	(tons/year) +	$ 3,919
36	$ =	$ 1.83	(tons/year) +	$ 3,678	$ =	$ 1.87	(tons/year) +	$ 3,699
37	$ =	$ 1.69	(tons/year) +	$ 3,475	$ =	$ 1.72	(tons/year) +	$ 3,494
38	$ =	$ 1.55	(tons/year) +	$ 3,286	$ =	$ 1.58	(tons/year) +	$ 3,304
39	$ =	$ 1.43	(tons/year) +	$ 3,111	$ =	$ 1.46	(tons/year) +	$ 3,127
40	$ =	$ 1.31	(tons/year) +	$ 2,947	$ =	$ 1.34	(tons/year) +	$ 2,962
	Excavated Landiflls								
		With out Daily Cover				**With Daily Cover**		
1	$ =	$ 168.44	(tons/year) +	$ 821,041	$ =	$ 171.85	(tons/year) +	$ 830,548
2	$ =	$ 81.88	(tons/year) +	$ 400,192	$ =	$ 83.54	(tons/year) +	$ 404,812
3	$ =	$ 53.05	(tons/year) +	$ 259,991	$ =	$ 54.12	(tons/year) +	$ 262,982
4	$ =	$ 38.65	(tons/year) +	$ 189,947	$ =	$ 39.44	(tons/year) +	$ 192,126
5	$ =	$ 30.03	(tons/year) +	$ 147,964	$ =	$ 30.64	(tons/year) +	$ 149,656
6	$ =	$ 24.29	(tons/year) +	$ 120,010	$ =	$ 24.78	(tons/year) +	$ 121,379
7	$ =	$ 20.20	(tons/year) +	$ 100,074	$ =	$ 20.61	(tons/year) +	$ 101,212

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls							
	Early Implementation of Synthetic Cap and Financial Assurance Cost Equation Controls							
8	$ =	$ 17.14	(tons/year) +	$ 85,148	$ =	$ 17.49	(tons/year) +	$ 86,113
9	$ =	$ 14.77	(tons/year) +	$ 73,562	$ =	$ 15.06	(tons/year) +	$ 74,393
10	$ =	$ 12.87	(tons/year) +	$ 64,316	$ =	$ 13.13	(tons/year) +	$ 65,040
11	$ =	$ 11.33	(tons/year) +	$ 56,771	$ =	$ 11.56	(tons/year) +	$ 57,409
12	$ =	$ 10.05	(tons/year) +	$ 50,503	$ =	$ 10.25	(tons/year) +	$ 51,069
13	$ =	$ 8.97	(tons/year) +	$ 45,219	$ =	$ 9.15	(tons/year) +	$ 45,723
14	$ =	$ 8.05	(tons/year) +	$ 40,707	$ =	$ 8.21	(tons/year) +	$ 41,160
15	$ =	$ 7.25	(tons/year) +	$ 36,814	$ =	$ 7.40	(tons/year) +	$ 37,222
16	$ =	$ 6.56	(tons/year) +	$ 33,425	$ =	$ 6.69	(tons/year) +	$ 33,794
17	$ =	$ 5.96	(tons/year) +	$ 30,451	$ =	$ 6.08	(tons/year) +	$ 30,786
18	$ =	$ 5.42	(tons/year) +	$ 27,824	$ =	$ 5.53	(tons/year) +	$ 28,128
19	$ =	$ 4.97	(tons/year) +	$ 25,613	$ =	$ 5.07	(tons/year) +	$ 25,892
20	$ =	$ 4.55	(tons/year) +	$ 23,524	$ =	$ 4.64	(tons/year) +	$ 23,780
21	$ =	$ 4.16	(tons/year) +	$ 21,649	$ =	$ 4.25	(tons/year) +	$ 21,883
22	$ =	$ 3.82	(tons/year) +	$ 19,959	$ =	$ 3.90	(tons/year) +	$ 20,173
23	$ =	$ 3.51	(tons/year) +	$ 18,429	$ =	$ 3.58	(tons/year) +	$ 18,626
24	$ =	$ 3.23	(tons/year) +	$ 17,040	$ =	$ 3.29	(tons/year) +	$ 17,221
25	$ =	$ 2.97	(tons/year) +	$ 15,775	$ =	$ 3.03	(tons/year) +	$ 15,942
26	$ =	$ 2.74	(tons/year) +	$ 14,620	$ =	$ 2.79	(tons/year) +	$ 14,774
27	$ =	$ 2.52	(tons/year) +	$ 13,563	$ =	$ 2.57	(tons/year) +	$ 13,705
28	$ =	$ 2.33	(tons/year) +	$ 12,594	$ =	$ 2.37	(tons/year) +	$ 12,725
29	$ =	$ 2.15	(tons/year) +	$ 11,703	$ =	$ 2.19	(tons/year) +	$ 11,824
30	$ =	$ 1.98	(tons/year) +	$ 10,883	$ =	$ 2.02	(tons/year) +	$ 10,994
31	$ =	$ 1.83	(tons/year) +	$ 10,126	$ =	$ 1.86	(tons/year) +	$ 10,229
32	$ =	$ 1.68	(tons/year) +	$ 9,428	$ =	$ 1.72	(tons/year) +	$ 9,523
33	$ =	$ 1.57	(tons/year) +	$ 8,869	$ =	$ 1.60	(tons/year) +	$ 8,957
34	$ =	$ 1.45	(tons/year) +	$ 8,268	$ =	$ 1.48	(tons/year) +	$ 8,349

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls										
	Early Implementation of Synthetic Cap and Financial Assurance Cost Equation Controls										
35	$ =	$	1.34	(tons/year) +	$	7,710	$ =	$	1.36	(tons/year) +	$ 7,785
36	$ =	$	1.23	(tons/year) +	$	7,193	$ =	$	1.26	(tons/year) +	$ 7,262
37	$ =	$	1.13	(tons/year) +	$	6,712	$ =	$	1.16	(tons/year) +	$ 6,776
38	$ =	$	1.04	(tons/year) +	$	6,265	$ =	$	1.07	(tons/year) +	$ 6,324
39	$ =	$	0.96	(tons/year) +	$	5,849	$ =	$	0.98	(tons/year) +	$ 5,903
40	$ =	$	0.88	(tons/year) +	$	5,462	$ =	$	0.90	(tons/year) +	$ 5,511
	Surface Impoundment										
1	$ =	$	443.30	(tons/year) +	$1,181,429						
2	$ =	$	215.45	(tons/year) +	$	574,773					
3	$ =	$	139.57	(tons/year) +	$	372,741					
4	$ =	$	101.68	(tons/year) +	$	271,855					
5	$ =	$	78.98	(tons/year) +	$	211,420					
6	$ =	$	63.88	(tons/year) +	$	171,208					
7	$ =	$	53.11	(tons/year) +	$	142,547					
8	$ =	$	45.06	(tons/year) +	$	121,106					
9	$ =	$	38.82	(tons/year) +	$	104,477					
10	$ =	$	33.84	(tons/year) +	$	91,215					
11	$ =	$	29.78	(tons/year) +	$	80,403					
12	$ =	$	26.40	(tons/year) +	$	71,427					
13	$ =	$	23.57	(tons/year) +	$	63,866					
14	$ =	$	21.14	(tons/year) +	$	57,415					
15	$ =	$	19.06	(tons/year) +	$	51,853					
16	$ =	$	17.24	(tons/year) +	$	47,014					

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls				
Early Implementation of Synthetic Cap and Financial Assurance Cost Equation Controls					
17	$ =	$ 15.65	(tons/year) +	$	42,771
18	$ =	$ 14.24	(tons/year) +	$	39,025
19	$ =	$ 13.06	(tons/year) +	$	35,873
20	$ =	$ 11.94	(tons/year) +	$	32,899
21	$ =	$ 10.94	(tons/year) +	$	30,231
22	$ =	$ 10.03	(tons/year) +	$	27,826
23	$ =	$ 9.22	(tons/year) +	$	25,651
24	$ =	$ 8.48	(tons/year) +	$	23,677
25	$ =	$ 7.80	(tons/year) +	$	21,881
26	$ =	$ 7.19	(tons/year) +	$	20,241
27	$ =	$ 6.62	(tons/year) +	$	18,741
28	$ =	$ 6.11	(tons/year) +	$	17,366
29	$ =	$ 5.63	(tons/year) +	$	16,102
30	$ =	$ 5.20	(tons/year) +	$	14,939
31	$ =	$ 4.79	(tons/year) +	$	13,867
32	$ =	$ 4.42	(tons/year) +	$	12,878
33	$ =	$ 4.13	(tons/year) +	$	12,086
34	$ =	$ 3.81	(tons/year) +	$	11,234
35	$ =	$ 3.51	(tons/year) +	$	10,445
36	$ =	$ 3.23	(tons/year) +	$	9,712
37	$ =	$ 2.98	(tons/year) +	$	9,032
38	$ =	$ 2.74	(tons/year) +	$	8,400

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls					
Early Implementation of Synthetic Cap and Financial Assurance Cost Equation Controls						
39	$ =	$	2.52	(tons/year) +	$	7,811
40	$ =	$	2.32	(tons/year) +	$	7,263

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls

Early Implementation Change of Soil cap to Synthetic Cap Cost Equation Controls

Pile Landfills

Years Until Closure	With out Daily Cover				With Daily Cover			
1	$ =	$ 113.43	(tons/year) +	$ 281,238	$ =	$ 164.43	(tons/year) +	$ 286,242
2	$ =	$ 55.22	(tons/year) +	$ 138,155	$ =	$ 79.98	(tons/year) +	$ 140,587
3	$ =	$ 35.83	(tons/year) +	$ 90,430	$ =	$ 51.85	(tons/year) +	$ 92,005
4	$ =	$ 26.14	(tons/year) +	$ 66,547	$ =	$ 37.80	(tons/year) +	$ 67,695
5	$ =	$ 20.33	(tons/year) +	$ 52,203	$ =	$ 29.39	(tons/year) +	$ 53,095
6	$ =	$ 16.47	(tons/year) +	$ 42,631	$ =	$ 23.78	(tons/year) +	$ 43,352
7	$ =	$ 13.71	(tons/year) +	$ 35,788	$ =	$ 19.79	(tons/year) +	$ 36,387
8	$ =	$ 11.64	(tons/year) +	$ 30,651	$ =	$ 16.80	(tons/year) +	$ 31,159
9	$ =	$ 10.04	(tons/year) +	$ 26,653	$ =	$ 14.48	(tons/year) +	$ 27,091
10	$ =	$ 8.76	(tons/year) +	$ 23,454	$ =	$ 12.63	(tons/year) +	$ 23,835
11	$ =	$ 7.72	(tons/year) +	$ 20,836	$ =	$ 11.12	(tons/year) +	$ 21,172
12	$ =	$ 6.85	(tons/year) +	$ 18,655	$ =	$ 9.86	(tons/year) +	$ 18,953
13	$ =	$ 6.12	(tons/year) +	$ 16,812	$ =	$ 8.81	(tons/year) +	$ 17,078
14	$ =	$ 5.49	(tons/year) +	$ 15,234	$ =	$ 7.91	(tons/year) +	$ 15,473
15	$ =	$ 4.95	(tons/year) +	$ 13,870	$ =	$ 7.13	(tons/year) +	$ 14,085
16	$ =	$ 4.49	(tons/year) +	$ 12,678	$ =	$ 6.45	(tons/year) +	$ 12,873
17	$ =	$ 4.07	(tons/year) +	$ 11,631	$ =	$ 5.86	(tons/year) +	$ 11,808
18	$ =	$ 3.71	(tons/year) +	$ 10,703	$ =	$ 5.33	(tons/year) +	$ 10,864
19	$ =	$ 3.40	(tons/year) +	$ 9,922	$ =	$ 4.89	(tons/year) +	$ 10,070
20	$ =	$ 3.12	(tons/year) +	$ 9,182	$ =	$ 4.48	(tons/year) +	$ 9,317
21	$ =	$ 2.86	(tons/year) +	$ 8,516	$ =	$ 4.10	(tons/year) +	$ 8,640
22	$ =	$ 2.62	(tons/year) +	$ 7,914	$ =	$ 3.77	(tons/year) +	$ 8,028
23	$ =	$ 2.41	(tons/year) +	$ 7,369	$ =	$ 3.46	(tons/year) +	$ 7,474

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls									
Early Implementation Change of Soil cap to Synthetic Cap Cost Equation Controls										
24	$ =	$ 2.22	(tons/year) +	$	6,874	$ =	$ 3.18	(tons/year) +	$	6,969
25	$ =	$ 2.04	(tons/year) +	$	6,421	$ =	$ 2.93	(tons/year) +	$	6,510
26	$ =	$ 1.88	(tons/year) +	$	6,008	$ =	$ 2.70	(tons/year) +	$	6,090
27	$ =	$ 1.74	(tons/year) +	$	5,629	$ =	$ 2.49	(tons/year) +	$	5,704
28	$ =	$ 1.60	(tons/year) +	$	5,281	$ =	$ 2.30	(tons/year) +	$	5,351
29	$ =	$ 1.48	(tons/year) +	$	4,961	$ =	$ 2.12	(tons/year) +	$	5,025
30	$ =	$ 1.37	(tons/year) +	$	4,666	$ =	$ 1.96	(tons/year) +	$	4,725
31	$ =	$ 1.26	(tons/year) +	$	4,394	$ =	$ 1.81	(tons/year) +	$	4,449
32	$ =	$ 1.16	(tons/year) +	$	4,142	$ =	$ 1.67	(tons/year) +	$	4,193
33	$ =	$ 1.09	(tons/year) +	$	3,941	$ =	$ 1.56	(tons/year) +	$	3,988
34	$ =	$ 1.00	(tons/year) +	$	3,724	$ =	$ 1.44	(tons/year) +	$	3,767
35	$ =	$ 0.93	(tons/year) +	$	3,523	$ =	$ 1.33	(tons/year) +	$	3,562
36	$ =	$ 0.85	(tons/year) +	$	3,336	$ =	$ 1.22	(tons/year) +	$	3,372
37	$ =	$ 0.79	(tons/year) +	$	3,162	$ =	$ 1.13	(tons/year) +	$	3,196
38	$ =	$ 0.73	(tons/year) +	$	3,000	$ =	$ 1.04	(tons/year) +	$	3,031
39	$ =	$ 0.67	(tons/year) +	$	2,849	$ =	$ 0.96	(tons/year) +	$	2,878
40	$ =	$ 0.61	(tons/year) +	$	2,709	$ =	$ 0.88	(tons/year) +	$	2,736
Excavated Landiflls										
		With out Daily Cover					**With Daily Cover**			
1	$ =	$ 76.29	(tons/year) +	$	454,600	$ =	$ 110.53	(tons/year) +	$	552,448
2	$ =	$ 37.15	(tons/year) +	$	222,332	$ =	$ 53.77	(tons/year) +	$	269,838
3	$ =	$ 24.11	(tons/year) +	$	144,913	$ =	$ 34.87	(tons/year) +	$	175,660
4	$ =	$ 17.59	(tons/year) +	$	106,208	$ =	$ 25.42	(tons/year) +	$	128,588
5	$ =	$ 13.69	(tons/year) +	$	82,989	$ =	$ 19.77	(tons/year) +	$	100,360
6	$ =	$ 11.09	(tons/year) +	$	67,514	$ =	$ 16.00	(tons/year) +	$	81,553
7	$ =	$ 9.23	(tons/year) +	$	56,466	$ =	$ 13.31	(tons/year) +	$	68,132

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls										
	Early Implementation Change of Soil cap to Synthetic Cap Cost Equation Controls										
8	$ =	$	7.84	(tons/year) +	$	48,185	$ =	$	11.30	(tons/year) +	$ 58,076
9	$ =	$	6.76	(tons/year) +	$	41,750	$ =	$	9.74	(tons/year) +	$ 50,266
10	$ =	$	5.90	(tons/year) +	$	36,608	$ =	$	8.50	(tons/year) +	$ 44,028
11	$ =	$	5.20	(tons/year) +	$	32,408	$ =	$	7.48	(tons/year) +	$ 38,935
12	$ =	$	4.62	(tons/year) +	$	28,914	$ =	$	6.64	(tons/year) +	$ 34,700
13	$ =	$	4.12	(tons/year) +	$	25,965	$ =	$	5.93	(tons/year) +	$ 31,127
14	$ =	$	3.70	(tons/year) +	$	23,445	$ =	$	5.32	(tons/year) +	$ 28,075
15	$ =	$	3.34	(tons/year) +	$	21,267	$ =	$	4.80	(tons/year) +	$ 25,440
16	$ =	$	3.02	(tons/year) +	$	19,370	$ =	$	4.34	(tons/year) +	$ 23,144
17	$ =	$	2.75	(tons/year) +	$	17,703	$ =	$	3.95	(tons/year) +	$ 21,128
18	$ =	$	2.50	(tons/year) +	$	16,230	$ =	$	3.59	(tons/year) +	$ 19,346
19	$ =	$	2.30	(tons/year) +	$	14,989	$ =	$	3.30	(tons/year) +	$ 17,846
20	$ =	$	2.10	(tons/year) +	$	13,815	$ =	$	3.02	(tons/year) +	$ 16,428
21	$ =	$	1.93	(tons/year) +	$	12,761	$ =	$	2.76	(tons/year) +	$ 15,154
22	$ =	$	1.77	(tons/year) +	$	11,809	$ =	$	2.54	(tons/year) +	$ 14,005
23	$ =	$	1.63	(tons/year) +	$	10,947	$ =	$	2.33	(tons/year) +	$ 12,965
24	$ =	$	1.50	(tons/year) +	$	10,165	$ =	$	2.15	(tons/year) +	$ 12,020
25	$ =	$	1.38	(tons/year) +	$	9,451	$ =	$	1.98	(tons/year) +	$ 11,160
26	$ =	$	1.27	(tons/year) +	$	8,799	$ =	$	1.82	(tons/year) +	$ 10,373
27	$ =	$	1.17	(tons/year) +	$	8,203	$ =	$	1.68	(tons/year) +	$ 9,654
28	$ =	$	1.08	(tons/year) +	$	7,655	$ =	$	1.55	(tons/year) +	$ 8,993
29	$ =	$	1.00	(tons/year) +	$	7,151	$ =	$	1.43	(tons/year) +	$ 8,386
30	$ =	$	0.92	(tons/year) +	$	6,688	$ =	$	1.32	(tons/year) +	$ 7,827
31	$ =	$	0.85	(tons/year) +	$	6,260	$ =	$	1.22	(tons/year) +	$ 7,311
32	$ =	$	0.79	(tons/year) +	$	5,864	$ =	$	1.12	(tons/year) +	$ 6,835
33	$ =	$	0.73	(tons/year) +	$	5,548	$ =	$	1.05	(tons/year) +	$ 6,454
34	$ =	$	0.68	(tons/year) +	$	5,207	$ =	$	0.97	(tons/year) +	$ 6,043

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls										
	Early Implementation Change of Soil cap to Synthetic Cap Cost Equation Controls										
35	$ =	$	0.62	(tons/year) +	$	4,891	$ =	$	0.89	(tons/year) +	$ 5,663
36	$ =	$	0.58	(tons/year) +	$	4,598	$ =	$	0.83	(tons/year) +	$ 5,310
37	$ =	$	0.53	(tons/year) +	$	4,326	$ =	$	0.76	(tons/year) +	$ 4,982
38	$ =	$	0.49	(tons/year) +	$	4,072	$ =	$	0.70	(tons/year) +	$ 4,676
39	$ =	$	0.45	(tons/year) +	$	3,836	$ =	$	0.65	(tons/year) +	$ 4,392
40	$ =	$	0.41	(tons/year) +	$	3,617	$ =	$	0.59	(tons/year) +	$ 4,128
	Surface Impoundment										
1	$ =	$	285.06	(tons/year) +	$	779,784					
2	$ =	$	138.64	(tons/year) +	$	379,837					
3	$ =	$	89.87	(tons/year) +	$	246,623					
4	$ =	$	65.52	(tons/year) +	$	180,088					
5	$ =	$	50.92	(tons/year) +	$	140,221					
6	$ =	$	41.21	(tons/year) +	$	113,687					
7	$ =	$	34.29	(tons/year) +	$	94,769					
8	$ =	$	29.10	(tons/year) +	$	80,612					
9	$ =	$	25.08	(tons/year) +	$	69,628					
10	$ =	$	21.88	(tons/year) +	$	60,865					
11	$ =	$	19.26	(tons/year) +	$	53,719					
12	$ =	$	17.09	(tons/year) +	$	47,784					
13	$ =	$	15.26	(tons/year) +	$	42,783					
14	$ =	$	13.70	(tons/year) +	$	38,515					
15	$ =	$	12.35	(tons/year) +	$	34,834					
16	$ =	$	11.18	(tons/year) +	$	31,630					

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls				
Early Implementation Change of Soil cap to Synthetic Cap Cost Equation Controls					
17	$ =	$ 10.15	(tons/year) +	$	28,820
18	$ =	$ 9.24	(tons/year) +	$	26,338
19	$ =	$ 8.47	(tons/year) +	$	24,250
20	$ =	$ 7.75	(tons/year) +	$	22,279
21	$ =	$ 7.11	(tons/year) +	$	20,510
22	$ =	$ 6.52	(tons/year) +	$	18,915
23	$ =	$ 5.99	(tons/year) +	$	17,472
24	$ =	$ 5.51	(tons/year) +	$	16,163
25	$ =	$ 5.08	(tons/year) +	$	14,971
26	$ =	$ 4.68	(tons/year) +	$	13,883
27	$ =	$ 4.32	(tons/year) +	$	12,887
28	$ =	$ 3.98	(tons/year) +	$	11,974
29	$ =	$ 3.67	(tons/year) +	$	11,135
30	$ =	$ 3.39	(tons/year) +	$	10,363
31	$ =	$ 3.13	(tons/year) +	$	9,651
32	$ =	$ 2.89	(tons/year) +	$	8,993
33	$ =	$ 2.70	(tons/year) +	$	8,467
34	$ =	$ 2.49	(tons/year) +	$	7,901
35	$ =	$ 2.30	(tons/year) +	$	7,377
36	$ =	$ 2.12	(tons/year) +	$	6,890
37	$ =	$ 1.96	(tons/year) +	$	6,438
38	$ =	$ 1.80	(tons/year) +	$	6,017

Exhibit E -2

Annualized Before-Tax Cost Equations Developed for Early Implementation of Capping and Groundwater Controls (2005$)

Years Until Closure of Unit	Environmental Controls					
Early Implementation Change of Soil cap to Synthetic Cap Cost Equation Controls						
39	$ =	$	1.66	(tons/year) +	$	5,626
40	$ =	$	1.52	(tons/year) +	$	5,262