AECOM

CCP and MSW Leachates:

A Risk-Based Comparison between Coal Combustion Product Landfills and Impoundments and Municipal Solid Waste Landfills

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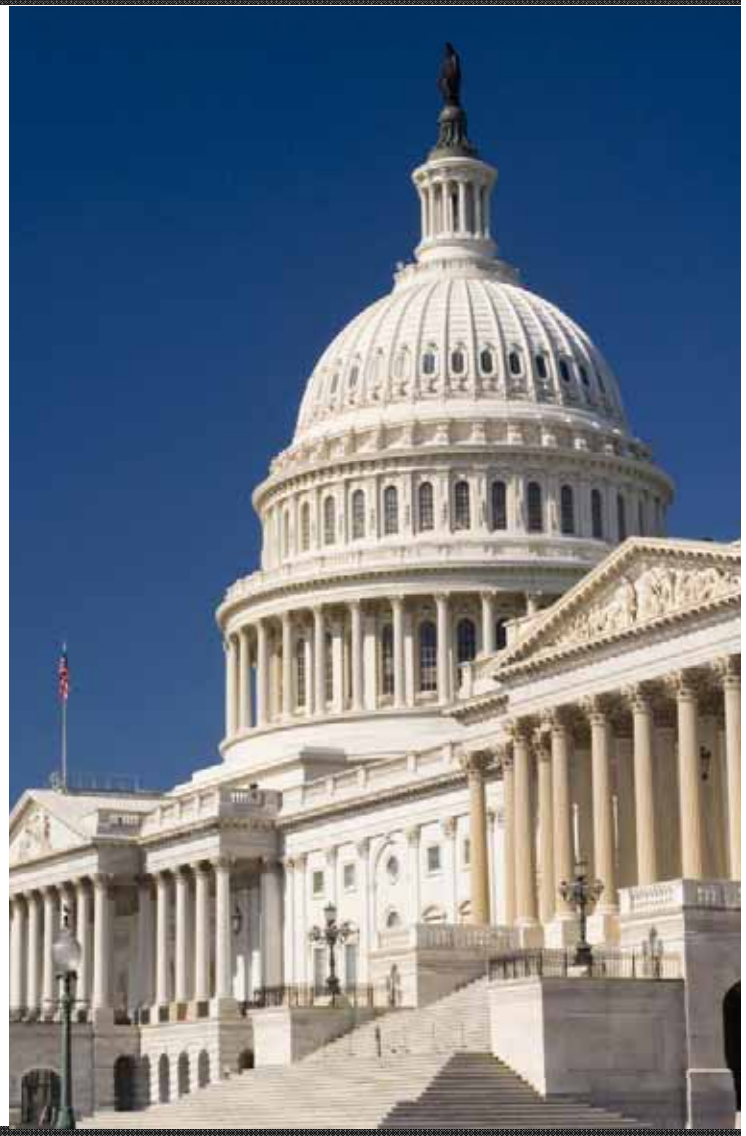
Issue

- EPA is developing national regulations for coal ash or coal combustion product (CCP) disposal under the RCRA
  - EPA is considering co-proposals to regulate CCP disposal under Subtitle C as a hazardous waste or under Subtitle D as a solid waste
  - CCPs almost never exceed the hazardous waste thresholds in the Toxicity Characteristic Leaching Procedure (TCLP), the test used under RCRA to determine if a waste is hazardous by characteristic
  - However, EPA is considering designating CCPs as a listed hazardous waste based primarily on risk assessment modeling and documented cases of groundwater and surface water impacts
- CCPs: Bottom ash, boiler slag, fly ash, flue gas desulfurization gypsum

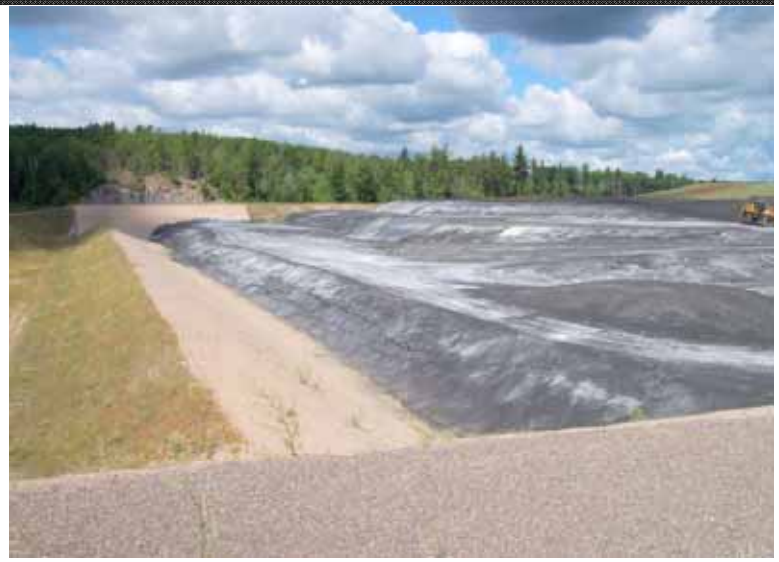
Regulatory Background

- In 1980, the Bevill Amendment exempted CCPs from the definition of “hazardous waste,” and authorized EPA to make a regulatory determination about regulation under Subtitle C
- In a series of Regulatory Determinations and a Report to Congress, EPA determined that CCPs did not warrant hazardous waste regulation under Subtitle C of RCRA
- The December 2008 structural failure of the impoundment at Kingston prompted EPA to commit to congress the development of regulations to address CCP disposal
- EPA has reopened regulation of CCPs under Subtitle C as an option for the current rulemaking
- USEPA used as one basis for its subtitle C option the draft national risk assessment that addressed the groundwater pathway for potential leaching of constituents from CCP disposal units



Background

- CCP Impoundments and Landfills
  - CCP impoundments and landfills are typically monofills
  - They are fairly consistent in composition, characterized by noncombustible inorganic constituents remaining after the burning of coal
- Subtitle D municipal solid waste (MSW) landfills
  - MSW landfills are more numerous and ubiquitous
  - They can receive a wide variety of wastes
  - MSW landfills are regulated as nonhazardous waste under RCRA (Subtitle D)



Objective of the Study

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- MSW landfills are successfully managed under Subtitle D of RCRA – are there differences between MSW and CCPs that would warrant a Subtitle C regulation for CCPs?
- Objective of the Study - to provide a human health and ecological risk-based comparison of leachate from MSW landfills to leachate from CCP landfills and impoundments to help EPA inform their decision-making process

Leachate

- Both types of disposal facilities generate leachate
- Leachate is generated principally by the infiltration of precipitation and/or the percolation of precipitation through the disposal site
- The relative risks of the leachates can be compared using risk-based screening methods
- Leachate was chosen as the metric for comparison in this evaluation because it is characteristic of the disposal site and its specific contents, and its potential for impact on the environment, to the extent possible, is independent of the geology or geography of the location of the disposal site

Leachate Data Sources

Factors considered for leachate database selection

Electronic availability; results presented on a per sample basis; representative of sites across the US

MSW leachate database:

Leach 2000

- USEPA data base
- Represents information for 121 MSW landfills
- Data available electronically for individual samples
- Samples per landfill ranged from 1 to 34
- Wide variety of analytes

CCP leachate database:

CPInfo

- Data collected by the Electric Power Research Institute (EPRI)
- Represents information for 30 CCP management units
- Data available electronically for individual samples
- Samples per unit ranged from 1 to 54
- Inorganics

Data Summaries

- Non-detects were assigned a value of “0” (detection limits were not available for all records).
- To avoid sample number bias, an average leachate concentration was calculated for each constituent for each MSW landfill and each CCP management unit.
- Summary statistics (min, max, mean, 50th and 90th %iles) were calculated for each constituent for all MSW landfills and all CCP management units.

SITE	SAMPLE RESULTS	AVERAGE RESULT
MSW - 1	•••••	•
MSW - 2	••••••••••	•
MSW - 3	•	•
MSW - 4	•••••••••• ••••••••• ••••••••• ••••	•
MSW - 5	••	•
↓	↓	↓

n = 121

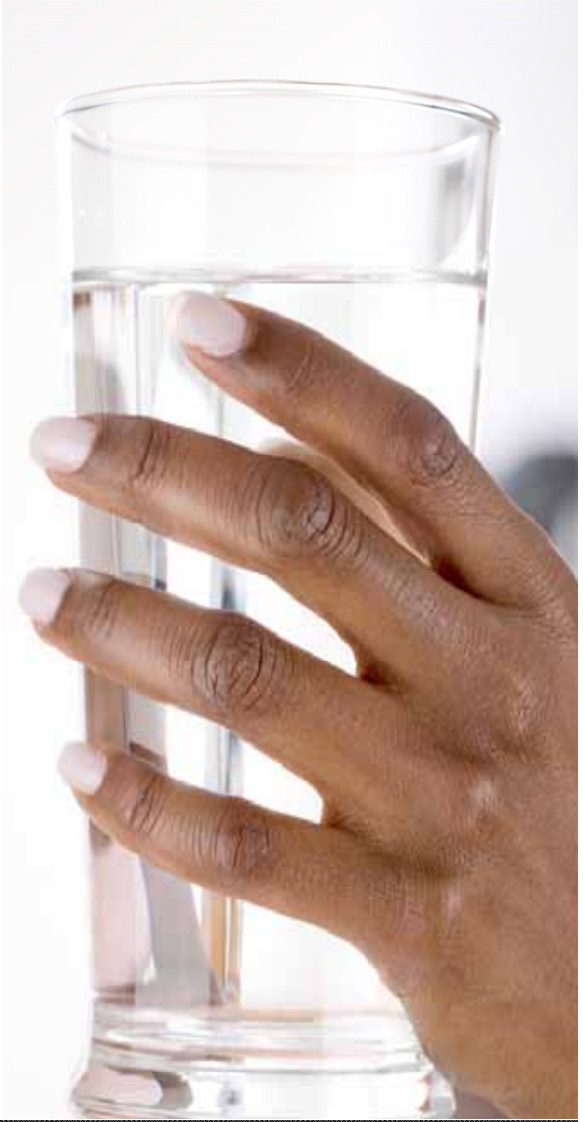
Risk Assessment Introduction

- Risk is a function of the concentration of a constituent in an environmental medium, the level of exposure to that medium, and the estimate of toxicity of the constituent:
  - ❖ **Risk = Concentration x Exposure x Toxicity**
- Given a target risk level, a screening level concentration of a constituent in an environmental medium can be calculated:
  - ❖ **Screening Level Concentration = $\frac{\text{Target Risk Level}}{\text{Exposure x Toxicity}}$**
- One can compare a measured environmental concentration to a screening level by a simple ratio to determine if the environmental concentration is above or below the screening level:
  - ❖ $\frac{\text{Environmental Concentration}}{\text{Screening Level Concentration}}$

Risk-Based Screening – Human Health

- Human health risk-based screening levels: EPA Regional Screening Levels (RSLs) for tap water
  - Where possible, surrogates were identified for constituents that did not have an RSL
  - Screening was conducted for both cancer and noncancer endpoints

Source:
(May 2010; http://www.epa.gov/region09/superfund/prg/index.html)



Risk-Based Screening – Ecological

- Ecological Risk-Based Screening Levels: The lowest value available from the following sources was used:
  - USEPA chronic ambient water quality criteria (AWQC) for aquatic life (USEPA, 2009a, http://www.epa.gov/waterscience/criteria/wqctable/nrwqc-2009.pdf)
  - USEPA Region 3 freshwater screening values (USEPA, 2008, http://www.epa.gov/reg3hscd/risk/eco/btag/sbv/fw/screenbench.htm)
  - USEPA Region 4 surface water screening levels (USEPA, 2001, http://www.epa.gov/region4/waste/ots/ecolbul.htm)
  - USEPA Region 5 ecological screening levels (ESLs) for surface water (USEPA, 2003, http://www.epa.gov/reg5rcra/ca/edql.htm)





Risk-Based Screening – Method

- Relative risks were developed by calculating the ratio of the leachate concentration for each constituent to its screening level
  - For noncarcinogens and for the ecological screen the target risk level is a hazard quotient of 1, thus the resulting ratio is equivalent to a hazard quotient
  - For carcinogens, the resulting ratio was multiplied by the target risk of $1x10^{-6}$ used in the calculation of the RSLs to develop a relative risk level

$$\text{Relative Risk} = \frac{\text{Constituent Concentration in Leachate}}{\text{Screening Level}} \times \text{Target Risk Level}$$

- So, we are asking the question, are the leachate concentrations above or below the risk-based screening level, and what is that ratio? Knowing the target risk level that the screening level is based on, we can use the ratio to estimate a relative risk level associated with that constituent.

- The relative risk results for each type of leachate are summed – for human health, noncancer and cancer results are summed separately

Results

Summary of Results						
Leachate Data Source	50th Percentile (a)			90th Percentile (b)		
	HH-C	HH-NC	Eco	HH-C	HH-NC	Eco
LEACH 2000 MSW	4.48E-04	1.45E+01	7.40E+06	7.27E-03	1.42E+02	8.01E+06
EPRI CCP	1.23E-03	1.83E+01	4.30E+03	6.20E-03	1.33E+02	4.20E+04
Ratio MSW/CCP	0.36	0.8	1721	1.2	1.1	191
Ratio CCP/MSW	2.75	1.26	5.81E-04	0.85	0.94	5.24E-03

Notes:
(a) Sum of risk level adjusted ratios of 50th percentile concentration to screening level.
(b) Sum of risk level adjusted ratios of 90th percentile concentration to screening level.

CCP - Coal Combustion Product.
Eco - Ecological results.
HH-C - Potentially carcinogenic human health results.
HH-NC - Noncarcinogenic human health results.
MSW - Municipal Solid Waste.

Note – it is unrealistic to assume that either type of leachate, MSW or CCP, would be the source of tap water or drinking water. Thus, this comparison of the leachate concentrations to the human health RSLs is for comparative purposes only; the comparison of the predicted risks is relevant, not the magnitude of the risks themselves.

Discussion – Human Health Risk-Based Results - 1

- Noncancer evaluation
  - The main noncancer risk drivers for the MSW leachate include manganese and arsenic, while for CCP leachate the noncancer risk drivers are molybdenum and arsenic
  - It is interesting that boron, considered in the field to be an indicator of CCP impacts to groundwater, also has elevated levels in MSW leachate as well as a high frequency of detection in the MSW leachate
- In the evaluation of potential carcinogens, arsenic is the main risk driver for both leachates
  - Arsenic was detected at a high frequency (on a site-averaged basis) for both leachate types (90:107 for the MSW leachate and 28:28 for the CCP leachate)
  - The range of site-averaged arsenic concentrations is much higher for the MSW leachate (maximum detect was 8100 µg/l for MSW leachate versus 998 µg/l for the CCP leachate)
  - However the percentile concentrations of arsenic are higher for the CCP leachate

Discussion – Human Health Risk-Based Results - 2

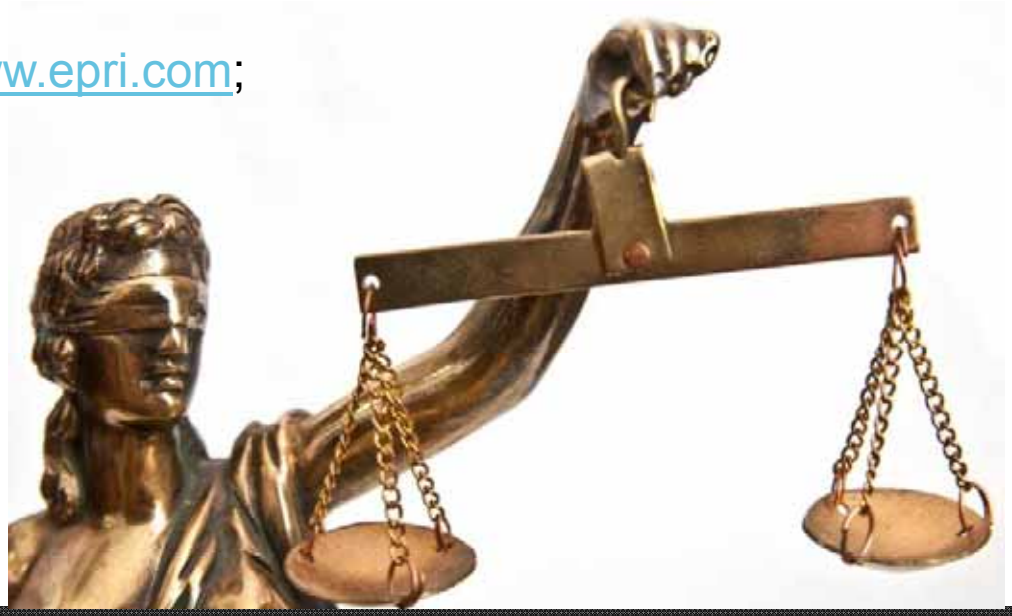
- The equivalence of the total potential carcinogenic risks for the two leachates is due to the many potential carcinogens present in the MSW leachate.
  - Arsenic is the only potential carcinogen present in the CCP leachate
  - At the 90th percentile level there are 31 detected potential carcinogens in the MSW leachate, including volatile organic compounds, semivolatile organic compounds, PCBs, dioxins and furans, and pesticides
  - Some of these constituents have low total numbers of detections in the MSW site-averaged data (for example, 3:6 for 1,4-dioxane); however, these low total numbers of detections are likely more a function of being analyzed in only a small subset of the MSW landfills evaluated in the database, and not a function of a constituent's presence or absence

Discussion – Ecological Risk-Based Results

The risk-based driver for the ecological risks for the MSW leachate is 2,4-DDE. It was detected in one landfill, but was only analyzed for that one landfill; thus, the low frequency is due to lack of analysis, not necessarily lack of presence. However, if this analyte were eliminated from the comparison, the MSW ecological risks would still be an order of magnitude (15-fold) higher than for the CCP leachate.

Conclusion

- Based on the results of this risk-based comparison, it can be concluded that the relative human health risks associated with leachates from MSW landfills and fly ash management are similar
- It should also be noted that as a monofill of essentially inorganic constituents, CCP management units do not need to be managed for the generation of flammable and explosive landfill gases, nor do they require “disease vector” management, both of which are required for MSW landfills
- The full report is available at www.epri.com; search for Report No. 1020555



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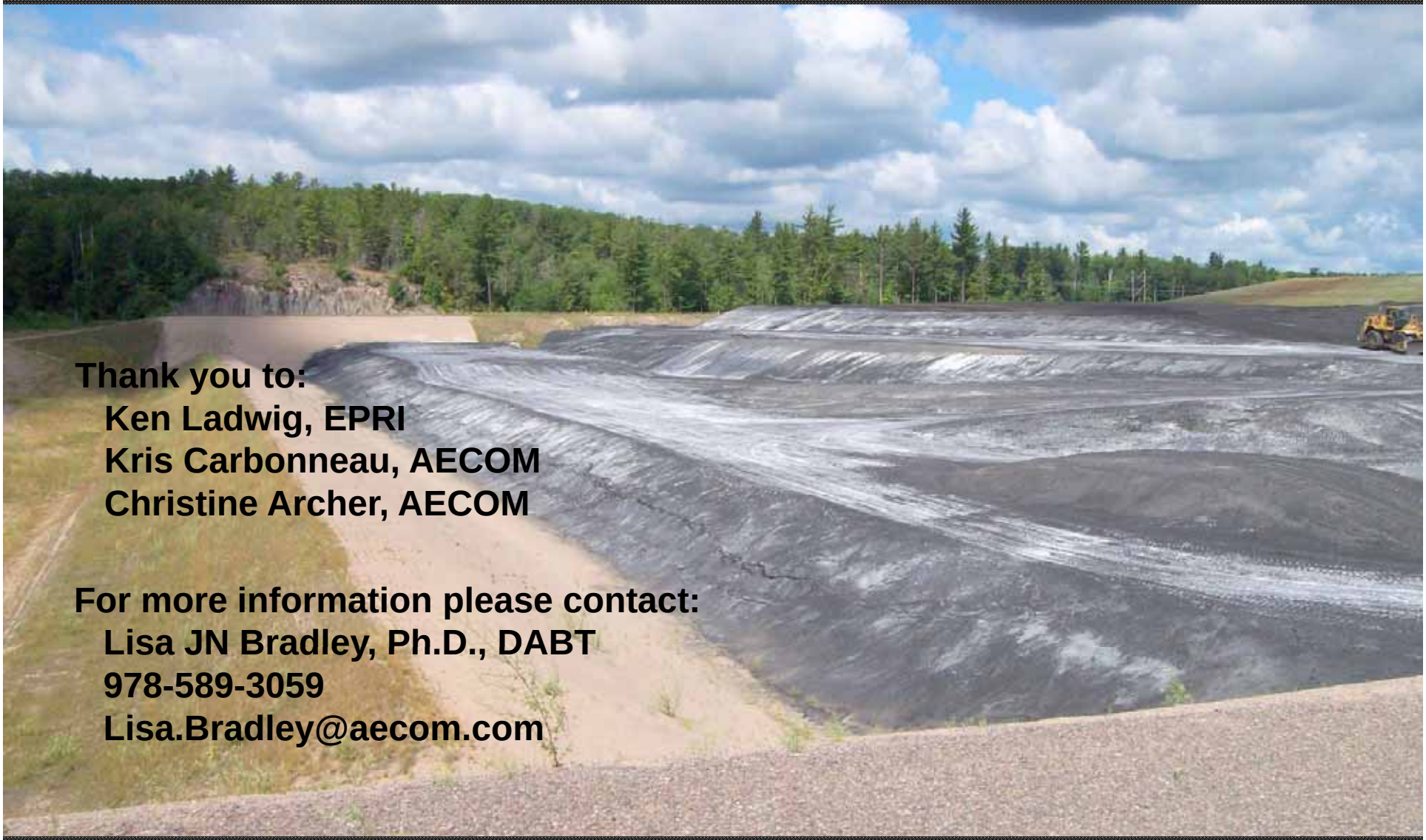

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