Refining risk-based approaches for determining extent of sub-surface soil excavations during closure by removal

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Agenda

1. Closure by removal - soil verification considerations
2. Initial approach at Santee Cooper's Grainger Ash Pond 1
3. Drivers for change
4. Continuous improvement process for Grainger Ash Pond 2
5. Refined approach for additional pond closures
6. Wrap-up

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Closure overview

- **Santee Cooper** committed to closing all CCR ponds by removal with beneficial use or landfilling
- First closure began at Grainger Ash Pond 1 in **2014** (non-CCR Rule)
  - Committed to removing soil as part of closure process
- Process improvements at:
  - Grainger Ash Pond 2
  - Winyah Ash Ponds (CCR Rule)
  - Jefferies Ash Pond
  - Cross Bottom Ash Pond (CCR Rule)

- **Haley & Aldrich** provides CCR Rule implementation and risk-based support

Soil verification considerations

Post-closure land use:

- Wetlands versus industrial use
- Deed restrictions as institutional controls

Soil sampling considerations:

- Sample collection timing (pre versus post CCR removal)
- Impacts of water management during closure operations and sampling
- Divide the pond into “decision units”
  - Segregation of “completed” vs. “in-progress” areas
  - # and size of “sampling units” & “decision units”
- Discrete versus composite sampling

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Soil verification considerations

Analytical considerations:

- Constituents of concern (may differ from CCR Rule Appendix III & IV)
- Analytical method selection
- Can your go-to lab handle the volume?
  - Turnaround times
  - How to handle recurring QC failures
  - Archived samples

Data evaluation considerations:

- Establish soil target criteria (i.e., remediation goals)
- Establish background concentrations
- How to determine and handle data outliers
- What to do if soil does not meet target criteria – risk evaluations?

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Initial sampling approach at Grainger Ash Pond 1

1. Removal of CCR material and 1 foot of soil*
2. Segregate an area for sampling – establish a "decision unit"
3. Sample and analyze exposed soil surface for COCs in each "decision unit"
4. If soil didn't meet target criteria:
   A. Re-analyze sample (typically QC failures associated with soil matrix)
   B. Resample and reanalyze
   C. Scrape or remove MORE soil, resample, and reanalyze
   D. Determine "next steps" – risk evaluation or additional removals

** 1 foot of soil was specified in 2013 settlement agreement*

Drivers for Change

- Water management issues – both from a daily operational standpoint & severe weather events
- Soil excavation rework – significant costs & schedule delays
- Sampling process – labor intensive & iterative
- Lab delays – impacts to closure schedule
- Remediation target challenges – increased need for communication & refinements

Severe weather events during closure of Grainger Ash Ponds

1,000 Year Flood:	October 2015	Gage at 16.20 feet- 5th highest recorded
Hurricane Matthew:	October 2016	Gage at 17.89 feet- 2nd highest recorded
Hurricane Irma:	September 2017	Gage at 11.57 feet
Hurricane Florence:	September 2018	Gage at 21.16 feet- Highest recorded
Hurricane Dorian:	September 2019	Gage at 12.48
Winter Storm:	February 2020	Gage at 12.80

Waccamaw River gage measurements for each event. Ash pond dikes about 2 feet lower than maximum flood gage reading.

Grainger Ash Pond 2 – AquaDam installation

Hurricane Florence flooding and pond overtopping risk

Opportunities

- Source removal & reduced hydraulic loading in ponds contributed to significant groundwater improvements
- Scientifically defensible process for “decontamination” per §257.102(c)
- Continuous improvement team approach yields process improvements, internal collaboration, and improved knowledge and skills.
- Gain credibility and trust of community
- Professional development and coordination with state regulators

Challenges

- Accelerated schedules to respond to recurring severe weather events
- Sampling & analysis can be costly and time intensive
- Visual removal to ash/soil interface is okay, but on-site microscope better (native gray soils found in ponds)
- Digging deeper doesn’t always mean you get better results
- Bottom of ash pond is below groundwater table making excavation difficult and a safety concern
- Over excavation of soils is costly and results in significant delays
- Hazardous field conditions

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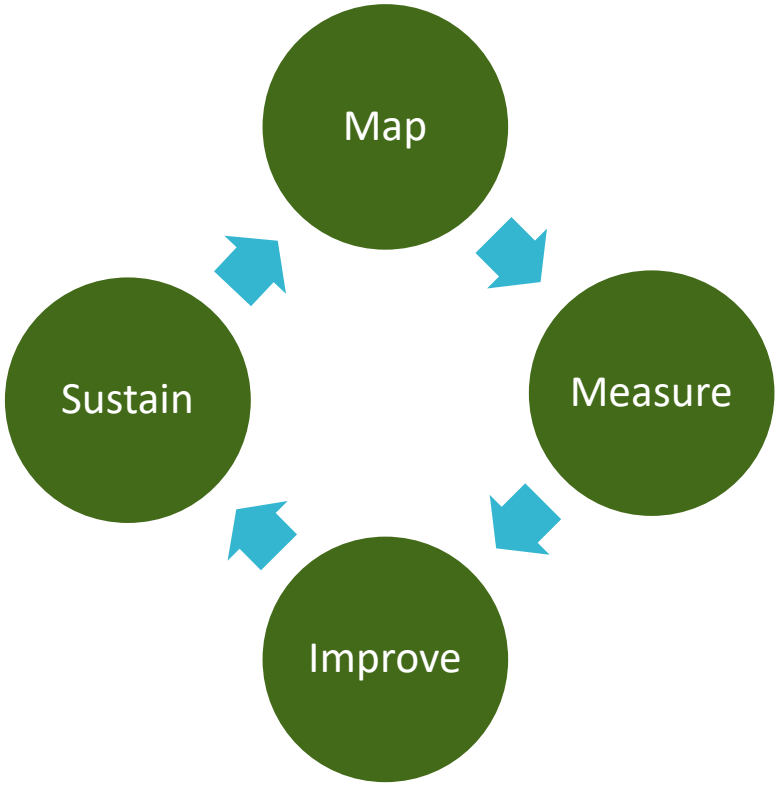
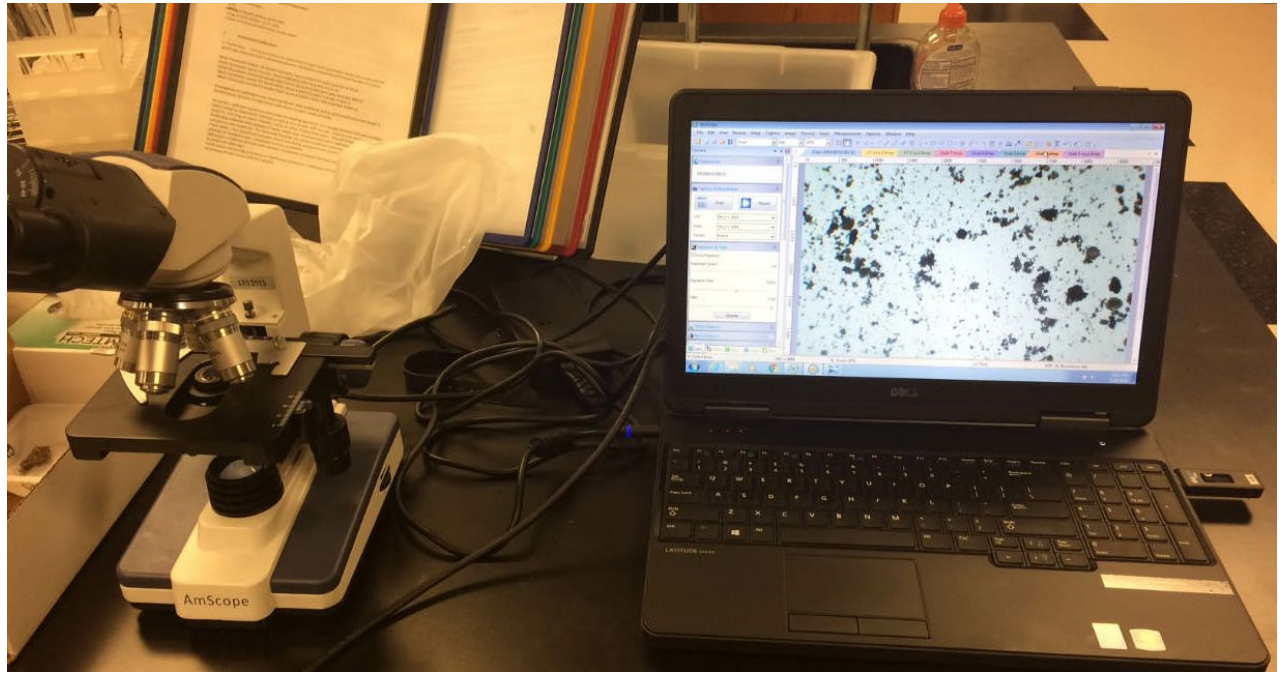
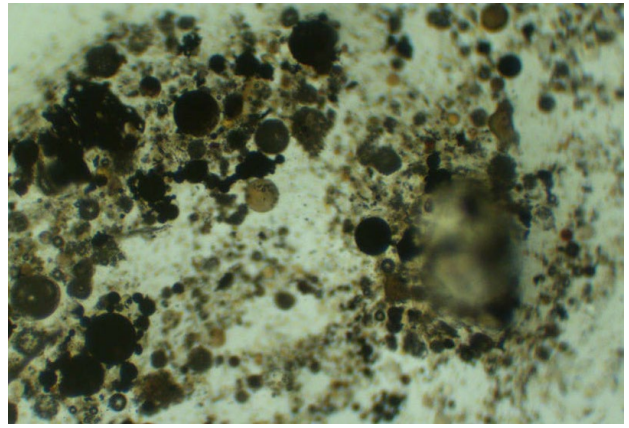
Continuous improvement goals

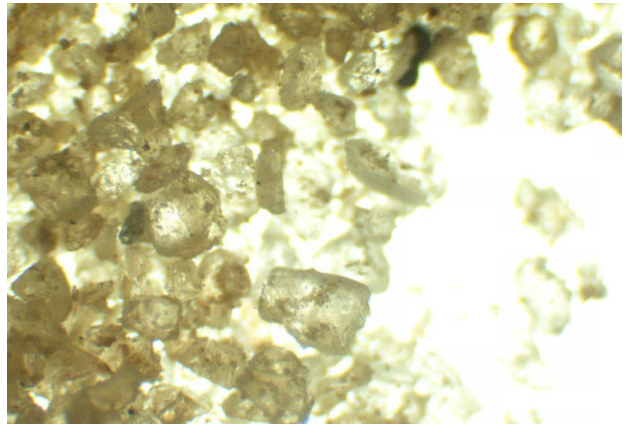
- For Grainger Ash Pond 2:
  - Identify ash/soil interface in the field
  - Revise target criteria using a risk-based approach
  - Identify opportunities for improved soil confirmation sampling process
    - Reduce number of soil samples
    - Reduce number of constituents analyzed
    - Accelerate time to analyze samples
  - Work with regulators for approval of risk evaluations
- For future pond closures:
  - Identify extent of required removals prior to excavating soil



Field identification of ash versus soil







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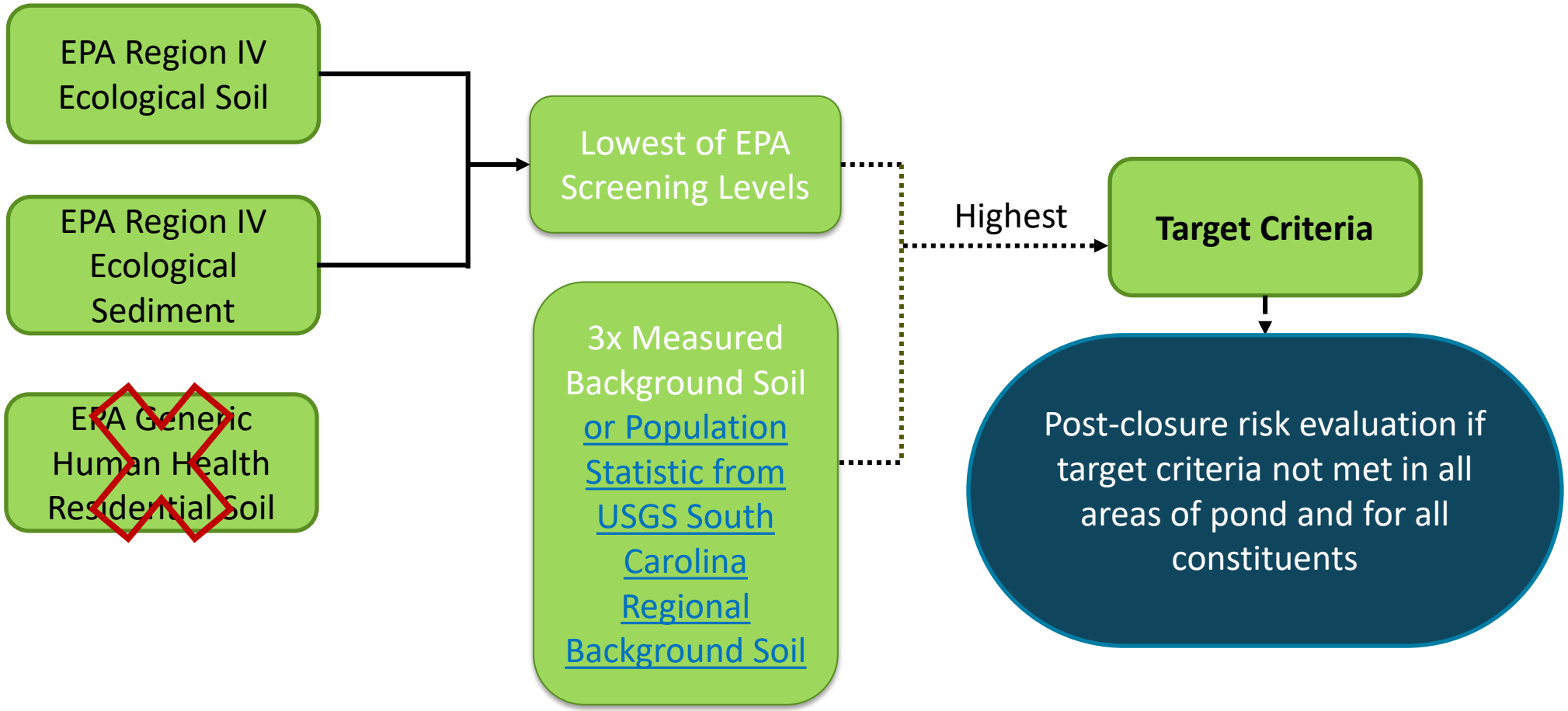
Revised process to determine soil target criteria – Ash Pond 2
A risk-based approach



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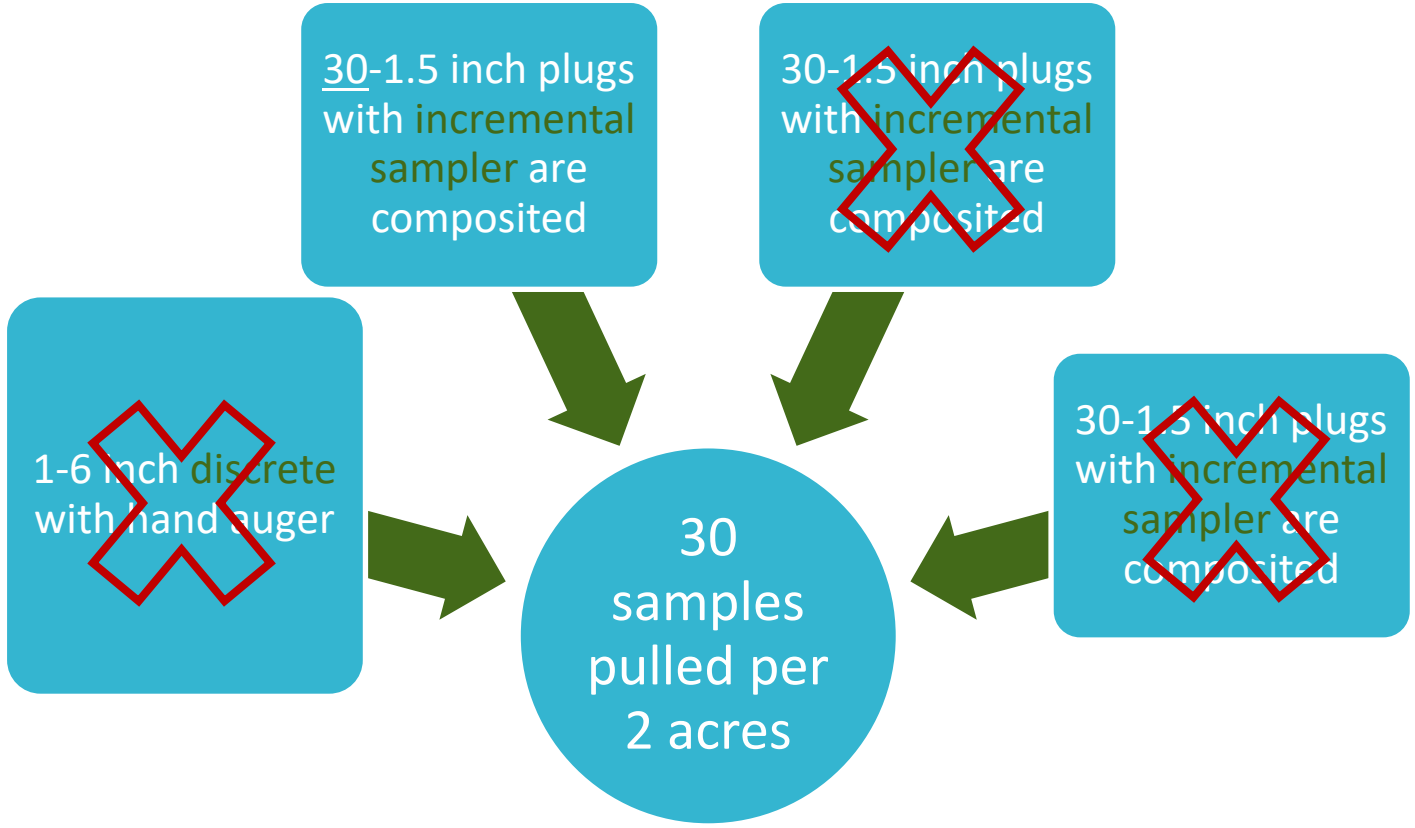
Revised soil sampling methodology – Ash Pond 2



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Analyte list reduction methodology

This is site-specific. Must agree upon reduction factors with regulators.

Constituent	Not detected above target criteria in ash	Max ISM samples <50% of the target criteria	No detection in soil samples
Aluminum	X		
Antimony	X	X	X
Arsenic			

- Other factors may include:
  - No established EPA screening level
  - Below GWPS/MCLs
- Agreement on how many factors must be met for removal from list.
- Consider what your sample population will be to have enough data to perform this methodology.

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Grainger Ash Pond 2 reduced from 26 to 17 constituents

Constituents of Concern			
Aluminum	Chromium	Lithium	~~Silver~~
~~Antimony~~	~~Chromium VI~~	Magnesium	Strontium
Arsenic	Cobalt	~~Manganese~~	~~Thallium~~
Barium	Copper	Mercury	Vanadium
~~Beryllium~~	~~Fluoride~~	Molybdenum	Zinc
Boron	Iron	Nickel	
~~Cadmium~~	~~Lead~~	Selenium	

Risk assessment

- Difficulty meeting criteria in clayey soils – digging deeper doesn't mean you get better results
- Justify 33 mg/kg target criteria for arsenic in soil (compared to approved value of 9.8 mg/kg)
- Human health risk-based evaluation
  - Demonstrated groundwater improvements and lack of surface water impacts
  - Evaluated potential downstream receptors
  - Conversion to wetlands would prevent human exposure to soil at site
- Ecological risk-based evaluation
  - County-wide background concentrations
  - Nutrients and dietary considerations
  - Frequency, magnitude, and pattern of detected chemicals
  - Mode of toxicity and potential for bioaccumulation
  - Multiple contaminant effects
  - Exposure considerations

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Real world observations from Grainger

- Usually meet target criteria in sandy soils
- Gray clays difficult to visually differentiate from ash – use of microscopic method
- Excavated an average of 2+ feet, sometimes up to 5 feet
- Meeting arsenic and barium remediation targets was challenging with clayey soils even with excessive excavation

Is the residual contamination 1 foot below the ash/soil interface truly due to presence of ash or some other reason?

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Winyah Ash Pond A – Key site differences

- Subject to CCR rule
  - State still requires verification process to determine soil removal extent
- Prior to removal of ash, conducted extensive borings to determine ash/soil interface
- Building CCR landfill in footprint of pond in phased approach
  - Supports analyte reduction methodology and less stringent target criteria due to reduced exposure

Winyah Ash Pond A – Process improvements

- Collected soil **samples from borings** in 6” increments
- Background soil borings on-site at approximate depth of pond bottom – **utilize 95% UTL** instead of 3x measured concentration
- Mapped site and correlated to GIS equipment on excavators **(excavate 12-15 inches)**
- Followed same analyte reduction methodology **(removed 13 constituents)**
- Risk evaluation TBD for remaining footprint outside landfill cells

Jefferies Ash Pond A – Process improvements

- Borings/analytical testing prior to soil removals while ash excavation is ongoing
  - Testing up to 2 feet below ash
  - If target criteria not met – limited testing to **no more than 3 feet below ash**.
- If target criteria not met at 3 feet, will use risk assessment process as at Grainger
- Followed same analyte reduction methodology **(removed 8 constituents)**

Cross Bottom Ash Pond – Process improvements

- Closure by removal of CCR impoundment
- Constructed with bentonite clay liner (not CCR Rule liner)
- Closure and sampling plan under review by SC DHEC
- Key proposed changes:
  - No or limited soil sampling due to clay liner
  - Removal of CCR to the liner (aided by GPS equipment and construction drawings)
  - Inspect liner for deficiencies
  - Further investigation activities in deficient or disturbed areas
  - Remove liner in its entirety

Pros and Cons

Driver of Change	Implemented Change	Pros & Cons
Water management issues (daily & severe weather)	Soil sampling in advance of soil excavation work	Pro – no segregation of cleaned areas, reduction in recontamination Con – still limited space for wastewater management prior to NPDES discharge
Soil excavation rework – significant costs	Soil sampling in advance of soil excavation work	Pro – obtain approval on grading plan in advance of doing the work Con – regulators may still require post removal sampling “after the fact”
Sampling process – labor intensive & iterative	Collect samples via borings and collect extra for storage to avoid resampling	Pro – reduced time in field Con – requires hiring contractor instead of in-house only labor
Lab delays – impacts to closure schedule	Communication plan, collecting samples in advance allows for more processing time, reduced analyte list, in-house lab became certified for soils analysis	Pro – downtime pressure removed from excavation crews & reduced lab testing Con – labs can still experience delays with sample volume
Remediation target challenges – increased need for communication & refinements	Revised process to establish soil target criteria using risk-based approach, reduced analyte list, & use of formal risk evaluations	Pro – less testing, communications with regulators Con – perception

Grainger Ash Pond post closure with planted wetlands and open water

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