

REINHOLD ENVIRONMENTAL Ltd.



**2014 Wastewater-Ash Round Table
& Expo Presentation**

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The CCR Rule: A Focus on Groundwater Monitoring & Remediation

Katie A. Bland, PE
Environmental Engineering Section Manager,
Burns & McDonnell Engineering Co., Inc.

Introduction

- Coal Ash Regulations – Groundwater
- How to Develop a Compliance Plan
- Before Monitoring – The Importance of Investigation
- Groundwater Statistics for Managers
- Cost Considerations
- Potential for Remediation
- Types of Remediation
- Summary

Introduction

- According to the EPA, more than **136 million tons** of coal combustion residuals (CCRs) are produced each year
 - ✓ 34% landfilled
 - ✓ 22% disposed of in surface impoundments

Introduction

- Both approaches are likely to require the following:
 - ✓ Groundwater monitoring for landfills built *before* the rule
 - ✓ Groundwater monitoring for landfills built *after* the rule



COAL ASH REGULATIONS – GROUNDWATER MONITORING

CCR Rule

- Consent Decree - Final Rule by December 19, 2014
- Proposed rule (2010) described two approaches
 - ✓ Regulation under Subtitle C of RCRA
 - ✓ Regulation under Subtitle D of RCRA



CCR Rule

- Subtitle D
 - Location standards
 - Composite Liners (required for new landfills and surface impoundments; retrofit of existing impoundments within 5 years)
 - Groundwater monitoring
 - Corrective action standards for releases from units
 - Closure/post closure care requirements
 - Requirements to address stability of units
- “D Prime” would allow existing impoundments to remain open for their useful life without retrofit of a composite liner

CCR Rule

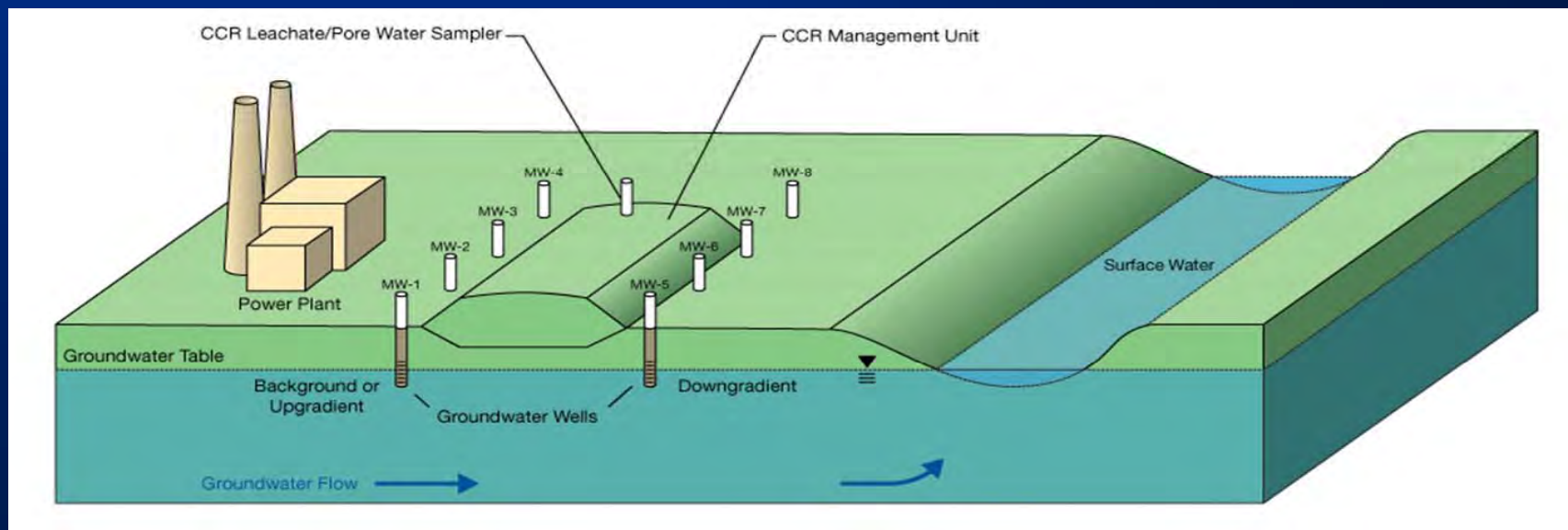
- Groundwater Monitoring Requirements
 - Will require monitoring at new and existing units
 - Many instances of groundwater impacts in technical background document
 - Detection and assessment monitoring
 - Proposed minimum requirements (Subtitle D)
 - ✓ 1 up gradient well
 - ✓ 3 down gradient wells

CCR Rule

- Examples of groundwater impairment in EPA text of the proposed rule
- Constituents of concern included (but not limited to) boron, selenium, arsenic, sulfate, iron, and zinc
- Courses of Action included:
 - ✓ Fines
 - ✓ Closure of facility
 - ✓ Remediation of groundwater

CCR Rule

- Significance....
 - ✓ Many facilities do not have any historical monitoring
 - ✓ Regulatory interest - especially at unlined sites
 - ✓ Many facilities are located in 'sensitive' environments





HOW TO DEVELOP A COMPLIANCE PLAN

Compliance Plan

- Basic Steps....
 - ✓ Conduct Desk Study
 - ✓ Develop “Conceptual Model”
 - ✓ Develop Cost Estimate for capital planning
 - ✓ Do not just “install wells and start sampling”



Compliance Plan

- What is a Desk Study?
 - ✓ Evaluate local geology and hydrogeology
 - ✓ Develop likely groundwater flow directions
 - ✓ Develop conceptual understand of likely hydrogeologic conditions
 - ✓ Document known and unknown design conditions
 - ✓ Pay special attention to potential direct contact with groundwater

Compliance Plan

- Capital opinion for budget planning (1-2 year horizon)
 - ✓ Work Plans
 - ✓ Drilling
 - ✓ Monitoring Well Installation
 - ✓ Permeability Testing
 - ✓ Reporting

All with contingency....

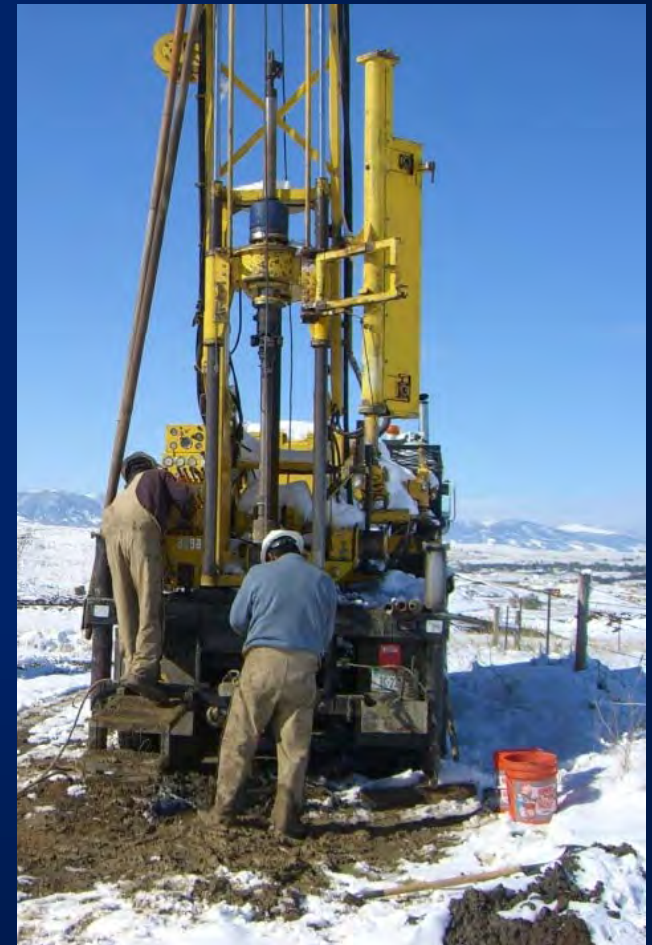




THE IMPORTANCE OF INVESTIGATION

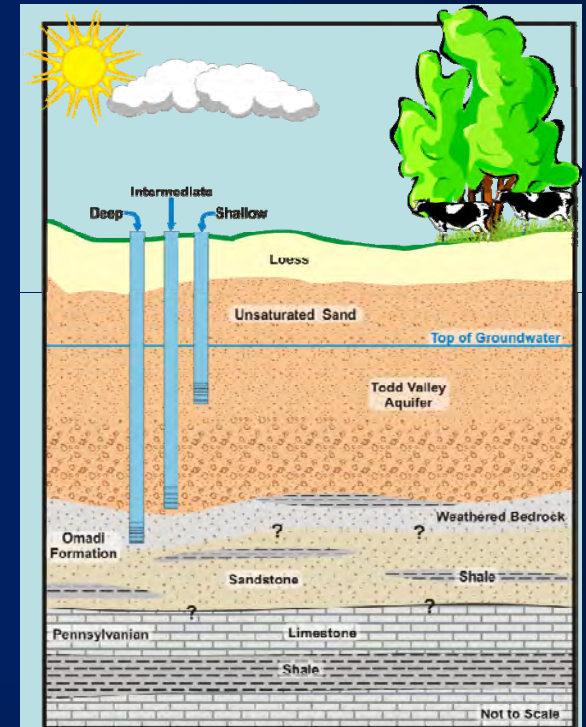
Importance of Investigation

- The Plans....
 - ✓ Site investigation work plan
 - ✓ Field sampling and analysis plan
 - ✓ Statistical analysis plan
- The Reports....
 - ✓ Geologic and hydrogeologic investigation report
 - ✓ Semi-annual Sampling report
 - Includes statistical analysis after about 2 years of data



Importance of Investigation

- Detailed site understanding is key...
- Conduct detailed geologic and hydrogeologic investigation
- Upgradient water quality!
- Monitored constituents are naturally occurring
- May occur naturally above compliance limits
- Regulators may rigorously scrutinize down gradient water quality



Importance of Investigation

- Investigate the Landfills and Ponds.....
 - ✓ Collect samples of Bottom Ash, Fly Ash, Scrubber slurry, etc.
 - ✓ Collect leachate samples
 - ✓ Measure leachate pH
 - ✓ Characterize the geometry of each site
 - ✓ Incorporate CCR management units into conceptual model

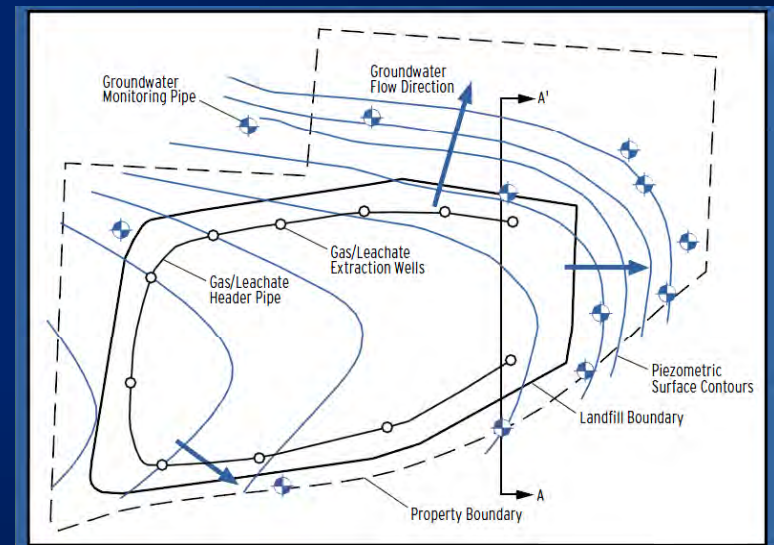




GROUNDWATER STATISTICS FOR MANAGERS

Groundwater Statistics

- Leachate water quality matters....
 - ✓ Leachate must be sampled for each unit if possible
 - ✓ Results must be compared to groundwater
 - ✓ Use Leachate data to avoid getting lost in the statistical weeds....
 - ✓ 2 years of quarterly data are needed BEFORE statistics

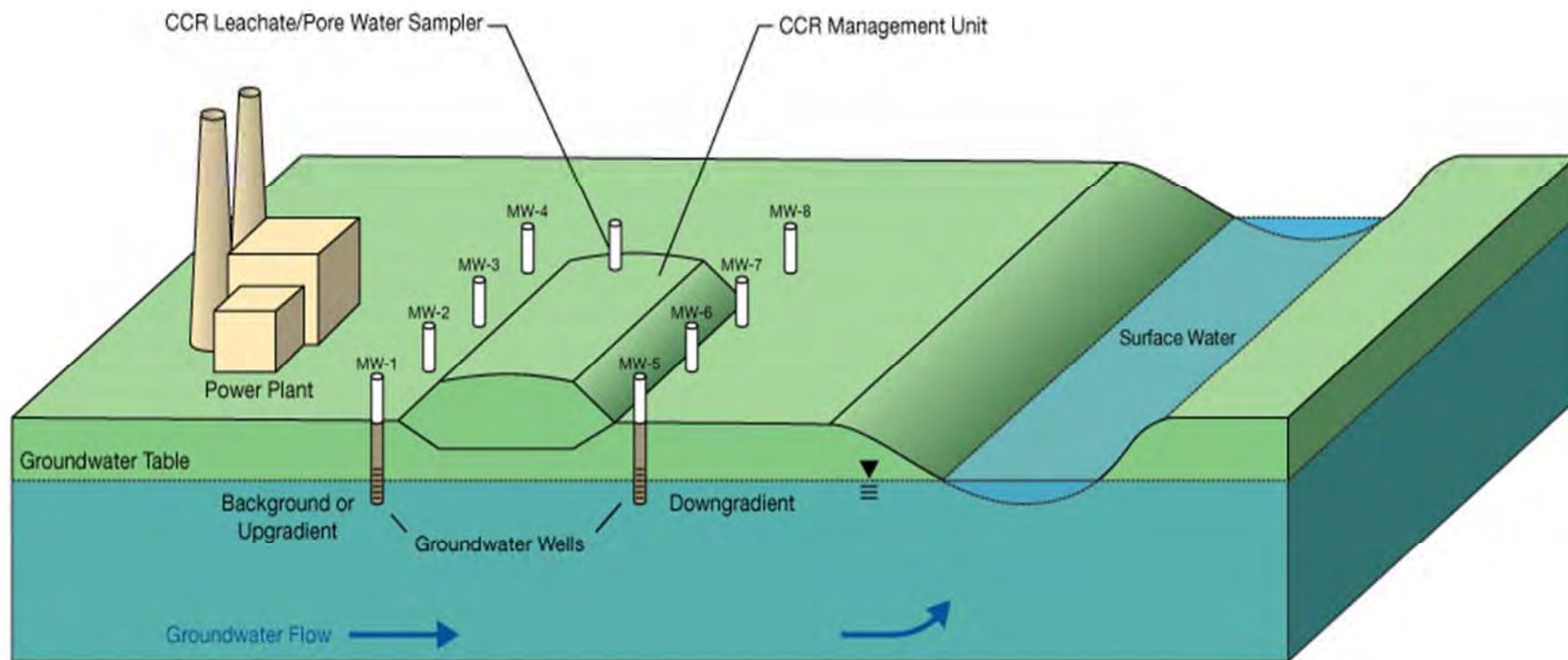


Groundwater Statistics

- So you are ramping up....think about ramping down now...
 - ✓ Consider customized monitoring program
 - ✓ Consider limiting statistics



Groundwater Statistics



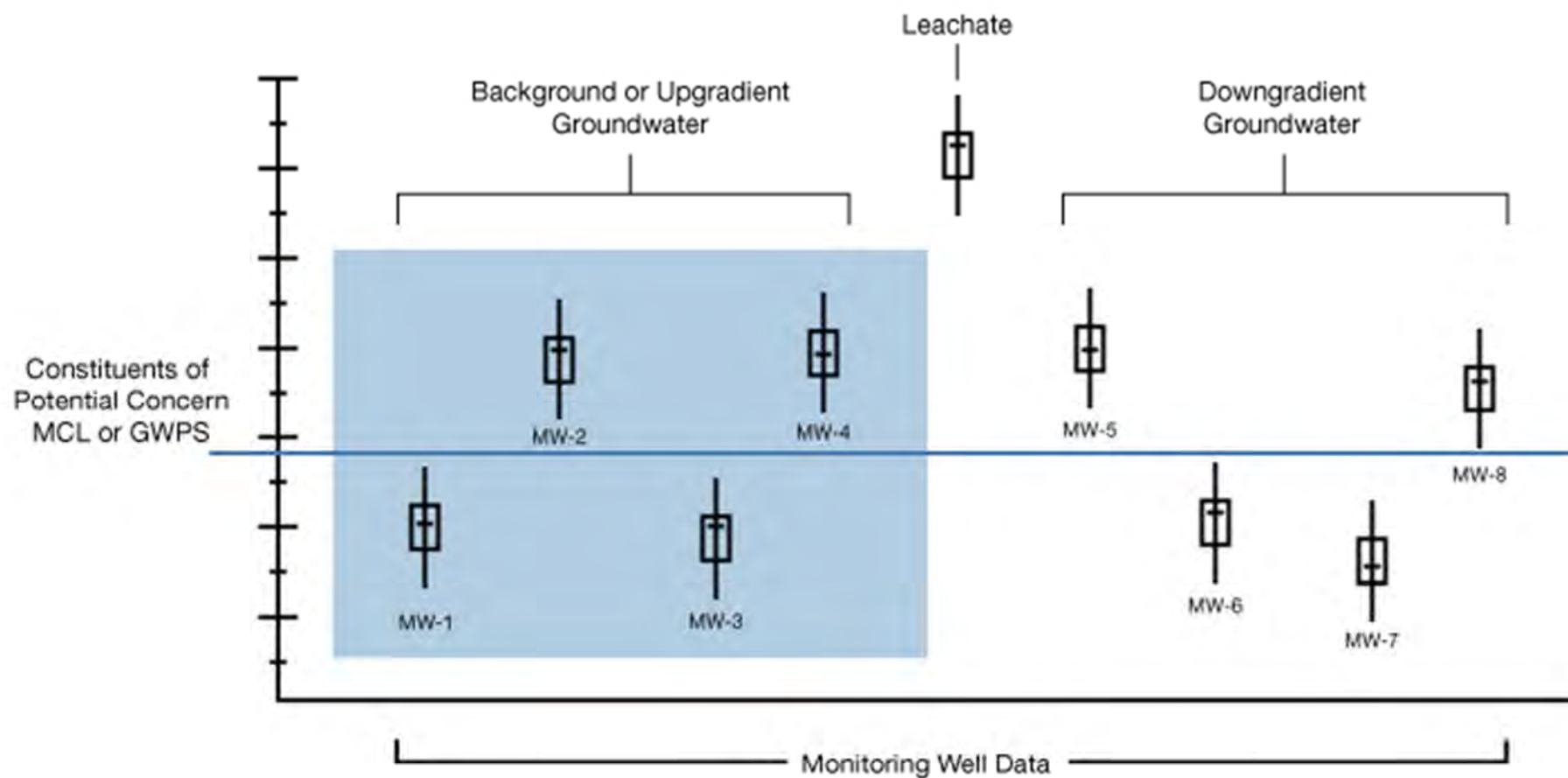


Figure 2: Theoretical Relationship Among Upgradient, Downgradient and CCR Leachate Water Qualities



COST CONSIDERATIONS

Cost Considerations

- Regulatory Impact Analysis (RIA) for overall rule reviewed costs of compliance with benefits

TABLE 1—SUMMARY TABLE COMPARISON OF REGULATORY BENEFITS TO COSTS—RANGING OVER ALL THREE BENEFICIAL USE SCENARIOS

[\$Millions @ 2009\$ prices and @ 7% discount rate over 50-year future period-of-analysis 2012 to 2061]

| | Subtitle C "Special waste" | Subtitle D | Subtitle "D prime" |
|--|-------------------------------|-----------------------------|------------------------|
| A. Present Values: | | | |
| 1. Regulatory Costs: | \$20,349 | \$8,095 | \$3,259. |
| 2. Regulatory Benefits: | \$87,221 to \$102,191 | \$34,964 to \$41,761 | \$14,111 to \$17,501. |
| 3. Net Benefits (2-1) | (\$251,166) to \$81,842 | (\$6,927) to \$33,666 | (\$2,666) to \$14,242. |
| 4. Benefit/Cost Ratio (2/1) | (11.343) to 5.022 | 0.144 to 5.159 | 0.182 to 5.370. |
| B. Average Annualized Equivalent Values:* | | | |
| 1. Regulatory Costs | \$1,474 | \$587 | \$236. |
| 2. Regulatory Benefits: | \$6,320 to \$7,405 | \$2,533 to \$3,026 | \$1,023 to \$1,268. |
| 3. Net Benefits (2-1) | (\$18,199) to \$5,930 | (\$502) to \$2,439 | (\$193) to \$1,032. |
| 4. Benefit/Cost Ratio (2/1) | (11.347) to 5.022 | 0.145 to 5.159 | 0.182 to 5.370. |

* **Note:** Average annualized equivalent values calculated by multiplying 50-year present values by a 50-year 7% discount rate "capital recovery factor" of 0.07246.

Cost Considerations

- Use front end planning and desk study to develop capital budget and schedule
- Schedules will be driven by locations / States
- Manage risk through contracting
- Invest initially – optimize long-term





REMEDIATION

Remediation

TABLE 6—TOTAL METALS CONCENTRATIONS FOUND IN CGRS
[ppm]

| Constituent | Mean | Minimum | Maximum |
|-----------------|--------|----------|---------|
| Antimony | 6.32 | 0.00125 | 3100 |
| Arsenic | 24.7 | 0.00394 | 773 |
| Barium | 246.75 | 0.002 | 7230 |
| Beryllium | 2.8 | 0.025 | 31 |
| Cadmium | 1.05 | 0.000115 | 760.25 |
| Chromium | 27.8 | 0.005 | 5970 |
| Lead | 25 | 0.0074 | 1453 |
| Mercury | 0.18 | 0.000035 | 384.2 |
| Nickel | 32 | 0.0025 | 54055 |
| Selenium | 2.4075 | 0.0002 | 673 |
| Silver | 0.6965 | 0 | 3800 |
| Thallium | 1.75 | 0.09 | 100 |

Remediation

- Parameters that will be monitored and used as indicators of groundwater contamination include:
 - Boron
 - Chloride
 - Conductivity
 - Fluoride
 - pH
 - Sulfate
 - Sulfide
 - Total Dissolved Solids (TDS)
- EPA selected constituents present in CCRs, which move quickly through subsurface media, to provide early detection of migrating contaminants.

Remediation

- A statistically significant increase in any of the monitoring parameters would require the facility to begin an assessment monitoring program, including monitoring of the following constituents:

- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Boron
- Cadmium
- Chloride
- Chromium
- Copper
- Fluoride
- Iron
- Lead
- Manganese
- Mercury
- Molybdenum
- Nickel
- pH
- Selenium
- Sulfate
- Sulfide
- Thallium
- TDS

Remediation

- Assessment following a statistically significant release should be completed within 90 days
- Considerations to include:
 - Effectiveness of potential corrective measures
 - Performance, reliability, and potential impacts of remedies, including safety impacts
 - Time required to complete remediation
 - Cost of remediation
 - Institutional requirements, such as state/local permits
 - Owner/operator must notify state & the public

Remediation

- Groundwater Protection Standard
 - For constituents with a Maximum Contaminant Level (MCL), the MCL shall be used
 - For constituents with no established MCL, the background concentration for the constituent established from wells shall be used, or
 - If background is higher than the MCL, the background concentration shall be used



Remediation

- Path Forward
 - Aquifer pump testing
 - Used to design proper remedial wells
 - Used to determine hydraulic conductivity, transmissivity, and storativity
 - Results used in groundwater modeling software to simulate groundwater behavior

Remediation

- Path Forward
 - Groundwater modeling
 - Cleanup alternative evaluation
 - Develop a corrective action plan
 - Develop design specifications & procurement documents
 - Installation of remedial system
 - Operation & maintenance of remedial system
- Engage regulators in decision-making
 - Open communication through entire process



TYPES OF REMEDIATION

Types of Remediation

- Natural Attenuation
 - Conduct groundwater modeling to predict fate/transport over time
 - Degradation modeling may indicate resolution of the problem over time
 - Can reduce overall closure costs by eliminating the need for active remediation

Types of Remediation

- Mobile Remediation
 - Constructed on trailers or skids
 - Cost effective
 - Can be controlled remotely
 - Ideal for remediation that's required at multiple facilities



Types of Remediation

- Bioremediation
 - Enhance/accelerate natural processes that may already be degrading contaminants within an aquifer
 - May warrant lab or field pilot testing

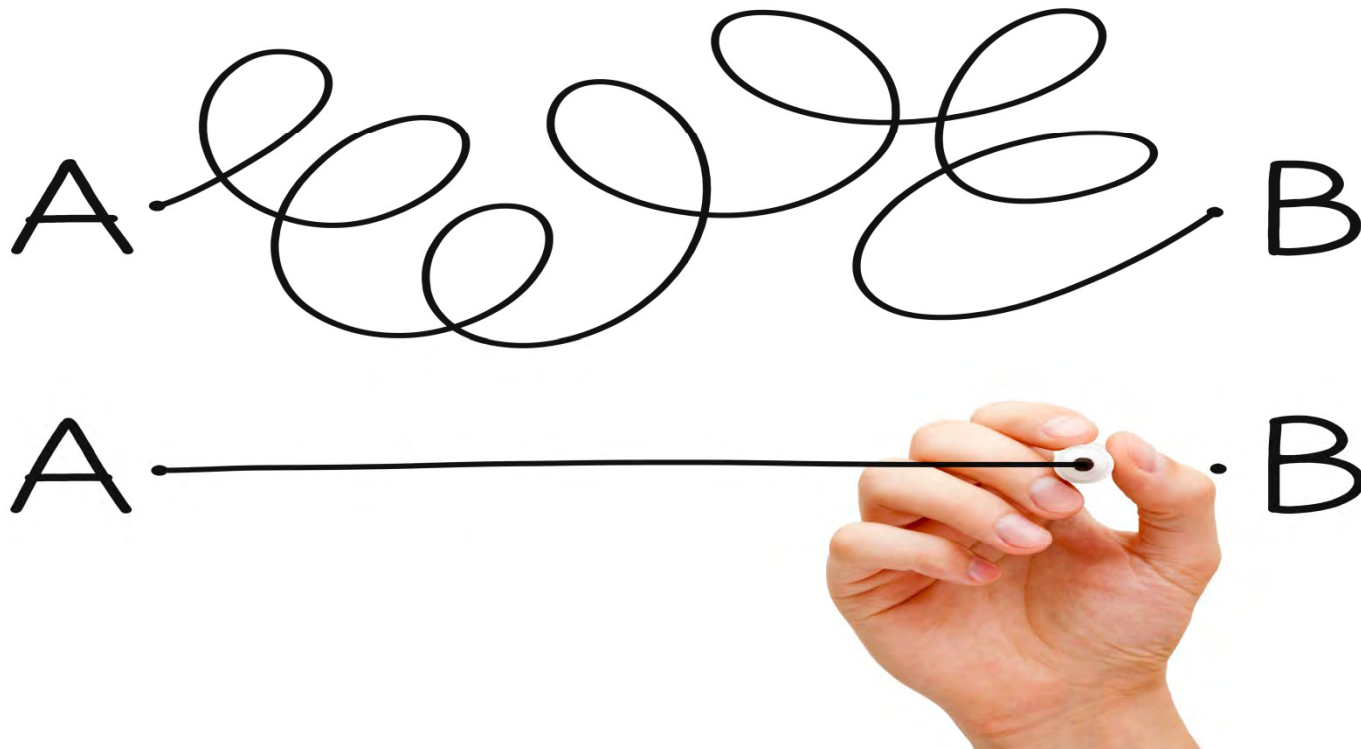


Summary

- Be prepared for the final CCR rule!
- Conduct a desk study for all sites / CCR management units
- Develop a compliance plan
- Develop a capital and long term O&M budget

Summary

- Conduct an investigation – avoid reacting to ‘bad data’
- Develop technically sound statistical analysis plan





Katie A. Bland, PE
Environmental Engineering
Section Manager

Burns & McDonnell Engineering Co., Inc.
9400 Ward Parkway
Kansas City, MO 64114
816.823.7042 – Direct
816.651.8842 – Cell
kbland@burnsmcd.com