REINHOLD ENVIRONMENTAL Ltd.

2015 Wastewater-Ash Round Table Presentation

September 22, 2015, in Charlotte, NC / Hosted by Duke Energy

Tricks and Trips in Ash Pond Closures

Wastewater – Ash/PCUG Conference, Charlotte, NC

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Gabe Lang, P.E.

September 22, 2015

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Overview

Overview

- Ash Ponds
- Regulations for Closure – Federal CCR Rule
- Regulations for Closure – CAMA (North Carolina)
- Closure Design Considerations
- Closure Implementation Considerations

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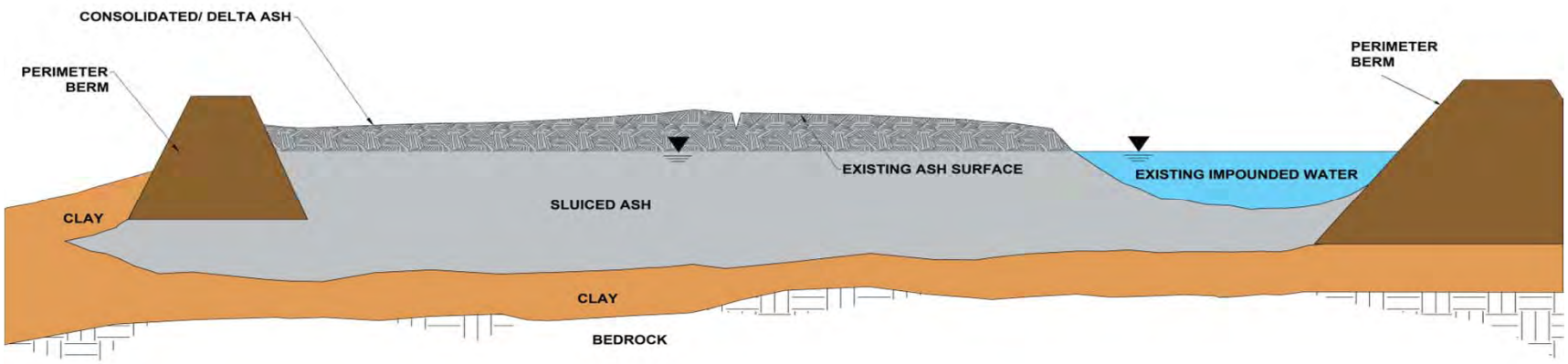
Ash Ponds

Ash Ponds



- Sluiced ash
- Impounded water
- High water content and low shear strength
- Unstable surface for personnel or equipment access
- Significant construction and operation challenges

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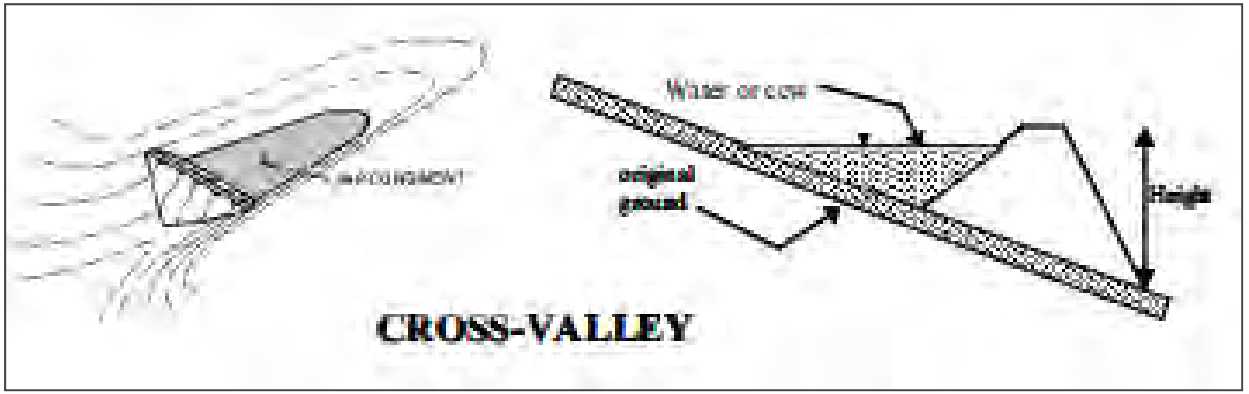
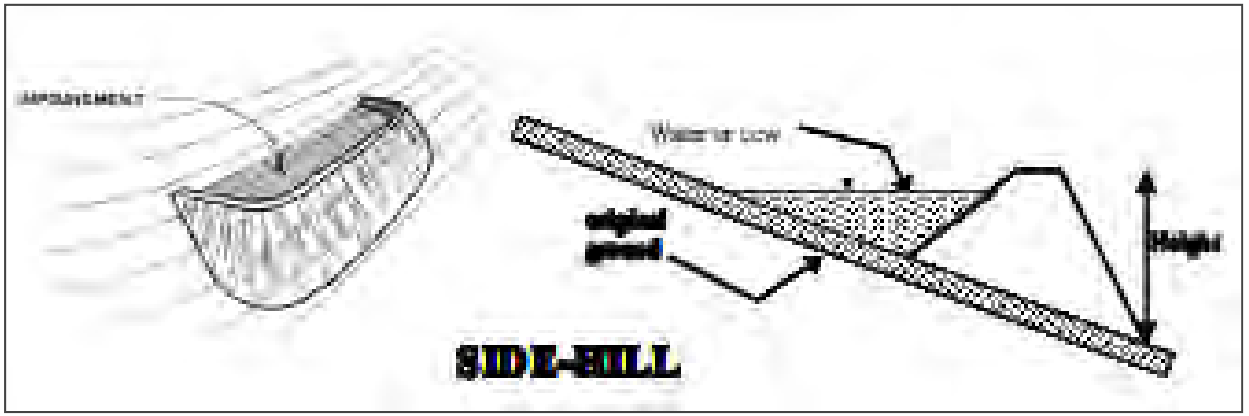
Ash Pond Configurations





From EPA Dam Inspection Forms, 2009

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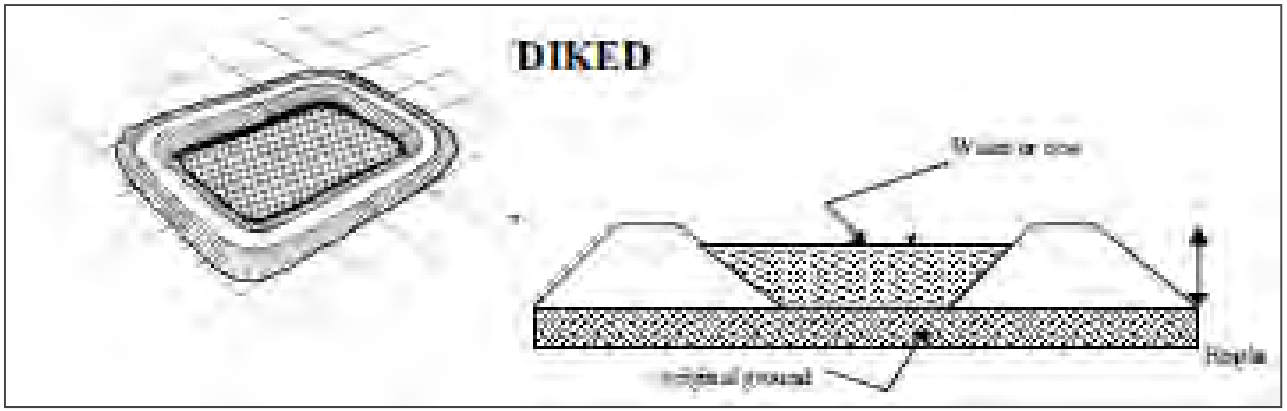
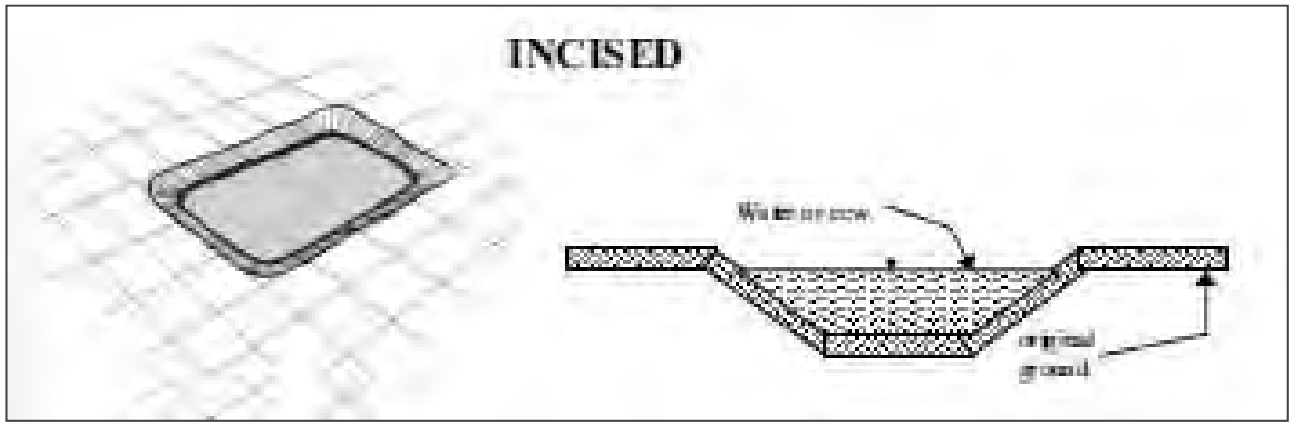
Ash Pond Configurations





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Regulations for Closure: Federal CCR Rule

CCR Rule Overview

- Final CCR rule published in the Federal Register on April 17, 2015.
- Final CCR rule will be effective 6 months after publication on October 14, 2015.
- Closure triggered based on CCR units not meeting different criteria at different compliance milestones.
- Owner must initiate closure of the CCR unit within 6 months if failing to meet T18, T30, or T42 technical criteria. Other requirements applicable for beneficial reuse cases.
- Initial Closure Period
  - 5 years is allowed to complete impoundment closure
- Extensions
  - For Impoundments >40 acres → Up to 5, 2-year extensions possible
  - For impoundments <40 acres → 1, 2-year extension is possible

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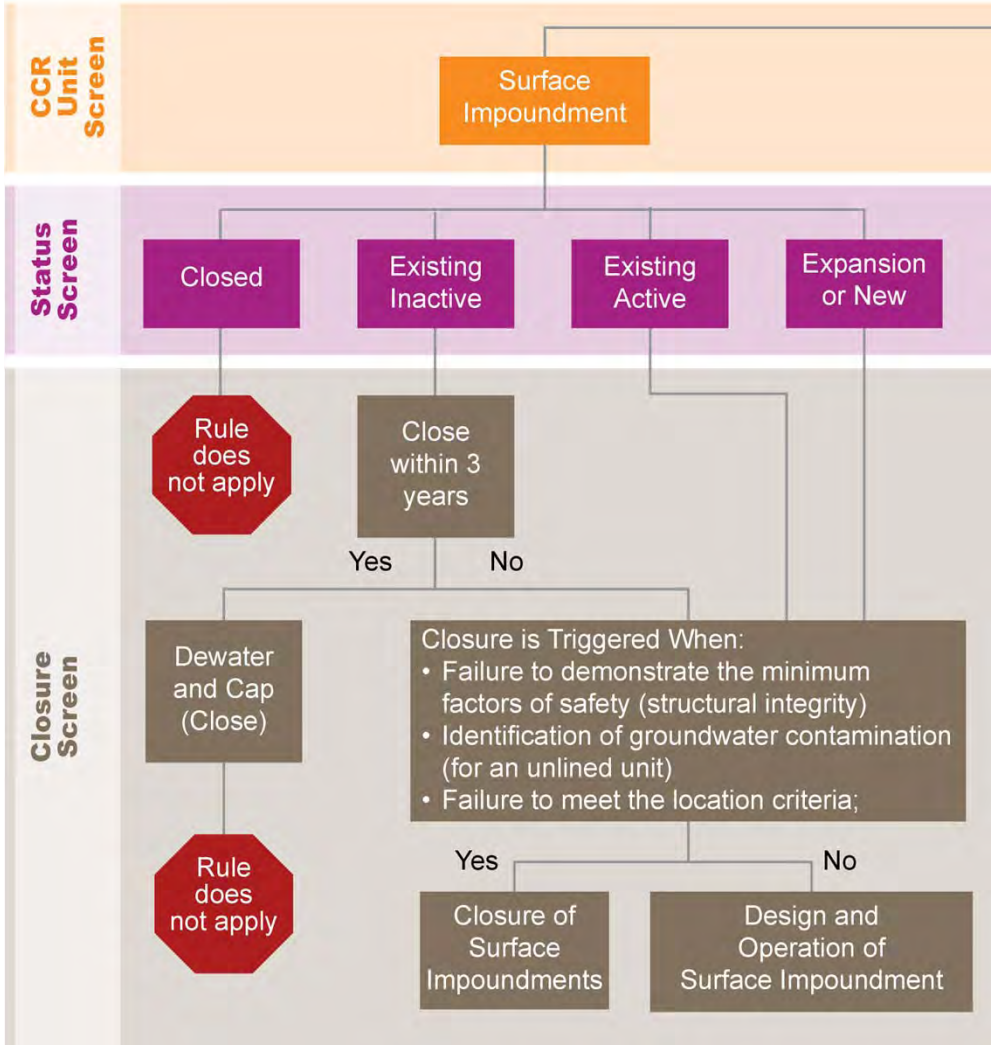
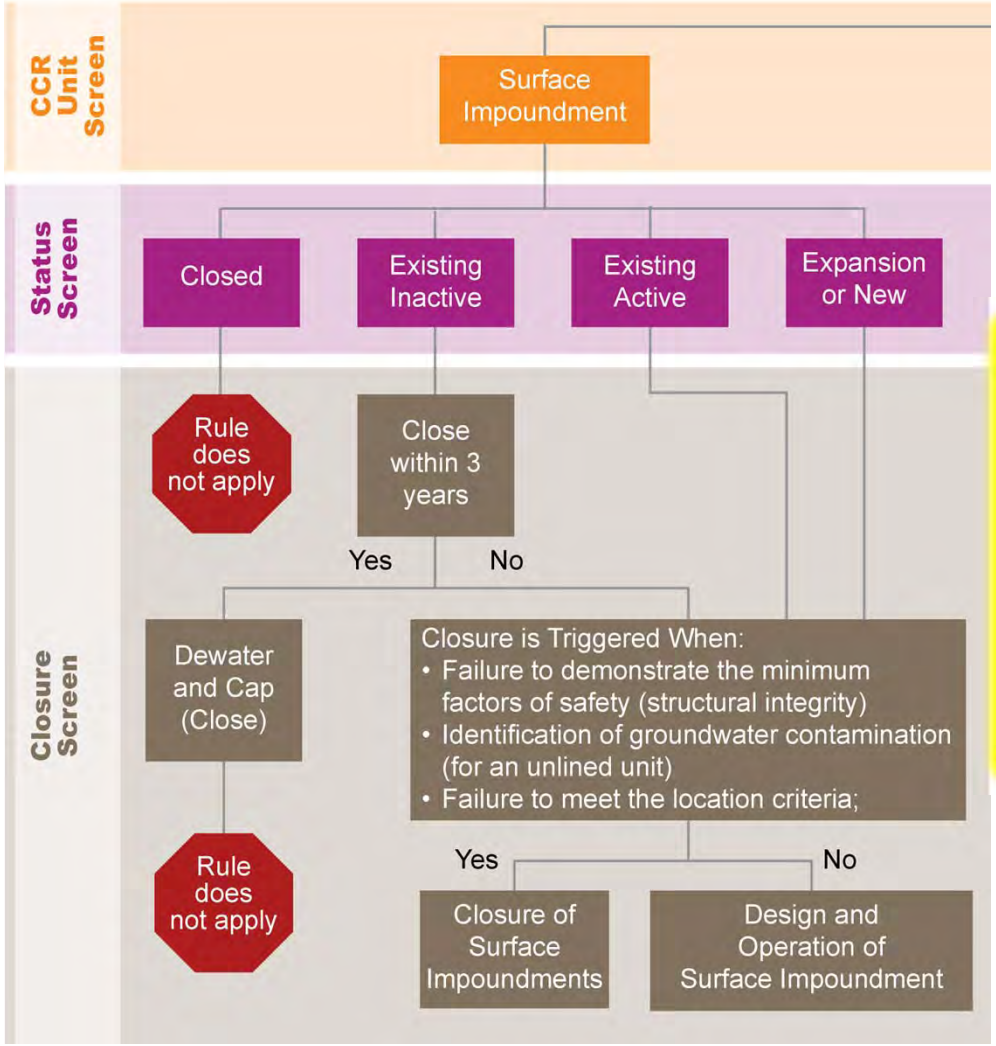
Unit, Status, and Closure Applicability Screens



Term	Definition
CCR Surface Impoundment	1. A natural topographic depression, man-made excavation, or diked area, which is 2. designed to hold an accumulation of CCR and liquids, and the unit 3. treats, stores, or disposes of CCR.
Inactive CCR Surface Impoundment	• CCR surface impoundment that no longer receives CCR on or after *180 days after publication date* and • still contains both CCR and liquids on or after *180 days after publication date*.
Existing (active) CCR Surface Impoundment	• CCR surface impoundment that receives CCR both before and after *180 days after publication date*, or • for which construction commenced prior to *180 days after publication date* and • receives CCR on or after *180 days after publication date*.
New CCR Surface Impoundment	CCR surface impoundment or lateral expansion of an existing or new CCR surface impoundment that first receives CCR or commences construction after *180 days after publication date*.

Unit, Status, and Closure Applicability Screens



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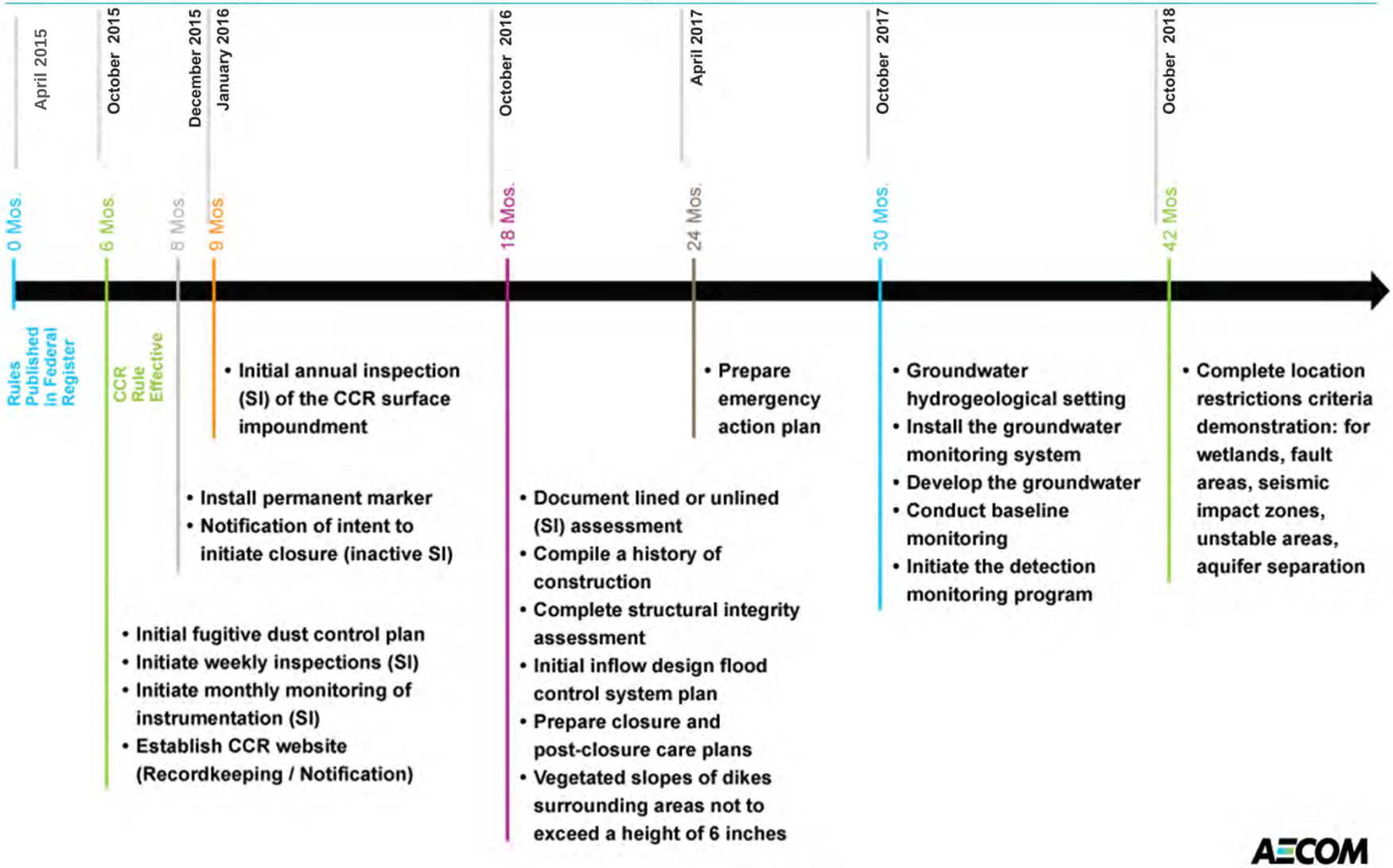
	publication date.
New CCR Surface Impoundment	CCR surface impoundment or lateral expansion of an existing or new CCR surface impoundment that first receives CCR or commences construction after *180 days after publication date*.

No definition of a previously closed surface impoundment in the rule.

Older closed units are defined in the preamble as exempt if capped or "otherwise maintained"—provided they no longer impound liquid.

Implementation Timeline for Existing CCR Surface Impoundment



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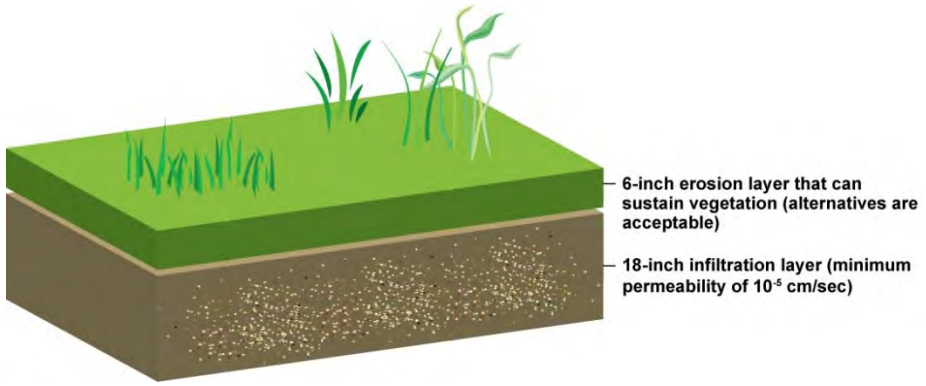
Closure of an Inactive Surface Impoundment

Dewatering – preparing a CCR surface impoundment for placement of final cover by:

- Eliminating free liquids by removing liquid wastes and solidifying the remaining wastes and waste residues
- Stabilizing remaining wastes sufficient to support the final cover system.

Closure in Place	Final cover must include 18-inch infiltration layer (minimum permeability 10^{-5} cm/sec) under a 6-inch erosion layer that can sustain vegetation (alternatives are acceptable)
Clean Closure	Remove all CCR from the unit and decontaminate all areas affected by releases from the impoundment, including the bottom liner, if applicable.



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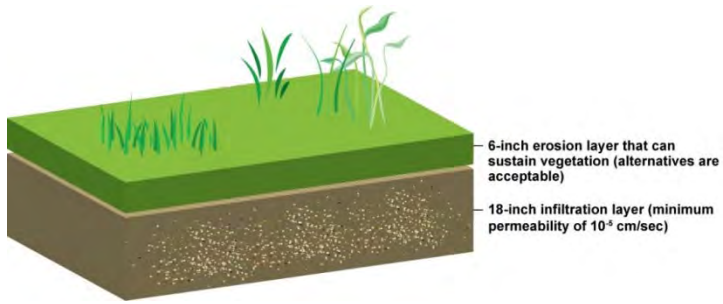
Groundwater Monitoring and Corrective Action

Applicability

- All CCR landfills (except inactive landfills that are not subject to the CCR Rule)
- All surface impoundments and lateral expansions (except inactive surface impoundments that will close within 36 months of the Rule)

Closure with a low permeability cover system can be a corrective action.



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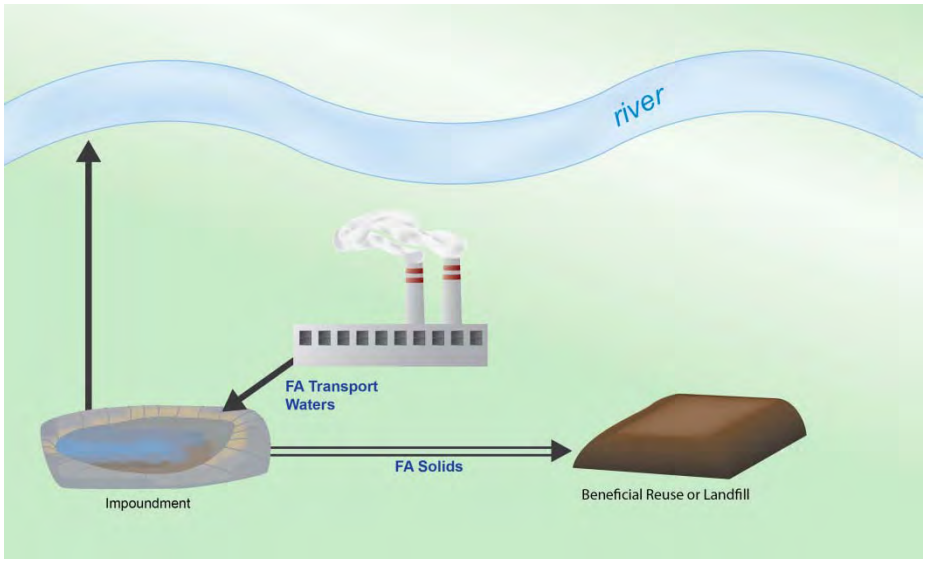
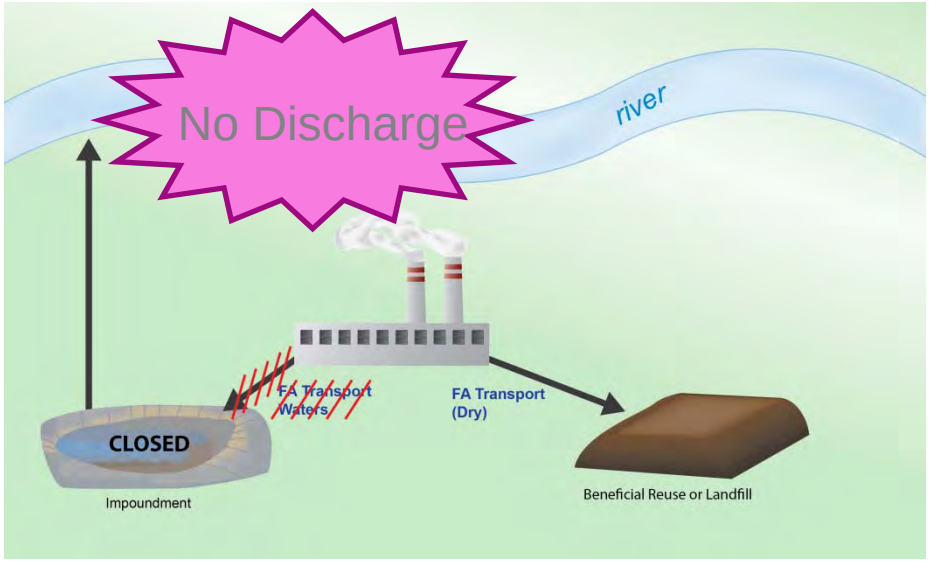
Other Challenges and Regulatory Impacts – Wastewater





- Wastewater from plant operations and site storm water (CCR Rule, ELGs)
- Construction water from dewatering operations during closure
- Water from active groundwater treatment systems
- Wet to dry conversions
- Landfill leachate treatment

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Regulations for Closure: CAMA (North Carolina)

Regulations Overview NC Coal Ash Management Act (CAMA)

- CAMA Prohibits:
    - New or Expanded Coal Combustion Residuals (CCR) Surface Impoundments
    - Disposal of CCR Where Coal-Fired Generating Units No Longer Produce Residuals
    - Discharge of Stormwater into CCR Surface Impoundments
- Establishes Coal Ash Management Commission to Oversee Program
- Requires Facilities Owned by Public Utility to Convert to “Dry” Fly Ash or Retire
    - Fly Ash Dry Conversion by December 31, 2018
    - Bottom Ash Dry Conversion by December 31, 2019
- Requires Groundwater Monitoring and Corrective Action, As Necessary
- Closure Requirements (and role of closure as part of correction action)

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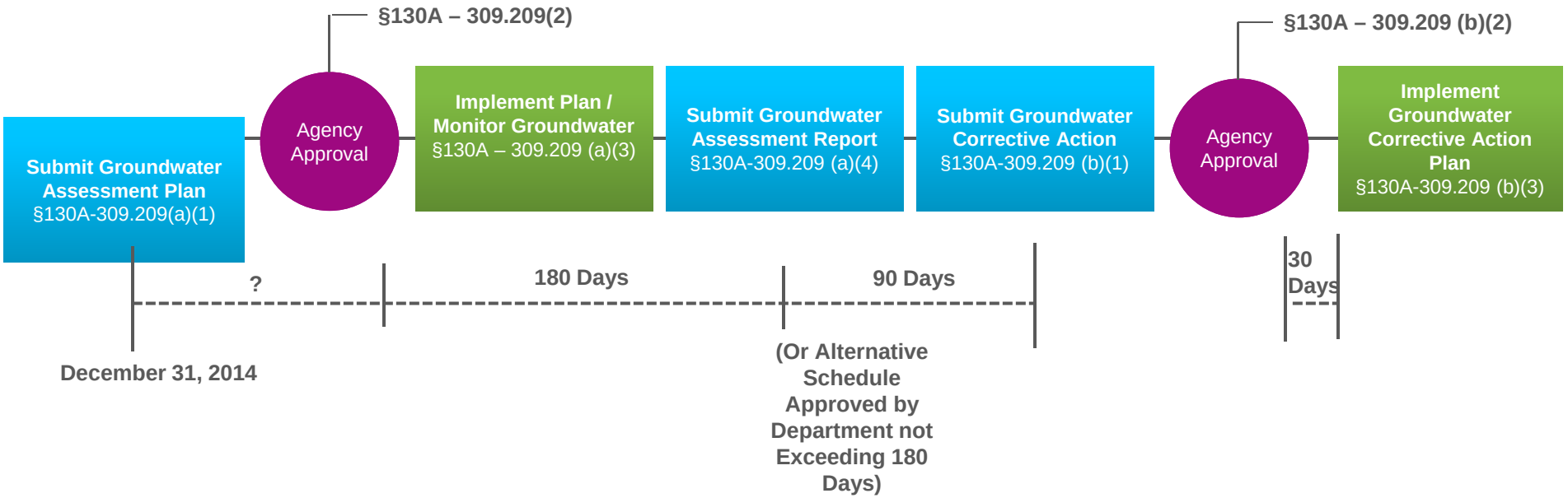
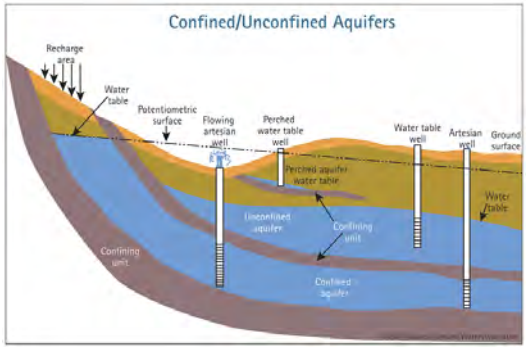
Groundwater Assessment and Corrective Action





- Closure
- Closure + MNA
- Closure + Additional Remediation

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Regulations – CAMA Risk Categories and Ranking Criteria

1. Hazard
2. Structure
3. Surface Water
4. Extent of Contamination
5. Receptors
6. Geology/Hydrogeology
7. CCR Volume
8. Floodplain
9. Misc

Low Risk

Intermediate Risk

High Risk

§130A-309.211(a)

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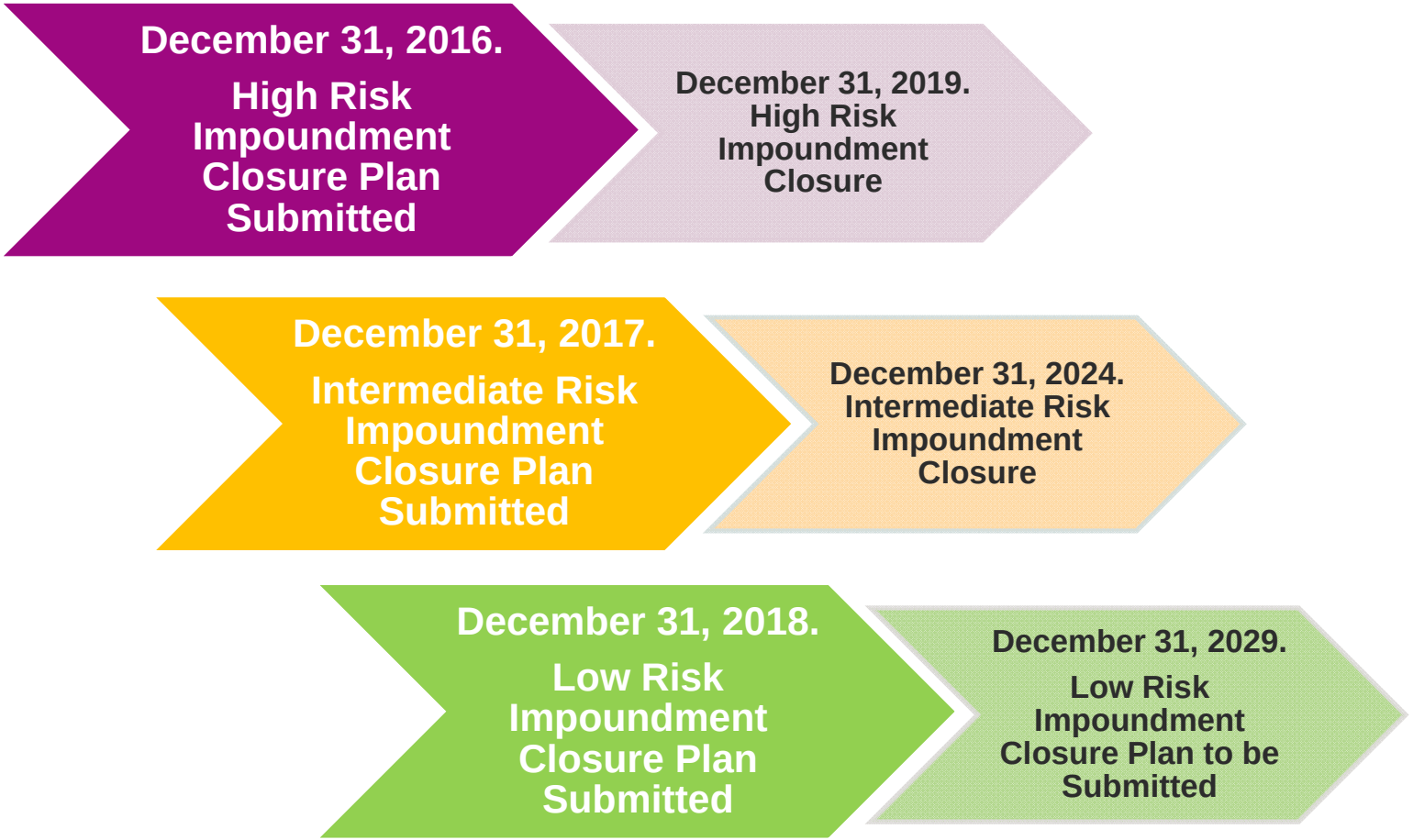
Regulations – NC CAMA Closure Timeline



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Regulations – NC CAMA High/Intermediate Risk Impoundment Closure Options

Risk Category	Closure Options	Description
High Intermediate	Clean closure	**Option 1. Convert to an Industrial Waste Landfill** Dewater Impoundment; Temporarily Remove CCR and Contaminated Soil; Install Leachate Collection System, Liner System; and Comply with Landfill Requirements in North Carolina **Option 2. Remove CCR and Return to a Non-Erosive and Stable Condition** Dewater Impoundment; and Transfer the CCR for Disposal in a Landfill, or Use CCR for Beneficial Use or Structural Fill
Low	Clean closure Closure in Place	**Option 1. Convert to an Industrial Waste Landfill** **Option 2. Remove CCR and Return to a Non-Erosive and Stable Condition** **Option 3. Closure in Place** Dewater Impoundment Install and maintain a Cap System to Minimize Infiltration and Erosion

All Options Must be Consistent with Achieving/Maintaining Groundwater Quality Standards

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Dam Decommissioning and Dewatering

- **Dam Decommissioning:**
  - Breach Plan demonstrating no impounding condition.
  - Geotechnical investigation to confirm stability/unit not subject to liquid flow behavior under static and dynamic loading conditions.

- **Dewatering:**
  - Impoundments located in whole above the seasonal high groundwater table shall be dewatered; or
  - Impoundments located in whole or in part beneath the seasonal high groundwater table shall be dewatered to the maximum extent practicable.
  - “Dewatering” not defined in CAMA Definitions §130A-309.201
  - CCR Rule discusses dewatering as removal of free liquid. Free liquid is defined as liquid that readily separates from the solid portion of a waste under ambient temperature and pressure.

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Closure Plan Development Timeline Comparison

CAMA

- High Risk Impoundment – by December 31, 2016
- Intermediate Risk Impoundment – by December 31, 2017
- Low Risk Impoundment – by December 31, 2018

Final CCR Rule

- October 10, 2016
- December 17, 2015 (Notification for inactive CCR Surface Impoundments intending to close within 3 years)

Key Considerations:

- Variable Timelines
- CAMA surface impoundment classification by agency not available until December 31, 2015

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Closure Plan Implementation Timeline Comparison

CAMA

- High Risk Impoundment – December 31, 2019
- Intermediate Risk Impoundment – December 31, 2024
- Low Risk Impoundment – December 31, 2029

Key Considerations:

- All unlined CCR surface impoundments are required to close under CAMA
- Aggressive timeline under CAMA for High Risk impoundments

Final CCR Rule

- Inactive Surface Impoundments intending to Close within 3 years – April 10, 2018
- Allowed 5 years to close under following triggers:
  - Within 30 days of known final receipt of waste or known final removal of CCR from unit
  - Within 2 years after the most recent receipt of CCR for idled units
  - Unit fails to meet technical criteria

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Closure Cover System Comparison

CAMA

- Cap system consisting of :
  - Permeability no greater than 1 x 10^{-5} cm/sec
  - At least 18 inches of low permeability earthen material
  - 6 inches of earthen material capable of sustaining plant growth

Key Considerations:

- Cap system requirements similar
- (also liner system requirements similar)

Final CCR Rule

- Cap system consisting of :
  - Permeability no greater than 1 x 10-5 cm/sec
  - Infiltration layer consisting of at least 18 inches of earthen material
  - 6 inches of earthen material capable of sustaining plant growth
- May elect to use alternative design, provided the system is designed and constructed to meet the criteria of the rule

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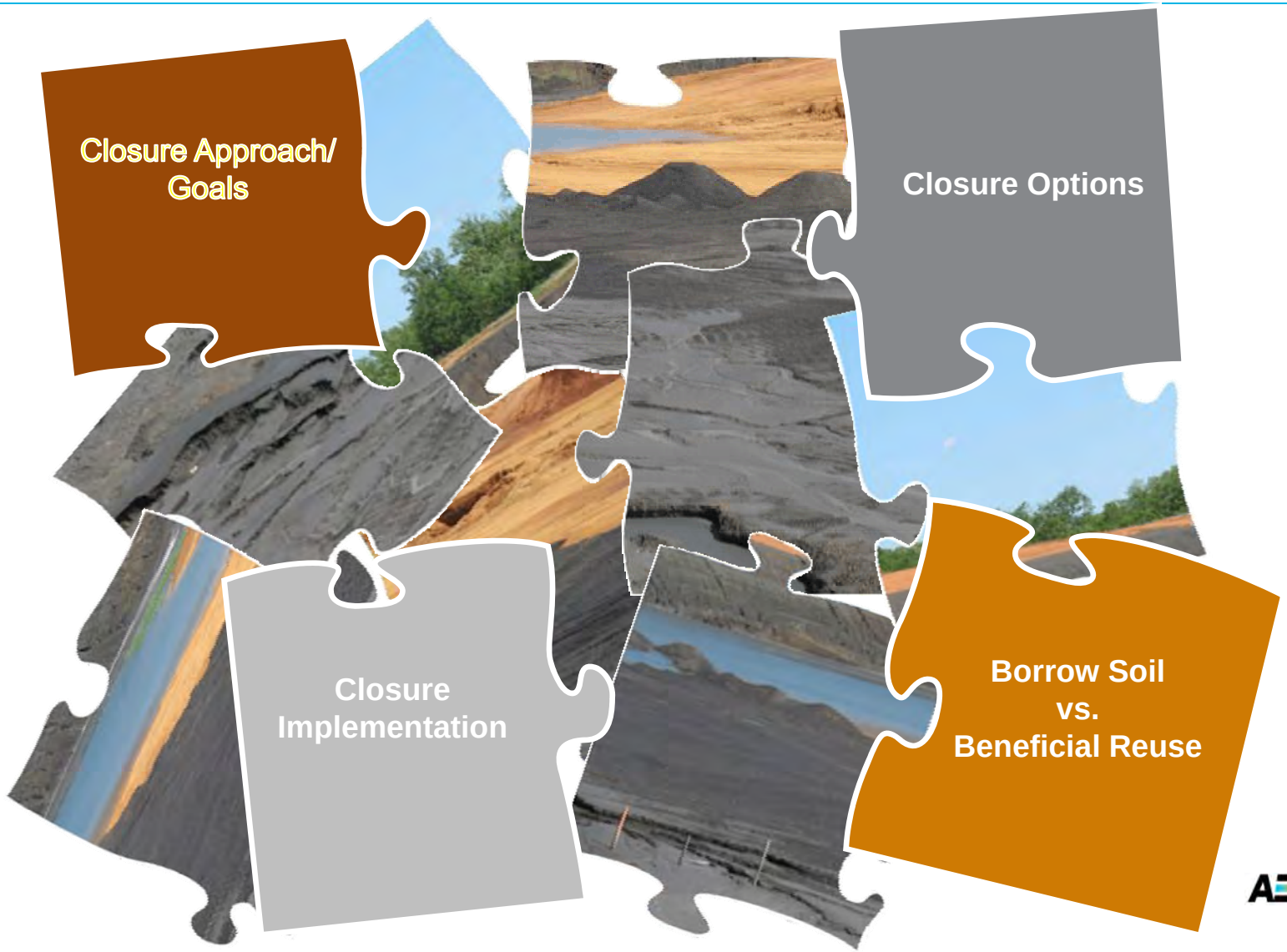
Closure Design/Implementation Considerations

Pond Closure Overview



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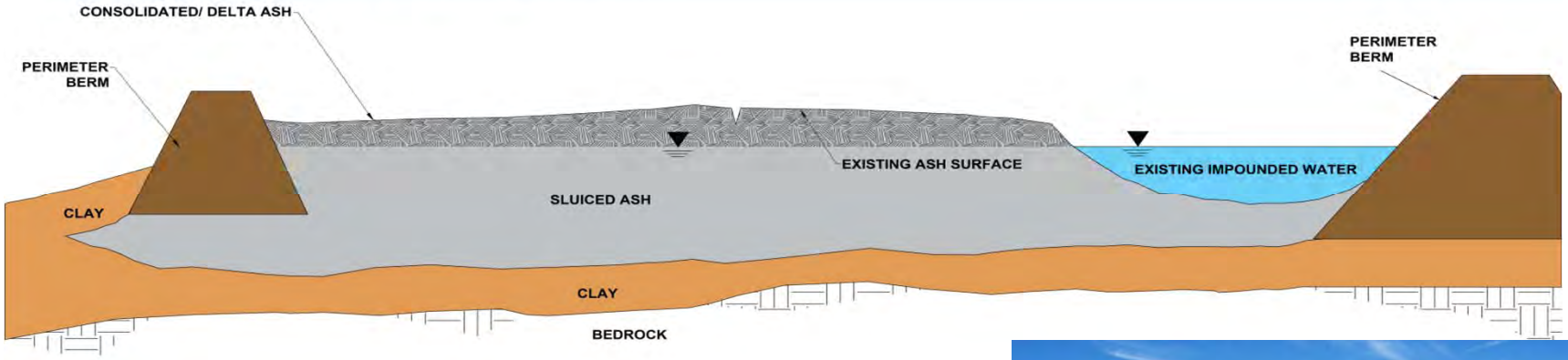
Pond Closure Overview



- Large Area (Hundreds of Acres)
- Perimeter Containment Berms
- Open Pool Areas
- Delta Ash (flat/uneven grades)
- Special Considerations (karst, seismic, etc.)

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Typical Ash Pond Conditions

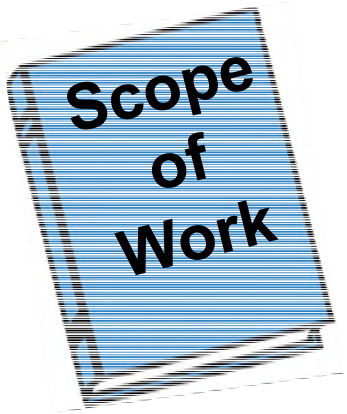
- Sluiced ash
- Impounded water
- High water content and low shear strength
- Unstable surface for personnel or equipment access
- Significant construction and operation challenges

Pond Closure Approach/Goals

1. Establish goals
2. Understand regulatory setting
3. Long Range Planning
4. Explore alternatives (be innovative)
5. Evaluate and select

Be systematic

Closure Strategy:
- Close in Place
- Footprint Reduction
- Clean Closure
- Beneficial Use



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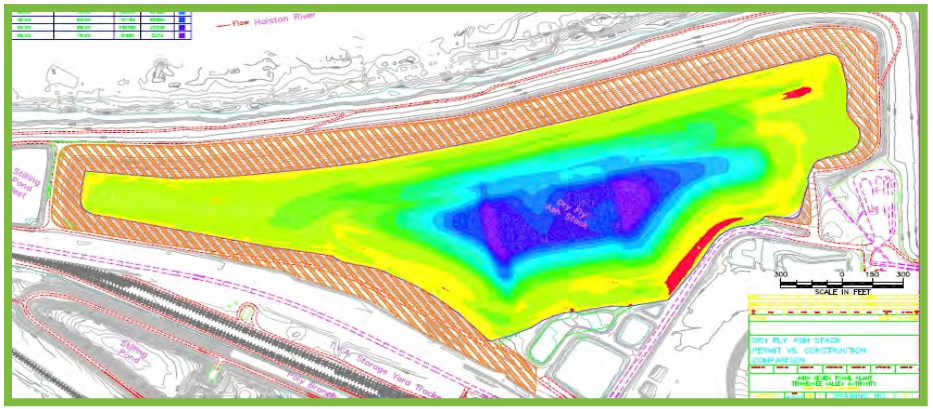
Pond Closure – Establish Goals

Closure of ash ponds is designed to meet the following goals:

- Provide long-term function with a minimum of maintenance
- Effectively manage surface water
- Provide an effective barrier against infiltration
- Reduce current/future environmental impacts
- Meet regulatory requirements
- Meet specified closure timeline



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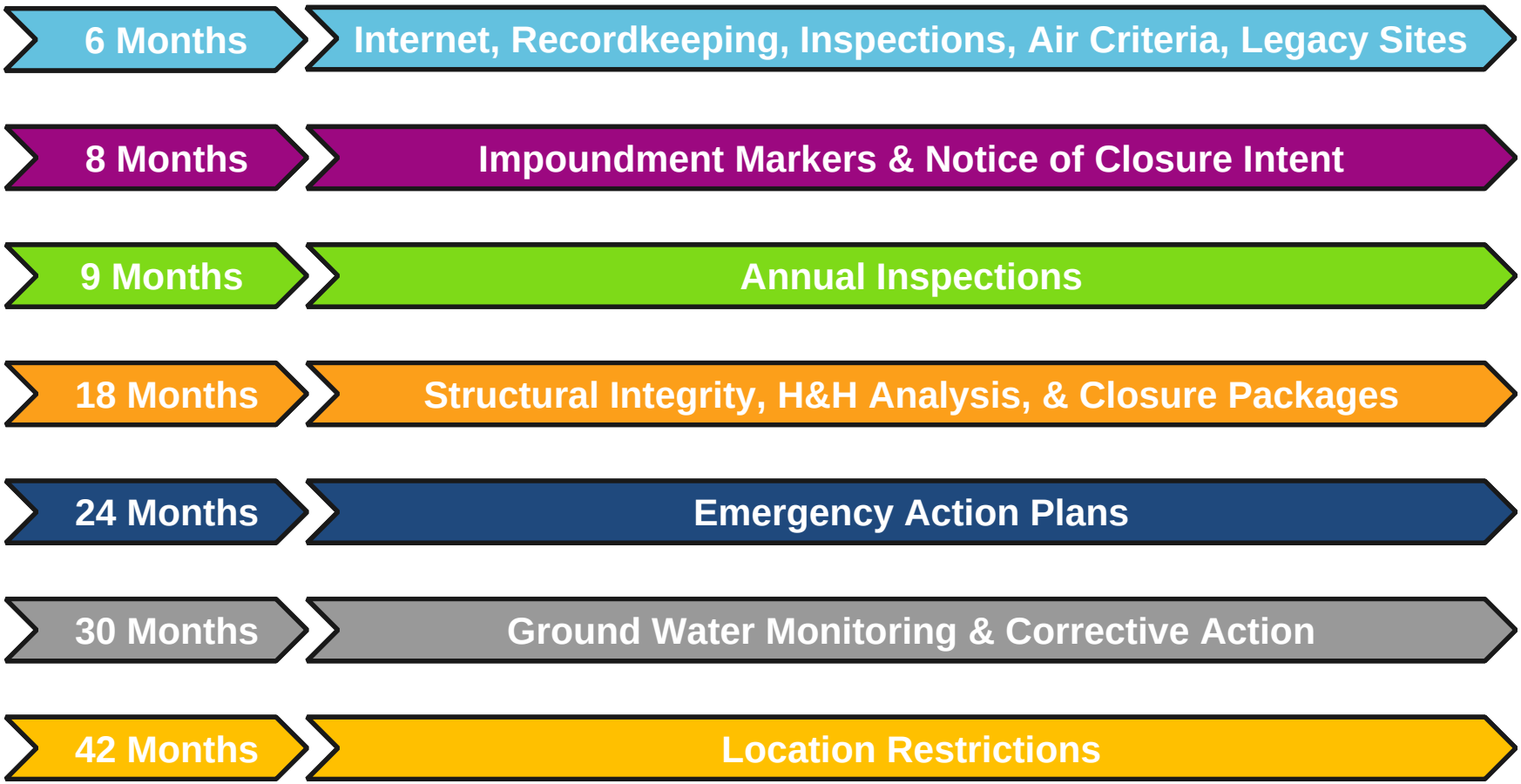
Pond Closure – Regulatory Setting

Implementation Timeline for Existing CCR Impoundment



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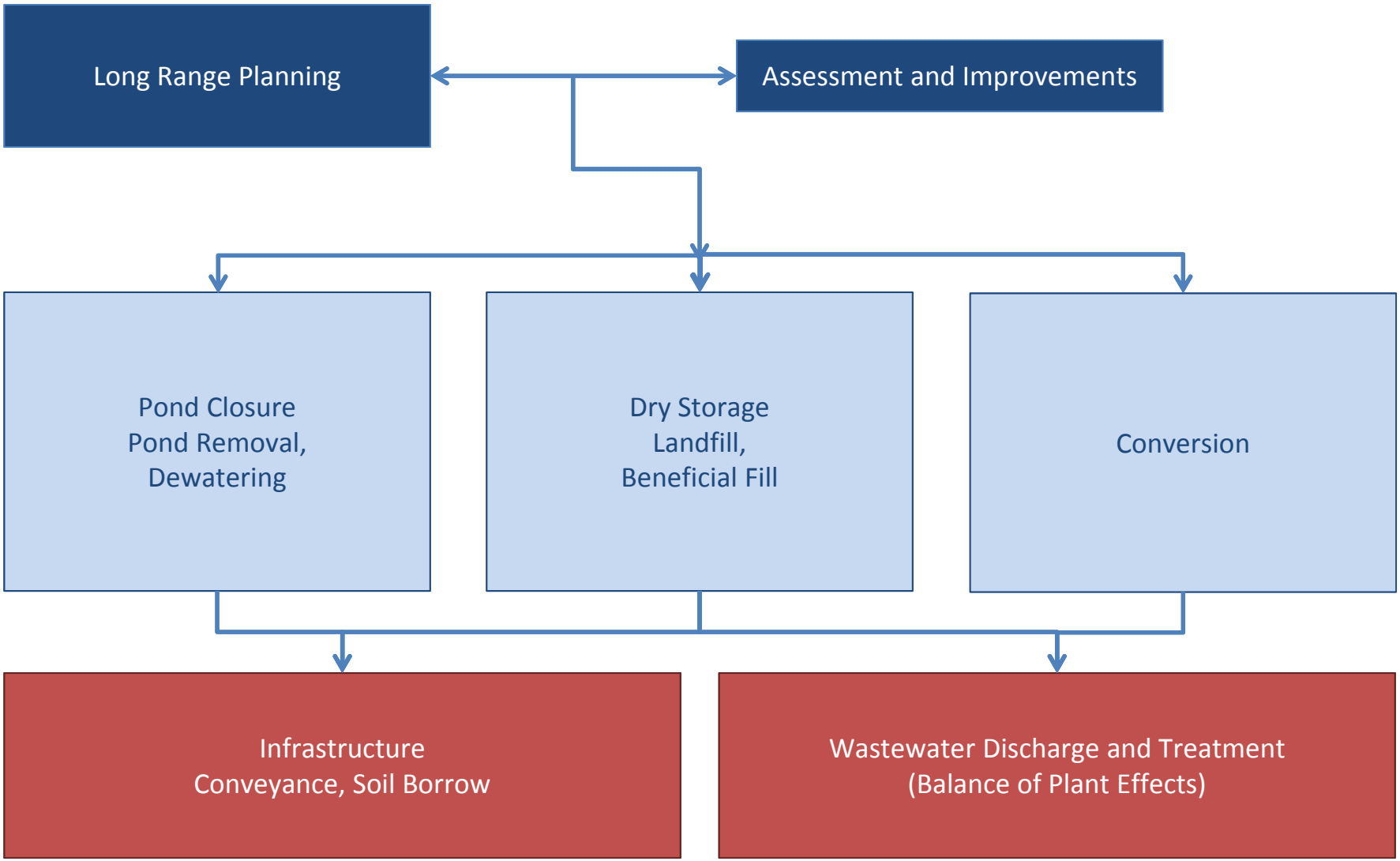
Pond Closure – Long Range Planning



Pond Closure Options/Implementation

Clean Closure:

Excavation and Lined On-site Disposal in an Ash Pond or Landfill involves removal ash material from the ponds, temporarily stockpiling material, lining the existing pond or landfill footprint(s), and replacing ash into the lined area(s)

Close In Place:

Cap in Place Closure allows the existing ash material to remain in place, and reduces the amount of fill required to bring the ponds to closure grades, with a liner cap installed at the closure grade peak

Footprint Reduction:

Footprint Reduction proposes constructing a new divider dike within the existing ash pond footprints to reduce the overall closure footprint area. This approach leaves existing ash material in place

Option 1: Excavate an entire pond and place on top of another pond (typically for multiple small to medium size pond sites); and

Option 2: Excavate a portion of a pond (typically the portion submerged in water) and place over another portion (typically the ash delta)

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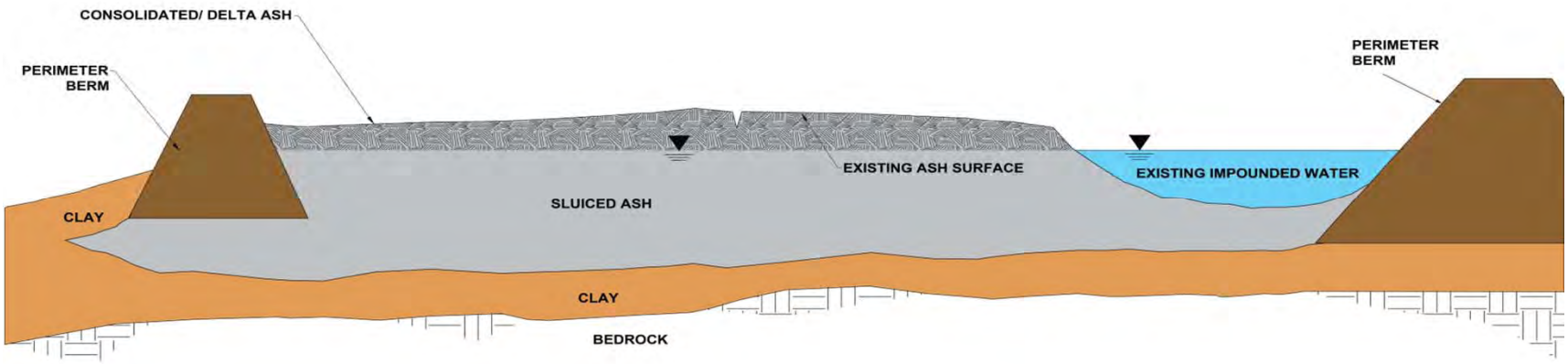
Clean Closure



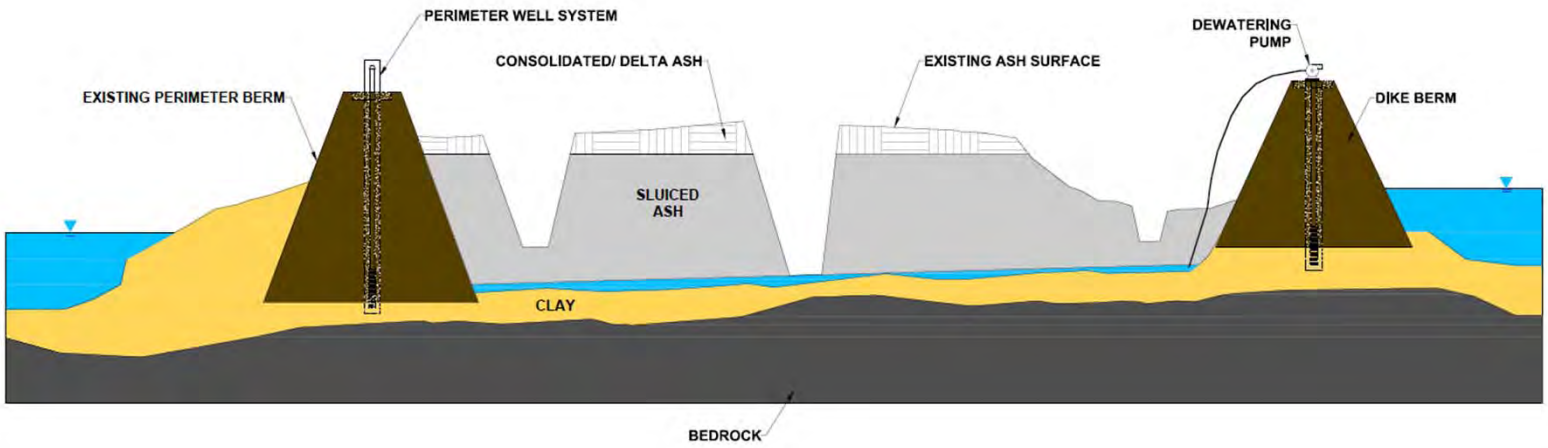
Engineering Approach

- Step 1 – Pond/Ash Water Removal
- Step 2 – Ash Removal
- Step 3 – Ash Stockpiling
- Step 4 – Liner Installation
- Step 5 – Ash Relocation
- Step 6 – Capping

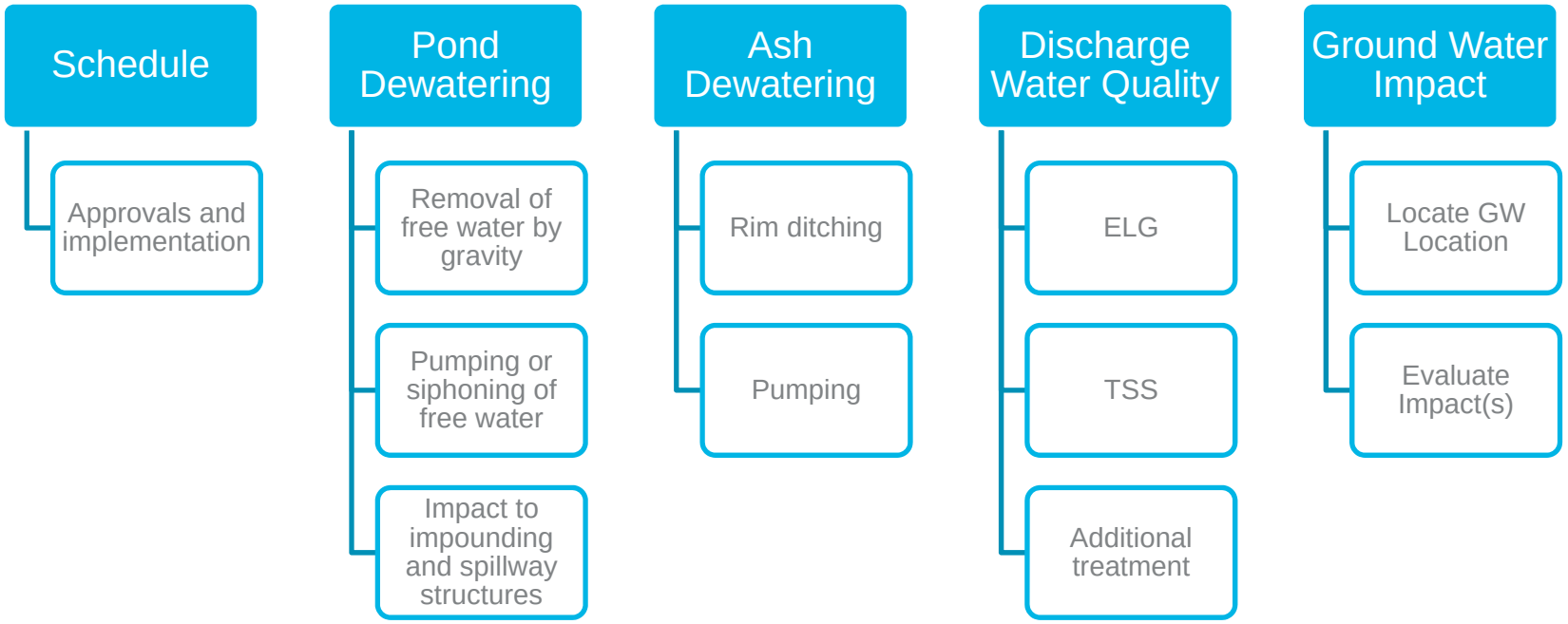
Clean Closure

Step 1: Pond/Ash Water Removal

- Perimeter well system and sump pumps to prevent inflow



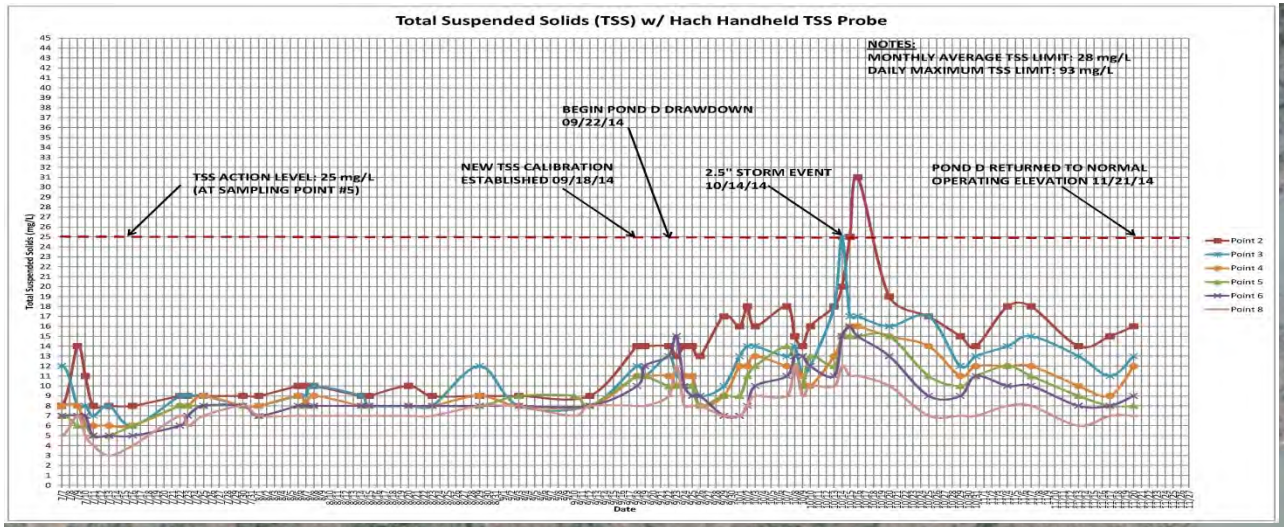
Clean Closure – Water Removal Considerations

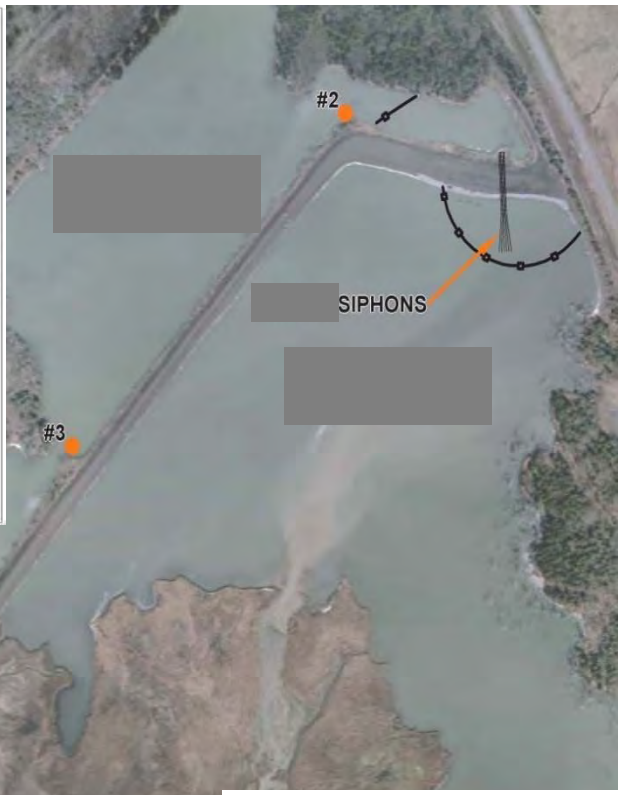


Clean Closure – Water Removal Impacts

- Potential impact on water quality during the construction activities:
  - Erosion of adjacent dike surfaces
  - Erosion of newly exposed surfaces within the ponds due to lowering of the water levels (head-cutting)
  - Decreased water levels/detention times for settling
  - Increased flow velocities in the ponds
  - Disturbance of and re-suspension of fine sediments within the ponds, especially near-neutrally buoyant cenospheres
  - Increased particulate from construction materials (fines from rip rap and other granular fill materials

Clean Closure – Water Removal Monitoring





Clean Closure – Water Removal Treatment

Water quality evaluation

- Sampling of surface water and entrained water to evaluate NPDES permit requirements
- Sampling and analysis protocol

Water treatment

- Mobile packaged water treatment system capable of providing treatment
- Site specific system design
- Treatment system design criteria: flowrate(s), influent physical/chemical characteristics, and required effluent quality.

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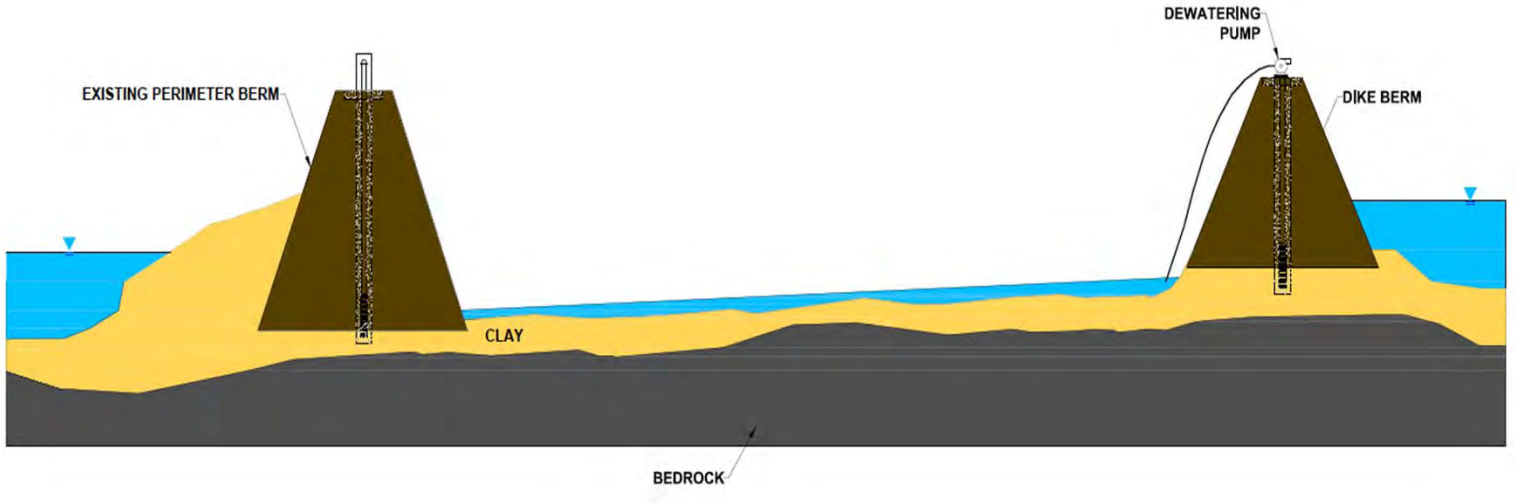
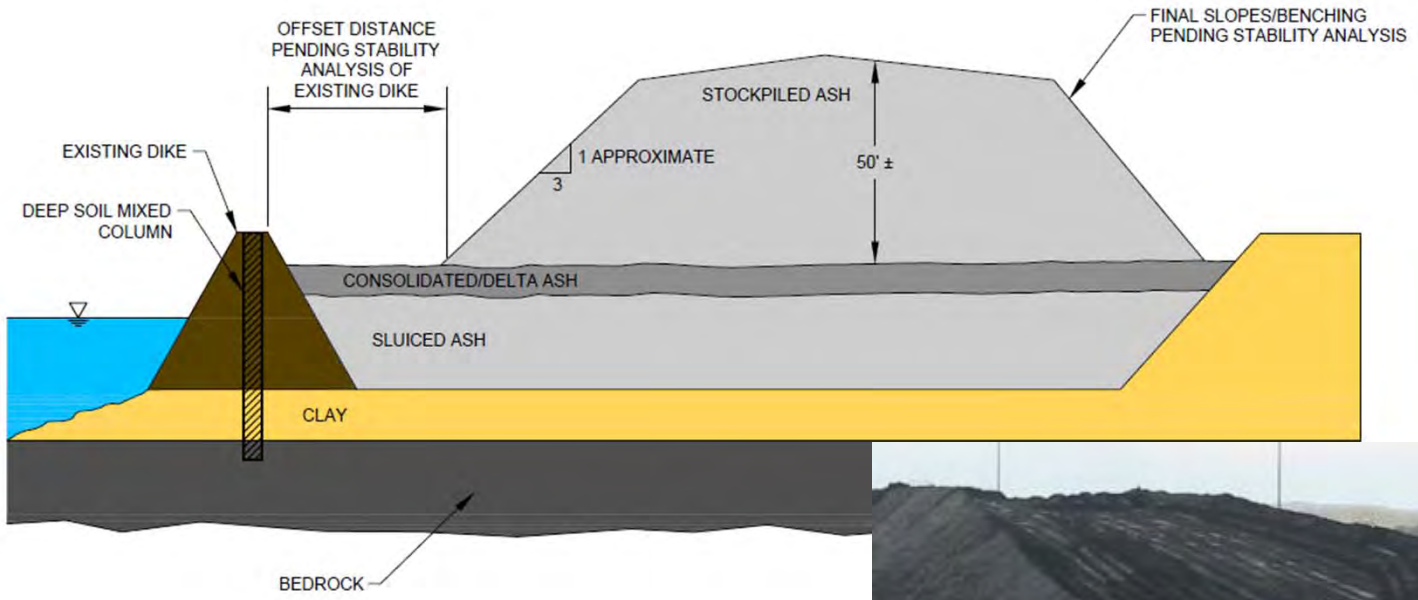
Clean Closure – Ash Removal

Step 2: Ash Removal



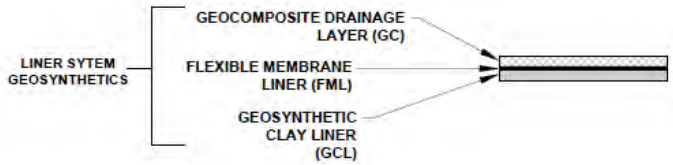
Clean Closure – Ash Stockpiling

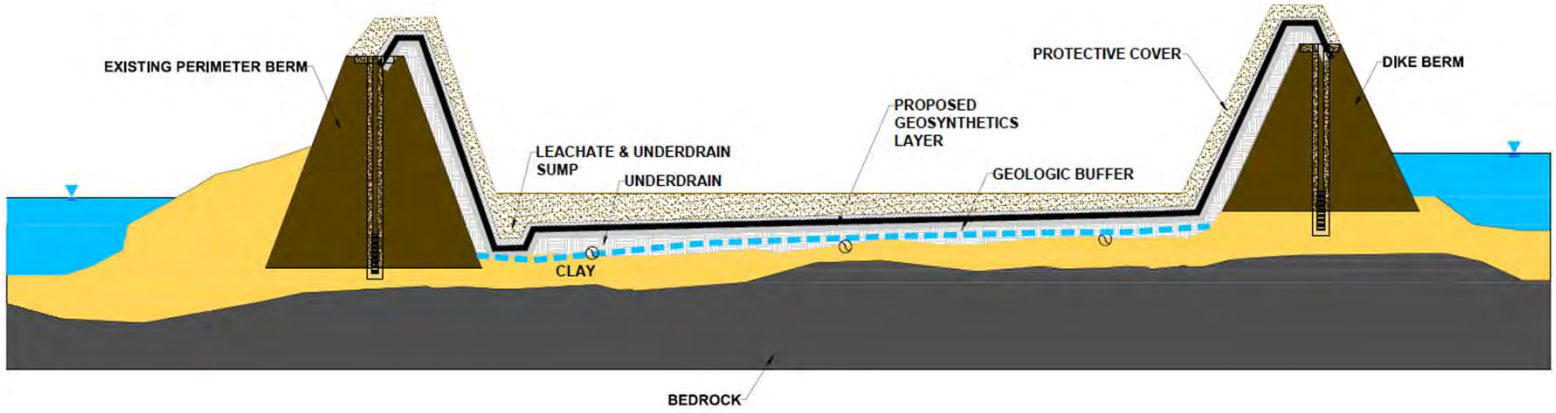
Step 3: Ash Stockpiling



Clean Closure – Liner Installation

Step 4: Liner Installation





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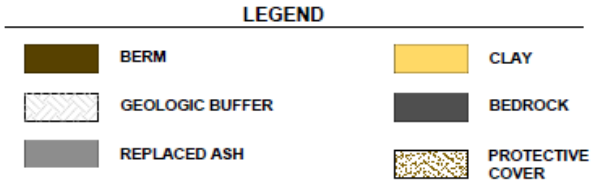
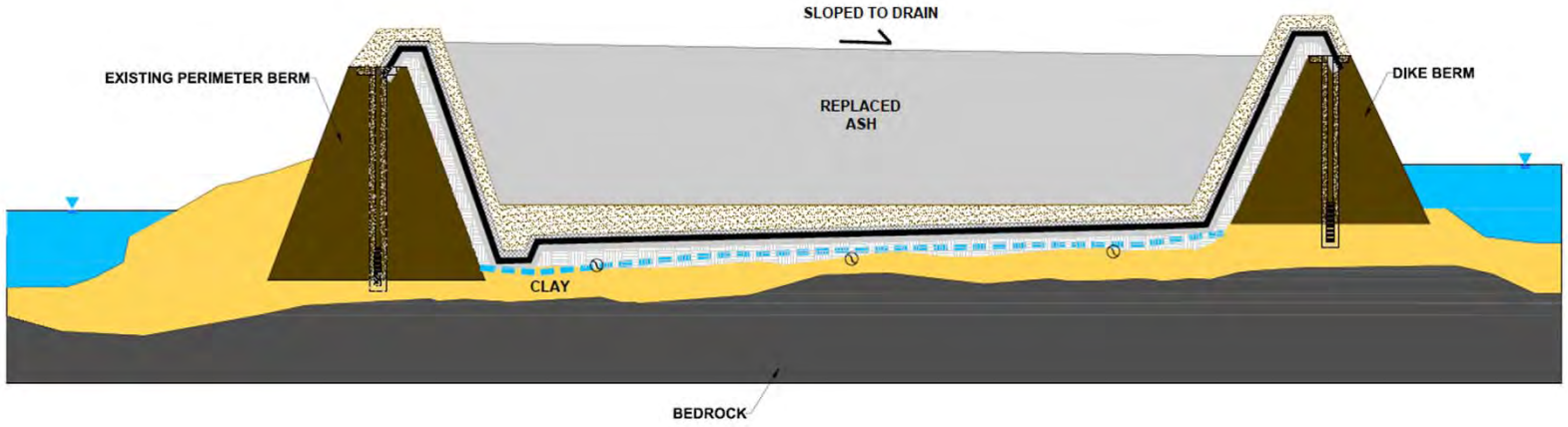
Clean Closure – Ash Relocation

Step 5: Ash Relocation





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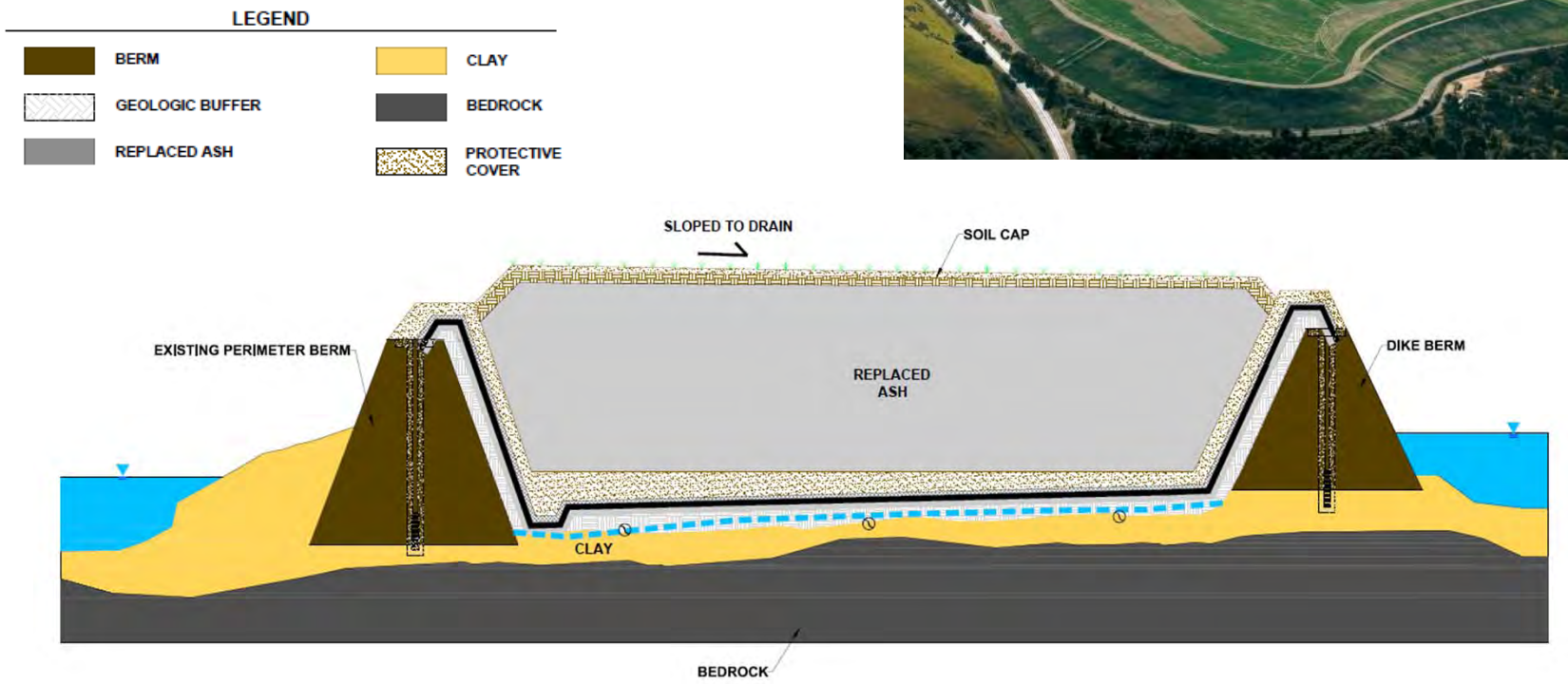
Clean Closure - Capping

Step 6: Capping



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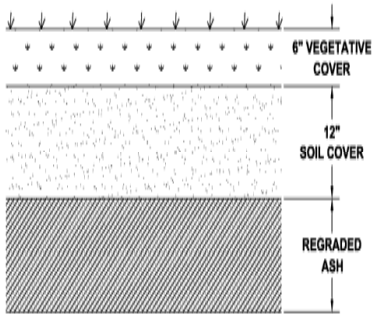
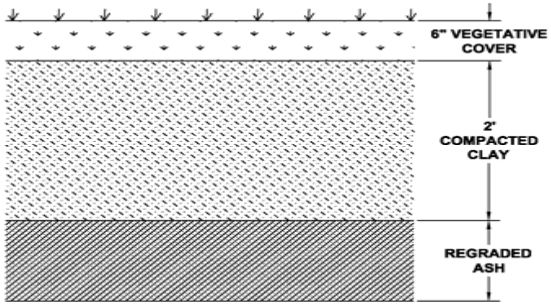
Clean Closure – Capping Options

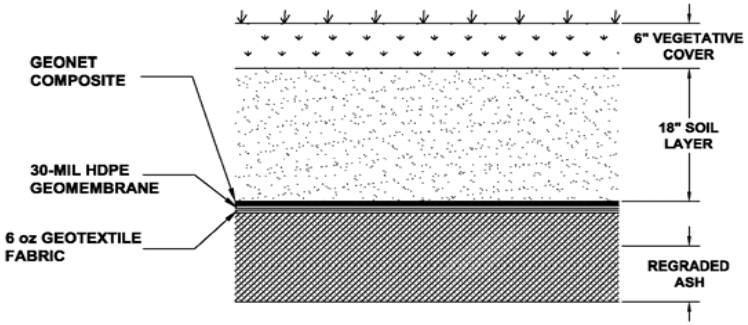
In-Place Closure:



Soil Cap:



Geomembrane Cap with Soil Cover



Complete Geomembrane Cap

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Clean Closure – Phasing

Phase closure/capping:

- Applicable to all closure options
- Allows capital to be expended over longer duration
- Reduces annual fill material needs
- Gradual operation transition
- Construction can be sequenced outside of winter months
- Can be focused in areas needing stability/seepage improvements

TASK	2015	2016	2017	2018	2019	2020	2021	2022	2023
CCP PLACEMENT									
PHASE 1 FINAL COVER									
PHASE 2 FINAL COVER									
PHASE 3 FINAL COVER									
PHASE 4 FINAL COVER									
PHASE 5 FINAL COVER									
PHASE 6 FINAL COVER									
PHASE 7 FINAL COVER									

Clean Closure – Risks/Challenges

Key Risks / Challenges

- Water
  - Ability to dewater below adjacent water levels
  - Create a “Clean” condition
  - Maintaining NPDES during dewatering
- Stability
  - Maintaining existing dike stability during construction
  - Stabilizing area for stockpiling
- Safety
  - Safety hazards associated with working in unstable ash
  - Safety concerns with working in water

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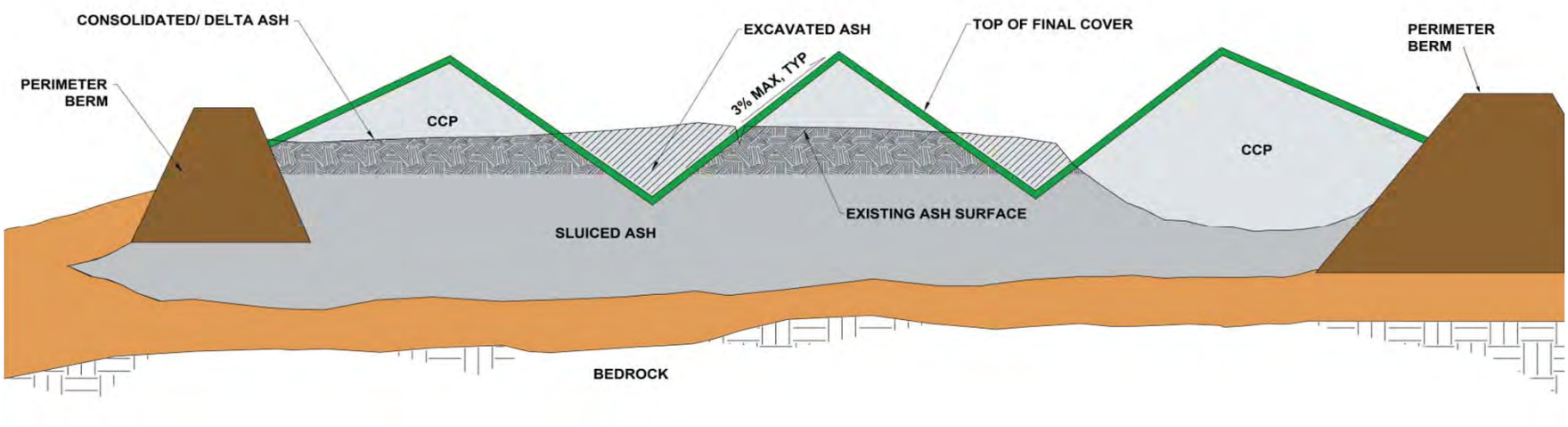
Close In Place



Engineering Approach

- Step 1 – Divert all flows from Pond
- Step 2 – Remove Pool Water
- Step 3 – Grade Existing Ash/Structural Fill
- Step 4 – Capping

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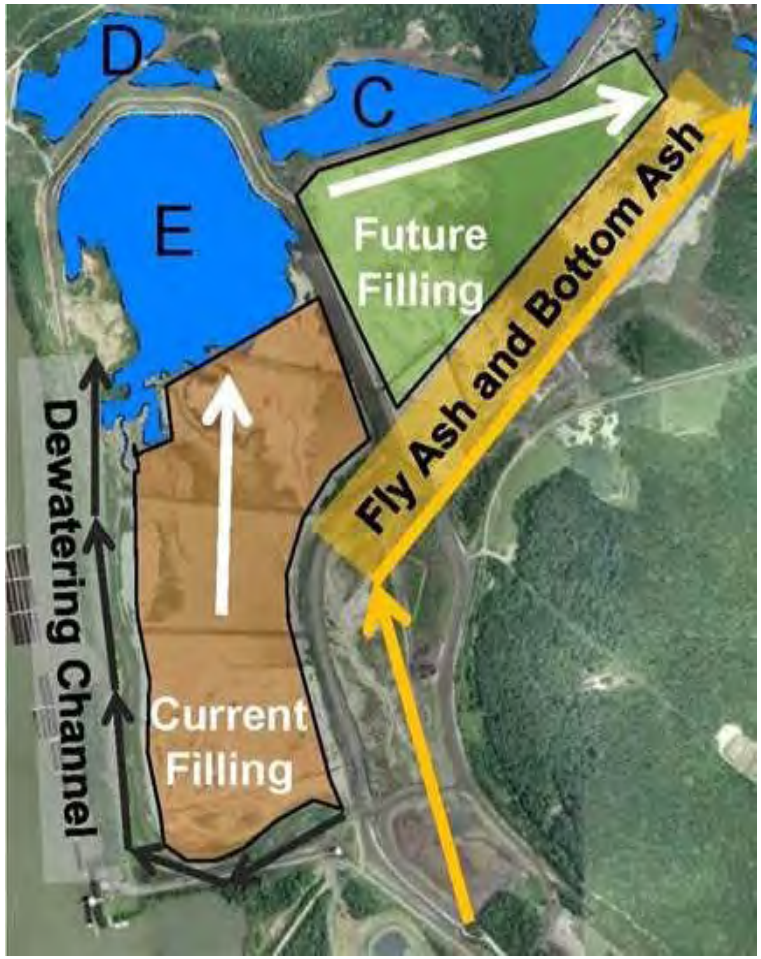
Close In Place – Divert Flows

Original Conditions

3 Years Later



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Close In Place – Grade Ash/Structural Fill

Closure/capping of ponds can require significant fill materials:

- Fills can be obtained from borrow areas or CCP's
  - Assess CCP generation and properties
  - Review potential on-site and off-site borrow areas
- Regulatory drivers
  - Are CCP's consistent with pond constituents
  - State Approval under NPDES
  - CCR regulations

40 acres

280,000 CY+ for a 2% slope

20,000 trucks

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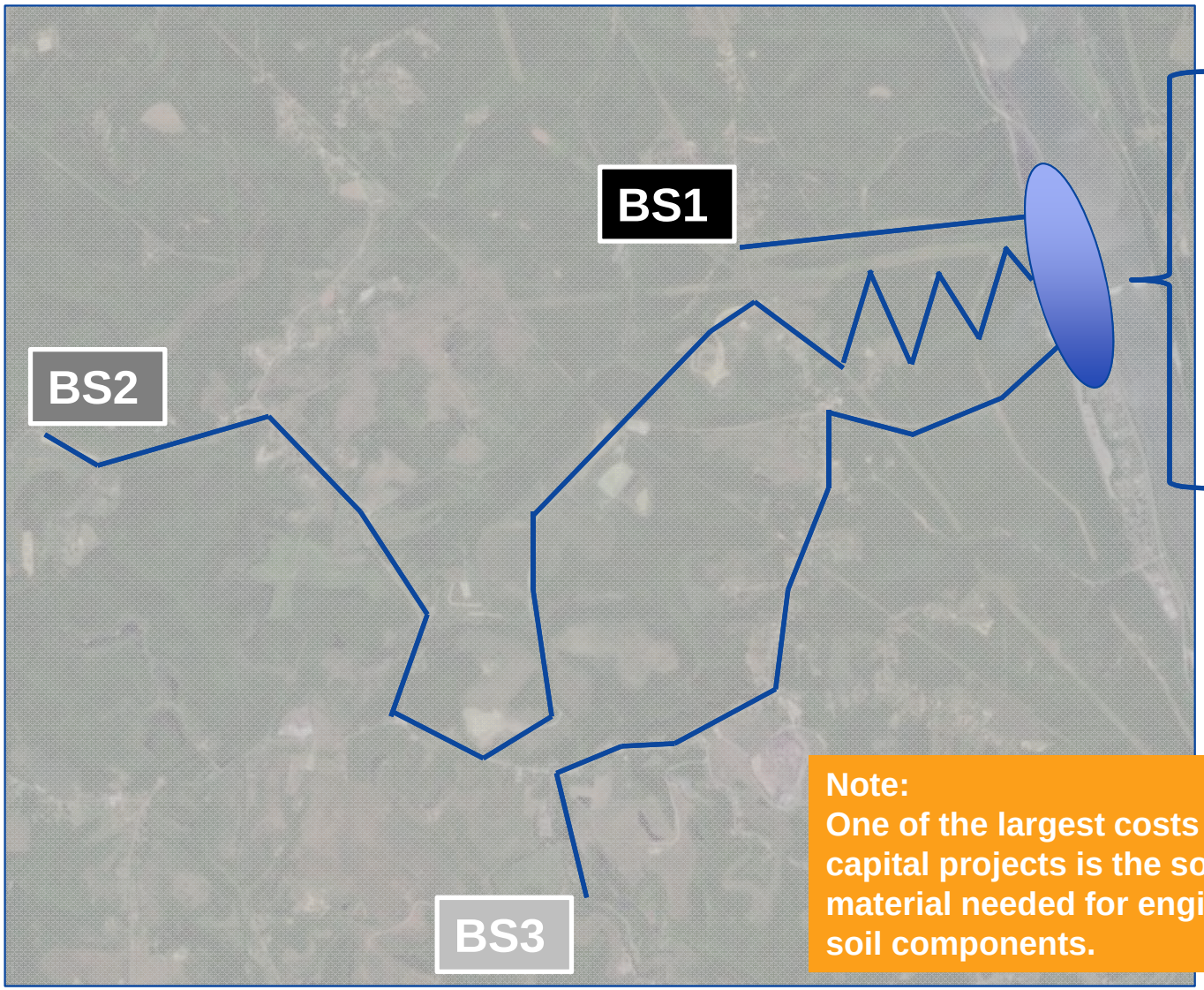
Close In Place – Grade Ash/Structural Fill

Borrow Source Factors:

Soil Availability and Quality

Transportation



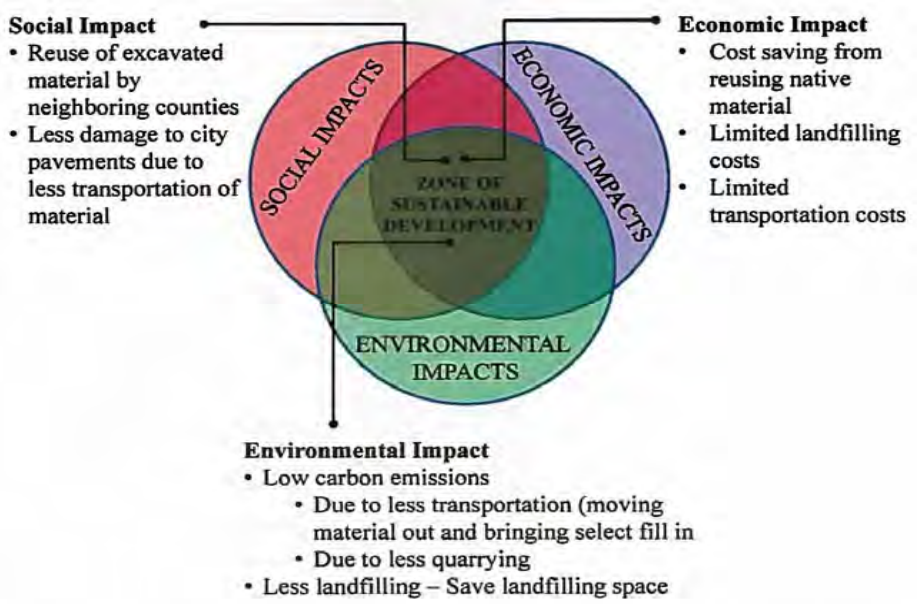
Landfill

Pond

Note:
One of the largest costs in CCP capital projects is the soil material needed for engineered soil components.

Close In Place – Grade Ash/Structural Fill

- Environmental impacts
  - Purchase and acquisition of undeveloped land
  - Erosion and sediment control
  - Traffic and highway safety
  - Road and bridge degradation
  - Air emissions
  - Consider future capping benefit
- Constructability/Closure Timing
  - Are sufficient quantities of material available for closure timeline
  - Are material properties sufficient for structural fill



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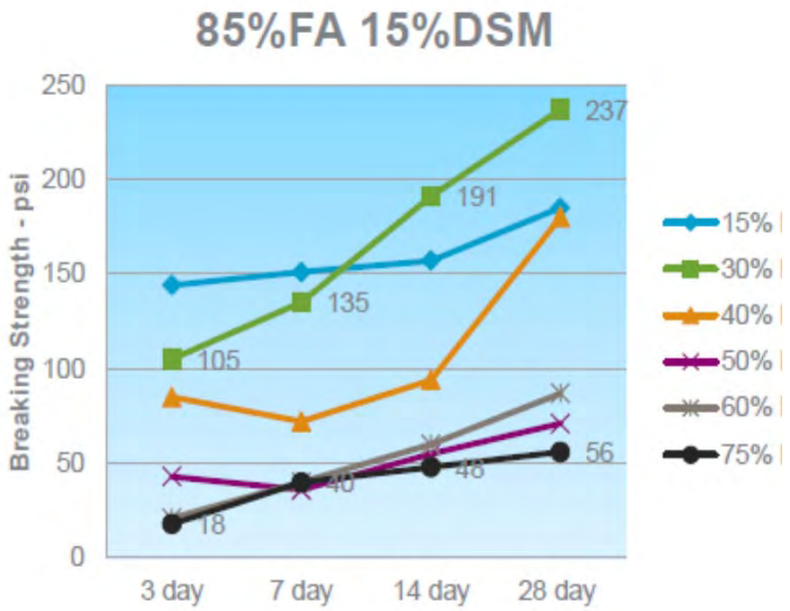
Close In Place – Beneficial Fill



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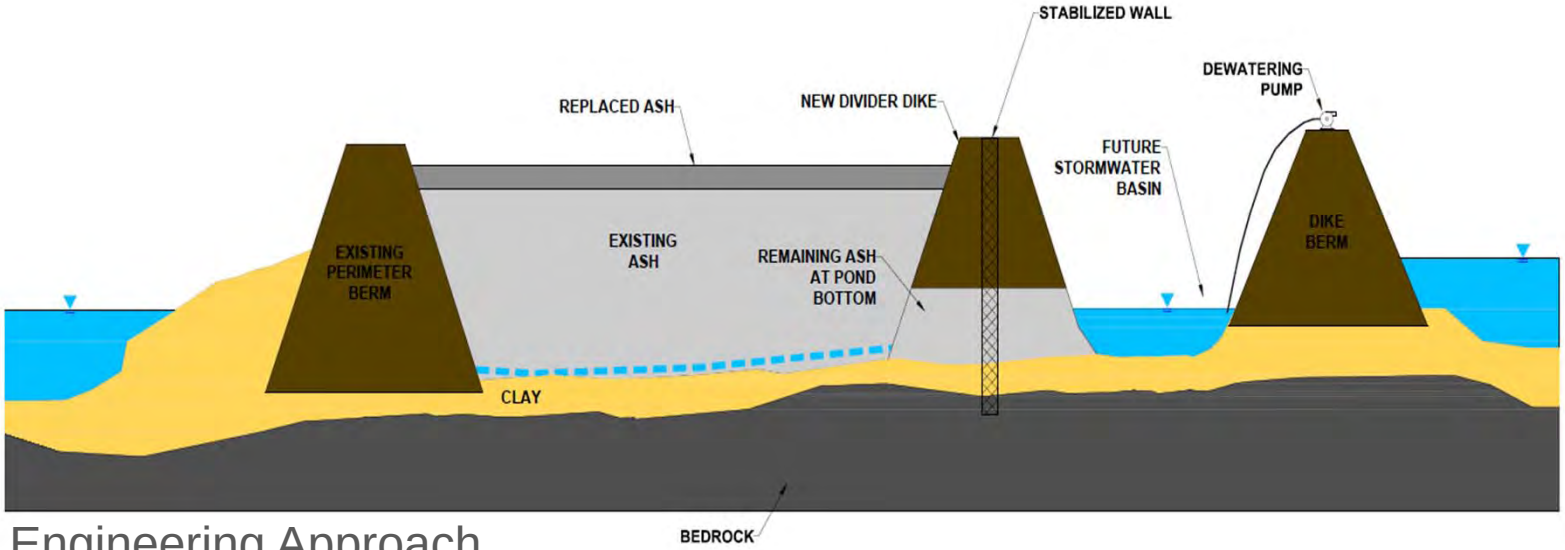
Close In Place – Risks/Challenges

Key Risks / Challenges

- Water
  - Maintaining NPDES during open pool dewatering
- Stability
  - Maintaining existing dike stability during construction
  - Creating stable long-term grades
- Safety
  - Safety hazards associated with working on unstable ash
  - Safety concerns with working around/adjacent to water

Footprint Reduction



Engineering Approach

- Step 1 – Pond/Ash Water Removal
- Step 2 – Ash Removal
- Step 3 – Ash Stockpiling
- Step 4 – Dike Construction
- Step 5 – Ash Regrading
- Step 6 – Capping

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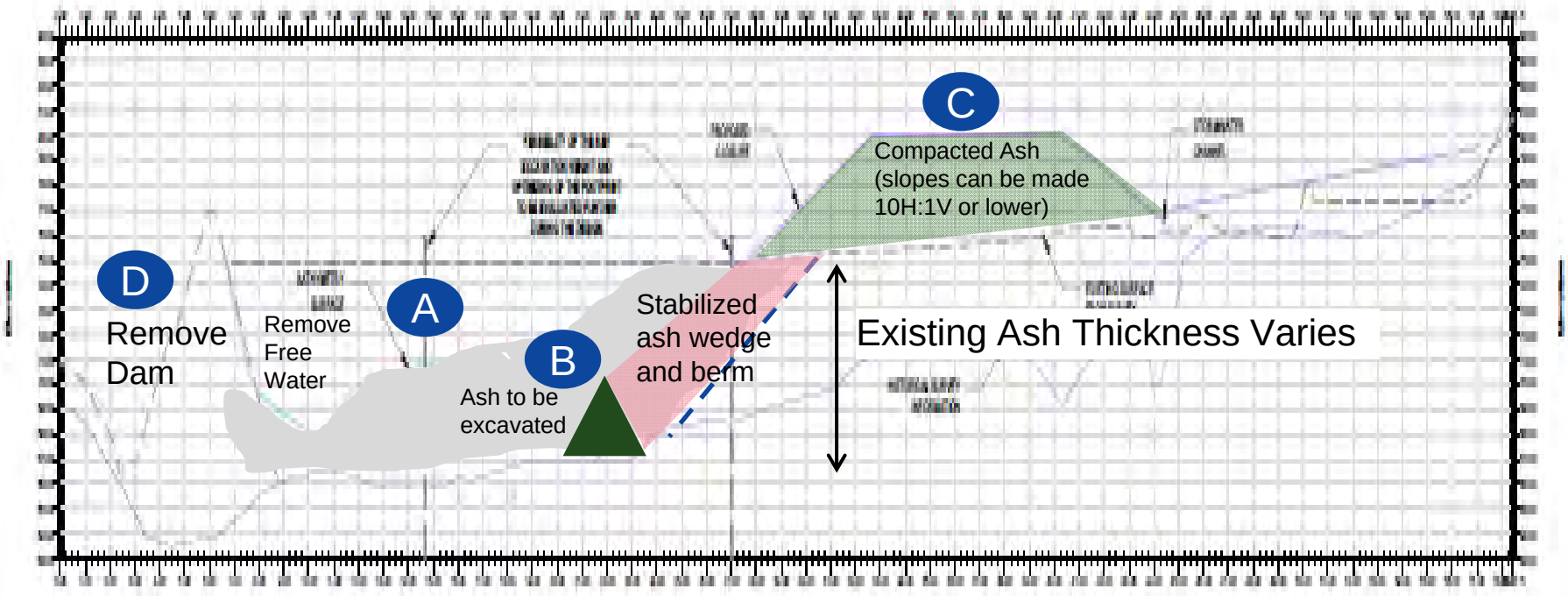
Footprint Reduction – Dike Construction

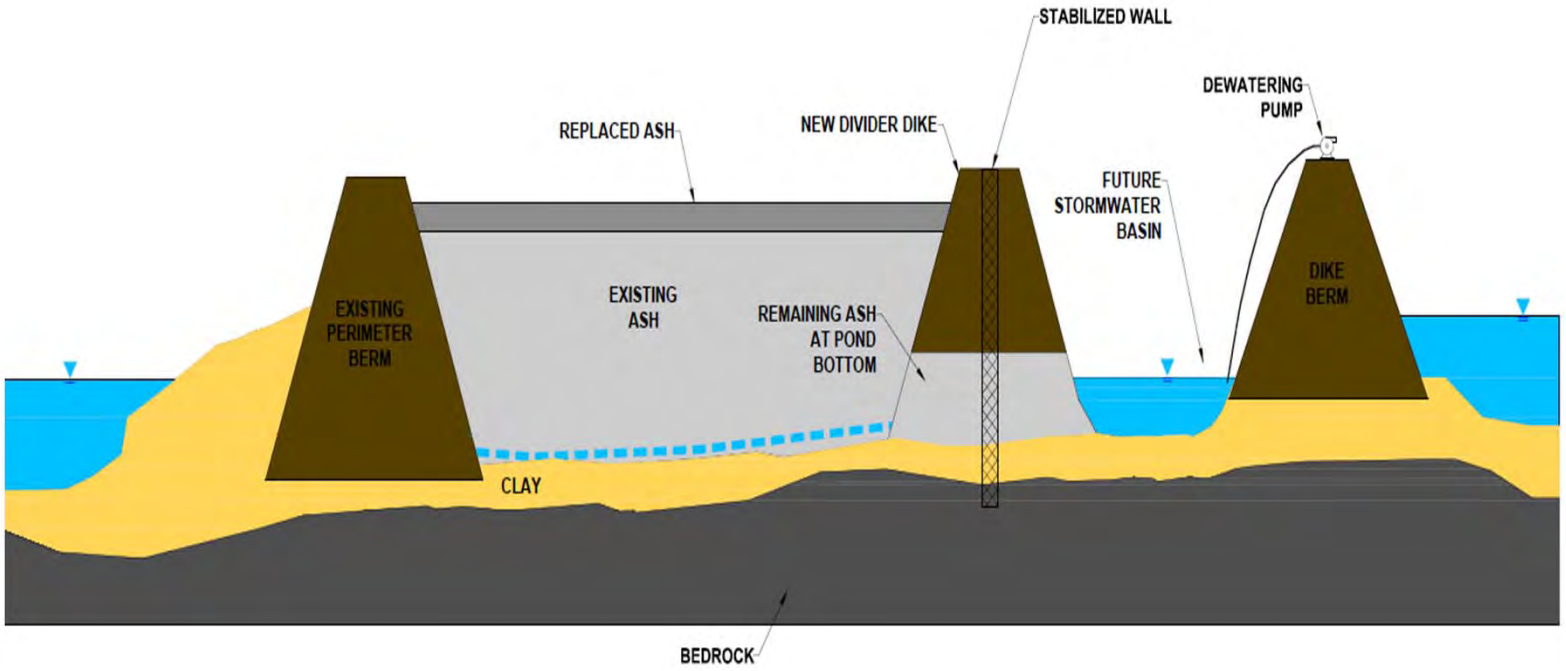
Step 2: Divider Dike Construction

- Continuous dewatering effort for duration
- Requires subgrade stabilization at divider dike
- Divider dike to be constructed from structural fill
- Anticipated to require soil stabilization wall



Footprint Reduction – Ash Regrading

Step 3: Ash Regrading



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Footprint Reduction – Risks/Challenges

Key Risks / Challenges

- Water
  - Ability to dewater entrapped water and below adjacent water bodies
  - Create a “Clean” condition
  - Maintaining NPDES during dewatering
- Stability
  - Maintaining/excavating existing ash
  - Stabilizing new dike on sluiced ash or unstable subgrade
  - Seepage from new dike
- Safety
  - Safety hazards associated with working in unstable ash
  - Safety concerns with working in water

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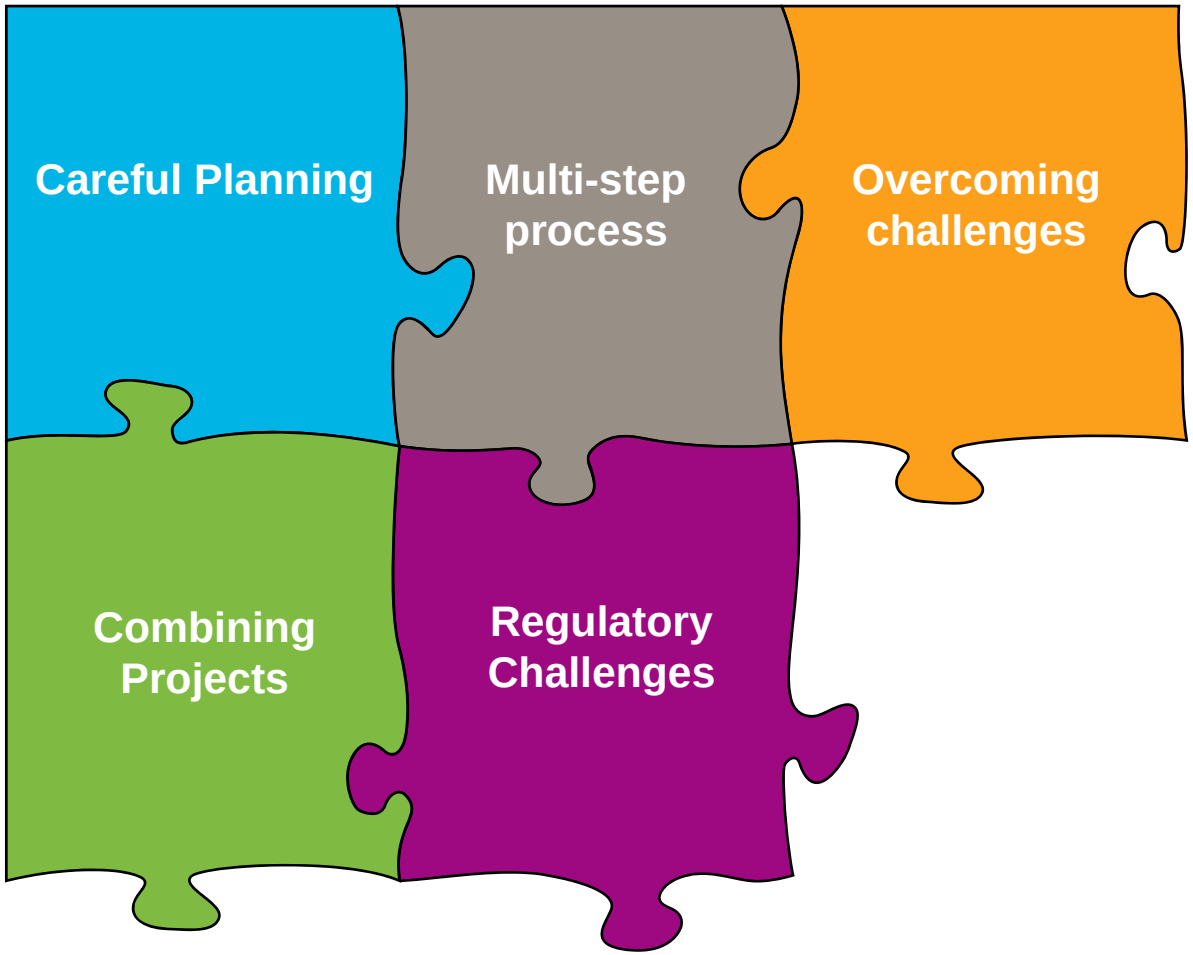
Solving the Closure Puzzle

It is a lengthy process…begin now!



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Questions