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FirmoGraphs

Benchmarking the CCR Industry – What does it mean for tomorrow?

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Ash Mart Project

- Started with AECOM initiative, document evolution of CCR regulations and impacts
- Continued with 2018 AECOM and FirmoGraphs teaming
- Status today:
 - Curated and reviewed 1000s of documents
 - Extracted high-value information
 - Mashed-up with EIA data
 - Improved monthly



CCR Market Overview

SITES

297

REGIONS

44

CCR Units

735

CCR Volume CY

2.05B

Water Volume CY

1.48B

Size Final Cover, Acres

37,841

Owner/Operators

111

- Operators: 100+
- Sites: ~300 locations, power plants and offsite landfills
- CCR Units: 735 with active compliance documentation
 - 30% Landfills (230)
 - 55% Surface Impoundments (406)
 - 15% Inactive Surface Impoundments (98)
- CCR Material:
 - Minimum 2B CY, bottom-up best estimate from inspections and closure plans
 - Landfills, 1B
 - Surface Impoundments, 900M
 - Maximum storage 3.5B CY, closure plans
- CCR Unit Area:
 - Landfills, 16k acres
 - Surface Impoundments, 21k acres
- Free Water within SI: ~1.5B CY (~300B gallons)



3 Stories

Location Restrictions

**Groundwater Protection
Standards (GWPS)**

**Bottom-Line Closure
Risk**



Story 1: Location Restrictions



Story 1: Location Restrictions

Under Part 257.61 - 64, operators were required to post Location Restrictions by Oct 17, 2018

Notifications ranged from 1-page, 2 paragraphs notice to more-detailed engineering studies

2 Compliance Date Impacts

- Apr 17, 2019 for 4 criteria
- Oct 31, 2020 for Upper Aquifer proximity



🔍 Closure by Apr 17, 2019 for LR

Yes ✓

No

🔍 Closure by Oct 31, 2020 for LR (Aq...

No

Yes

🔍 Type CCR Unit

ISI

SI

LF

Ash Mart KPIs

Organizations

10

Sites

26

CCR Units

32

CCR Vol Best Est, CY

109M

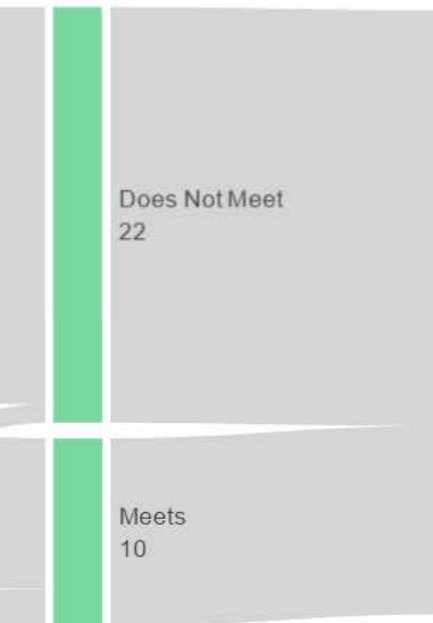
Size Final Cover, Acres

1,704

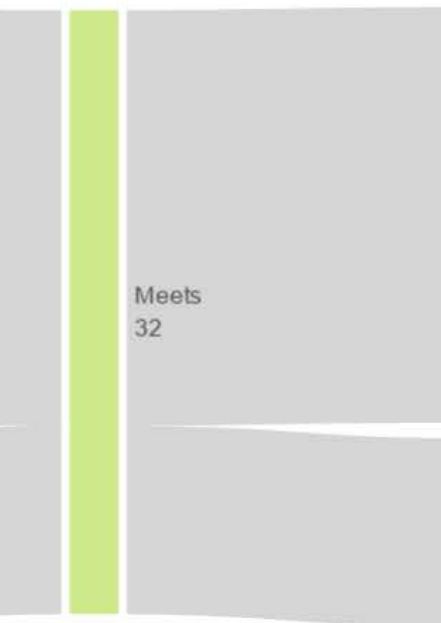
Aquifer



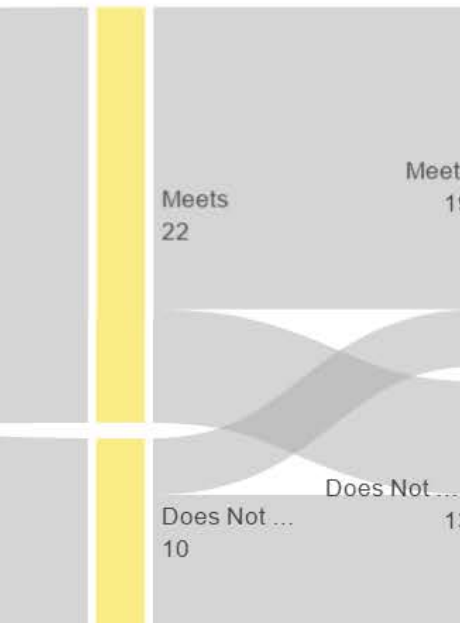
Wetlands



Fault Areas



Unstable Areas



Seismic Zones



AECOM

Q Closure by Apr 17, 2019 for LR

No

Yes

Q Closure by Oct 31, 2020 for LR (Aq...

Yes ✓

No

Q Type CCR Unit

ISI

SI

LF

Ash Mart KPIs

Organizations
34

Sites
89

CCR Units
146

CCR Vol Best Est, CY
559M

Size Final Cover, Acres
9,825



Q Closure by Apr 17, 2019 for LR

Yes ✓

No

Q Closure by Oct 31, 2020 for LR (Aquifer)

No

Yes

Q Type CCR Unit

ISI

SI

LF

Sites

26

CCR Units

32

CCR Volume, CY

108.3M

Size Final Cover, Acres

1.59k

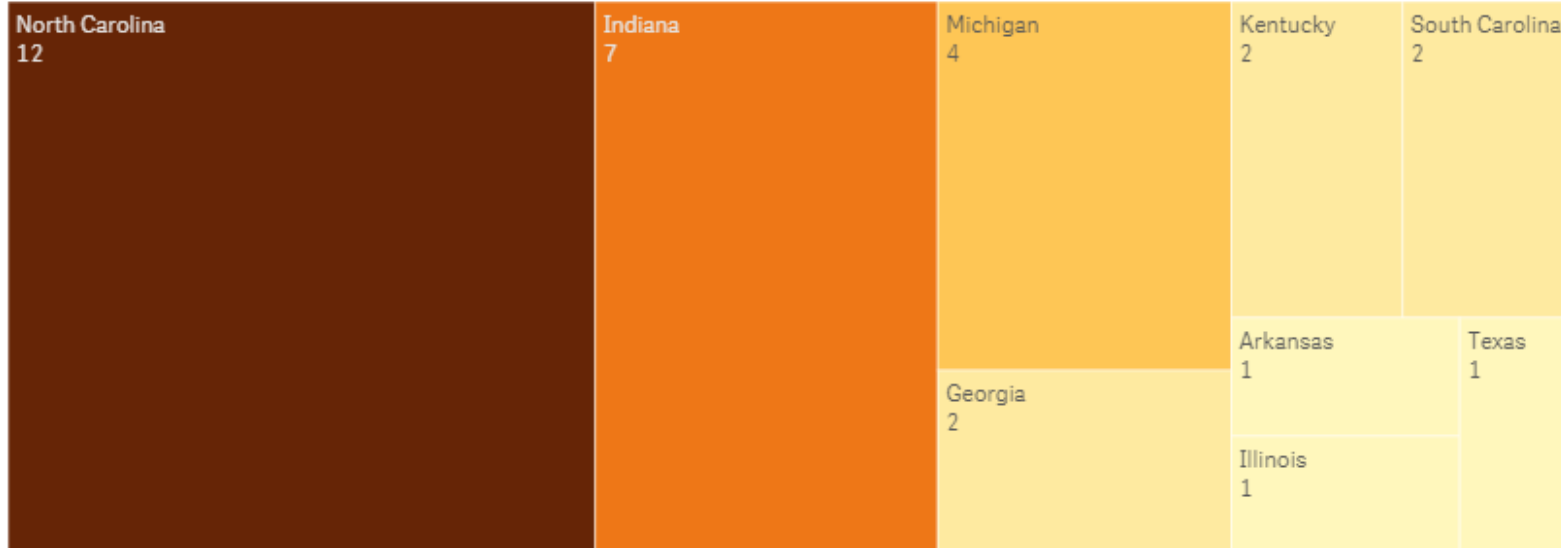
Water Volume, CY

991.6M

Regions

9

Location Restriction Pending Closures



🔍 Closure by Apr 17, 2019 for LR

No

Yes

🔍 Closure by Oct 31, 2020 for LR (Aquifer)

Yes ✓

No

🔍 Type CCR Unit

ISI

SI

LF

Sites

91

CCR Units

149

CCR Volume, CY

559.6M

Size Final Cover, Acres

9.84k

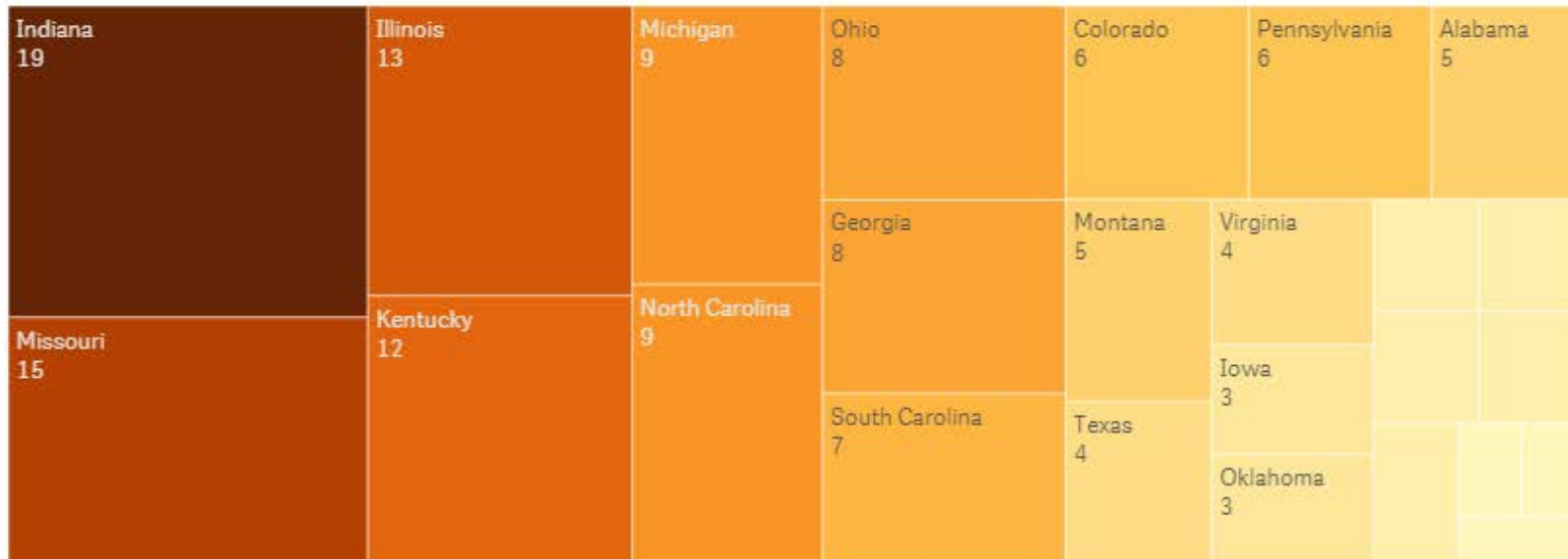
Water Volume, CY

268.1M

Regions

25

Location Restriction Pending Closures





Story 2:
Groundwater
Protect Standard
Exceedances



Story 2: GWPS Exceedances



These are situations where there was a SSL observed above the GWPS and ASD wasn't successfully determined



Notifications ranged from 1-page, 2 paragraphs notice to more-detailed engineering studies



GWPS, Sites and Organizations

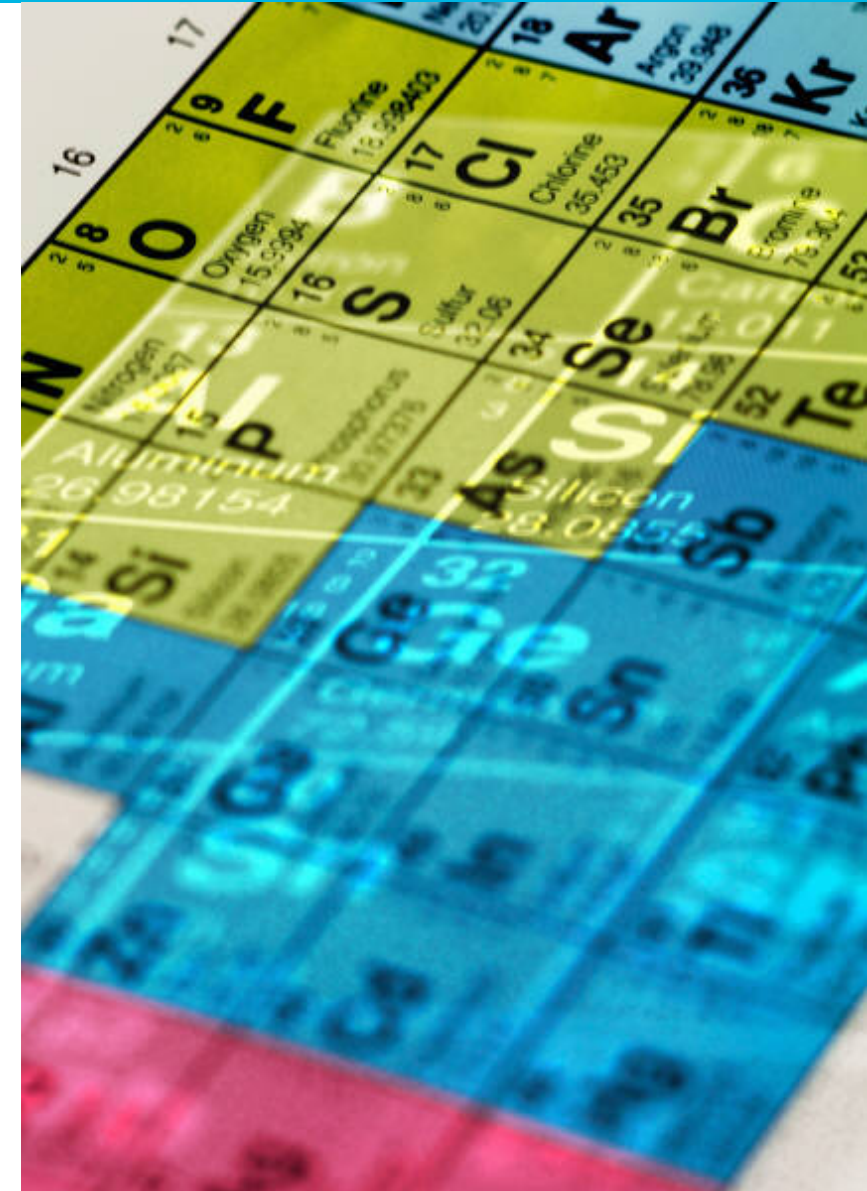
- About 41 owner-operators (of 111), 136 sites, 268 CCR units impacted by GWPS exceedances
 - 35 organizations, 112 sites with Surface Impoundments
 - 28 organizations, 50 sites with Landfills
- GWPS at larger sites, Total CCR volume nearly 1.1B CY (of 2B)

91 percent of coal plants have unsafe levels of one or more coal ash constituents in groundwater, even after we set aside contamination that may naturally occurring or coming from other sources.



GWPS, Analytes

- Lithium (Li), Cobalt (Co), and Arsenic (Ar) had the most-frequent GWPS exceedances, more than 100 CCR units
- Lead (Pb), Mercury (Hg), Chromium (Cr), Barium (Ba) were the least-exceeded, less than 20 CCR units
 - Ba – 7 sites
 - Cr – 4 sites
 - Hg – 3 sites
 - Pb – 4 sites



Q Flag SSL

No

Yes

Q Type CCR Unit

ISI

LF

SI

Sites
297

CCR Units
735

Owner/Operators
111

CCR Volume, CY
2.05B

Size Final Cover, Acres
37.84k

Water Volume, CY
1.48B

Sites Exceeding Action Levels, Count per Analyte

Region Site	Q	Sites	SSLs	Li	Co	Ar	Mo	Rad	Se	Be	Tl	F	Ba	Cr	Pb	Hg
Totals		297	632	158	117	112	105	32	20	19	13	10	7	4	4	3
North Carolina		14	93	17	25	17	7	7	1	7	6	0	0	1	0	0
Indiana		17	90	18	14	19	20	1	1	0	4	0	0	1	2	0
Montana		2	36	15	10	0	1	7	3	0	0	0	0	0	0	0
Kentucky		16	32	11	1	5	13	0	2	0	0	0	0	0	0	0
Alabama		8	31	8	7	7	5	1	0	3	0	0	0	0	0	0
Illinois		18	30	8	3	5	7	0	2	0	3	0	2	0	0	0
Wyoming		4	29	5	3	3	5	4	4	0	0	1	0	0	1	0
Texas		17	25	8	9	1	0	1	1	1	0	0	2	0	0	1
South Carolina		7	24	8	4	5	1	1	0	3	0	0	0	0	0	0
Tennessee		7	24	7	8	6	1	0	0	0	0	1	0	0	1	0
Missouri		16	24	5	0	7	10	0	0	0	0	0	0	0	0	0
Ohio		10	22	5	5	2	5	1	1	1	0	0	1	0	0	0
Alaska		1	20	4	0	4	4	0	0	0	0	4	0	0	0	0



Q Flag SSL

Yes ✓

No

Q Type CCR Unit

LF ✓

ISI

SI

~20% LF

Sites Exceeding Action Levels, Count per Analyte

Region Site	Q	Sites	SSLs	Li	Co	Ar	Mo	Rad	Se	Be	Tl	F	Ba	Cr	Pb	Hg
Totals		50	123	33	21	16	17	7	8	2	2	2	3	2	0	3
North Carolina		5	20	5	5	2	0	1	0	2	2	0	0	1	0	0
Texas		3	12	2	3	1	0	1	1	0	0	0	2	0	0	1
Florida		4	12	2	1	2	1	4	0	0	0	0	0	0	0	2
Utah		3	11	3	2	1	3	0	1	0	0	0	0	1	0	0
Indiana		3	8	2	2	1	2	0	0	0	0	0	0	0	0	0
West Virginia		2	7	1	0	2	1	1	0	0	0	1	1	0	0	0
Kentucky		5	6	3	1	0	2	0	0	0	0	0	0	0	0	0
Nebraska		2	6	1	1	2	1	0	1	0	0	0	0	0	0	0
Alaska		1	5	1	0	1	1	0	0	0	0	1	0	0	0	0
Tennessee		1	4	2	2	0	0	0	0	0	0	0	0	0	0	0
Mississippi		2	4	2	1	0	1	0	0	0	0	0	0	0	0	0
Ohio		2	4	2	0	0	1	0	1	0	0	0	0	0	0	0
Colorado		3	4	2	0	0	0	0	2	0	0	0	0	0	0	0

Sites
50

CCR Units
56

Owner/Operators
28

CCR Volume, CY
414M

Size Final Cover, Acres
4.82k

Water Volume, CY
0

Q Flag SSL

Yes ✓

No

Q Type CCR Unit

SI ✓

ISI

LF

~45% SI

Sites Exceeding Action Levels, Count per Analyte

Region Site	Q	Sites	SSLs	Li	Co	Ar	Mo	Rad	Se	Be	Tl	F	Ba	Cr	Pb	Hg
Totals		107	480	121	90	92	82	23	9	17	11	7	4	2	3	0
Indiana		11	80	16	12	17	17	1	1	0	4	0	0	1	2	0
North Carolina		11	73	12	20	15	7	6	1	5	4	0	0	0	0	0
Montana		2	34	14	10	0	1	7	2	0	0	0	0	0	0	0
Alabama		7	30	8	7	6	5	1	0	3	0	0	0	0	0	0
Illinois		7	30	8	3	5	7	0	2	0	3	0	2	0	0	0
Kentucky		8	26	8	0	5	11	0	2	0	0	0	0	0	0	0
South Carolina		5	23	8	3	5	1	1	0	3	0	0	0	0	0	0
Tennessee		4	20	5	6	6	1	0	0	0	0	1	0	0	1	0
Missouri		5	19	4	0	6	9	0	0	0	0	0	0	0	0	0
Ohio		5	17	3	5	2	4	1	0	1	0	0	1	0	0	0
Alaska		1	15	3	0	3	3	0	0	0	0	3	0	0	0	0
Wyoming		3	14	2	1	2	4	2	1	0	0	0	0	0	0	0
Texas		4	13	6	6	0	0	0	0	1	0	0	0	0	0	0

Sites

107

CCR Units

202

Owner/Operators

34

CCR Volume, CY

683.4M

Size Final Cover, Acres

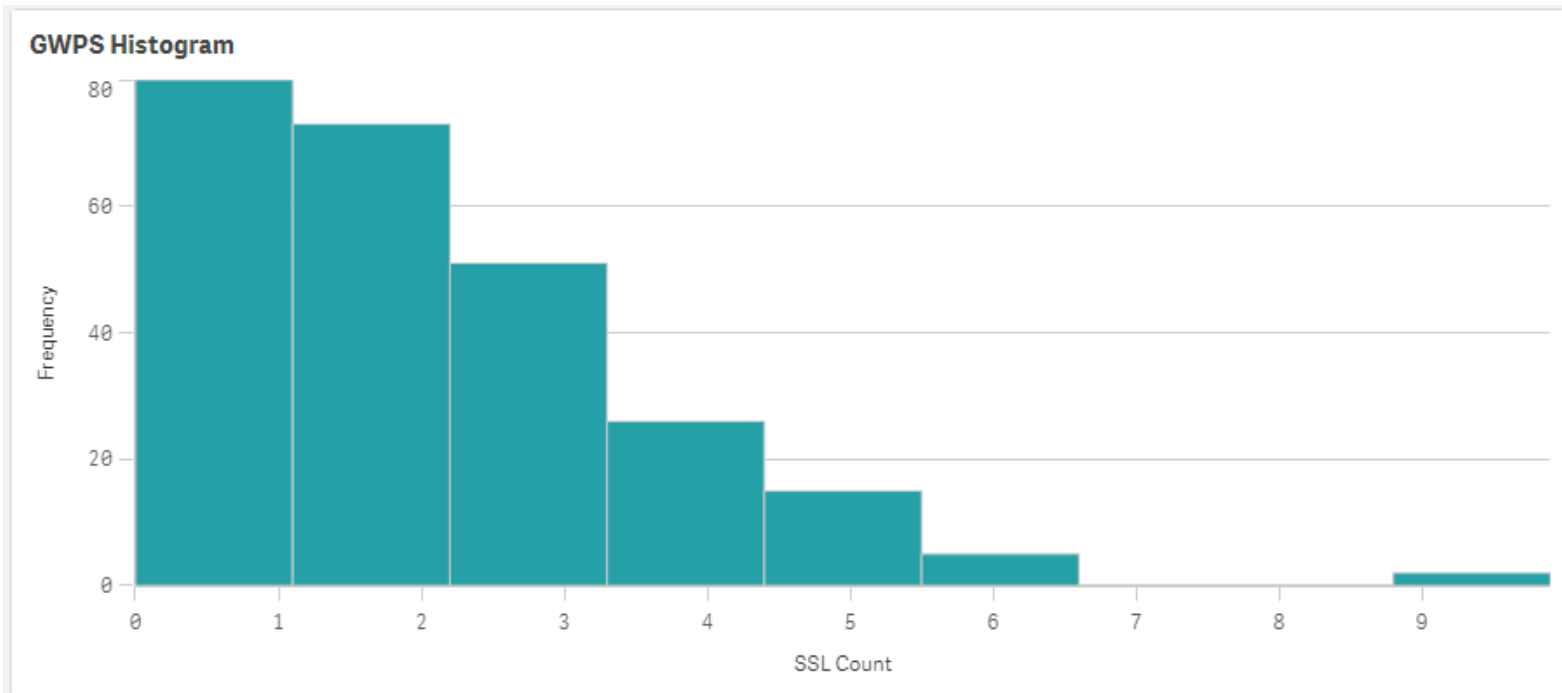
12.58k

Water Volume, CY

1.26B



Story 2: GWPS



For Appendix IV Constituents: Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Fluoride, Lead, Lithium, Mercury, Molybdenum, Radium, Selenium, Thallium

- Most of the Units with GWPS SSLs had only 1 or 2 analytes
- Implications
 - ACM notifications have started
 - If ACM is triggered, closure maybe required by October 31, 2020
- ~1B CY of impounded water





Story 3: Unit and Site Closure Risk

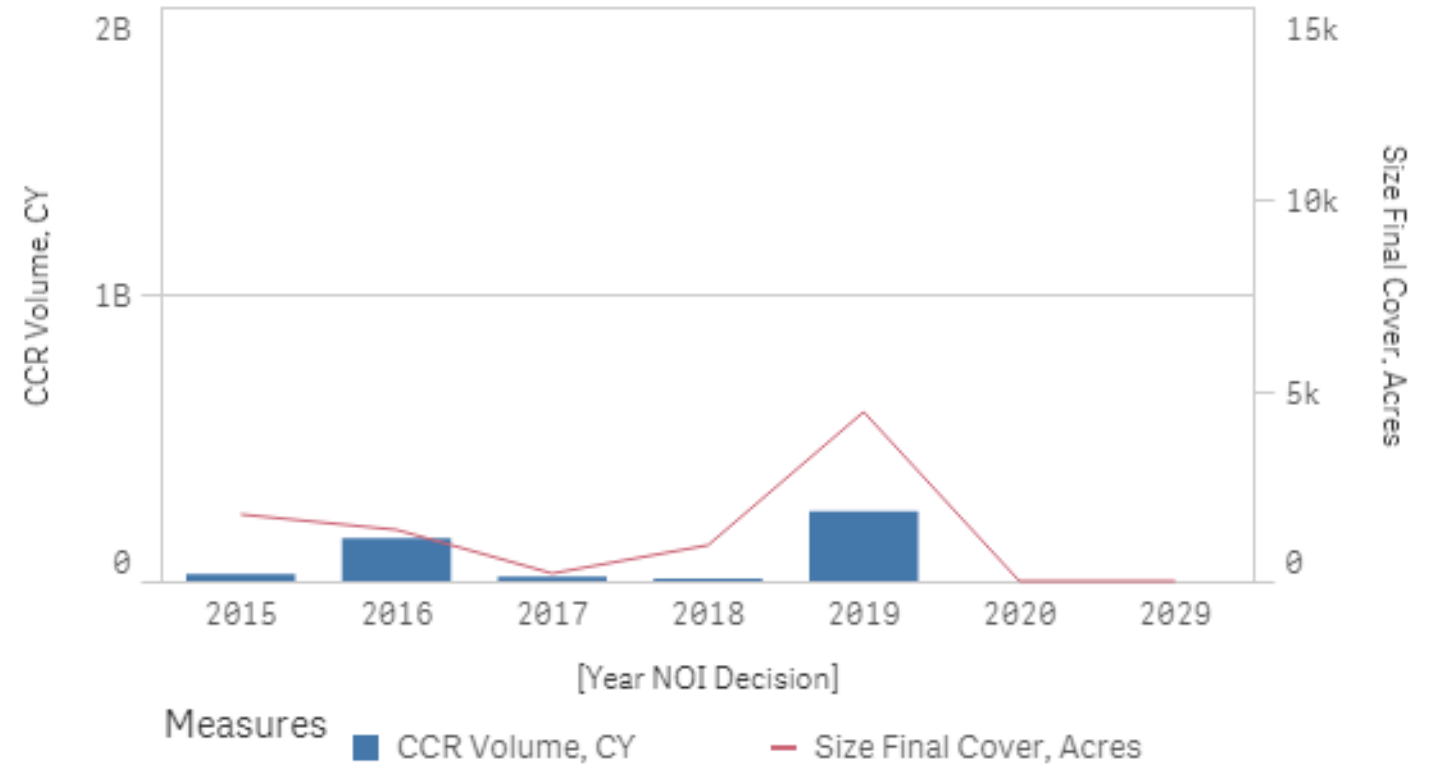


Notices of Intent

Surface impoundments with known ongoing closures, with Notices of Intent Submitted

	SI	ISI
Number of CCR Units	131	86
Acres of CCR Units (acres)	7k	2k
Volume of CCR Units (CY)	426M	15M

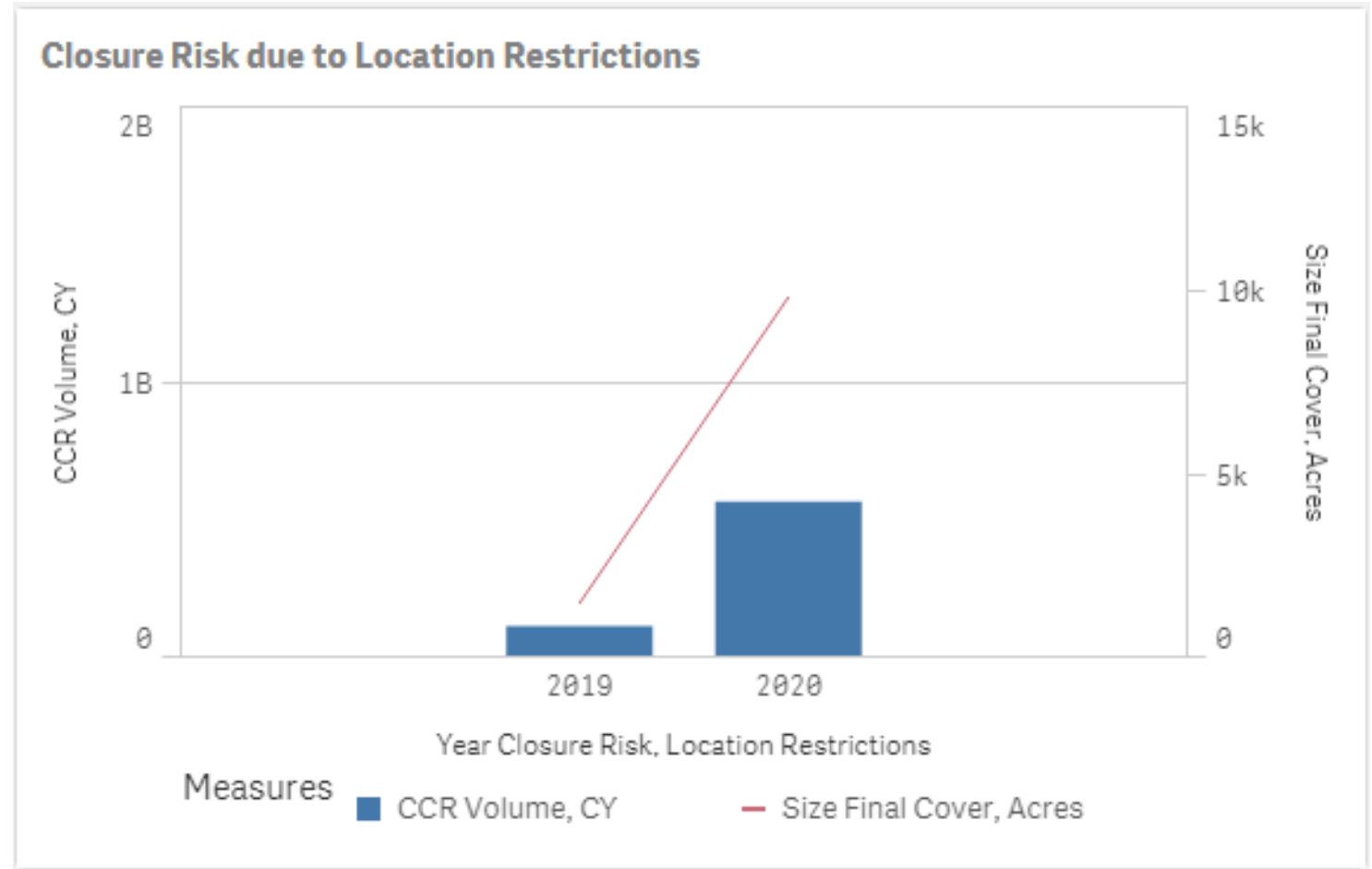
Closing with NOI



Location Restrictions

Surface impoundments at risk of closing, due to location restrictions (due to aquifer)

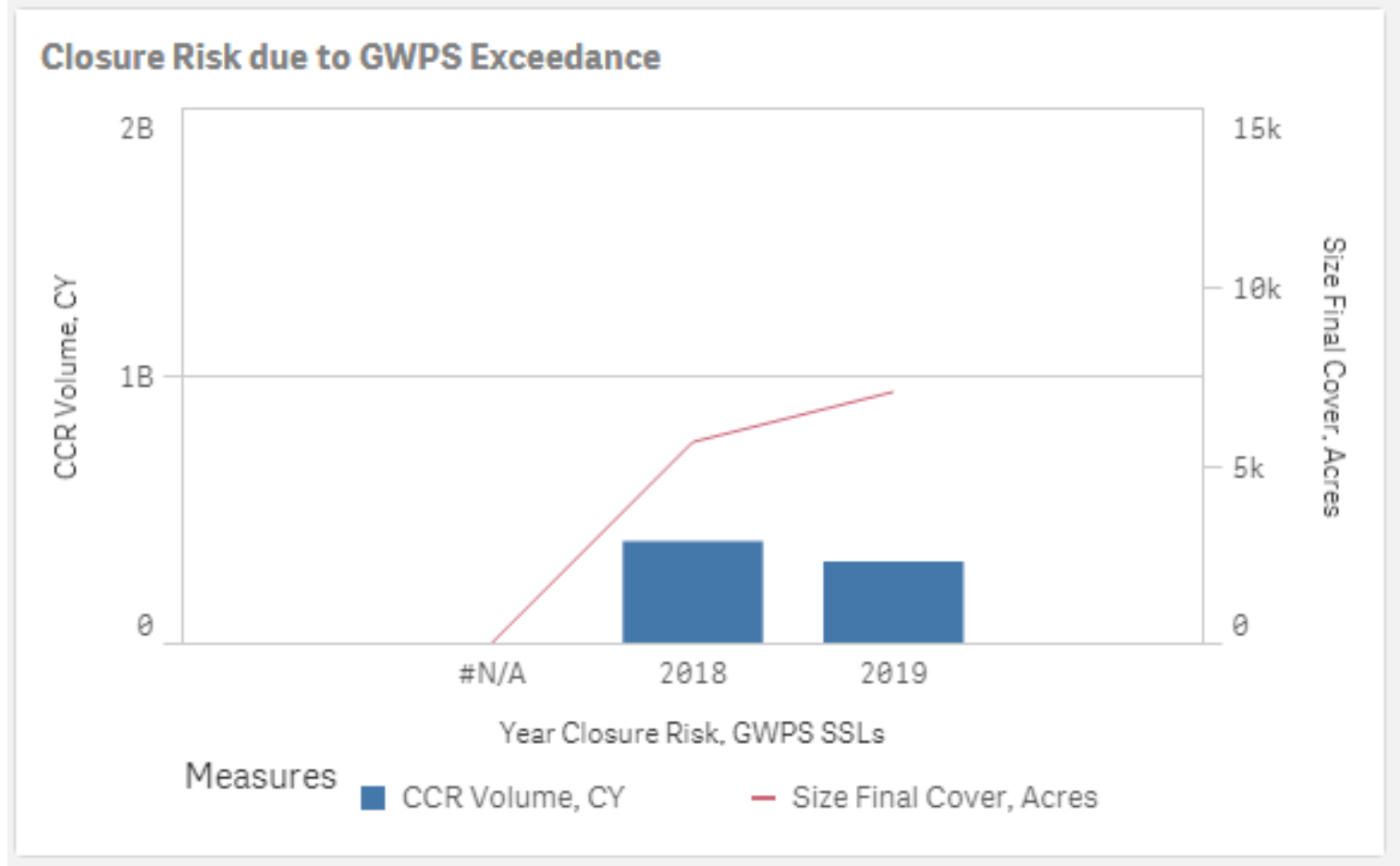
	SI
Number of CCR Units	147
Acres of CCR Units (acres)	10k
Volume of CCR Units (CY)	560M



GWPS Exceedance

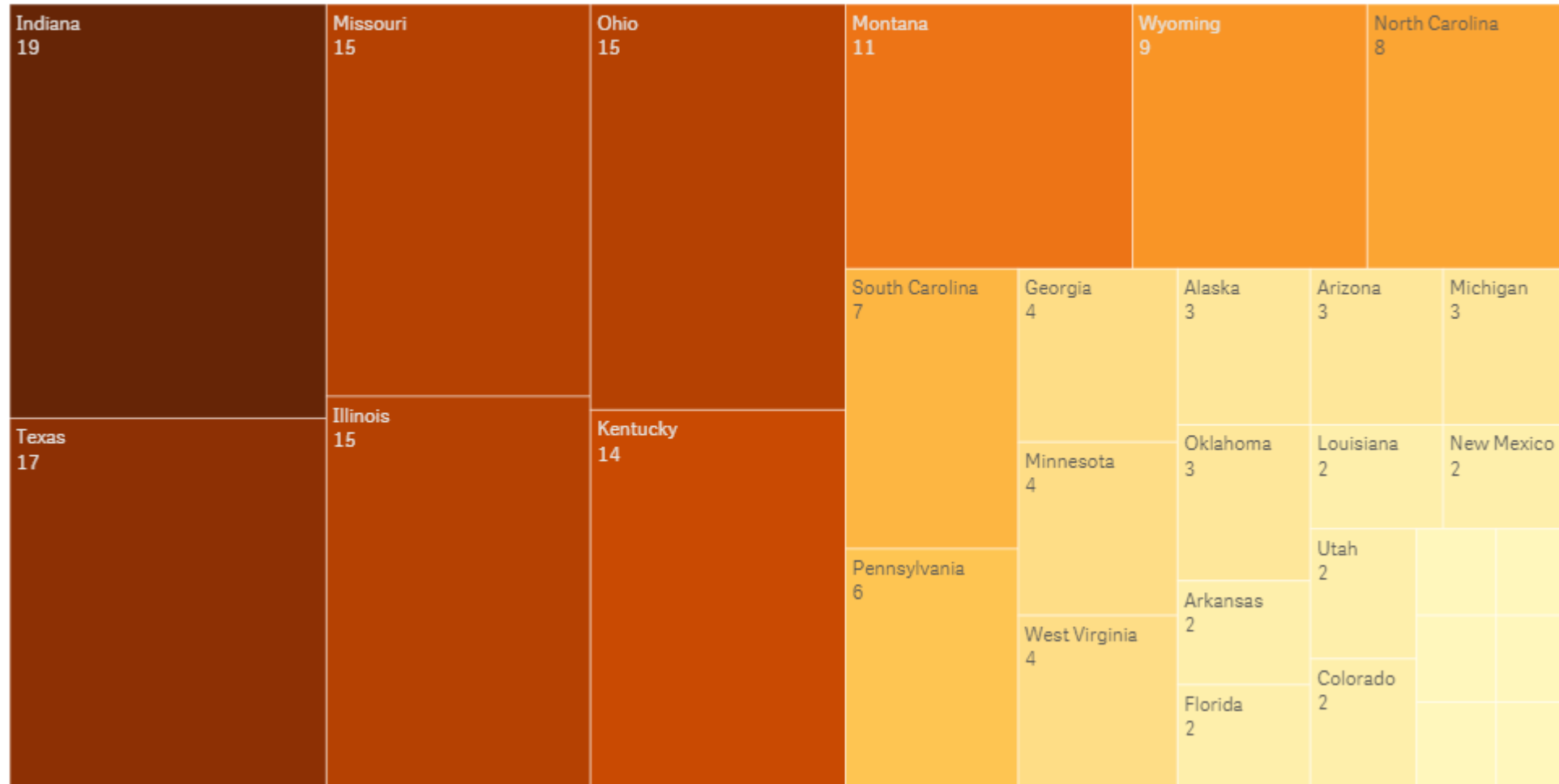
Surface impoundments at risk of closing, due to GWPS exceedances

	SI
Number of CCR Units	200
Acres of CCR Units (acres)	12k
Volume of CCR Units (CY)	680M



Combined Surface Impoundment Closure Risk for Location Restrictions and GWPS Exceedances – Remaining Units

Closure Possible due to GWPS or LR, August 2019

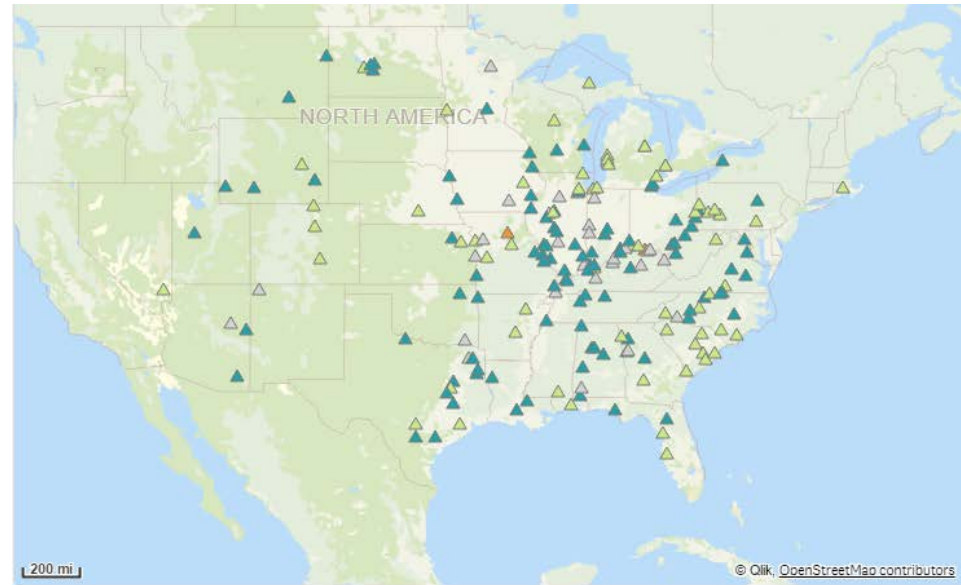
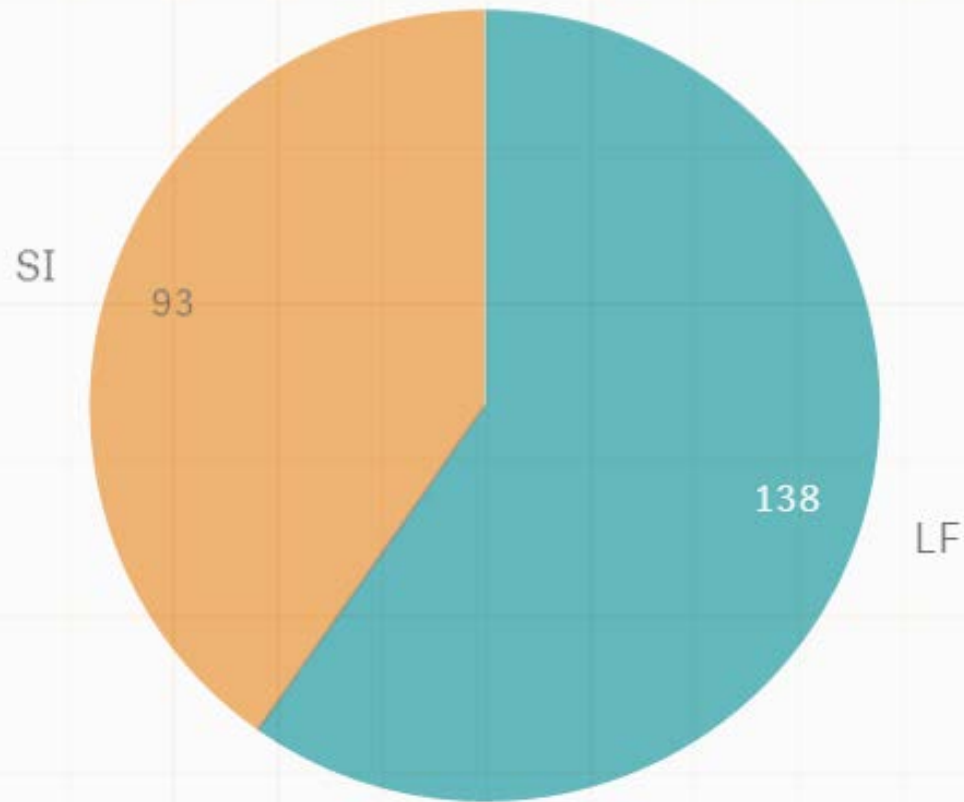


CCR Units 178
CCR Volume, CY 351.6M
Size Final Cover, Acres 8.57k



Operating without LR or GWPS SSL

Type CCR Unit



Organizations
69
Sites
196
CCR Units
411
CCR Vol Best Est, CY
915M
Size Final Cover, Acres
19,873

Q Approach to Closure, CP	Q Type CCR Unit	Q Flag, Hybrid?
Closure by Removal	SI ✓	No
Closure in Place	ISI	Yes

What is Next?



Preventing Closure

No Alternative Disposal Capacity
Boiler Cessation
Extensions



Power Industry Impact

MWh generation at-risk
Tons coal not delivered / month at-risk



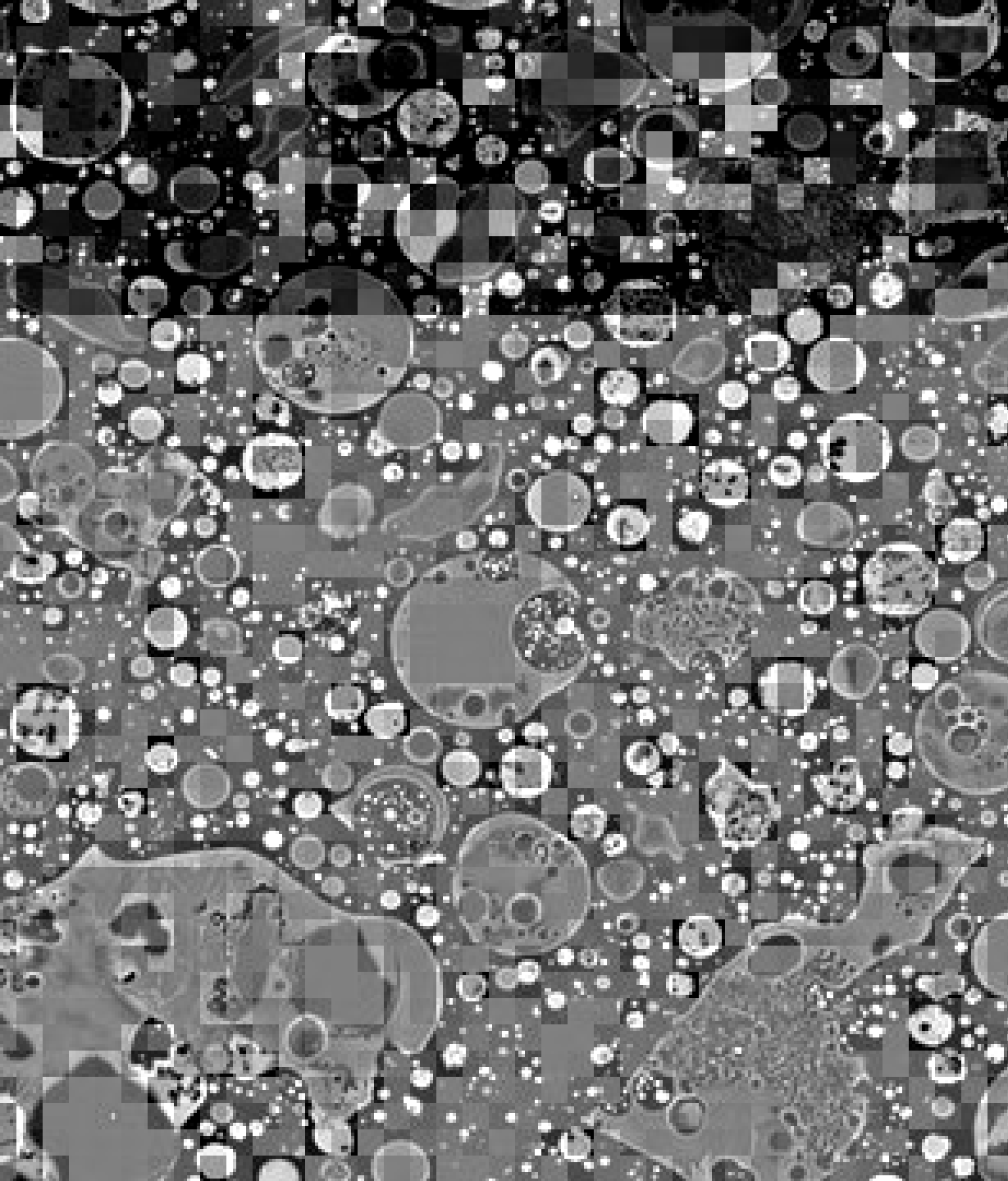
Future Work

“What If” regulatory scenarios

- State Actions
- Federal Actions

More Beneficial Use





03

So THAT'S what it means



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Observed Trends

- The units are diverse with unique conditions
- Safety factor and the 4 location restriction criteria were not a problem for the industry
- Why were there so many closures before the triggers
 - Plant closures (end of life)
 - Proactive behavior
 - Other reasons



Dan River Steam Station collapsed coal ash impoundment

Observed Trends *(continued)*

- Placement above uppermost aquifer is a key factor in next wave of closures
 - GW is a concern and a large number of units have entered Assessment monitoring
 - Approx. 65% of plants are in GW assessment



TVA – Kingston Fossil Plant

Observed Trends *(continued)*

- Due to anticipated closure dates and triggers, a large wave of closures are coming late in 2020
 - Each year, on average, about 35 ponds (SI and ISI) and about 1,500 acres have closed
 - 2018 was about 50% of this average (trending downward)
 - THERE IS A LOT LEFT TO DO...approximately 60%+ of acreage
 - The frequency of CbR and CIP to date is likely more for CIP, but CbR is more than likely anticipated
 - The next wave is 8 to 10 times the amount that has been averaged over the previous years





Thank You!

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