

REINHOLD ENVIRONMENTAL Ltd.



## **2014 NO<sub>x</sub>-Combustion Round Table & Expo Presentations**

February 10 & 11, 2014, in Charlotte, NC / Hosted by Duke Energy

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## Challenges in Meeting Upcoming Wastewater Discharge Limits



Michelle Mayfield, URS

**2014 NOx-Combustion/PCUG Conference**

**Hosted by Duke Energy**

February 10, 2014

# Safety Moment – Water Sampling

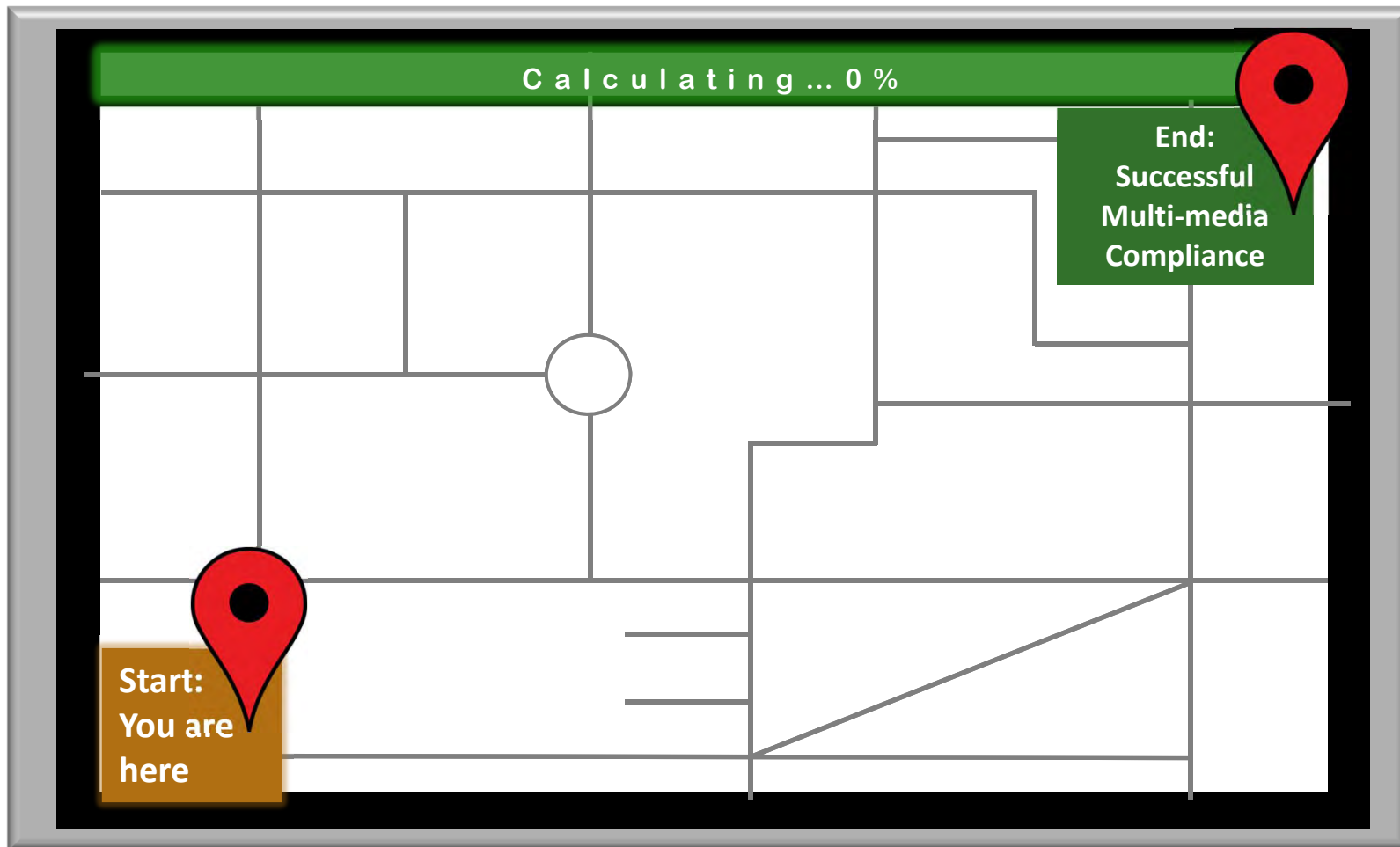
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- Be aware of potential dangers
  - Sampling material(s)
  - Site location
- Always follow general safety rules:
  - Wear proper PPE
  - Stay attuned to environmental factors such as overheating, wild animals, and insects
  - Watch for slippery surfaces, deep water, and use flotation devices as appropriate when sampling on or near water
  - Prepare an emergency contact sheet
  - Have a reliable communication device

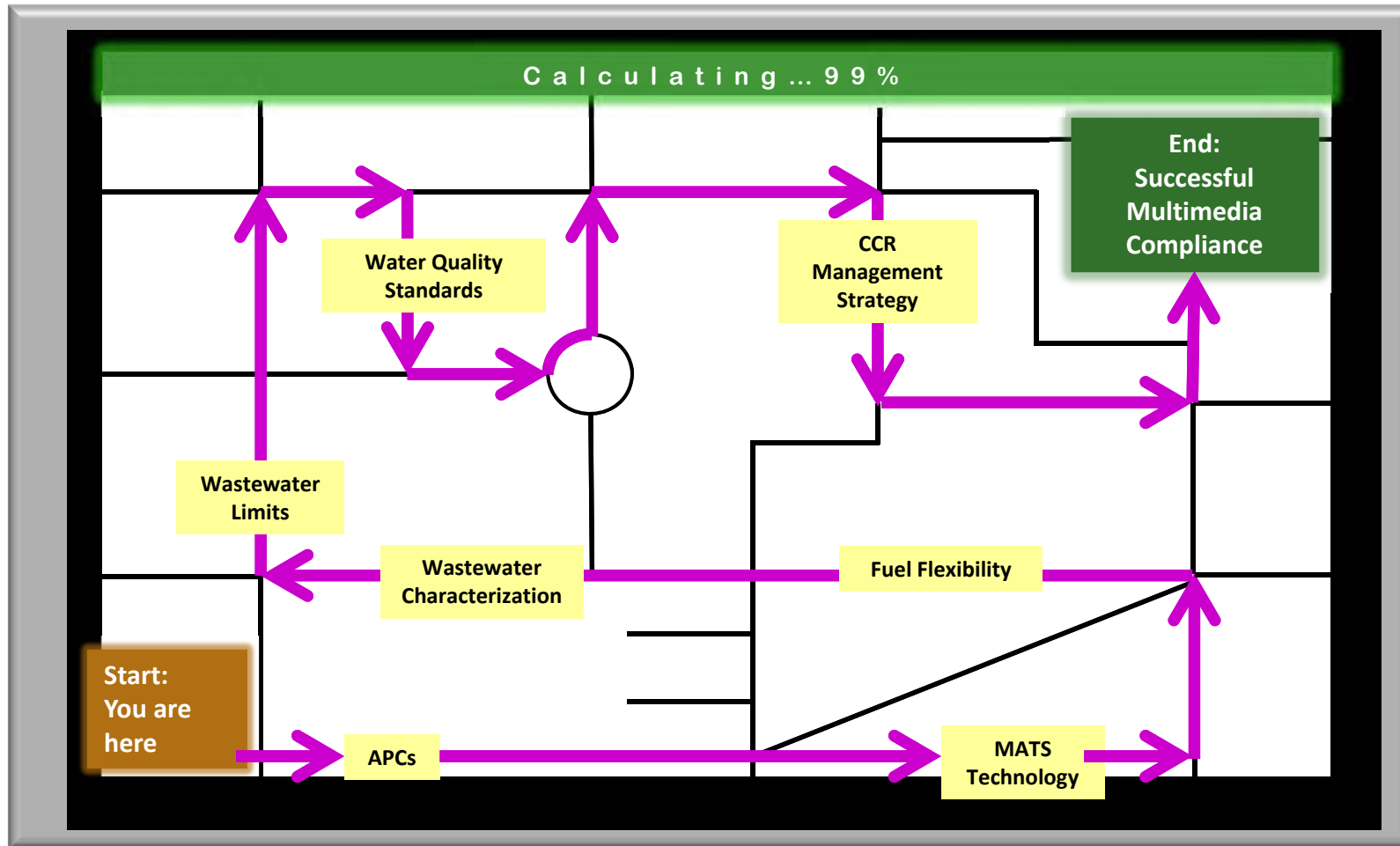
**Proper safety precautions should always be observed!**



# Path to NPDES compliance is a complex road map



# Finding the way is an unique journey for each plant



**Presentation objective:** Identify the challenges and suggest guidance to navigate the route to successful NPDES compliance.

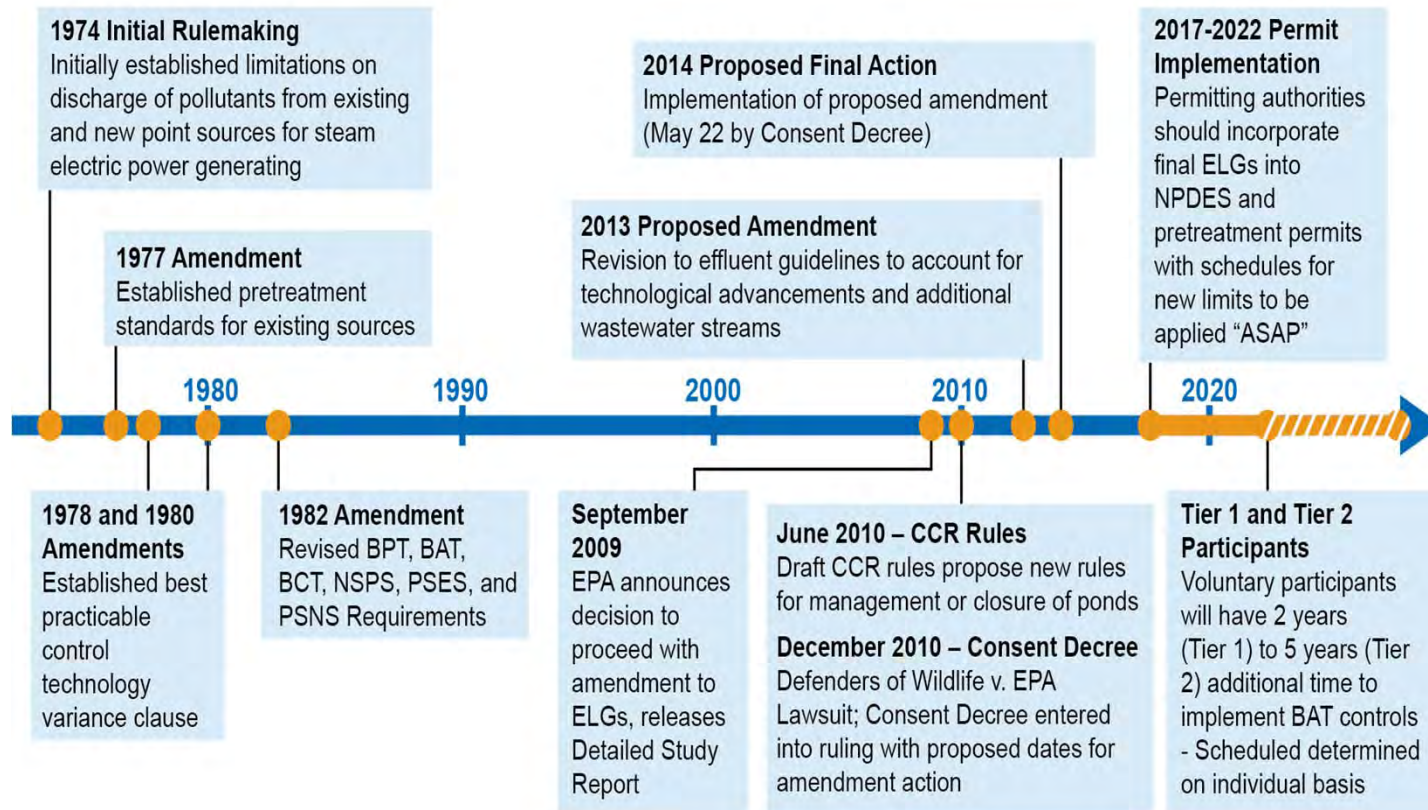
# Agenda

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- ELG Overview and Coordination with the CCR Rules
- Fuel Flexibility
- Impact of MATS Compliance
- Even More Rules?
- Planning Strategy

# History of the ELGs

- New energy production technologies (gasification) and increased air pollution control technologies (FGD, SCR, FGMC) generating unique wastewater streams



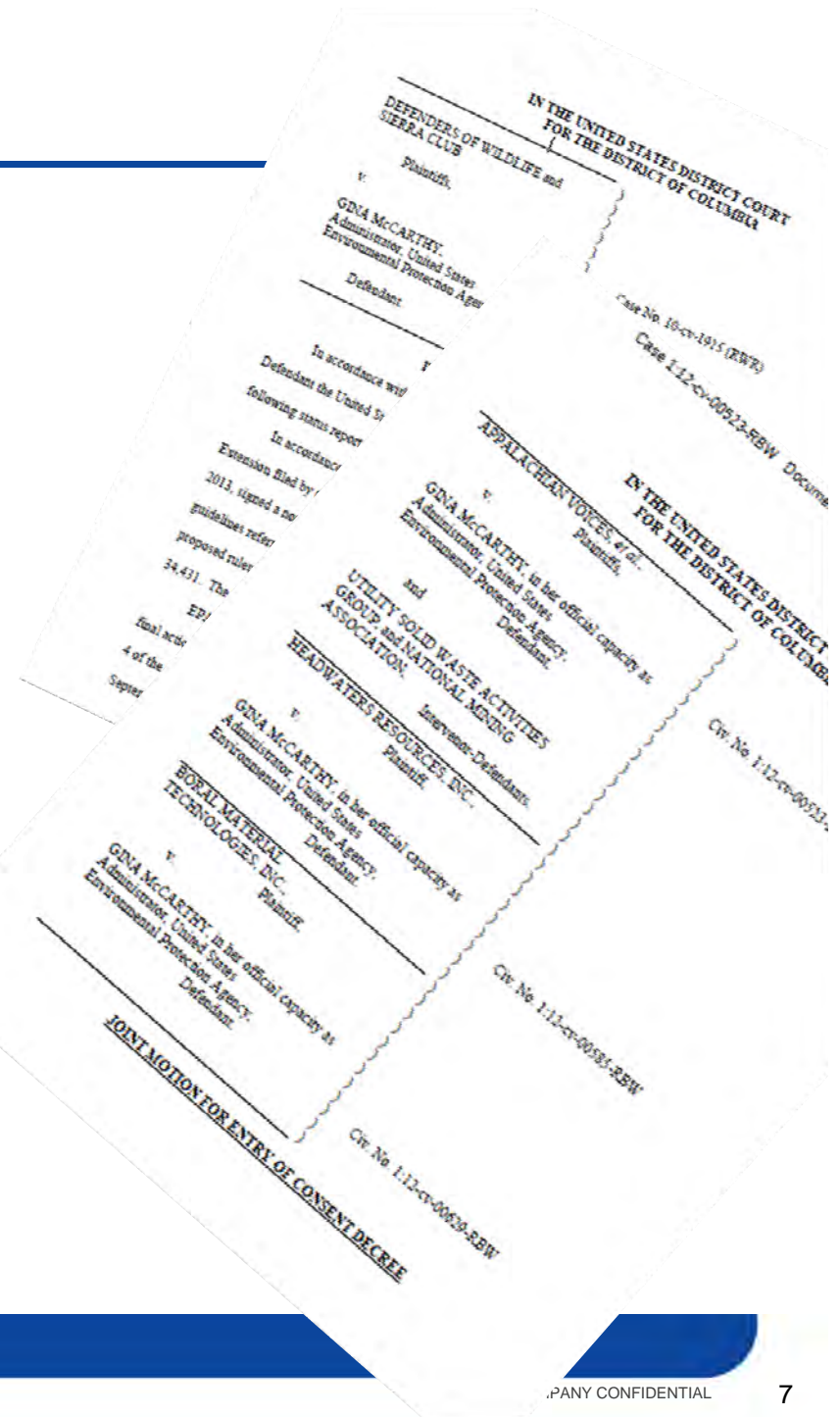
# Hold the presses

## December 2013 ELG Status Report

“EPA has advised Plaintiffs that it will require additional time to prepare a notice taking final action on its proposed rulemaking beyond the May 22, 2014... If those negotiations are unsuccessful, EPA intends to file a motion with the Court, requesting additional time to make a decision taking final action on the proposal.”

## January 2014 CCR Joint Motion for Entry of Consent Decree

In the proposed consent decree, EPA agrees to sign for publication in the Federal Register by December 19, 2014, a notice taking final action regarding EPA’s proposed revision of RCRA subtitle D regulations pertaining to coal combustion residuals.



# Consider all the Options (Existing) – EPA Preferred

Increasing Pollutant Reduction 

	Current Conditions	Option 3a	Option 3b	Option 3	Option 4a
<b>FGD Wastewater (including gypsum wash water)</b>	Included as Low Volume Wastes T = Impoundment L: TSS & Oil and Grease	BPJ determination (technology and limits)	T: Chemical Precipitation(CP) <sup>a</sup> 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 <sup>a</sup> and BT L: Hg, As, Se and nitrate-nitrite	
<b>Fly Ash Transport Water</b>	T: Impoundment L: TSS & Oil and Grease	T: Dry handling <sup>b</sup> L: Zero discharge			
<b>Bottom Ash Transport Water</b>	T: Impoundment L: TSS & Oil and Grease	T: Impoundment L: Equal to BPT (no change from current rule)			T: Dry handling/ closed loop <sup>c</sup> 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
<b>Coal Combustion Residual Leachate</b>	Included as Low Volume Wastes T = Impoundment L: TSS & Oil and Grease			T: Impoundment L: Equal to BPT (no change from current rule)	
<b>FGMC Wastewater (Activated Carbon Injection)</b>	Included as Low Volume Wastes but common practice is no discharge			T: Dry handling <sup>b</sup> L: Zero discharge (current practice)	
<b>Nonchemical Metal Cleaning Wastes*</b>	Included in Metal Cleaning Wastes BPT for Cu and Fe			T: CP L: Cu, Fe	

- \*Nonchemical metal cleaning wastes exemption: if previously permitted as LVW without copper and iron limits (up to 27% of plants) – if notified EPA during the comment period
- Pretreatment Standards for Existing Sources (PSES) & Pretreatment Standards for New Source (PSNS) are similar to BAT options
- New Source Performance Standards (NSPS) equivalent to Option 4 or 4a plus As and Hg limits for leachate

# Comparison of Proposed Limits to Existing Limits

## FGD Wastewater (all dischargers; approximately 311 plants)

	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

# What is a New Source?



- A new source is the unit generating wastewater, not the treatment system; changes to the water treatment system are not generally considered new sources.
- Facilities that were identified as “new sources” under the current ELG will continue to be subject to the new source standards promulgated in 1982 as well as the revised standards in this proposed rule. They are considered “existing sources” for newly-regulated streams.

## EPA's Definition

A building, structure, facility or installation (can be a whole facility or as small as a piece of equipment) for which:

- Construction (including preparation work of the site and entering into binding contracts) commenced after publication of proposed applicable standards (for indirect dischargers) or after promulgation (for direct dischargers), **and** one of the following apply:
  - On a site with no other source; **or**
  - It totally replaces the equipment of an existing source; **or**
  - Its processes are “substantially independent of an existing source at the same site”, relative to the extent of integration with an existing source, and other factors.

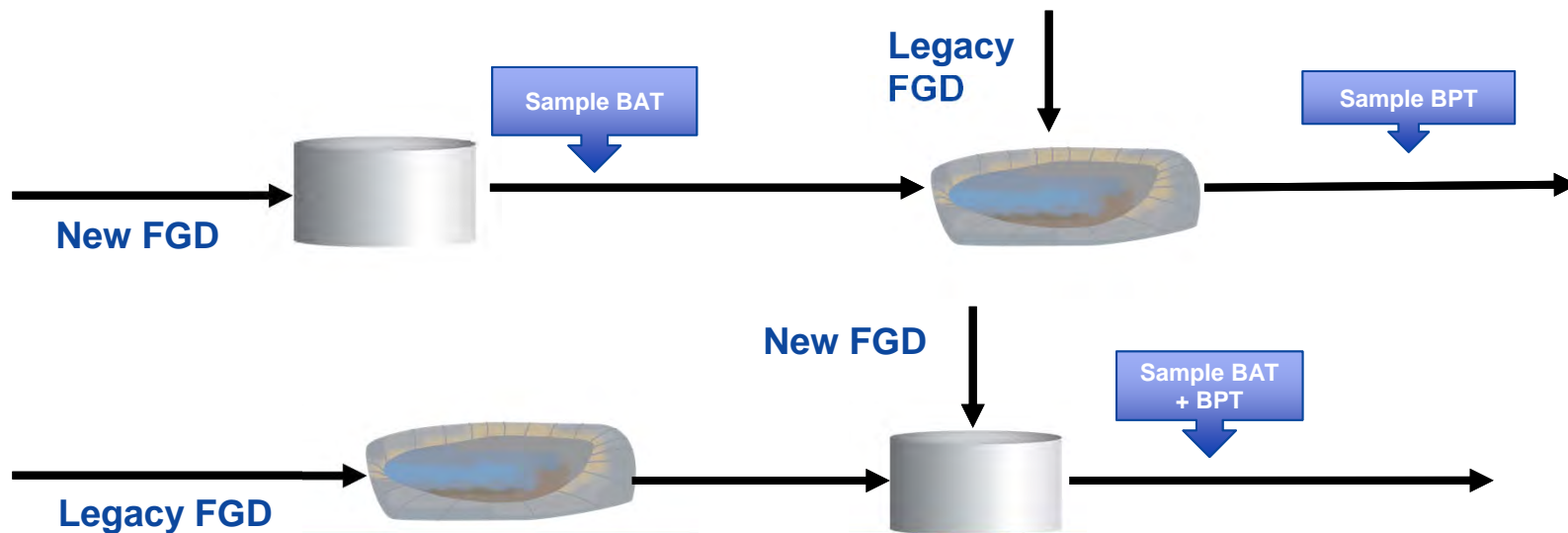
## Other Miscellaneous Requirements

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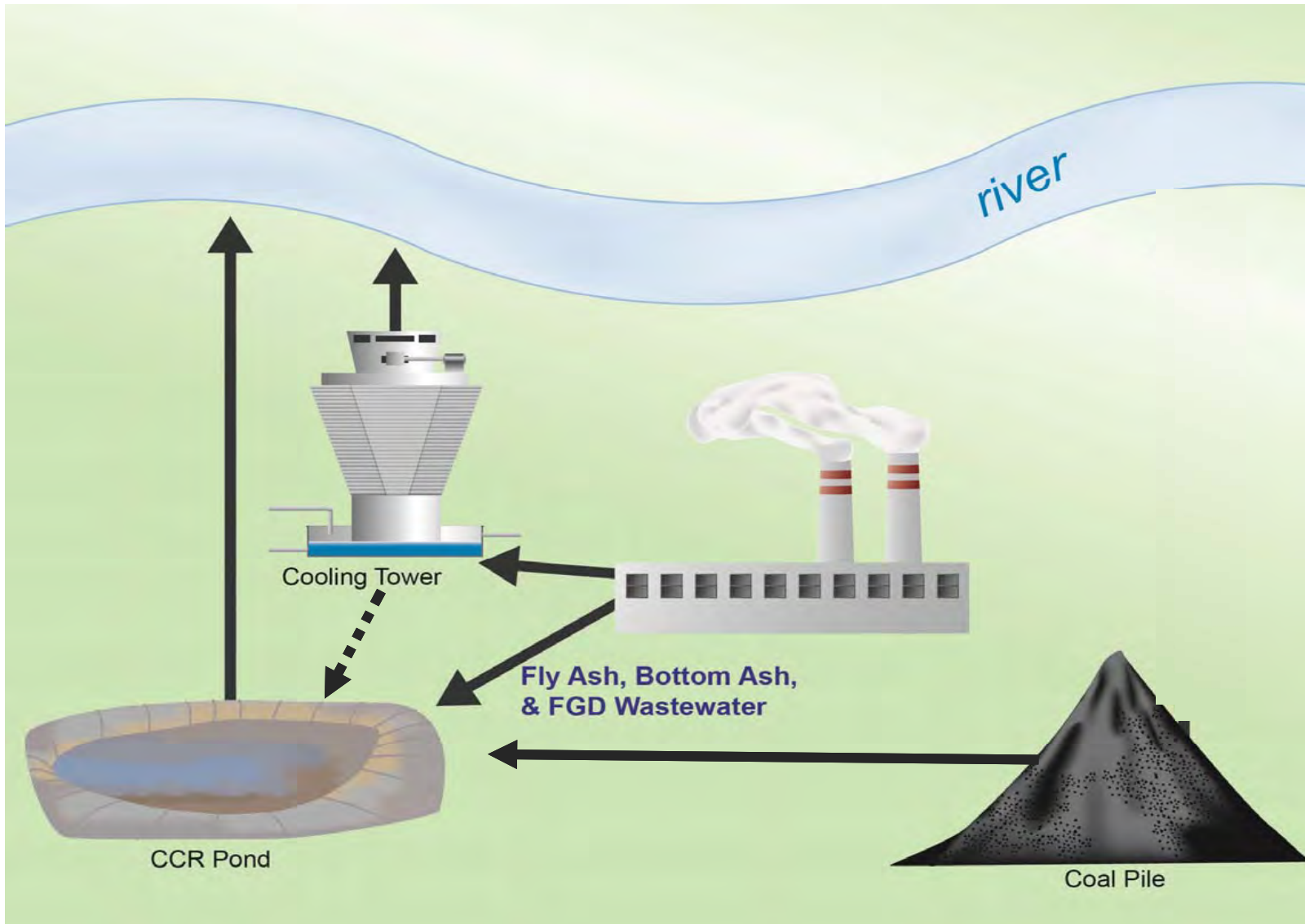
- Compliance Deadlines for Dischargers
  - Direct Dischargers comply “on or after the date established by the permitting authority that is as soon as possible with the next permit cycle after July 1, 2017” for FGD wastewater, transport waters, leachate (Options 4 and 5), and FGMC wastewater.
  - Indirect Dischargers comply “as soon as possible beginning July 1, 2017”
  - EPA 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 Methods 1631 or 245.7 for mercury
  - For FGD wastewater, an SOP for using Collision Cell technology (with 200.8) is called out in draft (hard to find a lab)

# Anti-Circumventing Provisions

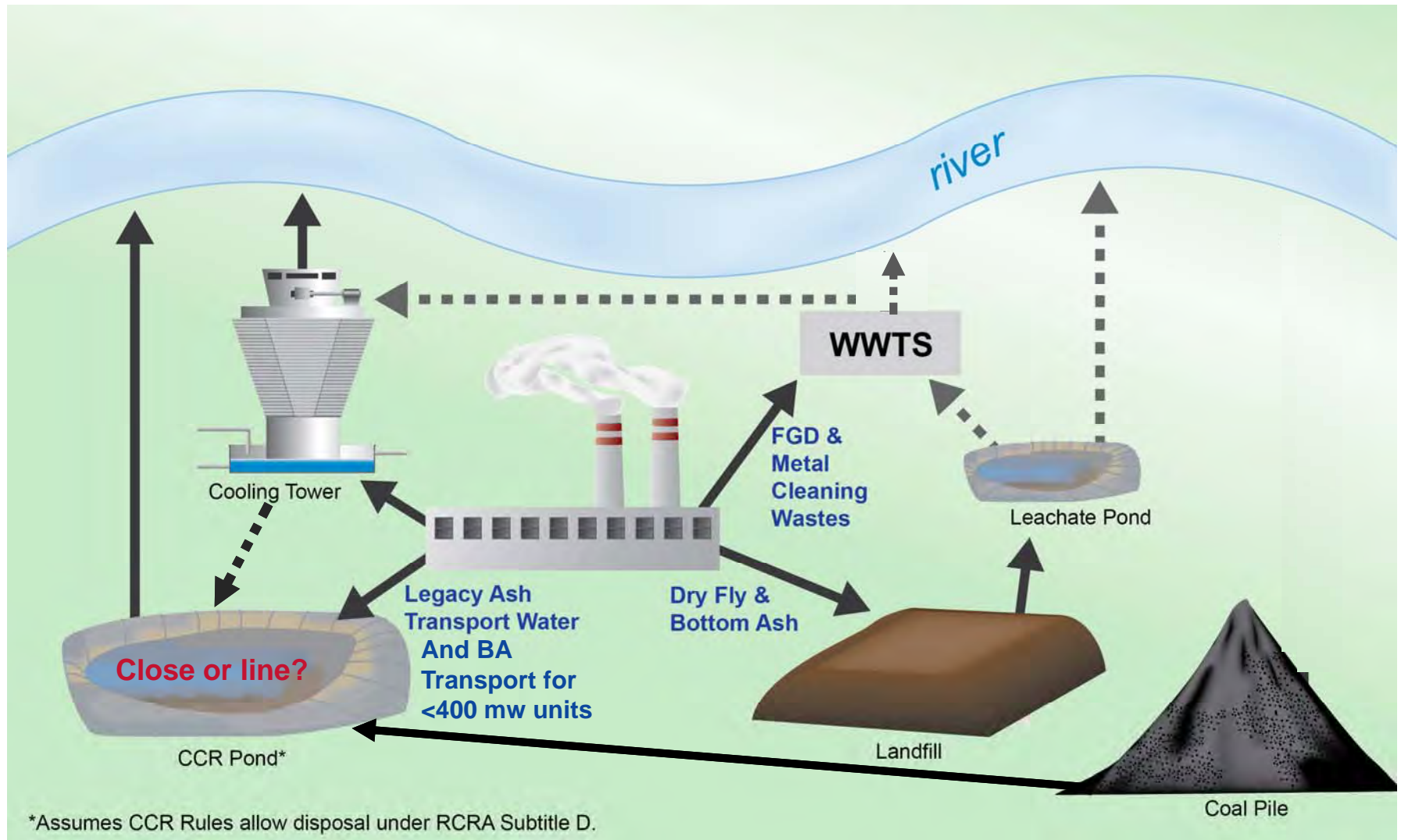
- If EPA has approved more than one method per analyte, then permittee must use a “sufficiently sensitive” method (meaning, the method is able to reliably report to concentrations below the effluent limit)
- Retention of “no discharge” requirements for wastewater streams, regardless of other uses (fly and bottom ash transport waters, or FGMC wastewater) - would also apply to any additional streams commingled with these streams while being reused
- Internal monitoring points to demonstrate compliance with new limits



# Permitting Example – Current



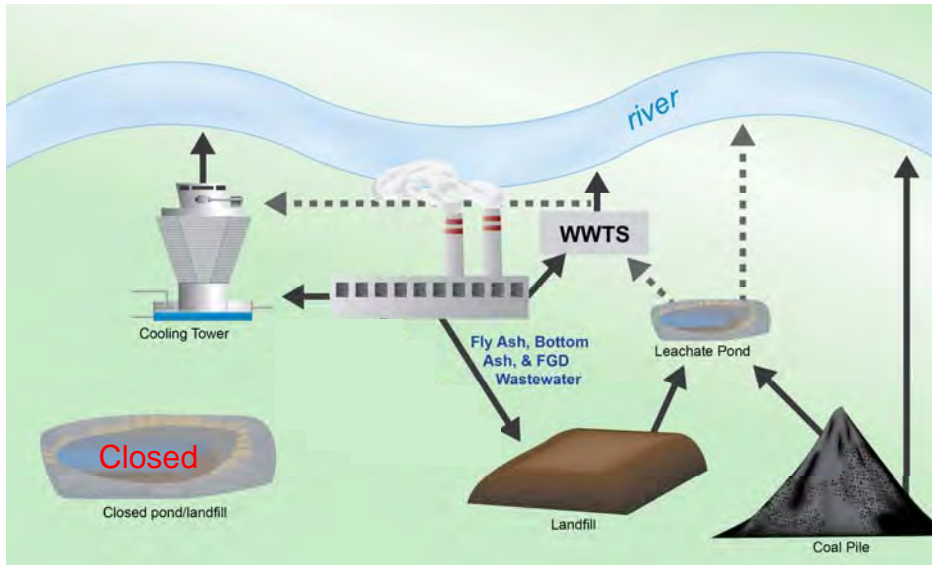
# Permitting Example – Future Option 4a



# Voluntary Program

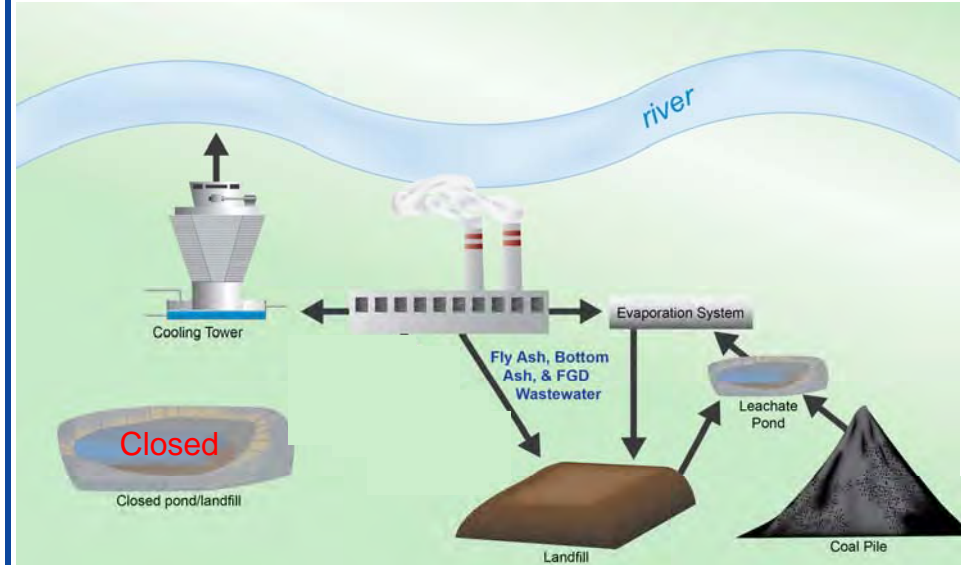
## Tier 1

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



## Tier 2

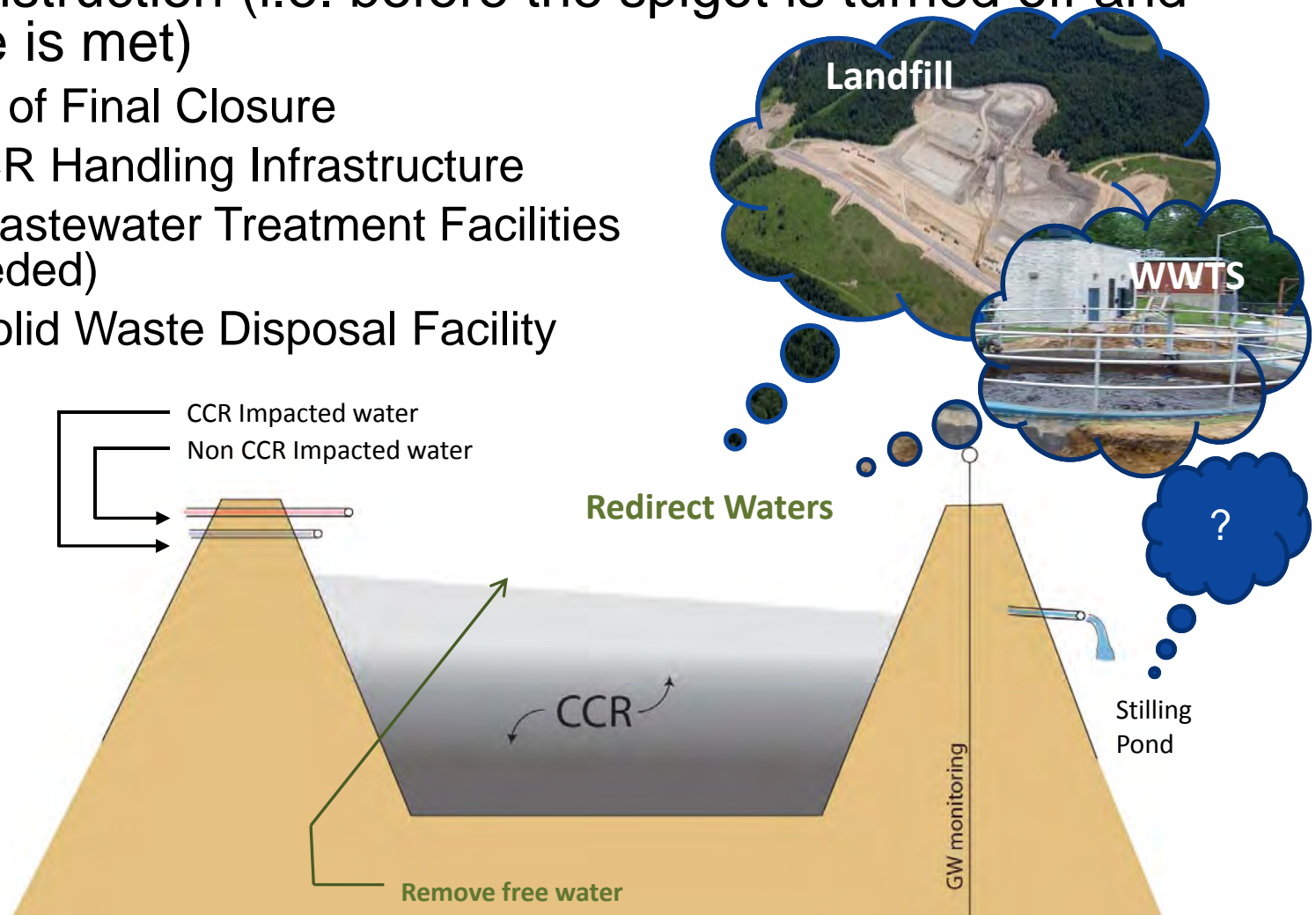
- Eliminate all process wastewater discharges to surface waters except cooling water discharges
- 5 additional years to implement BAT



- Must notify regulators of intent by July 1, 2017 and provide a plan.
- Permit would include specific limits and milestones.
- Must comply with “any other requirements” established by EPA.

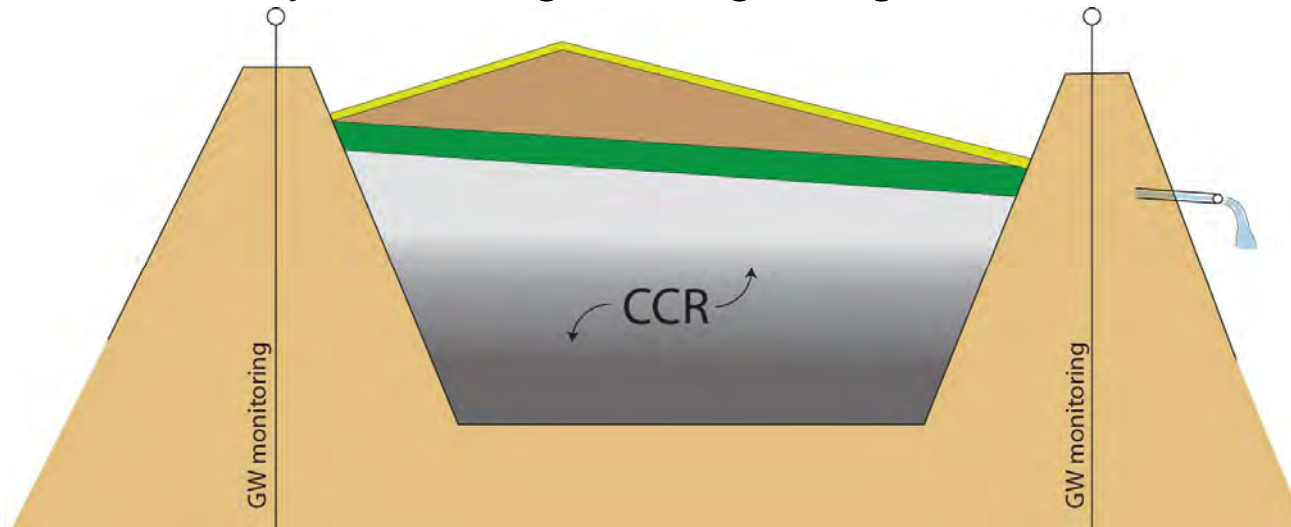
# Understanding Schedule Constraints

- 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



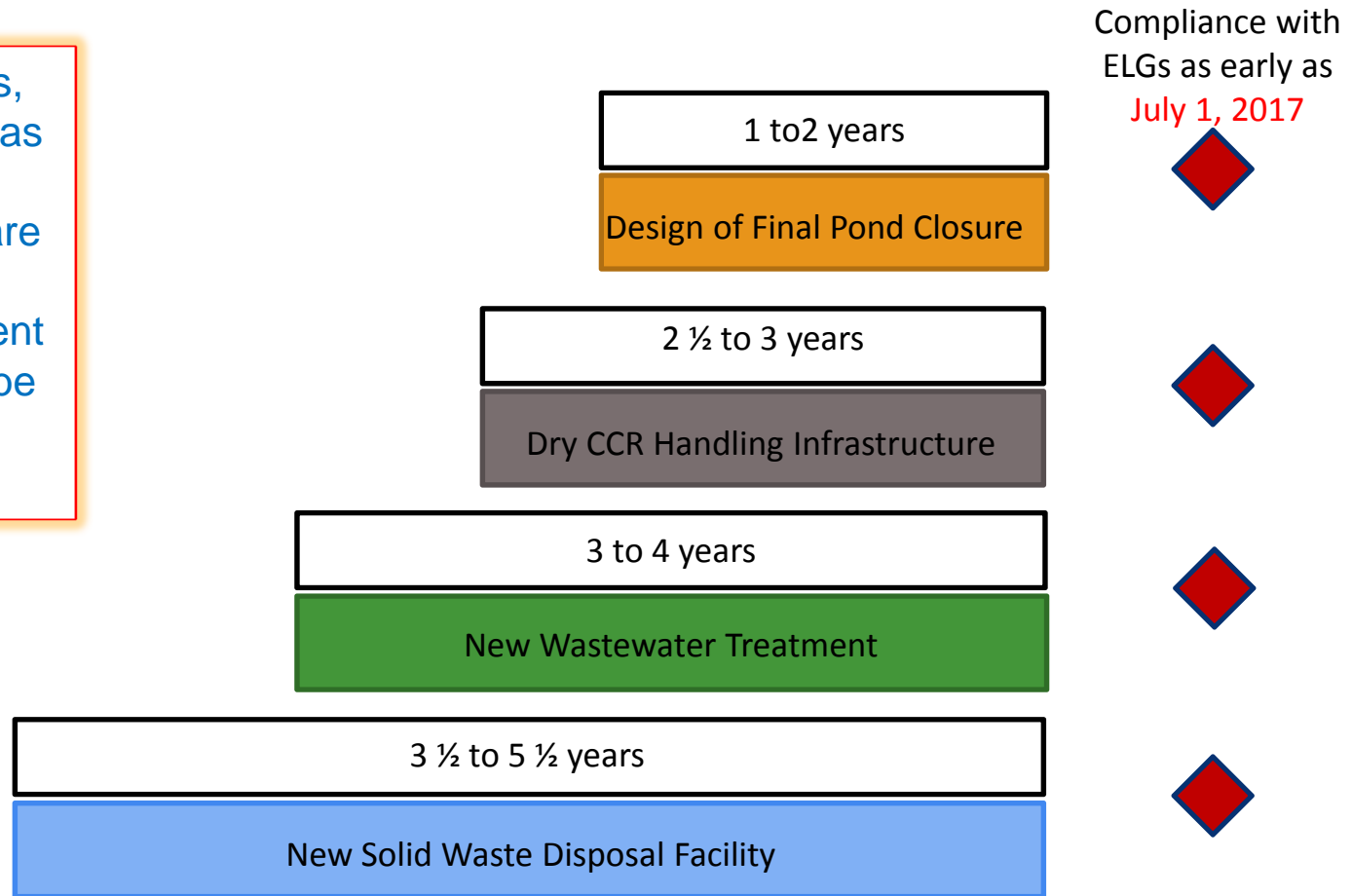
# Impact of the CCR Rules – Focus on Pond Closures

- 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...”



# ELG/CCR Compliance Planning

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



*The time to begin is now*

## Where does this lead us?

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- Water balance redesign
  - Internal outfalls (FGD, maybe leachate)
  - No reuse of relatively clean bottom ash transport water
  - Flow segregation (legacy vs newly generated)
  - New internal outfalls
- Operational changes
- Wastewater treatment systems
  - Decentralized?
  - FGD/leachate treatment systems
- Dry ash handling
  - New landfills
  - Pond closures

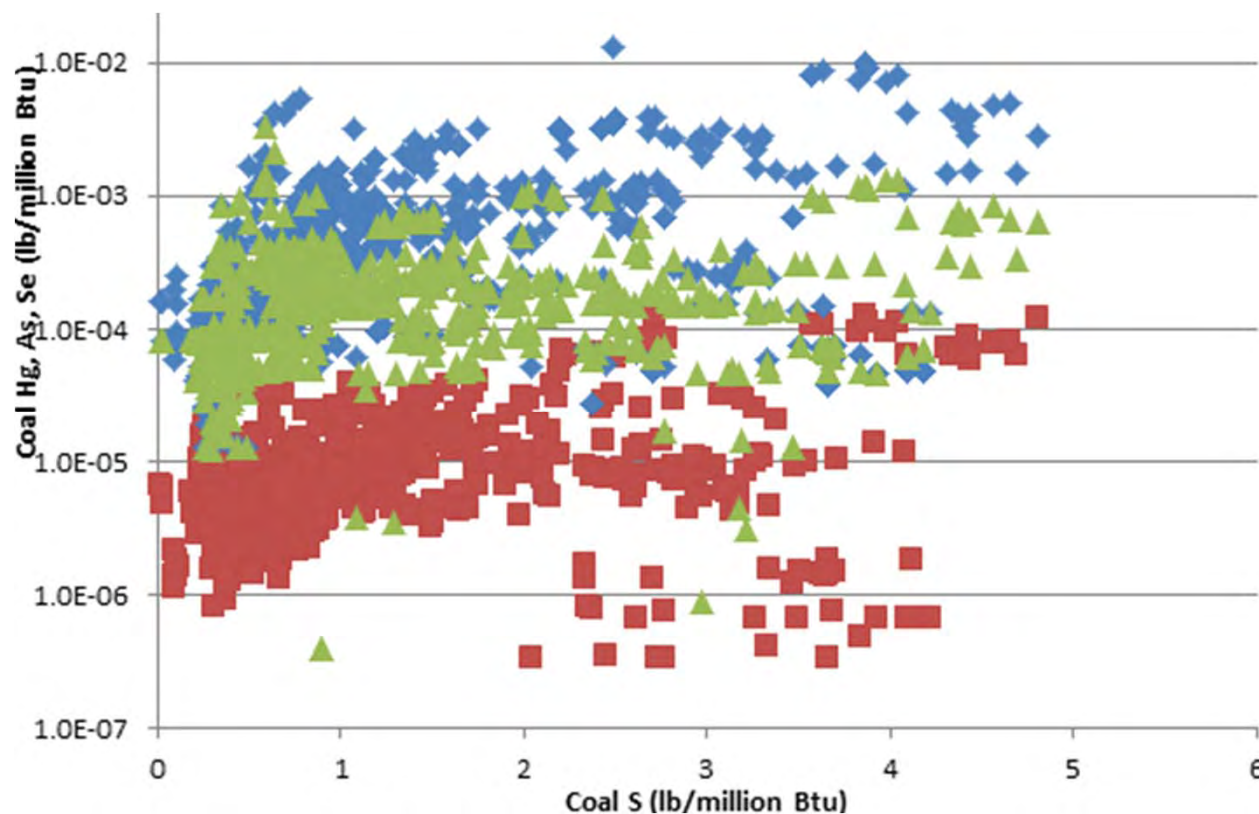


**Fuel Flexibility**



## Increasing S and Cl in Fuel Coal

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



■ Hg  
◆ As  
▲ Se

Not to mention other influences on FGD blowdown: ORP, trace elements and fines from limestone, Hg re-emissions

Source: 2010 ICR data

# Affects of Fuel Change on Plant Systems

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- 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)
  - FGD ww, lime, fly ash and gypsum mixed to form concrete-like by-product
  - Retrofitting a ZLD-BS to an existing plant may result in Cl concentration increases beyond the capacity of existing materials, especially in the absorber if operate scrubber at higher COC; effect would increase as coal Cl increases
  - 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, air preheater, and ESP
  - Reduce Hg capture in FGD, cause re-emission

## Addressing Limits to Fuel Flexibility

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



## Impact of MATS Compliance



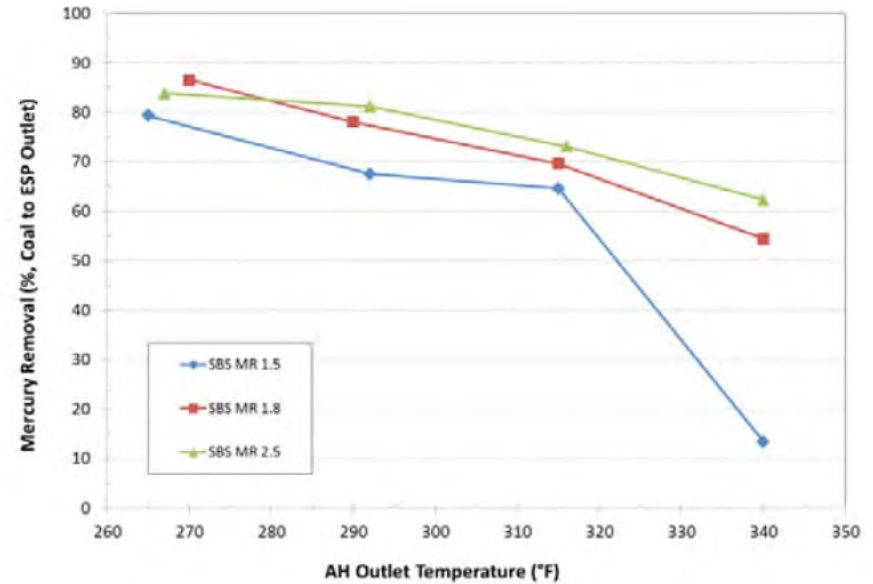
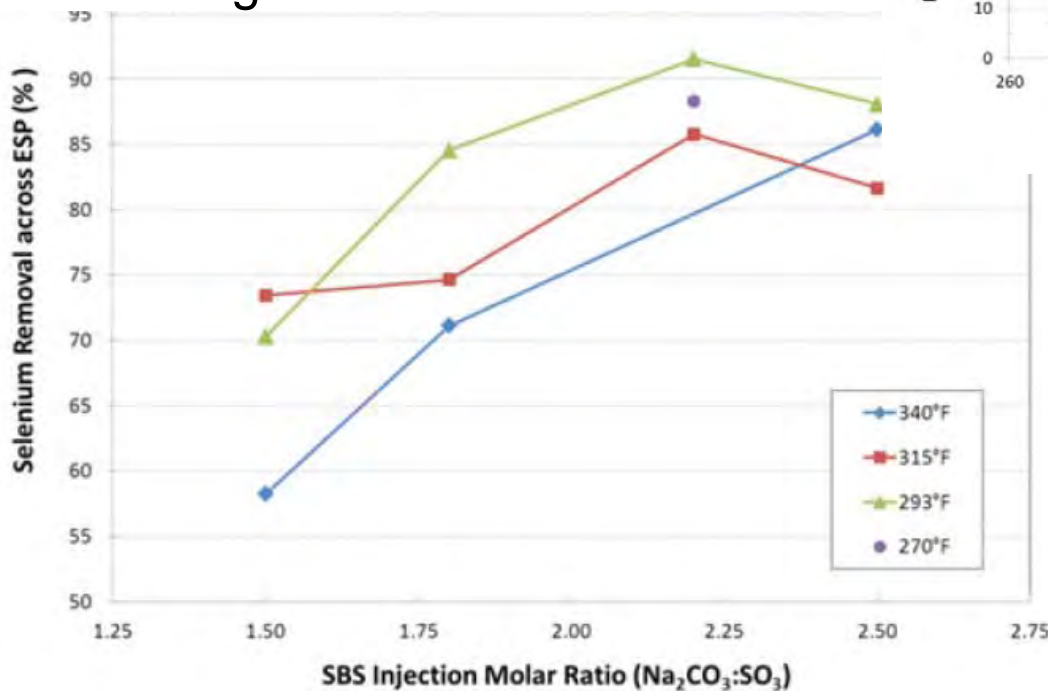
## Mercury and Air Toxics Standards (MATS)

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- 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)
  - ELGs: “... 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 (ESP additives, halogens, dry sorbent injection, etc.) were not assessed during ELG development for impacts on fly ash transport water, fly ash leachate, or FDG wastewater
  - Increased mercury, selenium, arsenic, nitrogen, and chromium in FGD wastewater
  - Increase fly ash solids production
  - Reduced or unknown effect of efficiencies for WWTS

# SBS Injection

- Single sorbent injection
- Increased Hg adsorption onto unburned coal
- High SO<sub>3</sub> removal prior to APH
- Capture more Hg, Se and HCL in fly ash, less in wet scrubber discharge





**Even More New Rules?**



# Water Quality Standards Proposed Rules

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- CWA 303(c)/40 CFR 131 - September 4, 2013, EPA published the proposed rule “Water Quality Standards Regulatory Clarifications” in the Federal Register(78 FR 54517). Comment period closed 1/2/2014;
- Antidegradation
  - States may identify High Quality Waters on a parameter-by-parameter basis as required in the Great Lakes Region (or water body by water body as long as not all criteria must be met)
  - States must provide an Alternatives Analysis before allowing even minor reduction of use in HQW
    - Determine if degradation is necessary if alternatives ways to accomplish activity are available
    - If warranted for *important* economic or social development,
  - “Once a parameter is determined to exist at a level that is better than applicable criteria, the state or tribe would conduct a Tier 2 review for that parameter”

## Water Quality Standards Proposed Rule, continued

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- Permit-based compliance schedule for WQBELs– allowed only if state/tribe authorized in WQS or implementation regulations
- Variances
  - ...are WQS that are a time-limited use and criterion for a specified pollutant(s), permittee(s), and/or water body or waterbody segment(s) that reflect the highest attainable condition during the specified time period.
  - Clarifies what information must be provided to demonstrate need and seek approval
- Clarification to selecting the Highest Attainable Use as designated use
- Clarification requiring Administrator's determination when new or revised WQS are necessary
- Triennial Reviews in light of new or updated criteria recommendations
- If finalized, will be implemented in next triennial review

# Water Quality Criteria

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- Kentucky
  - Selenium fish tissue chronic standard of 8.6 micrograms per gram dry weight (ug/g/dw) for whole body fish tissue or 19.3 ug/g for egg or ovary tissue (if fish tissue not available or adequate, use chronic limit of 5 ug/l.)
  - Disapproved new acute standard for selenium (continuing to use existing 20 ug/l)
- North Carolina
  - Metals (arsenic, chromium III and VI, copper, nickel, zinc)

## A future ELG?

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- Condenser cooling water
- Coal Pile Runoff
- Selective Catalytic Reduction and Selective Non-Catalytic Reduction Wastewater
- Carbon Capture Wastewater
- Selected Low Volume Waste

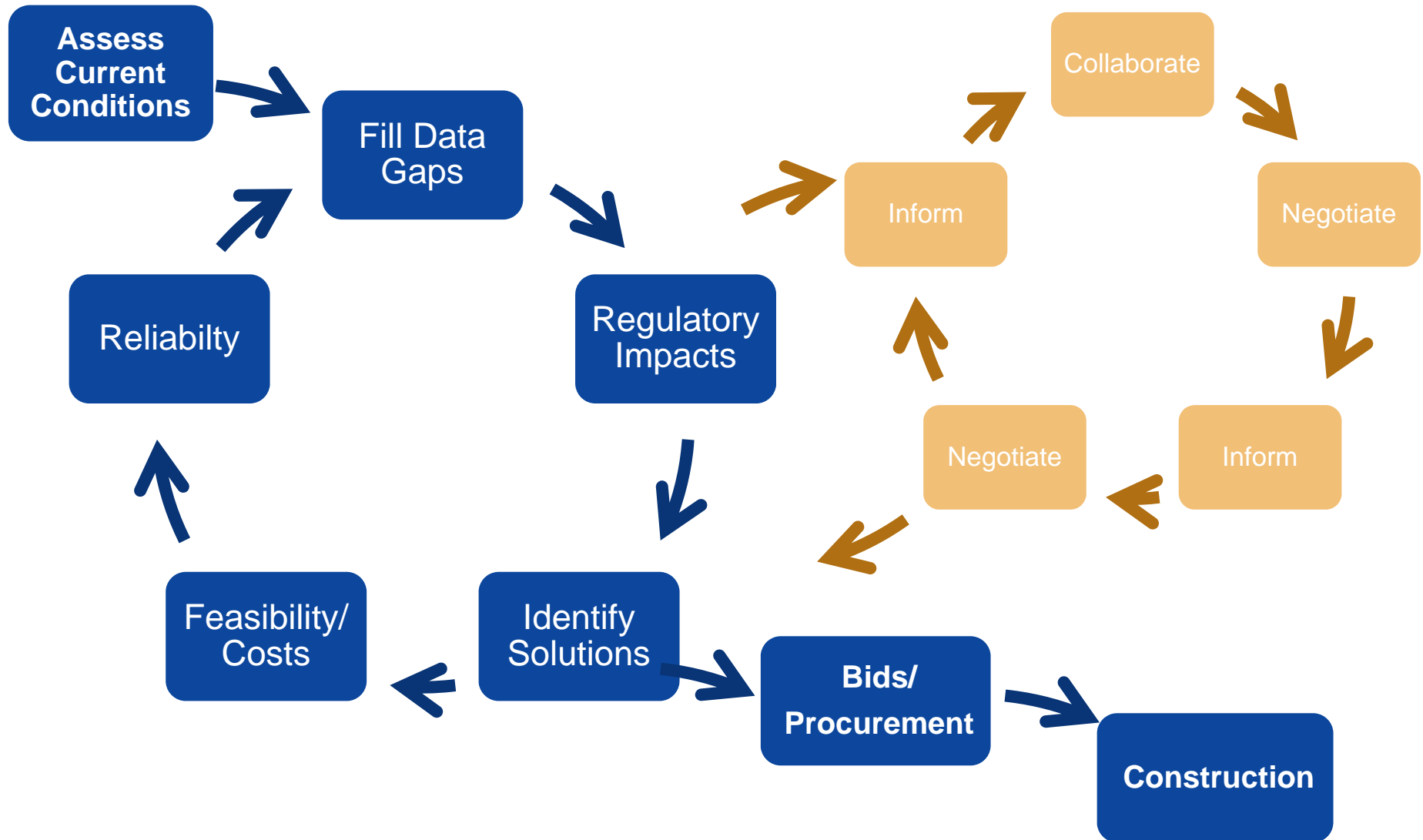
Type of Wastestream	Number of Plants <sup>a</sup>	Minimum Flow <sup>b</sup> (GPY)	Maximum Flow <sup>b</sup> (GPY)
Ion Exchange Wastewater	134	2,590	60,400,0000
Boiler Blowdown	164	3,790	616,000,000
Evaporator Blowdown	1	1,830,000	1,830,000
Floor Drains	220	12,000	10,500,000,000



**What Can We Be Doing Now?**

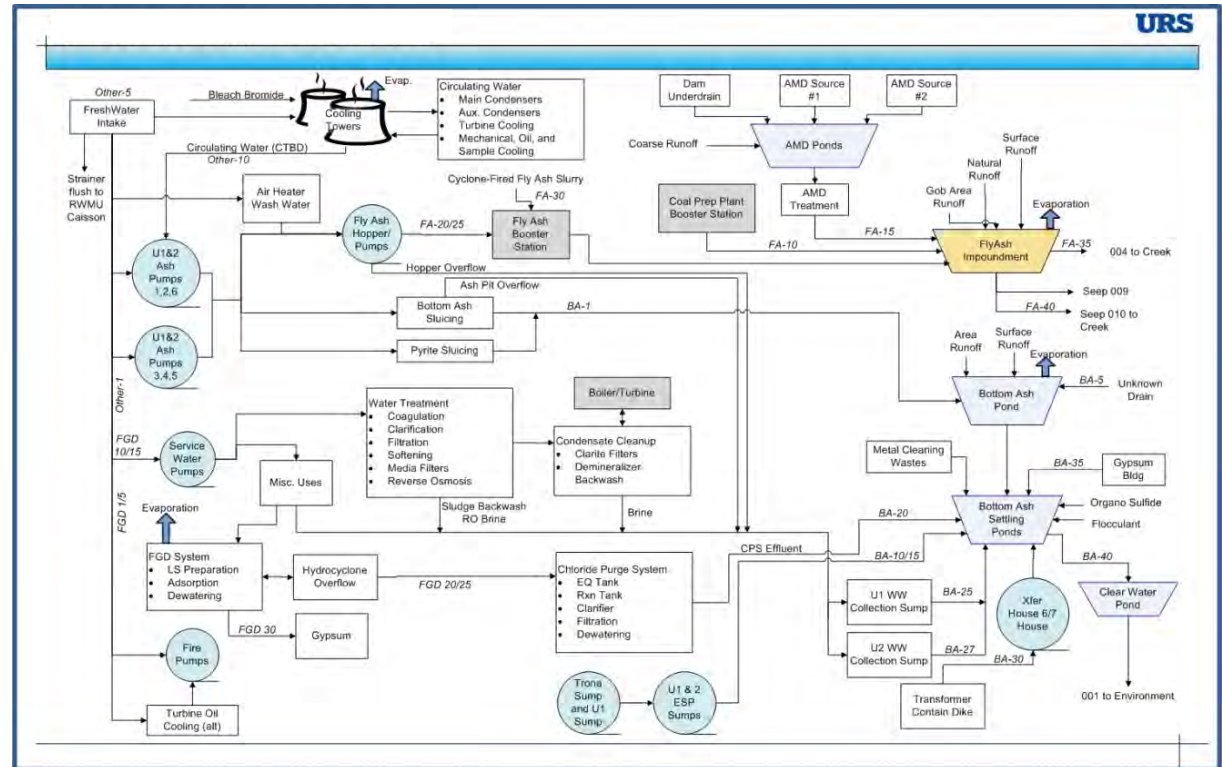


# Make a Plan



# Assess Current Conditions

- Compliance Review
  - Impaired streams?
- Water balance updates
  - Input from Operators to review and clarify existing water balances
  - Field verification
  - Drainage design?



## Regulatory Impacts: FGD Wastewater

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- EPA's BAT technology assumes
  - flow minimization of FGD wastewater?
  - equipment capable of handling operations with high chlorides operation (to facilitate reduced blowdown)
- Internal outfalls (FGD, maybe leachate)
- Flow segregation (legacy vs. newly generated)



When is Dry FGD not dry?

Since EPA did not evaluate ww discharged from Dry FGD systems or used to clean Dry FGD systems, these flows are not subject to the new FGD limits, per EPA's *Technical Development Document*.

## Regulatory Impacts: Other streams

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- Wet sluice back up to dry fly ash system? Evaluate implementing duplicity to eliminate all wet sluicing.
- Low Volume Waste Sources
  - Segregate flows from leachate, FGMC, FGD?
  - Reuse?
  - Separate treatment?
- Nonchemical Metal Cleaning Wastes
  - Segregate from Low Volume Wastes?
  - New limits and treatment?

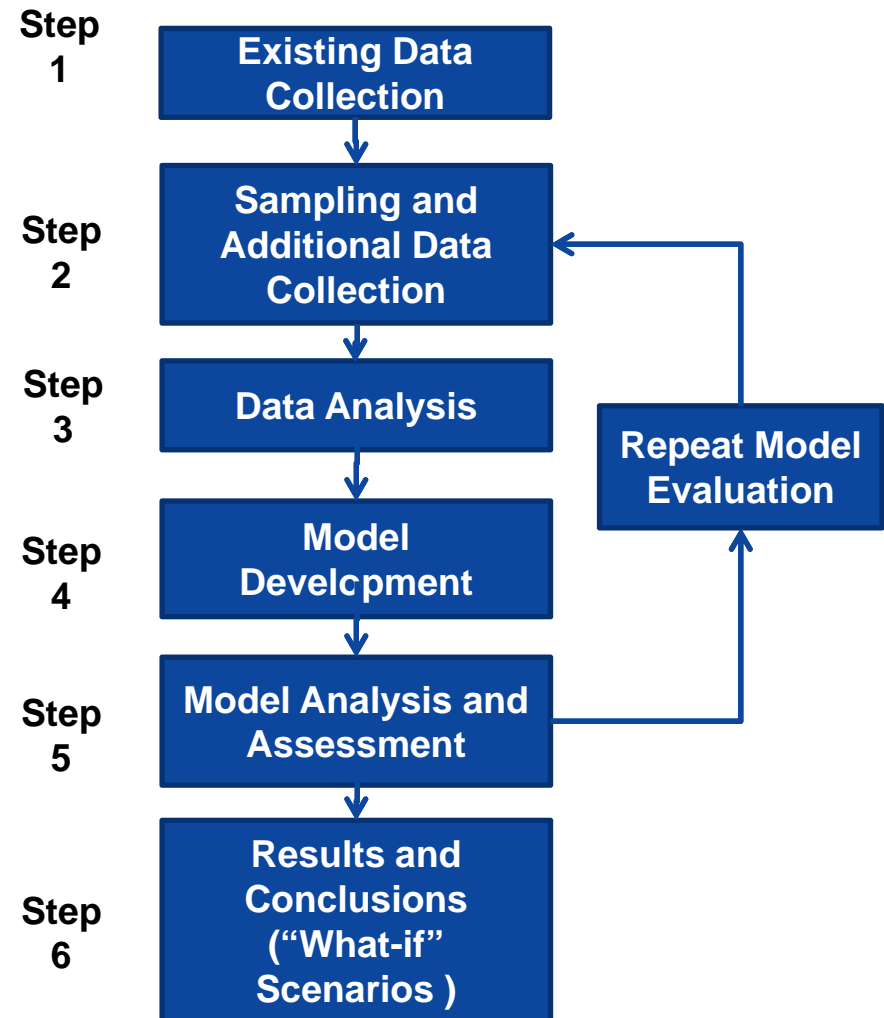
## Fill Data Gaps

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- Update water balance diagrams
  - Quantify flows – average daily usage, peak and minimums
- Wastewater characterization
  - Seasonal sampling may be needed
  - Sample points of source, concentration or changes within the system, and treatment influent
  - Analyze coal, source water and limestone
- Source water needs and characterization

# Identify Solutions

- Optimize water balance
- Predict future discharges under varying scenarios
  - Changing operating environments
  - Concentration fluctuations
  - Stringent regulation implementation
  - Potential system modifications
  - Evaluate “What if” scenarios



## Identifying Solutions: FGD Wastewater Treatment

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- Improve FGD water balance
- Physical/Chemical Treatment to precipitate heavy metals as solids
- Biological Treatment to convert metals from soluble to insoluble species using bacterial reactions (convert selenate and selenite to elemental forms and entrain in biological material)
- Non-Thermal Zero Discharge
  - Deep Well Injection
  - Blending System
- Thermal Zero Discharge
  - Brine Concentrator/ Crystallizer
  - Wastewater Evaporation System
  - Wastewater Spray Dryer
  - Evaporation ponds

# Identifying Solutions: Dry Fly Ash Handling

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- Wet Vacuum Pneumatic Systems
  - Vacuum water is not transport water and can be discharged or reused
- Dry Vacuum Systems
- Pressure Systems
- Combined Vacuum/Pressure Systems
- Mechanical Systems



# Identifying Solutions: the New Operator

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- Biological Systems

- Sensitive to variation of influent conditions due to unit outages and start ups, chemical cleaning wastewater, ambient temperature swings, or 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 communications

## Identifying Solutions: Improved Controls Upstream

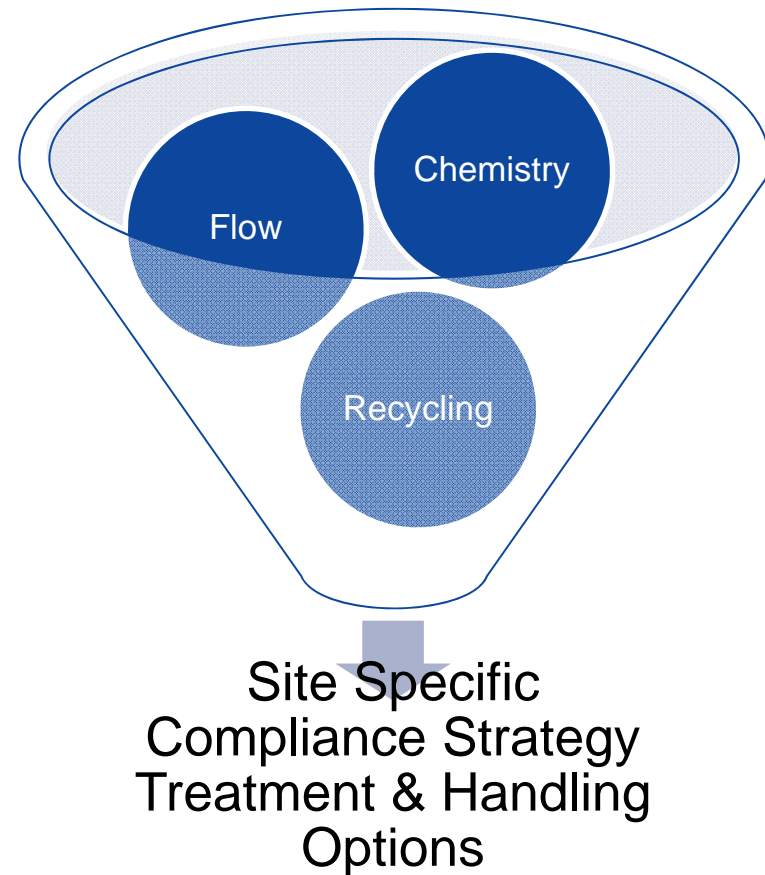
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- FGD System may need to be better controlled
  - WW typically contains mercury, boron, selenite/selenate, high in TDS and halogens
  - ORP: LSFO FGD systems with fixed oxidation air rates may over oxidize at low load or low demand
  - Results in high 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 or use reducing agents
- SCR oxidizes mercury to improve FGD capture (catalyst regeneration)
- Filter Fabric AQC may reduce solids and thus pollutants (part of MATS compliance?)
- ESP residence time drives Hg capture

# Identify Solutions

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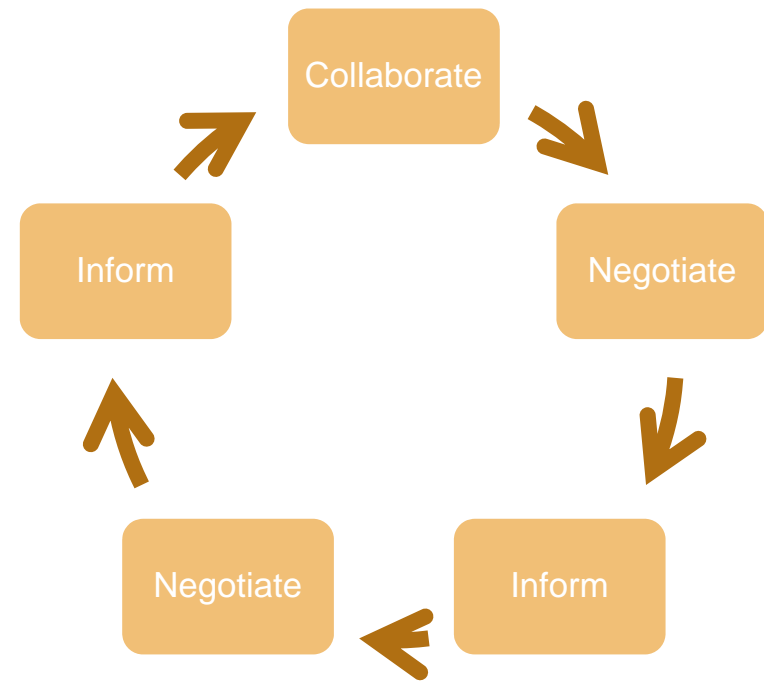
- Wastewater treatment systems
  - Decentralized?
  - FGD/leachate treatment systems
  - Pilot testing
- Dry ash handling
  - New landfills
  - Pond closures
- Screening Level Costs
- Reliability



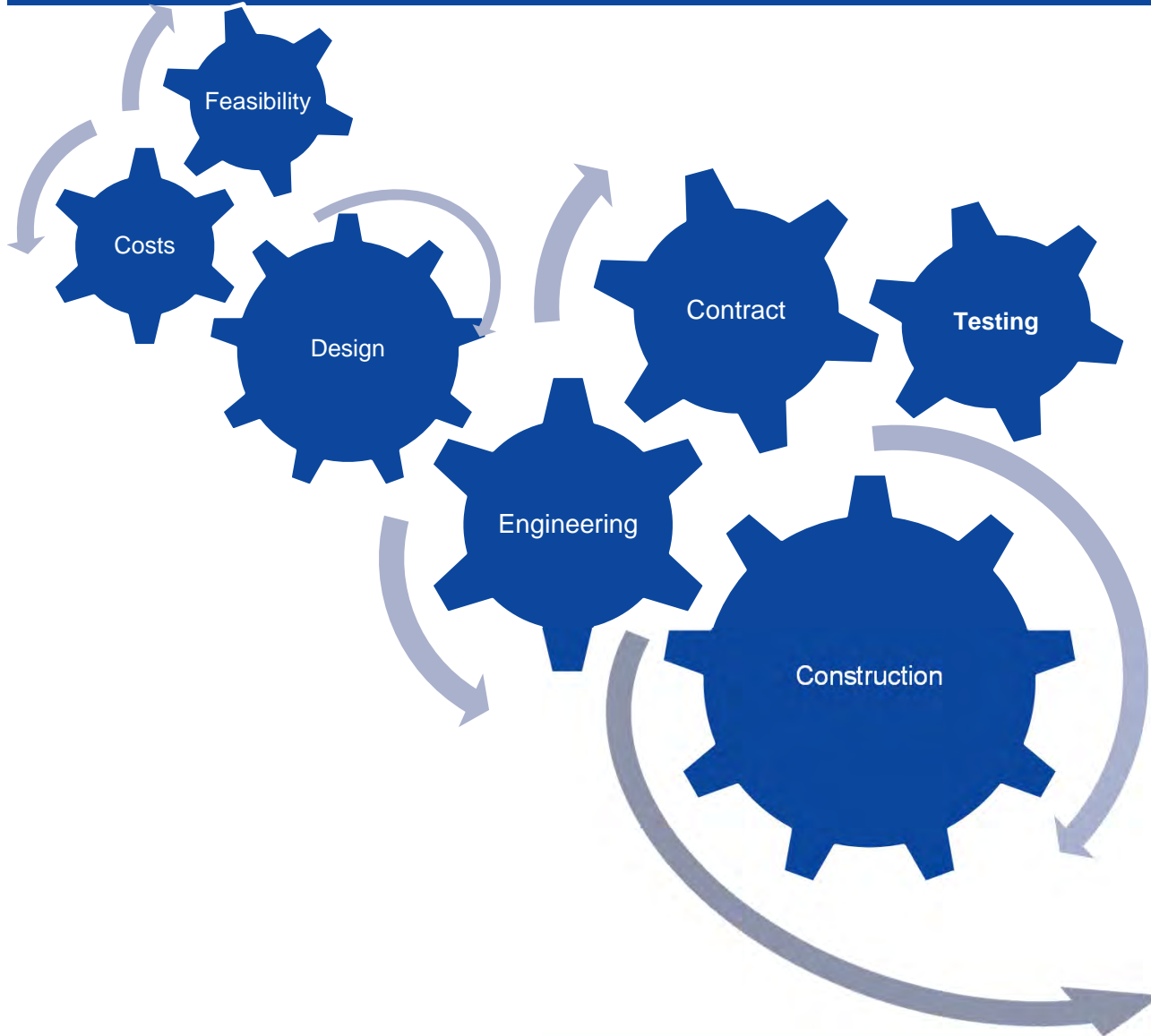
# Resource Agencies

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- Communication
- Understanding
- Partnership
- New/temporary discharges
- Scheduling implementation



# And Then...



**Compliance!**

# Summary

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- 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?)
  - Allow time for testing before making technology selection
  - Allow time for testing before the compliance date
- Rule Finalization
  - Final rule action by May 2014 (per the consent order) – looking for an extension
  - Determine participation in voluntary program by July 1, 2017 (??)
- CCR – December 19, 2014
- 316(b) – unknown



**Point of Contact**



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