REINHOLD ENVIRONMENTAL Ltd.

2013 APC Round Table & Expo Presentation

July 8-9, 2013, in St. Louis, MO / Hosted by Ameren

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Practical Aspects of ELG Implementation

APC Conference July 9, 2013

Agenda

- ELG Overview
- Fuel Flexibility
- Robust Treatment Controls
- Impact of MATS Compliance
- Dealing with Legacy vs. New Flows
- Impact of the CCR Rules

History of the ELGs

- New energy production technologies (gasification) and increased air pollution control technologies generating a unique wastewater stream
- Approximately 1,100 facilities are subject to these regulations.
- These standards are enforced through individual NPDES permits.
- ELGs = Technology-based limits. Water Quality-based limits may also apply. The more stringent of the TBEL and WQBEL are applied in the permit.
- Largely based on 2009 EPA Detailed Study Report

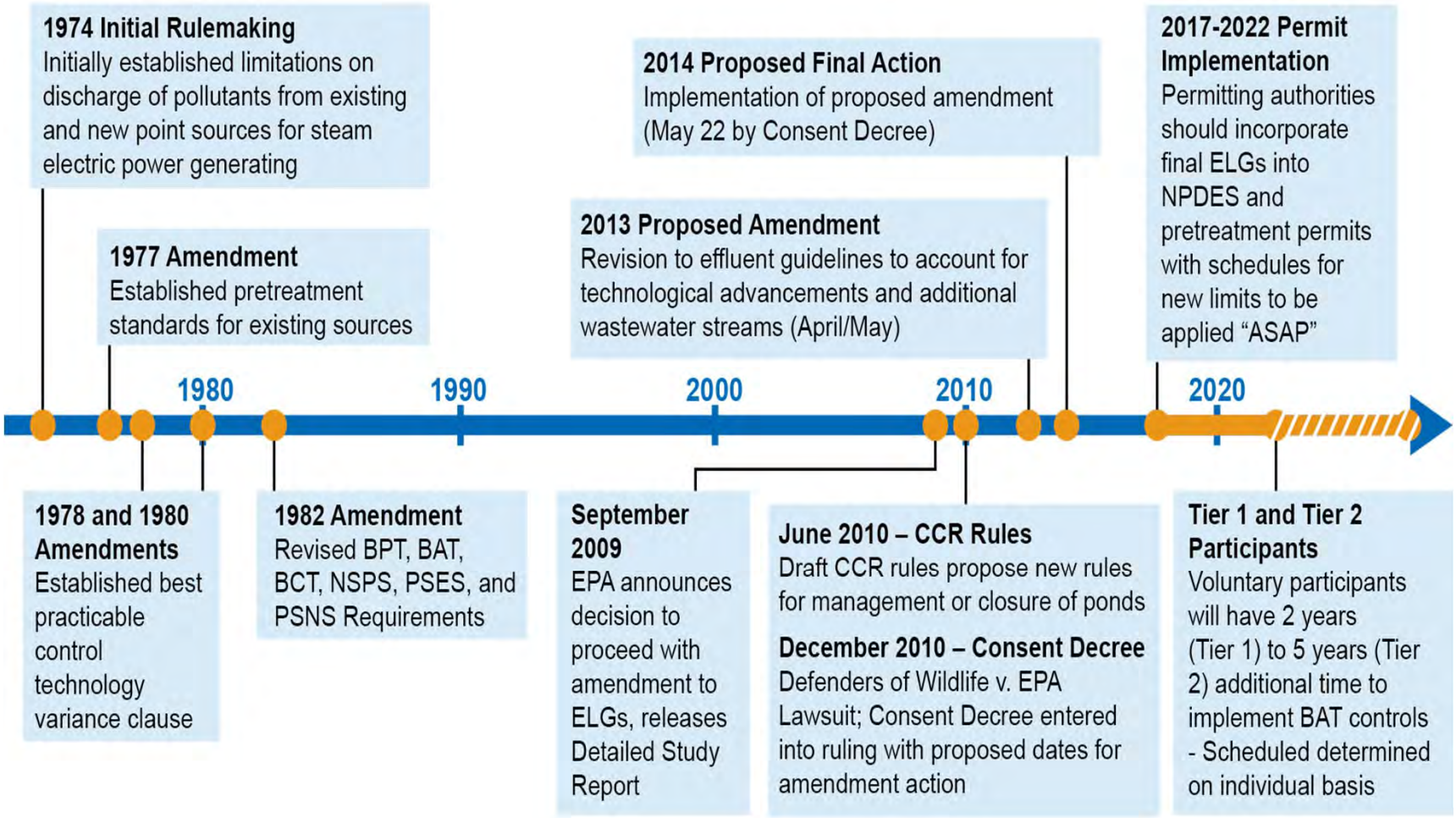
Fossil Fuel Steam Electric Plants

Coal Combustion Products Impoundments & Landfills

Nuclear Fuel Steam Electric Plants

Combined Cycle Systems

History of the ELGs



Applicability

- Changes primarily affect coal-fired power plants.
- Not intended to affect existing facilities not previously subject to rule.
- Clarified:
  - Applicable to facilities who's primary purpose is to sale power (e.g., not a support operation such as at industrial sites or universities)
  - Includes plants using fuels derived from fossil fuels (e.g., petroleum coke, synthesis gas)
  - Discharges from combustion turbine and steam turbine portions of a combined cycle generating unit are subject to ELGs.
- Existing oil-fired plants or units ≤50 mw will not see many changes.
  - Existing Direct - identical to current limits.
  - Existing Indirect – adds limits for nonchemical metal cleaning wastes.
  - New Sources – new standards are applicable regardless if direct or indirect discharge

Consider all the Options (Existing)

Table Legend:
EPA "preferred" options noted in red.
T = Treatment Technology and L = Limits

Increasing Pollutant Reduction

	Option 1	Option 3a	Option 2	Option 3b	Option 3	Option 4a	Option 4	Option 5
FGD Wastewater	Chemical precipitation (CP) [a]	Best Professional Judgment (BPJ) determination	CP [a] and biological treatment (BT)	T: CP [a] and BT for facilities ≥ 2000 MW scrubbed capacity; BPJ determination <2000 MW L: Hg, As, Se and nitrate-nitrite ≥ 2000 MW scrubbed capacity; BPJ determination <2000 MW	T: CP [a] and BT L: Hg, As, Se and nitrate-nitrite	T: CP [a] and BT L: Hg, As, Se and nitrate-nitrite	CP [a] and BT	CP and vapor compression evaporation (VCE)
Fly Ash Transport Water	Impoundment (equal to BPT)	T: Dry handling L: Zero discharge	Impoundment (equal to BPT)	T: Dry handling [b] L: Zero discharge	T: Dry handling [b] L: Zero discharge	T: Dry handling [b] L: Zero discharge	T: Dry handling L: Zero discharge	T: Dry handling L: Zero discharge
Bottom Ash Transport Water	Impoundment (equal to BPT)	T: Impoundment L: Equal to BPT	Impoundment (equal to BPT)	T: Impoundment L: Equal to BPT	T: Impoundment L: Equal to BPT	T: Dry handling/ closed loop [c] for units >400 MW; Impoundment ≤ 400 MW L: Zero discharge for units >400 MW; Equal to BPT ≤ 400 MW	Dry handling/ closed loop [c]	Dry handling/ closed loop [c]
Combustion Residual Leachate	Impoundment (equal to BPT)	T: Impoundment L: Equal to BPT	Impoundment (equal to BPT)	T: Impoundment L: Equal to BPT	T: Impoundment L: Equal to BPT	T: Impoundment L: Equal to BPT	CP [a]	CP [a]
FGMC Wastewater	Impoundment (equal to BPT)	T: Dry handling L: Zero discharge	Impoundment (equal to BPT)	T: Dry handling [b] L: Zero discharge	T: Dry handling [b] L: Zero discharge	T: Dry handling [b] L: Zero discharge	T: Dry handling L: Zero discharge	T: Dry handling L: Zero discharge
Gasification Wastewater	VCE	T: VCE L: Hg, As, Se, TDS	VCE	T: VCE L: Hg, As, Se, TDS	T: VCE L: Hg, As, Se, TDS	T: VCE L: Hg, As, Se, TDS	VCE	VCE
Nonchemical Metal Cleaning Wastes	CP	T: CP L: Cu, Fe	CP	T: CP L: Cu, Fe	T: CP L: Cu, Fe	T: CP L: Cu, Fe	CP	CP

Consider all the Options (Existing) – EPA Preferred

Increasing Pollutant Reduction

	Current Conditions	Option 3a	Option 3b	Option 3	Option 4a
FGD Wastewater	Included as Low Volume Wastes T = Impoundment L: TSS & Oil and Grease	BPJ determination (technology and limits)	T: Chemical Precipitation(CP) [a] and Biological Treatment (BT) for facilities ≥ 2000 MW scrubbed capacity; BPJ determination <2000 MW L: Hg, As, Se and nitrate-nitrite ≥ 2000 MW scrubbed capacity; BPJ determination <2000 MW	T: CP[a] and BT L: Hg, As, Se and nitrate-nitrite	T: CP[a] and BT L: Hg, As, Se and nitrate-nitrite
Fly Ash Transport Water	T: Impoundment L: TSS & Oil and Grease	T: Dry handling [b] L: Zero discharge	T: Dry handling [b] L: Zero discharge	T: Dry handling [b] L: Zero discharge	T: Dry handling [b] L: Zero discharge
Bottom Ash Transport Water	T: Impoundment L: TSS & Oil and Grease	T: Impoundment L: Equal to BPT (no change from current rule)	T: Impoundment L: Equal to BPT (no change from current rule)	T: Impoundment L: Equal to BPT (no change from current rule)	T: Dry handling/ closed loop [c] for units >400 MW; Impoundment ≤ 400 MW L: Zero discharge for units >400 MW; Equal to BPT ≤ 400 MW

Must meet the limits established, regardless if use the preferred technology or not

Consider all the Options (Existing) – EPA Preferred

Increasing Pollutant Reduction

	Current Conditions	Option 3a	Option 3b	Option 3	Option 4a
Coal Combustion Residual Leachate	Included as Low Volume Wastes T = Impoundment	T: Impoundment L: Equal to BPT (no change from current rule)	T: Impoundment L: Equal to BPT (no change from current rule)	T: Impoundment L: Equal to BPT (no change from current rule)	T: Impoundment L: Equal to BPT (no change from current rule)
FGMC Wastewater	Included as Low Volume Wastes but common practice is ZLD	T: Dry handling [b] L: Zero discharge (current practice)	T: Dry handling [b] L: Zero discharge (current practice)	T: Dry handling [b] L: Zero discharge (current practice)	T: Dry handling [b] L: Zero discharge (current practice)
Nonchemical Metal Cleaning Wastes	Included in Metal Cleaning Wastes BPT for Cu and Fe	T: CP L: Cu, Fe	T: CP L: Cu, Fe	T: CP L: Cu, Fe	T: CP L: Cu, Fe

New Source and Pretreatment Standards

	Pretreatment Standards for Existing Sources (PSES)	Pretreatment Standards for New Source (PSNS) after implementation date (*All facilities*)	New Source Performance Standards (NSPS) after implementation date (*All facilities*)
FGD Wastewater	Equivalent to BAT options T:BPJ or CP and BT L: Hg, As, Se and nitrate-nitrite	Equivalent to BAT options T:BPJ or CP and BT L: Hg, As, Se and nitrate-nitrite	Equivalent to BAT Option 4 T:BPJ or CP and BT L: Hg, As, Se and nitrate-nitrite
Fly Ash Transport Water	Equivalent to BAT options T: Dry handling [b] L: Zero discharge	Equivalent to current PSNS T: Dry handling [b] L: Zero discharge	Equivalent to current NSPS T: Dry handling [b] L: Zero discharge
Bottom Ash Transport Water	Equivalent to BAT 4a T: Dry handling/ closed loop [c] for units >400 MW; Impoundment ≤ 400 MW L: Zero discharge for units >400 MW; Equal to BPT ≤ 400 MW	Equivalent to BAT options T: Impoundment except for Option 4a (Dry handling/ closed loop [c] for units >400 MW; Impoundment ≤ 400 MW) L: Same as BPT except for Option 4a (Zero discharge for units >400 MW; Equal to BPT ≤ 400 MW)	Equivalent to BAT Option 4 T: Dry handling/ closed loop L: Zero discharge
Combustion Residual Leachate	Equivalent to BAT options T: Impoundment L: TSS, O&G	Equivalent to BAT options T: Impoundment L: TSS, O&G	T: CP[a] L: Arsenic (0.008 mg/l max and 0.006 mg/l average) and Mercury (242 ng/l max and 119 ng/l average)
FGMC Wastewater	Equivalent to BAT options T: Dry handling [b] L: Zero discharge	Equivalent to BAT options T: Dry handling [b] L: Zero discharge	T: Dry handling [b] L: Zero discharge
Nonmetal Cleaning Wastes	T: CP L: Cu *Oil-fired and units <50 MW only subject to this standard	T: Chemical precipitation L: Cu	T: Chemical precipitation L: Cu, Fe

Comparison of Proposed Limits to Existing Limits

FGD Wastewater (all dischargers)

	1982 - Daily Max	1982 - Monthly Average	Daily Max	Monthly Average
Arsenic, total	**Previously only limited for BPT as Low Volume Wastes**		8 ug/l	6 ug/l
Mercury, total			242 ng/l	119 ng/l
Selenium, total			16 ug/l	10 ug/l
Nitrate/Nitrite as N			0.17 mg/l	0.13 mg/l
Total Suspended Solids	100.0 mg/l	30.0 mg/l	100.0 mg/l	30.0 mg/l
Oil and Grease	20.0 mg/l	15.0 mg/l	20.0 mg/l	15.0 mg/l

Combustion Residual Leachate (new sources only)

	1982 - Daily Max	1982 - Monthly Average	Daily Max	Monthly Average
Arsenic, total	**Previously only limited for BPT as Low Volume Wastes**		8 ug/l	6 ug/l
Mercury, total			242 ng/l	119 ng/l
Total Suspended Solids	100.0 mg/l	30.0 mg/l	100.0 mg/l	30.0 mg/l
Oil and Grease	20.0 mg/l	15.0 mg/l	20.0 mg/l	15.0 mg/l

Permitting Example - Current

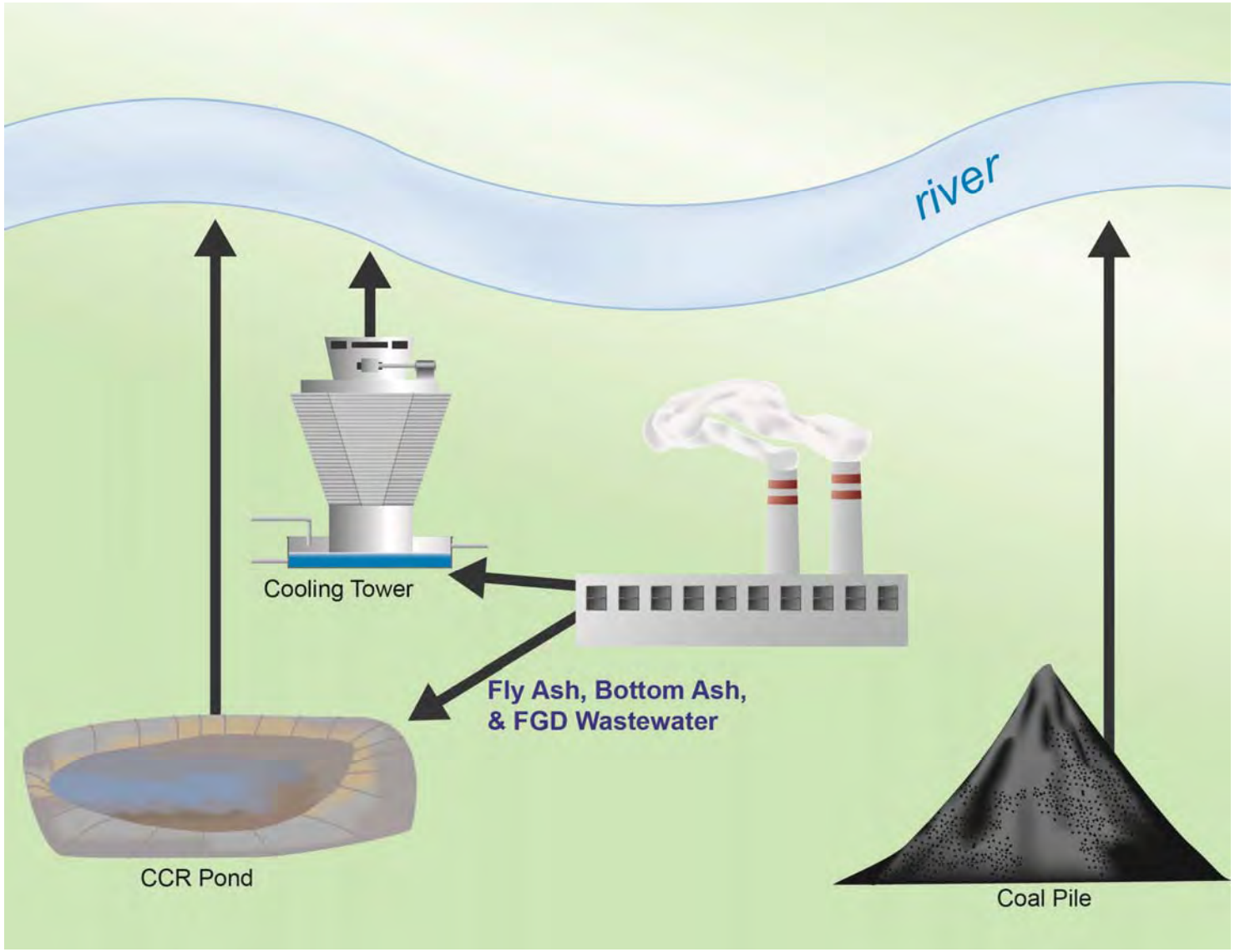
Indiana Facility – Permit Issued 2005
4 generating units: 220 MW, 469 MW, 532 MW, and 580 MW (1801 MW total)
Average discharge **19.3** MGD to a stream with 7Q10 = 0

Outfall 001 – Ash Pond		
• Bottom Ash Transport Water	• Metal Cleaning Wastes	• Coal Pile Runoff
• Fly Ash Transport Water	• Air Preheater Wash*	• Yard and Floor Drains
• Low Volume Wastes	• Cooling Tower Blowdown (periodically)	• FGD Wastewater

**Fact Sheet specifies Air Preheater Wash is considered low volume based on 1975 Jordan Memorandum.*

	Daily Max	Monthly Average
Total Suspended Solids	100.0 mg/l	30.0 mg/l
Oil and Grease	20.0 mg/l	15.0 mg/l
Copper, total (only when discharging metal cleaning wastes)	0.2 mg/l (reduced from 1 mg/l on BPJ due to dilution)	NA
Iron, total (only when discharging metal cleaning wastes)	1 mg/l	NA
Free Available Chlorine (only when discharging cooling tower blowdown to pond)	0.5 mg/l	0.2 mg/l

Permitting Example – Current



Permitting Example – Future Options 3a, 3b, and 3

Indiana facility – 4 generating units: 220 MW, 469 MW, 532 MW, and 580 MW (1801 MW total); Average discharge 12 MGD; No Discharge Fly Ash Transport Water

Outfall 001 – Ash Pond		
• Bottom Ash Transport Water	• Metal Cleaning Wastes	• Coal Pile Runoff
• ~~Fly Ash Transport Water~~	• Air Preheater Wash*	• Yard and Floor Drains
• Low Volume Wastes	• Cooling Tower Blowdown (periodically)	• ~~FGD Wastewater~~

NEW Internal Outfall - FGD Wastewater – Chemical Precipitation + Biological Treatment - Option 3

	Daily Max	Monthly Average
Arsenic, total	8 ug/l	6 ug/l
Mercury, total	242 ng/l	119 ng/l
Selenium, total	16 ug/l	10 ug/l
Nitrate/Nitrite as N	0.17 mg/l	0.13 mg/l
Total Suspended Solids	100.0 mg/l	30.0 mg/l
Oil and Grease	20.0 mg/l	15.0 mg/l

Unknowns: Will …

? there be enough dilution with just bottom ash transport water that the air preheater wash, other low volume wastes, metal cleaning wastes and FGD wastewaters won't trigger additional WQBELs?

? the permit writer to apply BPJ to FGD wastewater equivalent to proposed numeric limits for Option **3a and 3b**

Permitting Example – Future Option 4a

Indiana facility – 4 generating units: 220 MW, 469 MW, 532 MW, and 580 MW (1801 MW total); Average discharge **3** MGD; **No Discharge Fly Ash nor Bottom Ash Transport Water for selected units**

Outfall 001 – Ash Pond		
• ~~Bottom Ash Transport Water~~ (3 out of 4 units)	• ~~Metal Cleaning Wastes~~	• Coal Pile Runoff
• ~~Fly Ash Transport Water~~	• ~~Air Preheater Wash*~~	• Yard and Floor Drains
• Low Volume Wastes	• Cooling Tower Blowdown (periodically)	• ~~FGD Wastewater~~

NEW Internal Outfall - FGD Wastewater – Chemical Precipitation + Biological Treatment

	Daily Max	Monthly Average
Arsenic, total	8 ug/l	6 ug/l
Mercury, total	242 ng/l	119 ng/l
Selenium, total	16 ug/l	10 ug/l
Nitrate/Nitrite as N	0.17 mg/l	0.13 mg/l
Total Suspended Solids	100.0 mg/l	30.0 mg/l
Oil and Grease	20.0 mg/l	15.0 mg/l

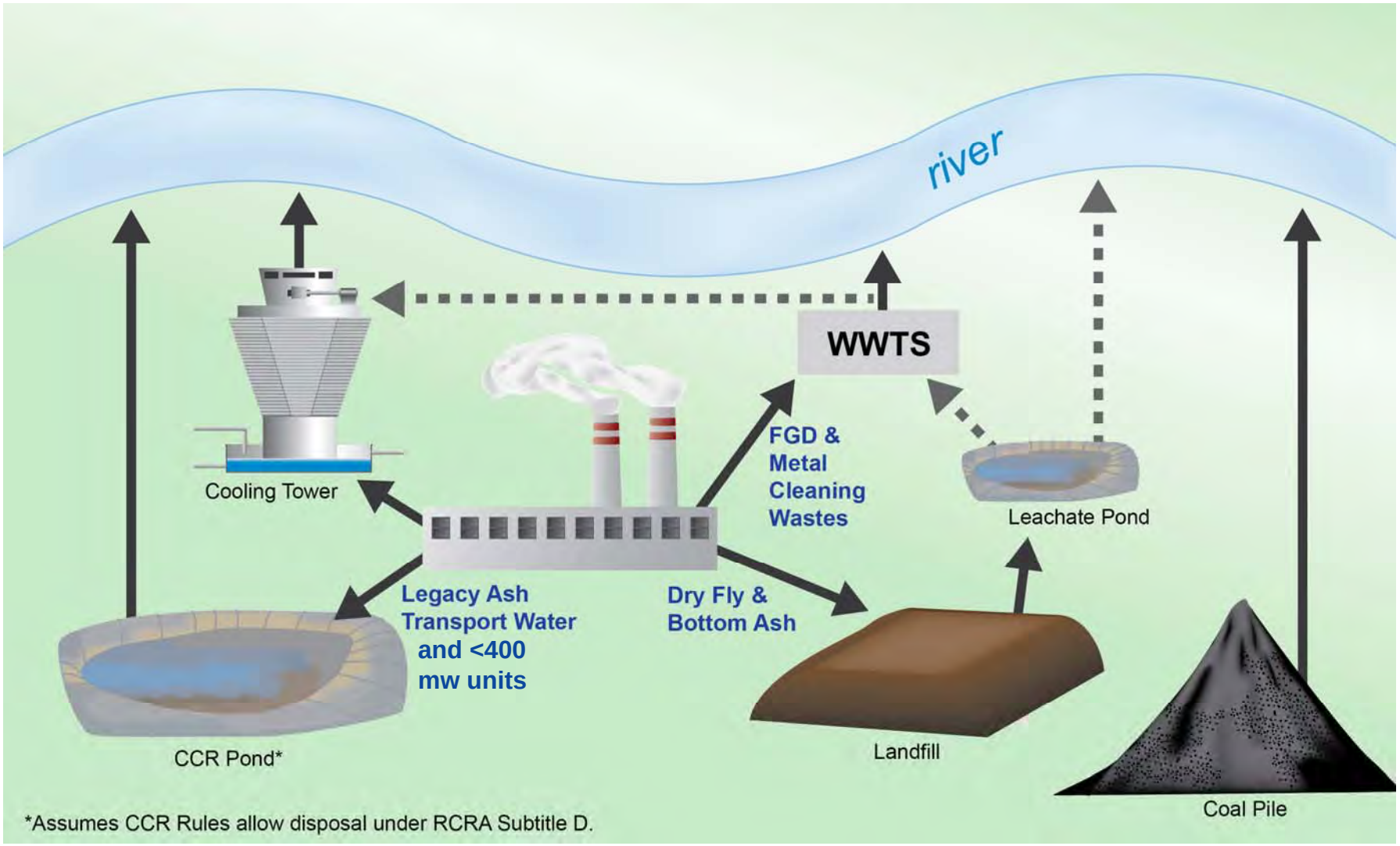
Treatment Scenario Options

? Combine Metal Cleaning Wastes and FGD for treatment? Biological system may not take variable streams.

? Operate separate chemical precip unit for Metal Cleaning Wastes or dispose off site?

? Send cooling tower blowdown to other permitted outfalls or install de-chlorination?

Permitting Example – Future Option 4a



Other Miscellaneous Requirements

- Compliance Deadlines for Dischargers
  - Direct Dischargers comply “as soon as possible with the next permit cycle after July 1, 2017” for FGD wastewater, transport waters, leachate (Options 4 and 5), and FGMC wastewater
  - Indirect Dischargers comply “as soon as possible beginning July 1, 2017”
  - Expects “all steam electric facilities will have the proposed BAT limitations applied to their permits no later than July 1, 2022”
- Analytical Monitoring
  - EPA Method 200.8 (ICP-MS) is a preferred analytical technique for As and Se; EPA Methods1631 or 245.7 for mercury
  - For FGD wastewater, an SOP for using Collision Cell technology (with 200.8) is called out in draft
  - If EPA has approved more than one method per analyte, then permittee must use a sufficiently sensitive method (minimum level of quantitation in sample matrix ≤ effluent limit)

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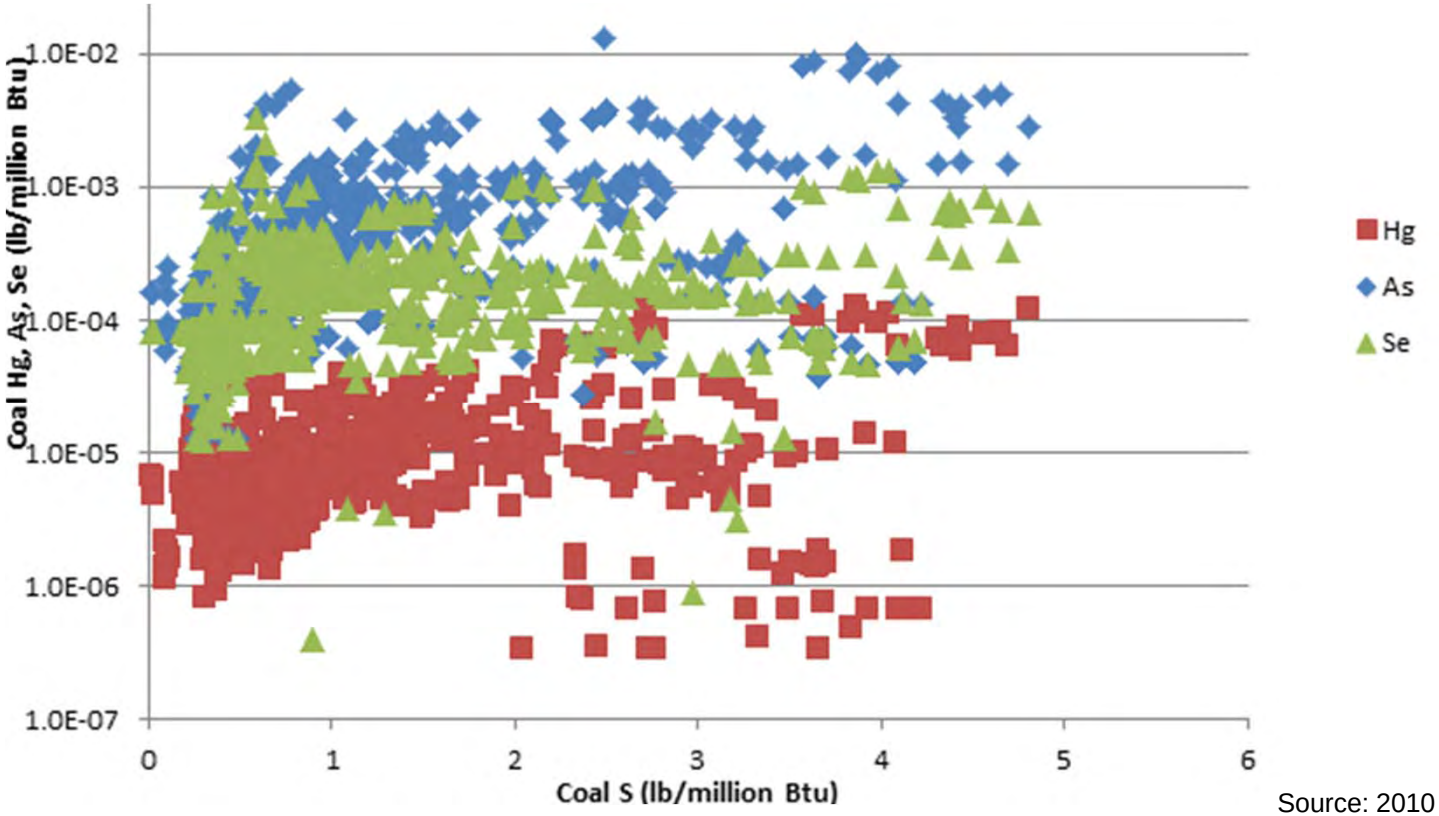
Fuel Flexibility

Increasing S and Cl in Fuel Coal

- Potential increases of Hg, As and Se concentrations in discharge
  - Higher S and Cl may increase blowdown, but Hg, As, and Se concentrations may stay same or increase depending on specific coals used



Source: 2010 ICR data

Affects on Plant Systems

- Thermal ZLD
  - Cl concentrations from coal dictates materials of construction
  - O&M activities (washing of vapor compressor and cleaning evaporation and crystallizer tubes) focus on minimizing corrosion
- ZLD Blending System (for stabilization/fixation)
  - Retrofitting a ZLD-BS to an existing plant may result in Cl concentration increases beyond the capacity of existing materials, especially in the absorber materials if operate scrubber at higher COC
  - Higher CL coals may require additional fly ash in the blend, which may require larger equipment
- Low Cl (PRB) coals may
  - Limit Hg oxidation by SCR and Air preheater, ESP, baghouses
  - Reduce Hg capture in FGD, cause re-emission

Source: Brodsky, et al, 2010

Addressing Limits to Fuel Flexibility

- Evaluate design coals for characteristics (Cl:S, Ash:S, etc.)
- Calculate material balances for ZLD blending systems (available amounts of fly ash, gypsum, purge water, lime)
- Identify system limitations (materials of construction, volumes, etc.)
- Coordinate with Fuels Department to understand the upper limits of viable S and Cl

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Robust Treatment Controls

The New Operator

- Biological Systems
  - Sensitive to variation of influent conditions due to unit outages and start ups, chemical cleaning wastewater, or ambient temperature swings, pH, etc.
  - Juggling multiple units (one settling and decanting while another is aerating and reacting)
  - Is pre-treatment (impoundment, phys/chem) functioning as expected?
  - What's coming to the system? What's happening in the rest of the Plant?
  - Needs well trained operators integrated into Plant management

Improved Controls Upstream

- FGD System may need to be better controlled
  - WW typically contains mercury, boron, selenite/selenate, high in TDS and halogens
  - ORP: LSFO FGD systems with fixed oxidation air rates may over oxidize at low load or low demand
  - Results in high ORP can lead to selenite conversion to selenate, which is more difficult to treat, and Hg partitioning to dissolved phase, putting more in the FGD purge
  - Low ORP could contribute to Hg re-emission
  - Other metals similarly affected (think WQBELs)
  - Excess oxidizer can interfere with bioreactor
  - May need to retrofit controls to avoid over oxidizing, use reducing agents
- SCR oxidizes mercury to improve FGD capture
- Filter Fabric AQC may reduce solids and thus pollutants (part of MATS compliance?)
- ESP residence time drives Hg capture

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Impact of MATS Compliance

Mercury and Air Toxics Standards (MATS)

- Finalized February 16, 2012; Compliance by March 2015
  - To reduce emissions of toxic air pollutants from existing coal and oil-fired plants
  - For all existing and new coal-fired EGUs, the rule establishes numerical emission limits for mercury, PM (a surrogate for toxic non-mercury metals including As, Cr, Ni), and HCl (a surrogate for all toxic acid gases)
  - "… available practices, technologies, and strategies to meet the new emission limits include using wet and dry scrubbers, dry sorbent injection systems, activated carbon injection systems, and fabric filters."
- Many potential control technologies were not assessed during ELG development for impacts on fly ash transport water, fly ash leachate, or FDG wastewater
  - Increased mercury, selenium, arsenic, nitrogen, chromium in FGD wastewater
  - Increase fly ash solids production
  - Reduced or unknown effect of efficiencies for WWTS

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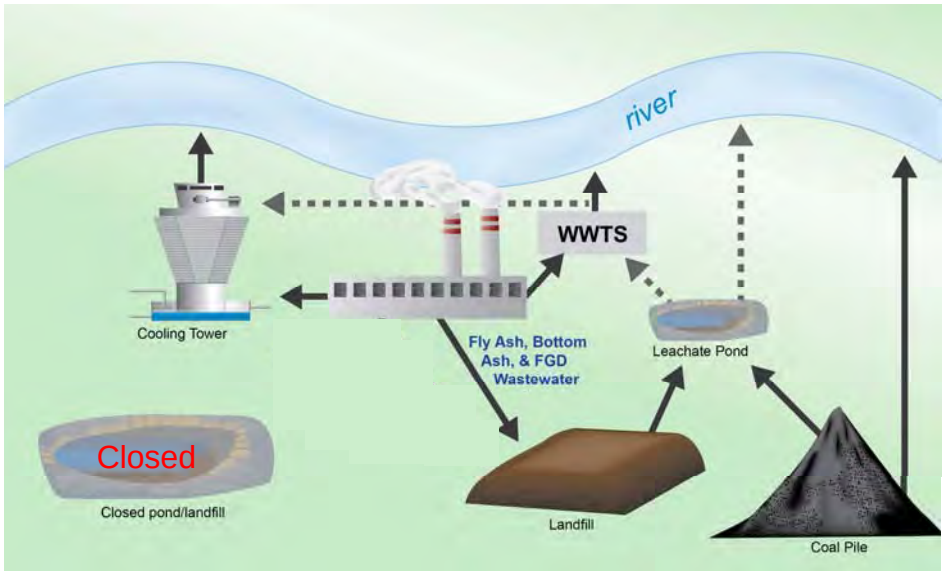
Legacy vs. New Flows

Voluntary Program

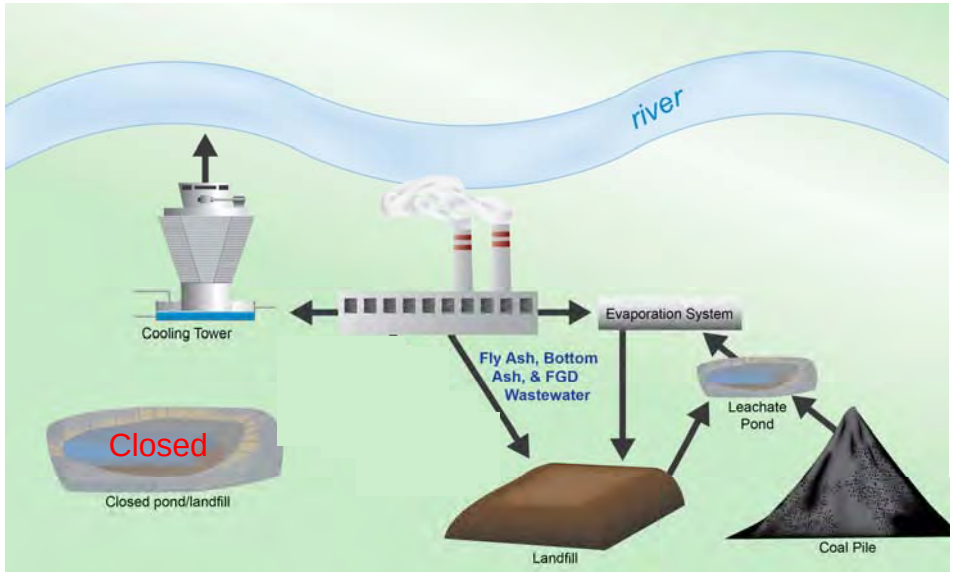
Tier 1

- Dewater, close and cap all CCR impoundments except leachate-only impoundments
- 2 additional years to implement BAT



Tier 2

- Eliminate all process wastewater discharges to surface waters except cooling water discharges
- 5 additional years to implement BAT



- Must notify regulators of intent by July 1, 2017 and provide a plan.
- Permit would include specific limits and milestones.

Impact of the ELG Rules for CCR Facilities:

- BMPs under consideration are similar to the structural integrity inspection and corrective active requirements proposed in the CCR rule, but do not include closure requirements proposed in the CCR rule.
- BMPs for CCR Surface Impoundments requirements are twofold:

Part 1: Inspections

- Period inspections
- Record keeping on site
- Take action for potentially hazardous conditions

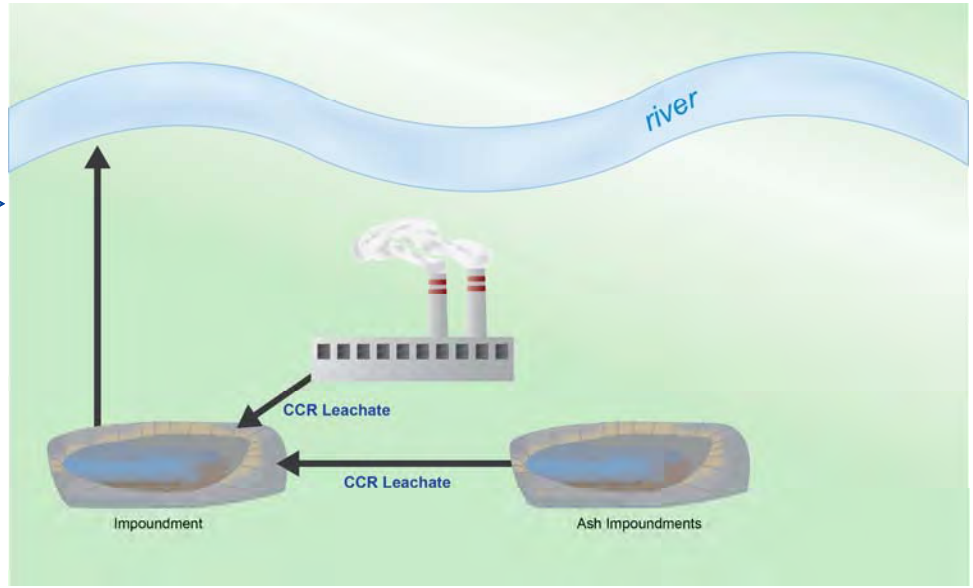
Part 2: Integrity - Establish BMPs for coal slurry impoundments, regulated by MSHA.

- Submit to EPA or the authorized state plans for the design, construction, and maintenance of existing impoundments and closure,
- Inspections by trained personnel who are knowledgeable in impoundment design and safety, and
- Provide an annual certification of compliance with plans

- These BMPs would apply to all CCR impoundments regardless of activity level, height, and storage.
- EPA is considering possible variations to the above.
- Revised Risk Assessment: Title D may be adequate

CCR Leachate Wastewater

No Change!



Options 1, 3a*, 2, 3b*, 3*, 4a*

- No Change
- BAT limits will be set equal to current BPT (TSS and Oil & Grease)
- Proposed Technology: Impoundment

Note: No longer regulated as low volume wastes

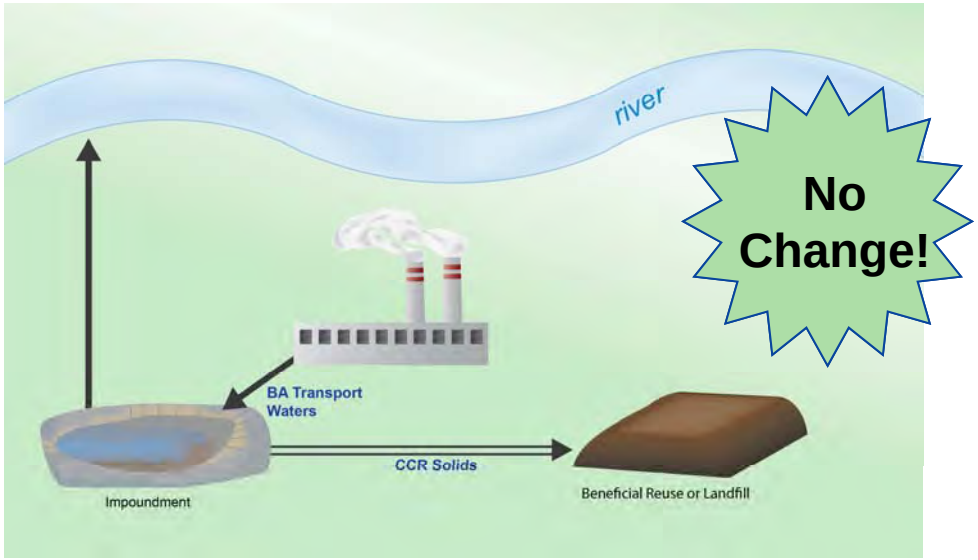
Options 4 and 5

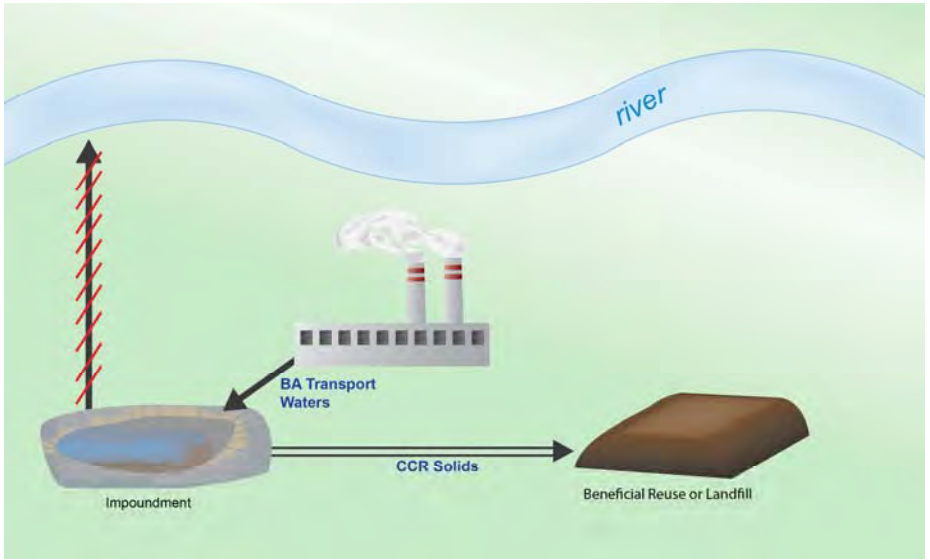
- Proposed Technology: Chemical Precipitation
- Would likely require arsenic and mercury limits

New Source Performance Standards

- Numeric Limits for arsenic and mercury
- Proposed Technology: Chemical Precipitation

Bottom Ash Transport Water





Options 1, 3a*, 2, 3b*, 3*, 4a*(≤400 mw units)

- No Change
- BAT limits will be set equal to current BPT (TSS and Oil & Grease)
- Proposed Technology: Impoundment

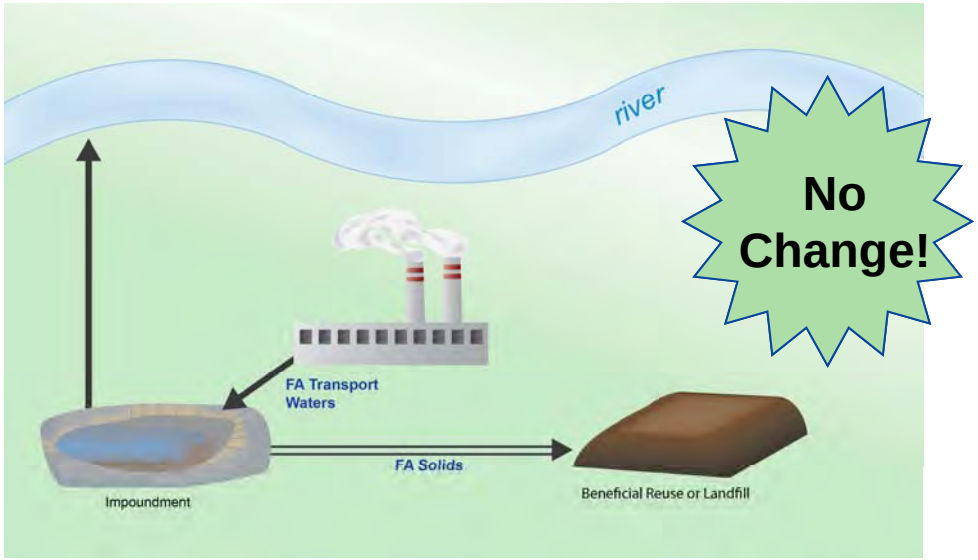
Options 4a* (>400 mw units), 4 and 5

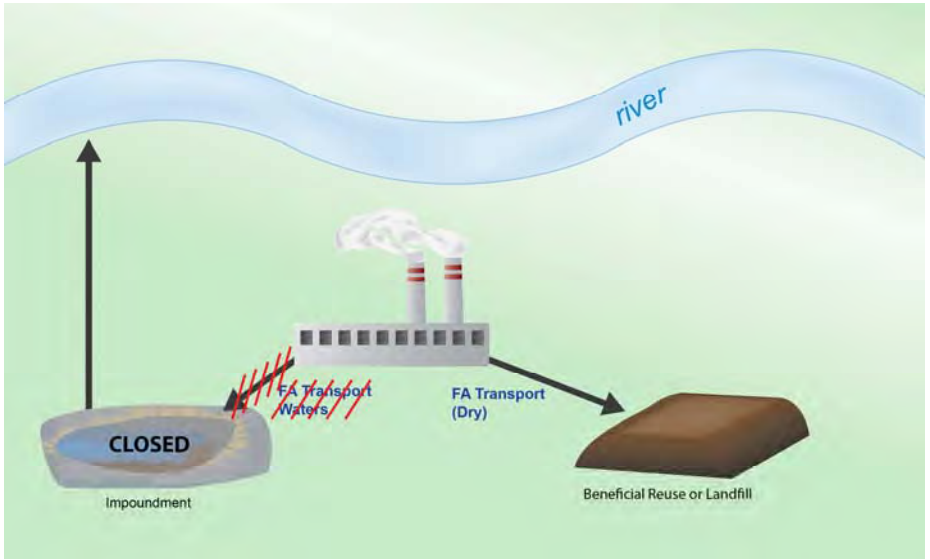
- New Flows: No Discharge Allowed
- Legacy Flows: Subject to BPT
- Proposed Technology: Dry Handling or Closed Loop Impoundments
- Impoundment to close under CCR rules

New Source Performance Standards

- No Discharge Allowed

Fly Ash Transport Water





Options 1 and 2

- No Change
- BAT limits will be set equal to current BPT (TSS and Oil & Grease)
- Proposed Technology: Impoundment

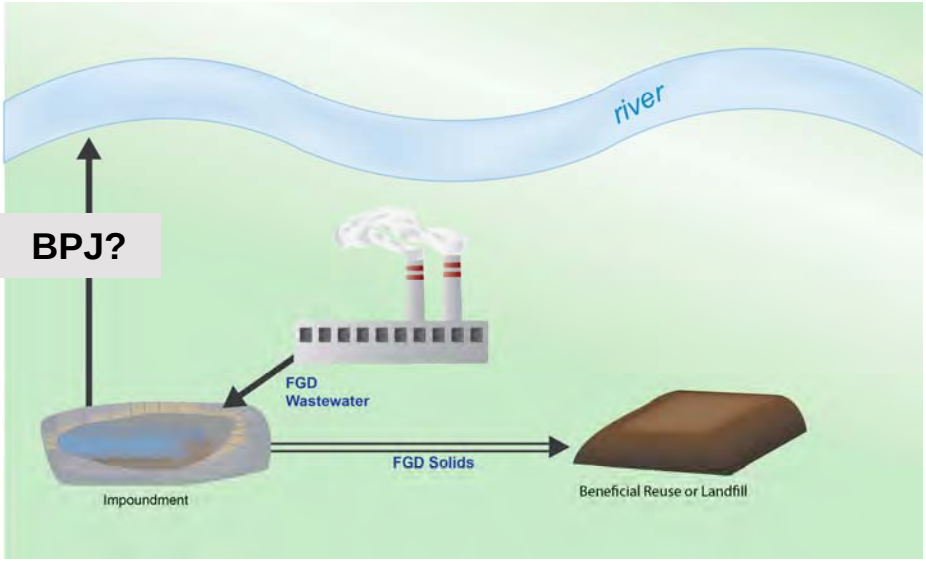
Options 3a*, 3b*, 3*, 4a*, 4, 5

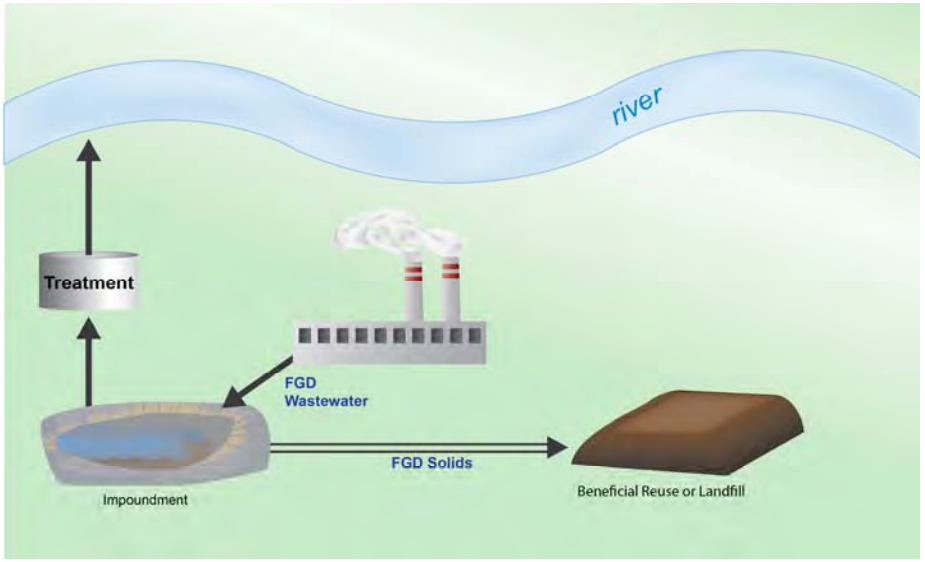
- New Flows: No Discharge Allowed
- Legacy Flows: Subject to BPT
- Proposed Technology: Dry Handling

New Source Performance Standards

- No Discharge Allowed (No Change)

FGD Wastewater





Options 3a*, 3b* (<2000 mw total)

- Best Professional Judgment – as determined by the permitting authority

Option 1

- Proposed Technology: Chemical Precipitation

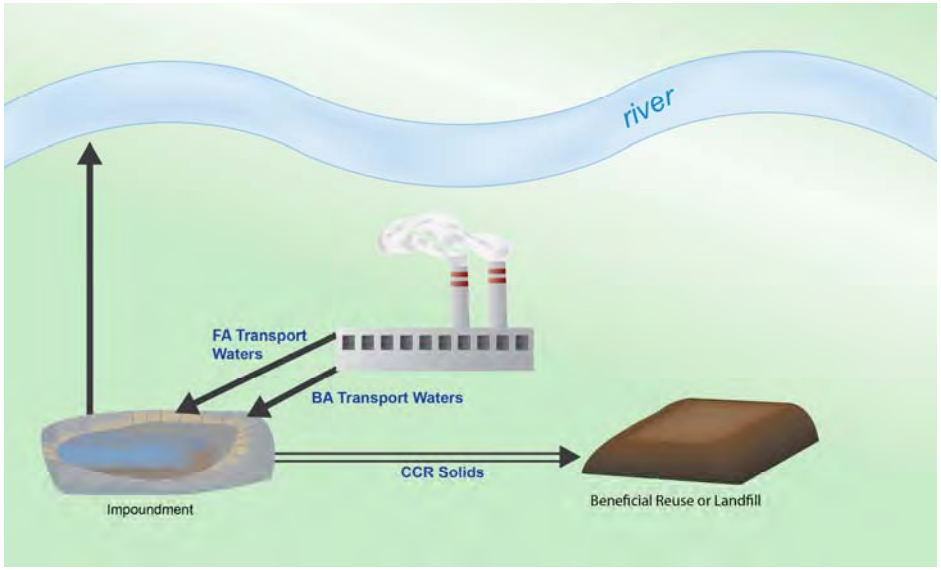
Option 5

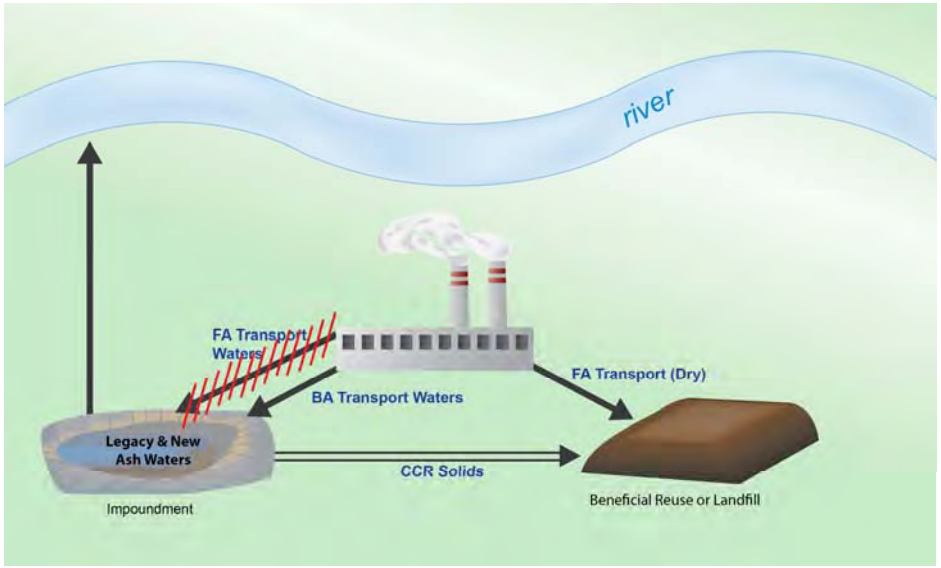
- Proposed Technology: Chemical Precipitation and Vapor Compression Evaporation

Options 2, 3b*(≥2000 mw total), 3*, 4a*, 4) and NSPS

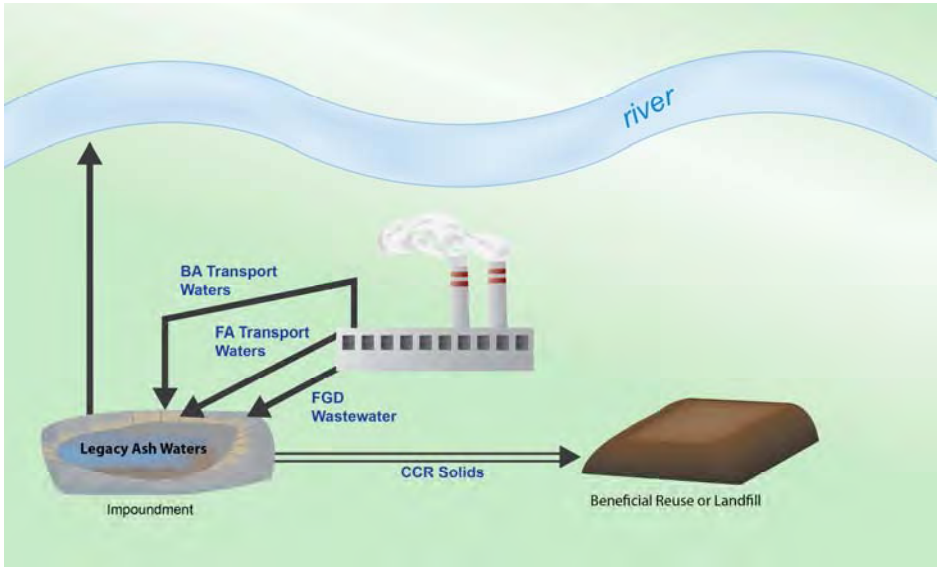
- New Flows: numeric limits for mercury, selenium, arsenic, and nitrate/nitrite
- Legacy Flows: Subject to BPT
- Proposed Technology: Chemical Precipitation and Biological Treatment

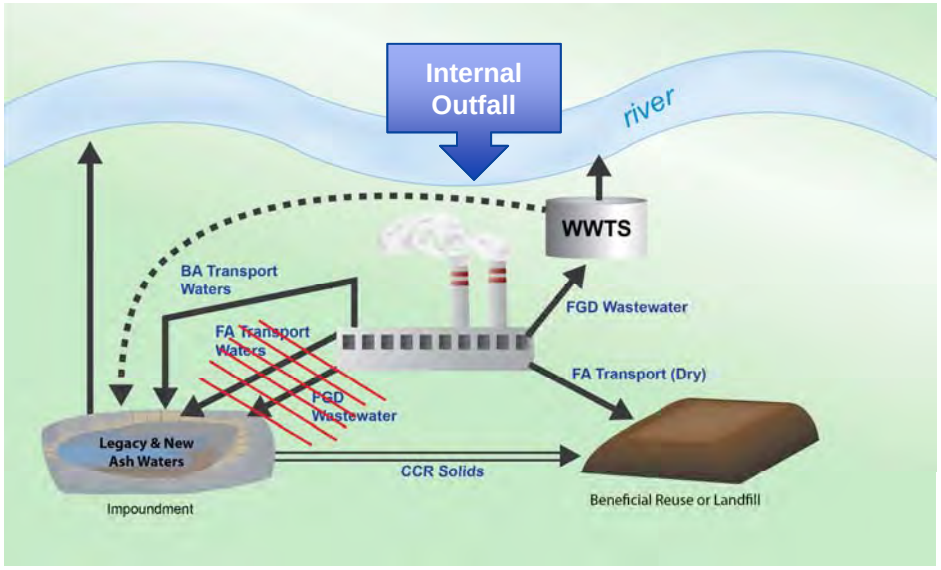
Combined Streams – FA + BA





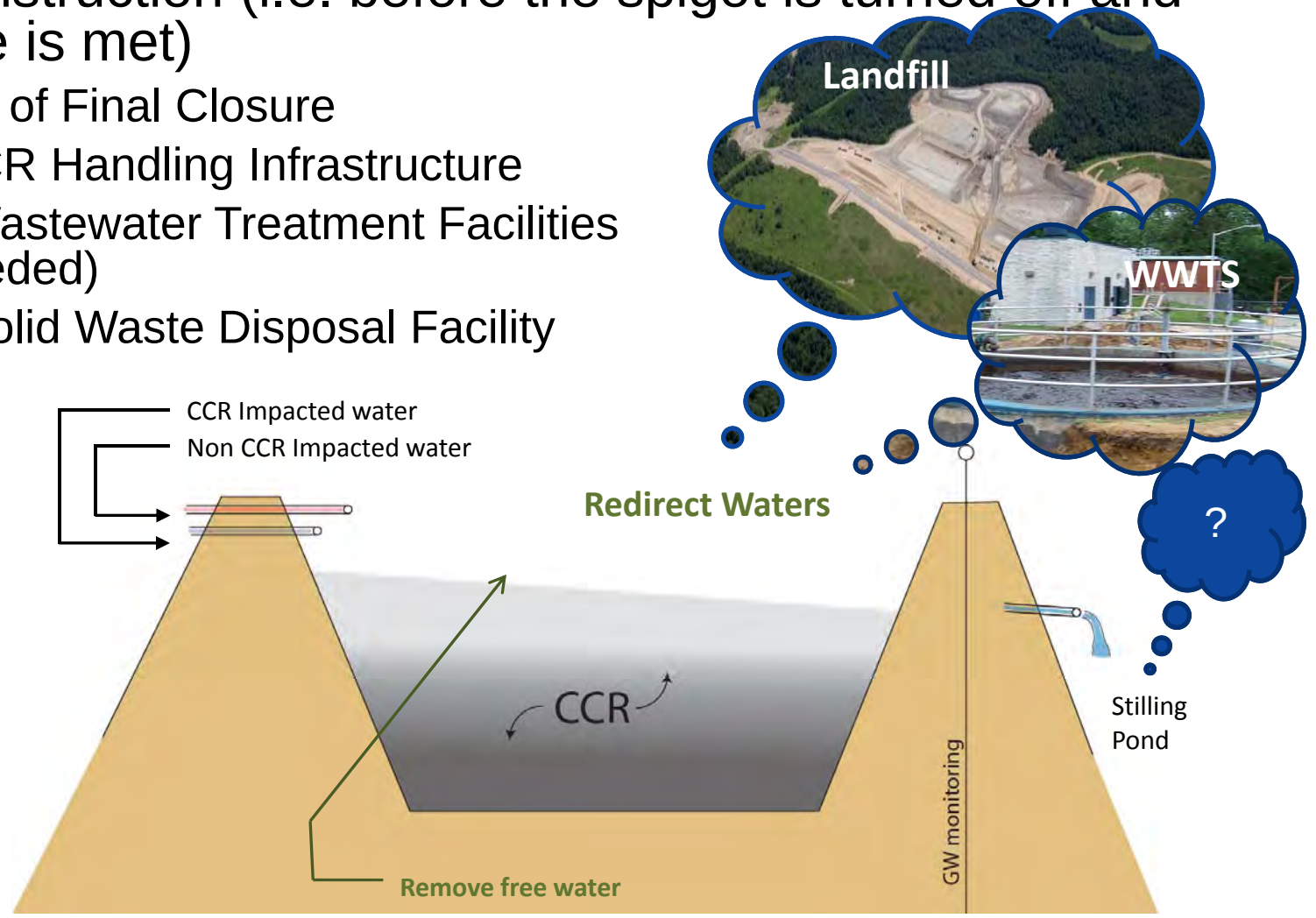
Combined Streams – FA + BA + FGD





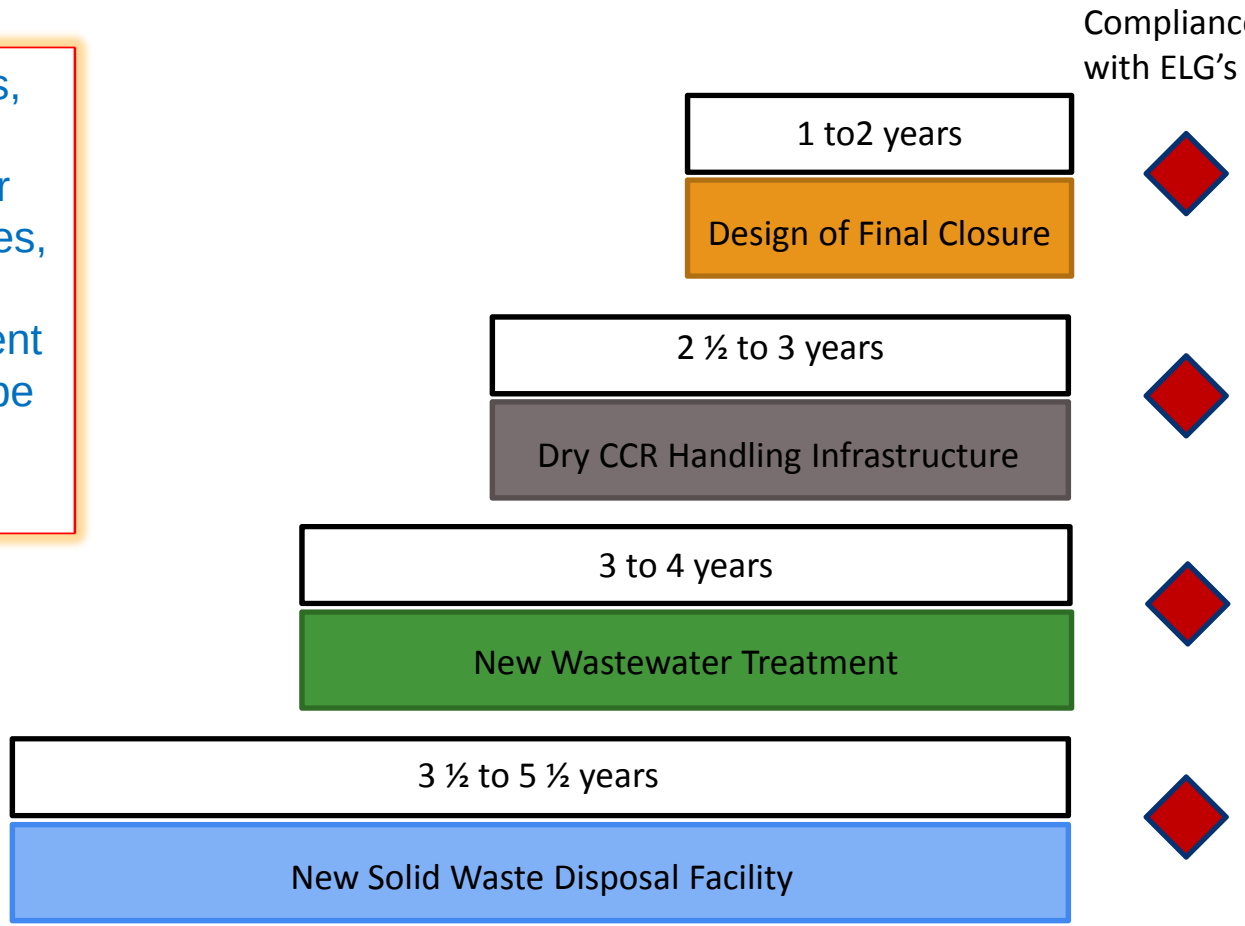
Understanding Schedule Constraints

- The following may be needed prior to the start of final closure construction (i.e. before the spigot is turned off and compliance is met)
  - Design of Final Closure
  - Dry CCR Handling Infrastructure
  - New Wastewater Treatment Facilities (as needed)
  - New Solid Waste Disposal Facility



Overall Dry CCR Conversion/Pond Closure Process

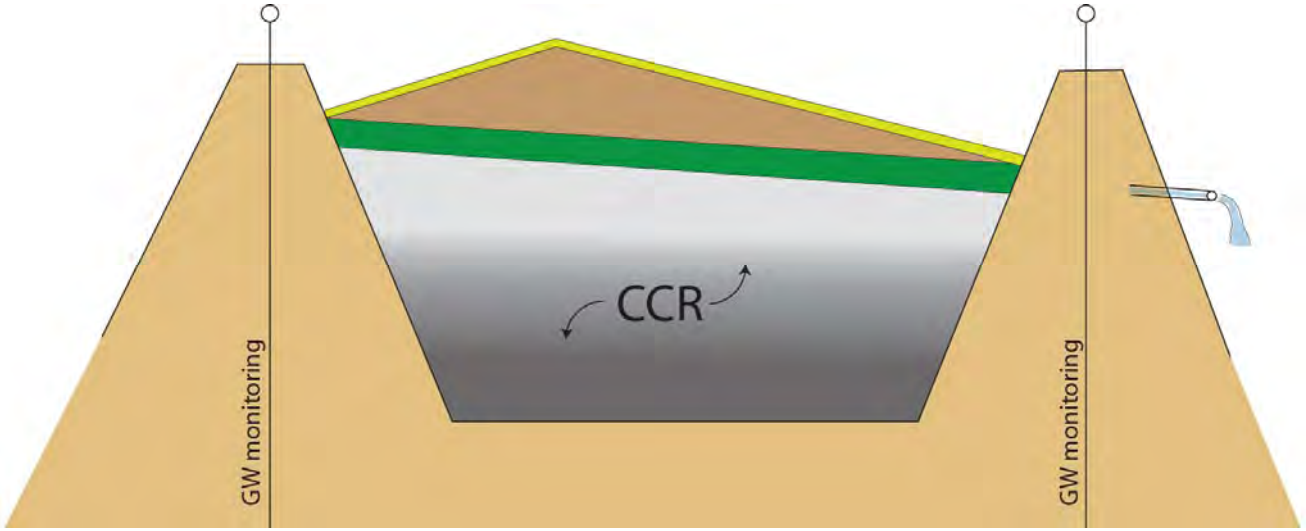
These tasks, while each having their own schedules, are VERY interdependent and should be executed together.



*The time to begin is…**NOW**!!!*

Impact of the CCR Rules – Focus on Pond Closures

- According to the draft CCR Regulations, ponds to begin closure 30 days after ceasing the receipt of CCRs and complete closure within 180 days.
  - "The owner or operator of the…surface impoundment must begin closure activities no later than 30 days after the date on which the CCR landfill or surface impoundment receives the known final receipt of CCR"
  - "The owner or operator of the CCR…surface impoundment must complete closure activities in accordance with the closure plan within 180 days following the beginning of closure…"



Next Steps

- Look at the big picture within each Plant
  - Characterize your wastewater streams, facility operations, identify limiting factors
  - Look for opportunities to improve facility operations
  - Assess cumulative impact of rules - collaborative solution involving all SMEs
  - Operate Plant as a team (minor changes can have significant downstream impacts)
  - Make a plan to comply with rules (finances, time frame, reliability?)
- Rule Finalization
  - Comments are due by August 6, 2013
  - Final rule action by May 2014 (per the consent order)
  - Determine participation in voluntary program by July 1, 2017

URS

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