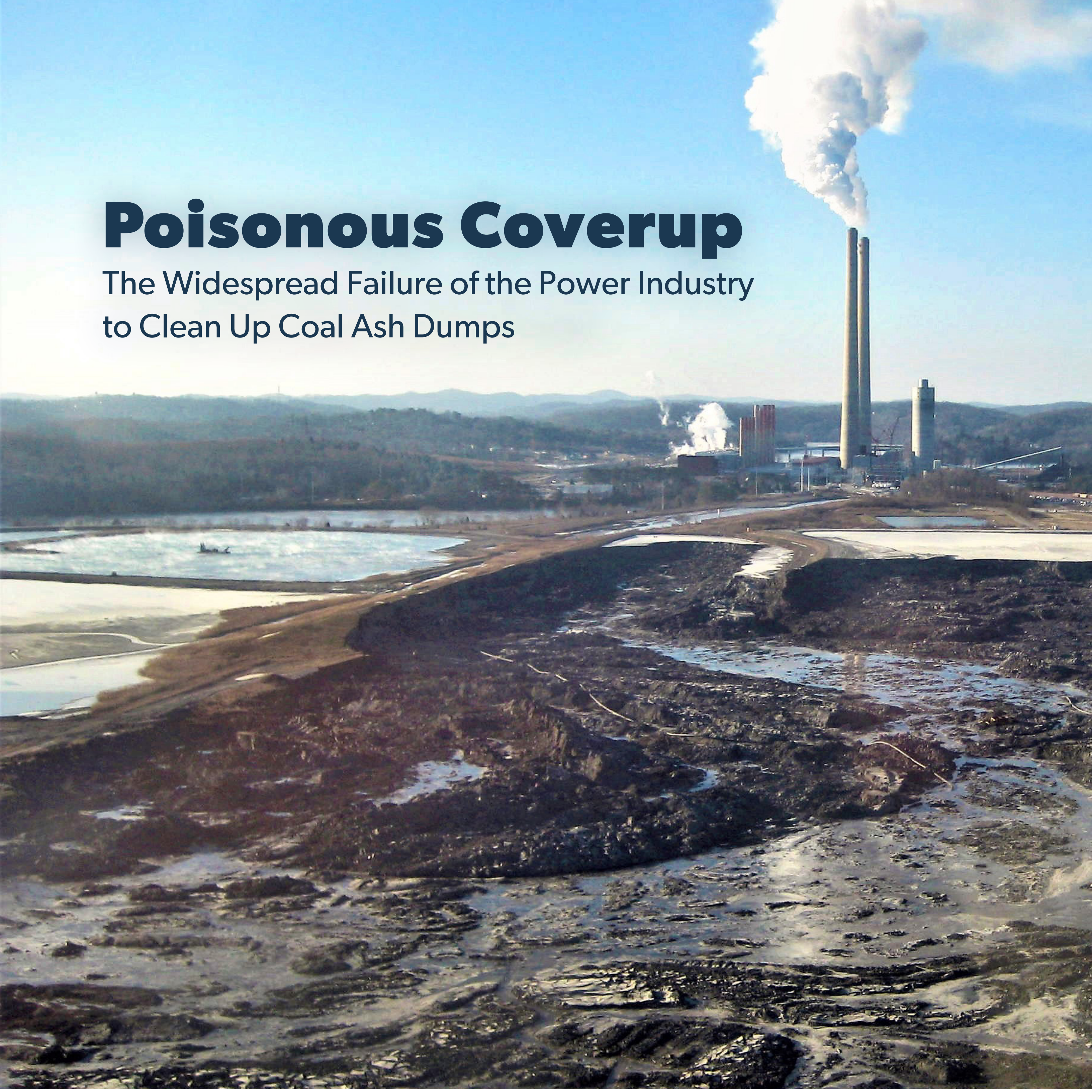
Poisonous Coverup

The Widespread Failure of the Power Industry to Clean Up Coal Ash Dumps



ENVIRONMENTAL INTEGRITY PROJECT

EARTHJUSTICE
BECAUSE THE EARTH NEEDS A GOOD LAWYER

EMBARGOED FOR RELEASE
November 3, 2022

ACKNOWLEDGEMENTS:

This report was researched and written by Abel Russ and Keene Kelderman of the Environmental Integrity Project and Lisa Evans and Caroline Weinberg of Earthjustice. Groundwater monitoring data gathering and analysis by Keene Kelderman and Vincent Bregman. Data gathering assistance from Preet Bains, Courtney Bernhardt, Griffin Bird, Kira Dunham, Anum Khan, Mariah Lamm, Dante Mack, Camden Marcucci, Louisa Markow, and Frances Stum (EIP), and Indra Frank and Tim Maloney (Hoosier Environmental Council).

THE ENVIRONMENTAL INTEGRITY PROJECT:

The Environmental Integrity Project (EIP) is a nonpartisan, nonprofit organization established in March of 2002 by former EPA enforcement attorneys to advocate for effective enforcement of environmental laws. EIP has three goals: 1) to provide objective analyses of how the failure to enforce or implement environmental laws increases pollution and affects public health; 2) to hold federal and state agencies, as well as individual corporations, accountable for failing to enforce or comply with environmental laws; and 3) to help local communities obtain the protection of environmental laws. For more information on EIP, visit: www.environmentalintegrity.org

EARTHJUSTICE:

Earthjustice is the premier nonprofit public interest environmental law organization. We wield the power of law and the strength of partnership to protect people's health, to preserve magnificent places and wildlife, to advance clean energy, and to combat climate change. For more information, visit: https://earthjustice.org/

For questions about this report, please contact EIP Director of Communications Tom Pelton at (443) 510-2574 or tpelton@environmentalintegrity.org.

PHOTO CREDITS:

Images: Cover photo, Kingston coal ash spill, TN, Earthjustice/TVA; coal ash bar sampling on Dan River, flickr/USFW; Kingston Fossil Plant, flickr/Appalacian Voices; aerial coal ash pond view, Shutterstock; photo of turtle covered in ash by Matt Butler, Program Director at Sound Rivers; picture of bulldozers moving ash by John Wathen, Creekkeeper of Hurricane Creek (Tuscaloosa, AL); Residents near Arrowhead coal ash landfill, Chris Jordan-Bloch, Earthjustice.

Poisonous Coverup:

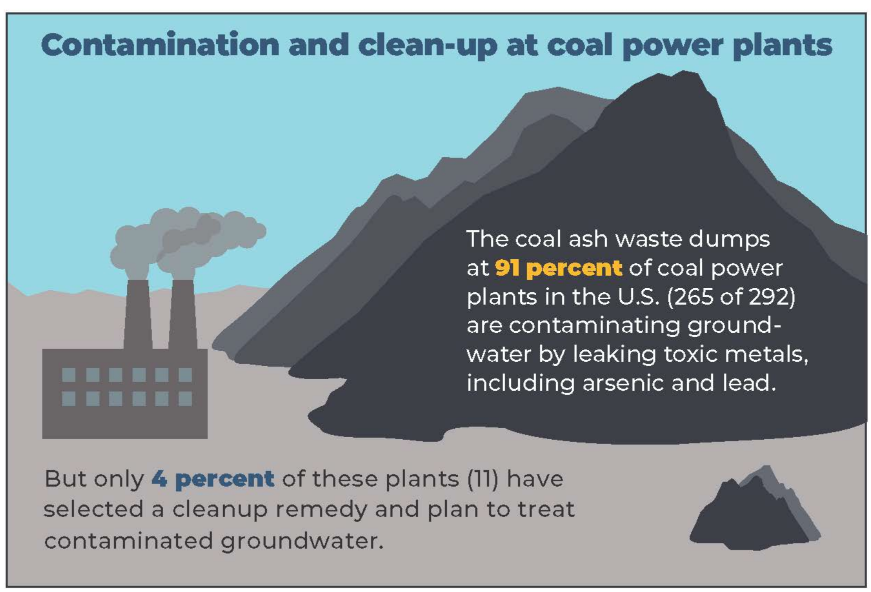
The Widespread Failure of Power Companies to Clean Up Coal Ash Dumps

Executive Summary

In every state where coal is burned, the utility industry is violating a federal regulation known as the Coal Ash Rule. To save money and avoid liability, nearly all coal plant owners are ignoring key requirements and employing common tricks to avoid mandatory cleanup. The result is widespread groundwater contamination that threatens our drinking water supplies and aquatic life. This report presents evidence of contamination at more power plants than previously documented – bringing the total to over 265 sites – and also describes the pervasive noncompliance that continues to prevent environmental restoration.

Coal ash – the toxic waste left after burning coal for electricity – is one of the largest industrial waste streams in the United States. It contains toxic metals and other pollutants that cause a wide range of harms to health and the environment. Although coal consumption has declined, the industry continues to generate about 70 million tons of coal ash annually.[1] It is estimated that after 100 years of burning coal, U.S. power plants have generated approximately 5 billion tons of coal ash – enough toxic waste to reach the moon in train cars.[2] Most of this ash has been dumped in unlined settling ponds and landfills, with minimal protections to prevent spills or leaking of hazardous chemicals.

The widespread harm from reckless dumping of coal ash is well recognized. In 2015, in response to nearly 160 cases of water contamination[3] and catastrophic coal ash spills at Tennessee Valley Authority's Kingston Fossil Plant in 2008[4] and Duke Energy's Dan River Generating Station in 2014,[5] the U.S. Environmental Protection Agency (EPA) established the first-ever regulations governing coal ash disposal. The primary goals of EPA's 2015 Coal Combustion Residuals (CCR) Rule, also known as the Coal Ash Rule,[6] are to stop the disposal of coal ash



in leaking or unlined ash ponds, to close ash ponds and landfills in a safe manner, to monitor groundwater for contamination, and to clean up contaminated sites and restore groundwater quality.

The first goal has been partly achieved, as most coal plants no longer send coal ash to leaking or unlined ash ponds. But this report shows that the other goals of the Coal Ash Rule have been thwarted by the utility industry's widespread violation of federal law. While monitoring results are public for most sites, the data show that results are being manipulated to make contaminated sites look clean and to avoid cleanup. In addition, for the sites with cleanup plans, the design and implementation of these plans fall far short of federal standards. This report serves as a warning bell for the need to change course to ensure that the federal rule actually restores coal ash-contaminated groundwater, closes all unlined and leaking coal ash ponds, and prevents future water contamination.

Coal Plants Are Polluting the Nation's Water

In this report, after adding dozens of coal ash disposal units to our database, and an additional two years of groundwater monitoring data posted by the regulated industry, we confirm the results of our 2019 report[7] – 91 percent of U.S. coal plants are causing unsafe levels of groundwater contamination. Most coal plants are contaminating groundwater with unsafe levels of arsenic, which is known to cause multiple types of cancer and to impair the brains of developing children. But arsenic is just one cause for concern. Boron, lithium, molybdenum, and sulfate are each present at unsafe levels at most coal plants, and most coal plants have unsafe levels of at least four toxic coal ash constituents.

The fact that contamination remains high three years after our first report is not a surprise. Once coal ash pollutants seep into groundwater, they are persistent and hard to clean up. This is why it is so important to deal with the source – leaking coal ash dumps – as soon as possible, before more pollutants seep out.

Most coal plants have not determined how much contamination is flowing to nearby drinking water wells, streams, lakes, or rivers, despite federal requirements to monitor the site boundary and define the extent of the contamination plume once pollution exceeds certain thresholds. This is dangerous because it leaves neighboring residents in the dark about potential contamination and because most coal plants are located next to water bodies that can be harmed by toxic coal ash contaminants. In fact, 74 percent of plants have a landfill or pond within a quarter mile of surface water, and 57 percent have a landfill or pond within 500 feet of surface water.[8] Unsafe levels of toxic metals in groundwater at coal plants threaten the safety of the nation's drinking water as well as the health and safety of lakes and rivers near the plants.

Although no comprehensive study has been performed on the subject, drinking water wells in at least 15 communities across the U.S. have been contaminated by metals from coal ash, and the true number may be much higher. The documented drinking water contamination sites include Town of Pines, Indiana (which was named a Superfund site because of the widespread pollution); Gambrills, Maryland; and Belmont, North Carolina, among others.[9] The most recent discovery of drinking water contamination in private wells occurred near Lansing, Michigan.[10]

The Industry is Flouting the Coal Ash Rule

Seven years after EPA established the first-ever protective requirements for coal ash disposal, progress to clean up contaminated groundwater and safely close dangerous coal ash ponds is dismal. Industry data reveal ongoing groundwater contamination and widespread violations of the federal rule. Our report exposes how the coal industry's illegal behavior is harming health and the environment nationwide. Specifically:

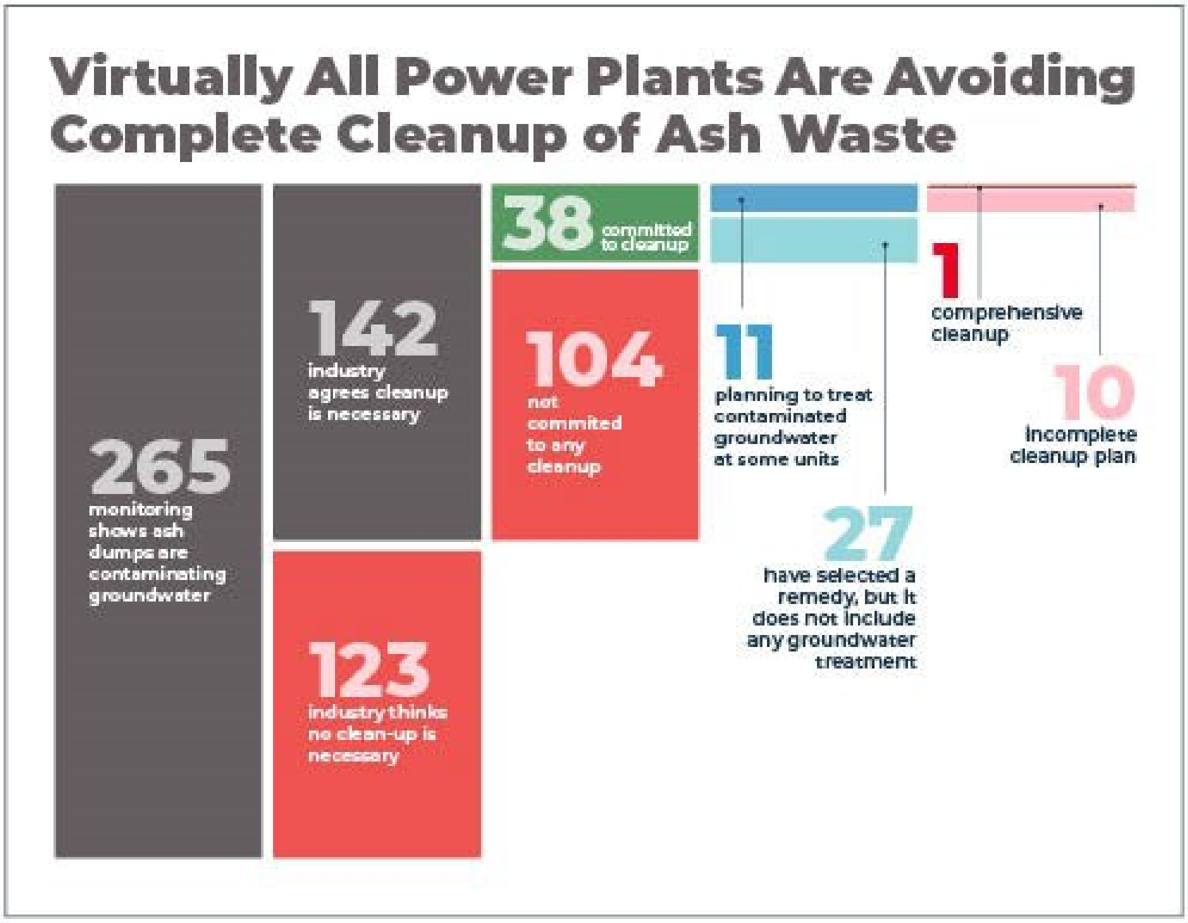
Power companies are illegally leaving coal ash in groundwater after closure:

- When coal ash is in contact with groundwater, toxic pollutants are constantly released into the environment, regardless of any cap placed over the ash. This is why the Coal Ash Rule prohibits closure that leaves coal ash in groundwater.
- At least 372 unlined ash ponds are within five feet of groundwater (and many of these are sitting in groundwater).[11] Of these 372 ash ponds, companies have closed 81 by removing the ash, and have scheduled the closure of another 91 by removal. But most of these ash ponds (200) are being closed in place, despite being in or dangerously close to groundwater.[12]
- 70 percent of the plants with ponds closing with ash in or near groundwater are located in disproportionately low-income neighborhoods or communities of color.[13]
- Climate change, which generates increasingly frequent and severe storms and flooding, greatly amplifies the risks posed by coal ash ponds closed in place near lakes and rivers. The ash in these ponds is likely to be in contact with groundwater, and their placement makes them susceptible to flooding and spills, even after closure.
- Recent evidence of the toxic contamination of numerous lakes adjacent to coal ash dumps in North Carolina points to the need to safely close coal ash ponds by moving them away from surface waters and groundwater.[14]

Power companies are illegally failing to clean up groundwater contaminated with coal ash:

- 91 percent of regulated coal plants (265 of the 292 plants we evaluated) are contaminating groundwater in 43 states.
- At nearly half of these plants (123 of the 265 contaminated plants), owners have denied responsibility for the contamination, and are not planning to take remedial action.
- The remaining 142 contaminated plants have submitted a plan detailing possible cleanup *options*, but only 38 of these have committed to a specific cleanup plan. This is despite the Coal Ash Rule's requirement to select a remedy "as soon as feasible."[15]
- The plants that *have not* committed to cleanup strategies include 240 individual disposal units. At 82 percent of these disposal units, plant owners have illegally delayed remedy selection for three or more years.

- Of the 38 plants that *have* committed to at least one cleanup action, 27 are not treating groundwater, but are instead relying on "monitored natural attenuation," which means the companies will just watch as the pollution continues to seep into the groundwater and flow offsite.
- The owners of the remaining 11 coal plants have committed to some kind of groundwater treatment for at least one disposal unit, for example by adding pipes, drainage systems, and pumps to remove contaminated water.
- However, even among these 11, all but one suffer from other serious problems that undermine the selected remedy and avoid comprehensive cleanup.



Power companies are hiding evidence of contamination:

Coal plant owners employ a variety of tricks to twist the facts and avoid taking responsibility for contamination. As discussed in more detail in this report, utilities do this in several ways. Among other things, plant owners:

- Use contaminated "background" wells as points of comparison, making it much harder to find statistical evidence of coal ash pollution
- Leave large parts of a disposal area unmonitored
- Use inappropriate statistical methods to hide spatial patterns of contamination
- Attribute the contamination to another source with sham "alternate source demonstrations"

Dangerous loopholes in the federal rule allow hazardous coal ash dumps to continue to pollute:

- At least 170 coal ash ponds are not being regulated by the Coal Ash Rule because they are so-called "legacy ponds," which means the power plants stopped generating electricity prior to October 2015. This is despite a 2018 mandate by the Court of Appeals for the District of Columbia[16] requiring the EPA to close this dangerous gap.
- In addition, the Coal Ash Rule leaves more than 500 million tons of coal ash unregulated in close to 300 inactive landfills because the rule exempts coal ash landfills that stopped receiving coal ash after October 17, 2015.[17] The authors of this report, along with several public interest groups, recently sued EPA to close this dangerous gap.

The Coal Ash Rule Has Exposed Coal Ash Pollution

The good news is that the EPA's Coal Ash Rule has succeeded in requiring coal plant owners to monitor groundwater and publicly report the results. The reporting requirements of the Coal Ash Rule allow regulators and the public to determine whether plants are complying with the rule's requirements, including the requirements to monitor, close, and clean up leaking ash dumps. Indeed, this year EPA began enforcing the terms of the rule with thorough analyses of compliance documentation at certain sites.

In addition, the Coal Ash Rule is putting an end to the use of unlined coal ash ponds, the most dangerous form of coal ash disposal. Although not all unlined ash ponds have closed, most have stopped receiving new ash, and power companies will have to phase them out completely over the next couple of years.[18]

However, the Coal Ash Rule has not been as successful with respect to cleanups. The rule was originally created as a completely self-implementing program that did not require enforcement by regulatory agencies or enforceable state or federal permits. While Congress gave the EPA authority to issue permits in 2016, EPA did not exercise enforcement authority until 2022, and a permitting rule, proposed in 2020, has never been finalized.[19] EPA started enforcing the terms of the Coal Ash Rule earlier this year at several power plants. This is a welcome development that should help bring those plants into compliance. However, hundreds of other sites continue to violate the federal rule, resulting in unabated coal ash pollution, unsafe coal ash pond closures, and years of delay in initiating cleanup actions.

Failing Grades for the Worst Coal Ash Sites in the Nation

Our report ranks power plants by the severity of groundwater contamination and looks at the 10 most contaminated sites in the U.S. to determine whether coal plant owners are cleaning up the coal ash dumps and treating the contaminated groundwater. Of the 26 leaking dumps at the 10 most contaminated sites, only five ash dumps have a final remedy, and all 10 sites continue to violate the Coal Ash Rule in a number of ways.

In addition, Earthjustice completed a database of Coal Ash Rule implementation at all 746 coal ash ponds and landfills with available information. This database shows whether an ash pond is too close to groundwater, whether a site has started the cleanup process, and much more. The database can be found at: https://earthjustice.org/coalash/data-2022.

Recommendations to Stop Coal Ash Pollution

This report reveals the extent of coal ash pollution currently plaguing the nation. The report also outlines how these problems can be remedied so that coal ash pollution, like coal, can become a dirty relic of the past. We call for:

- **Full industry compliance with federal law.** First and foremost, coal plants must comply with the Coal Ash Rule. Plant owners must install an adequate number of monitoring wells, analyze their groundwater data correctly, stop attributing contamination to unnamed "alternate" sources with sham determinations, remove coal ash from groundwater, and promptly take cleanup actions that restore groundwater quality.

- **Increased federal oversight**. We are encouraged by EPA's recent attempts to call out industry noncompliance, but so far the agency has just scratched the surface. Greater EPA oversight could stop the widespread violations perpetuated by coal plants nationwide. At some of the worst sites, EPA may have to enter to enforceable consent decrees to ensure that cleanup is done correctly.

- **Enforceable cleanup schedules.** The Coal Ash Rule requires the owners of sites in corrective action to select a cleanup plan "as soon as feasible." Many owners are exploiting this language to delay selecting and implementing cleanup plans. Where owners have waited too long, EPA should take action to impose both a penalty and a firm schedule for remedy selection and cleanup.

- **Plant-wide cleanup requirements**. We frequently see contamination caused, in large part, by older coal ash disposal units that are exempt from the current Coal Ash Rule. EPA must close existing loopholes and establish cleanup requirements for all coal ash dumps including coal ash ponds and landfills that are no longer in use. This is the only way to restore groundwater quality and protect the nation's water resources.

- **Testing of drinking water near ash dumps**. There is currently no general requirement for coal plants to test drinking water wells in communities next to their plants. Coal ash pollution is odorless, tasteless, and visually undetectable. It is therefore essential that plants test all drinking water wells on their properties and within a half mile of their ash dumps to protect the health of fenceline communities. Many of these communities lack the means and expertise to test their own water. This is an environmental justice issue because coal ash dumps disproportionately threaten low-income communities and communities of color.

- **Protection of vulnerable communities.** EPA's Coal Ash Rule gave fenceline communities a role to play in ensuring adequate cleanup of coal ash pollution. These communities, however, need technical assistance to participate meaningfully in the cleanup process and in enforcing the requirements of the rule. Funding for technical assistance has long been available to communities harmed by toxic waste, but EPA has not yet provided this much-needed assistance to coal ash-impacted communities.

- **Prohibition of dangerous coal ash reuse.** Use of coal ash as a substitute for clean fill (e.g., soil) spreads toxic waste to residential neighborhoods, rural areas, and mining communities. As plant owners close existing dumps and remove ash from groundwater, there is increased pressure to reuse the ash in dangerous ways. EPA must prohibit the use of coal ash as fill unless full protective measures such as liners, monitoring, and caps are required everywhere it is placed.

A turtle is pulled out of spilled coal ash near the L.V. Sutton Power Station outside Wilmington, N.C. Flooded conditions from Hurricane Florence caused parts of the ash pond's dam to fail.

Immediate attention to these recommendations will protect the health and environment of millions of U.S. residents by preventing the spread of toxic coal ash pollution and requiring the restoration of poisoned water nationwide.

Table of Contents

Coal ash contamination is an environmental justice issue. About 70 percent of ash ponds that are dangerously close to groundwater are in lower-income neighborhoods or communities of color.

A. Background on Coal Ash Waste

Officials take water samples in the aftermath of the Dan River Steam Station (Duke Energy) coal ash spill north of Eden, NC, in 2014.

Coal ash – the toxic waste left over after burning coal for electricity – is one of the largest industrial waste streams in the United States. As recently as 2012, U.S. coal plants generated more than 110 million tons of coal ash every year.[20] Although coal consumption has declined somewhat over the last decade, the industry continues to generate about 70 million tons of coal ash every year.[21] Over the course of a century of coal-fired power, the industry has generated approximately 5 billion tons of ash.[22] The utility industry has dumped most of this coal ash in unlined settling ponds and landfills, with minimal protections. In 2019, EIP and Earthjustice analyzed groundwater monitoring data from hundreds of coal ash dumps and found that more than 91 percent of them are contaminating groundwater with unsafe levels of toxic metals and other pollutants.[23] As described below, this statistic continues to be true, though we now know of over twenty additional contaminated sites.

1. Coal Ash Pollutants and Risks

Coal ash contains a long list of toxic metals and other pollutants that cause a wide range of adverse impacts to human health and the environment. In 2014, the EPA completed a risk assessment that estimated the magnitude of the risks, and the pollutants posing the greatest risks, from coal ash dumps.[24] The EPA determined that the following coal ash pollutants were dangerous enough that they warranted regular monitoring:

- Arsenic causes many adverse health impacts, including multiple forms of cancer, neurological impairments in children, and skin conditions.[25] EPA's risk assessment predicted significant risks of both cancer and non-cancer health effects near unlined coal ash ponds and landfills.[26]
- Boron is associated with developmental and reproductive toxicity (e.g., low birthweight and testicular atrophy),[27] and is also toxic to aquatic life.[28] EPA's risk assessment predicted significant risks to both humans and aquatic plants and animals.[29]
- Cadmium causes kidney damage and is probably carcinogenic (according to the EPA).[30] In a preliminary screening analysis, EPA found potential risks to humans

through both drinking water and contaminated fish.[31] Cadmium is also toxic to fish themselves,[32] and EPA's risk assessment predicted significant ecological risks from cadmium.[33]

- Cobalt is associated with blood disease, thyroid damage, and other endpoints.[34] EPA's risk assessment predicted significant cobalt risks in association with certain types of ash ponds.[35]
- Chromium, particularly the form known as hexavalent chromium, can cause cancer at very low doses and can also cause liver damage and other non-cancer health effects.[36]
- Fluoride is a neurotoxin[37] that can also cause tooth and bone damage,[38] and may be carcinogenic.[39]
- Lead is a well-known and potent neurotoxin. It is also, according to EPA, a "probable carcinogen,"[40] and can be toxic to aquatic life.[41] There is no truly "safe" level of lead exposure, especially for children.[42]
- Lithium can cause kidney damage, neurological damage, decreased thyroid function, and birth defects.[43] EPA's risk assessment predicted significant lithium risks to humans via drinking water.[44]
- Mercury is a potent neurotoxin that bioaccumulates in aquatic food chains.[45] EPA's risk assessment predicted significant mercury risks via fish consumption, but not through drinking water.[46] This is important because it suggests that mercury may present a significant risk even where groundwater concentrations are below drinking water standards.
- Molybdenum has been associated with gout-like symptoms in humans, and reproductive toxicity in laboratory animals.[47] EPA's risk assessment predicted significant molybdenum risks.[48]
- Radium (specifically the radium isotopes radium-226 and radium-228) is a radioactive and cancer-causing metal. EPA's risk assessment did not look at radium, but EPA added radium to the list of groundwater monitoring constituents in the Coal Ash Rule "because there is evidence from several damage cases of exceedances of gross alpha [radiation], indicating that radium from the disposal of coal ash may be problematic."[49]
- Selenium bioaccumulates in aquatic food chains and is toxic to fish.[50] Selenium can also be toxic to humans, affecting skin, blood, and the nervous system.[51] In a preliminary screening analysis, EPA found that potential selenium risks to humans were greater through fish consumption than through drinking water.[52] EPA noted that selenium was the "most prevalent" constituent of concern in proven damage cases involving surface water impacts.[53] These damage cases typically involve fish kills or other fish toxicity, and have been "extensively studied" in places like North Carolina, South Carolina and Texas.[54]
- Thallium has been associated with a long list of adverse health effects including liver and kidney damage and hair loss.[55] EPA's risk assessment predicted significant risks via drinking water, and in a preliminary screening analysis also identified potential risks through the consumption of thallium-contaminated fish.[56]

Groundwater at coal plants is typically contaminated with unsafe levels of several of these pollutants, which create a cumulative risk to people and aquatic life. For example, there are

The cleanup effort at the site of the TVA coal ash disaster at the Kingston Fossil Plant in Tennessee.

at least six neurotoxins in coal ash (including manganese, which is commonly found in coal ash but is not regulated by the Coal Ash Rule), at least five known or suspected carcinogens, and several pollutants that are toxic to aquatic life.

It is important to note that the risks estimated by EPA are expected to get worse over time, for at least several decades, unless there is corrective action and cleanup. According to EPA models, if leaking ash dumps are left alone, contamination in nearby residential wells could continue to increase for over 70 years for some pollutants, and thousands of years for others.[57] This means that much of the harm from improper coal ash disposal has not yet happened, and today's decisionmakers have an opportunity to prevent the worst.

In addition, it is important to protect the nation's groundwater from these toxic chemicals even if the water is not currently being used for drinking water. As the agency stated in 2015,

> EPA's longstanding and consistent policy across numerous regulatory programs has been that groundwater contamination is a significant concern that merits regulatory action in its own right, whether or not the aquifer is not currently used as a source of drinking water. Sources of drinking water are finite, and future users' interests must also be protected.[58]

Clean aquifers are an increasingly scarce resource, and we should be protecting our aquifers for future use. The utility industry's large-scale pollution of groundwater at nearly all coal plant sites in the U.S. must be immediately stopped and groundwater quality restored.

2. History of Federal Coal Ash Regulations

For decades, the U.S. EPA studied the coal ash disposal problem and struggled over how to address its scale, complexity, and gravity.[59] It wasn't until public and Congressional pressure reached a crescendo following the 2008 disaster at the Tennessee Valley Authority (TVA) Kingston Fossil Plant that the agency publicly committed to regulate coal ash. The catastrophic collapse of the Kingston ash pond, the largest toxic waste spill in U.S. history, released more than five million cubic yards of coal ash, destroying dozens of homes, and contributing to the illness and deaths of scores of cleanup workers.[60] The TVA spill was followed in February 2014 by another disastrous breach of a coal ash impoundment at Duke Energy's Dan River Generating Station, which released 0.5 million cubic yards of water and fly ash and polluted 70 miles of river in North Carolina and Virginia.[61]

Despite these disasters and the EPA Administrator's commitment in January 2009 to regulate coal ash, the EPA still had to be sued in 2012 by nine citizen groups and an Indian tribe (including the authors of this report) to compel it to regulate this toxic waste.[62] Finally, in 2015, the EPA promulgated what is now known as the "CCR Rule" or the "Coal Ash Rule."[63] For a limited universe of ash landfills and surface impoundments, the Coal Ash Rule established nationally applicable minimum criteria, including location restrictions; liner design criteria; structural integrity requirements; operating criteria; groundwater monitoring and corrective action; closure and post-closure requirements; and recordkeeping and notification requirements.[64]

The Coal Ash Rule has gone through some changes since 2015. Among other things:

- In response to a legal challenge filed by the authors of this report and others,[65] EPA agreed to strengthen the rule in a few key ways, including eliminating a loophole for coal ash impoundments that closed by April 2018 and agreeing to add boron to the list of pollutants that, when exceeded, trigger cleanup obligations.[66] To date, EPA has proposed making boron a chemical that drives cleanups but has not yet finalized that change.
- In 2016, Congress gave EPA the authority to approve state coal ash programs that operate in lieu of the Coal Ash Rule, but only if they are "at least as protective" as the Coal Ash Rule.[67]
- In July 2018, EPA waived groundwater monitoring requirements in certain situations, extended the deadlines for closing certain coal ash units, and revised groundwater protection standards for four pollutants.[68]
- In August 2018, the D.C. Circuit Court of Appeals found in favor of the environmental organizations that had challenged the 2015 rule (including the authors of this report). The court held that all unlined and clay-lined ash ponds are inherently unsafe and must close, and that impoundments at inactive power plants, known as "legacy ponds," must be regulated.[69] EPA has not yet extended the Coal Ash Rule to legacy ponds.
- In 2020, EPA created a closure schedule for unlined and clay-lined impoundments, requiring owners to stop adding coal ash to these units by April 11, 2021, but also allowing for extensions in some circumstances.[70]
- Later in 2020, EPA created a pathway for the industry to get approval for ash pond liners that don't meet EPA's liner design criteria.[71]

Despite these changes, the basic structure and function of the Coal Ash Rule remains the same: The owners and operators of regulated coal ash units must meet certain location restrictions and operating criteria, must monitor onsite groundwater for signs of contamination, and must take corrective action to restore groundwater quality if the contamination exceeds certain thresholds.

3. How the Coal Ash Rule Is Supposed to Work

The 2015 Coal Ash Rule created location restrictions, operating and design standards, groundwater monitoring programs, corrective action (cleanup), and closure requirements for coal ash ponds and landfills.[72] The rule does not cover all coal ash dumps. Coal ash landfills that stopped receiving waste before October 2015 are exempt, along with some older impoundments (those that were dried out before October 2015, have stayed dry, and have not received any new waste).[73] As explained below, the exemptions are a severe impediment to groundwater restoration at most sites, because most sites have one or more older, unregulated ash dumps.

The groundwater monitoring programs established by the Coal Ash Rule include requirements related to the number and placement of wells, the constituents that must be measured, and the monitoring schedule.[74] Each monitoring network is required to have both upgradient and downgradient wells. The upgradient wells should theoretically show the quality of groundwater before it passes under or through an ash dump.[75] Downgradient wells monitor the groundwater after it passes under or through an ash dump. If an ash dump is leaking, the downgradient wells will show higher concentrations of coal ash contaminants than the upgradient wells.

Groundwater monitoring networks can be specific to individual coal ash ponds or landfills, or they can be "multiunit" systems, encircling two or more ash dumps.[76] Once a well network is established, groundwater monitoring proceeds in a series of stages:

- First, each owner must conduct a round of baseline monitoring, sampling each well at least eight times and measuring all 21 pollutants in the Coal Ash Rule.[77] For existing coal ash dumps, the Coal Ash Rule required completion of baseline monitoring by October 2017.
- Next, each owner must initiate "detection monitoring," looking for a short list of chemicals that are good indicators of coal ash pollution, including boron, sulfate, and a few others. The detection monitoring constituents are listed in Appendix III to the Coal Ash Rule,[78] and shown in Table A1 of this report.
- If detection monitoring finds significantly elevated concentrations of these pollutants, then owners must either (a) demonstrate that the pollution is coming from something other than the regulated coal ash unit, or (b) initiate "assessment monitoring."[79]
- In assessment monitoring, each owner must measure a longer list of fifteen pollutants that are likely to present significant risks to human health and the environment.[80] These include arsenic, cadmium, cobalt, lithium, molybdenum and others, and are found in Appendix IV to the Coal Ash Rule. They are also listed in Table A1 of this report.
- If these assessment monitoring pollutants are found to be significantly elevated above groundwater protection standards, and the owner cannot demonstrate that the pollution is coming from another source, then the owner must initiate corrective action, evaluate a menu of remedial options (known as an "assessment of corrective measures"), and select a remedy.[81]

The monitoring schedule described above takes place over a period of years. With a few exceptions,[82] all sites completed baseline monitoring and posted the results in March 2018 (or earlier). Since then, owners have generally been monitoring on a semi-annual basis for Appendix III constituents, and, in some cases, for Appendix IV constituents.

B. The Vast Majority of Coal Plants Continue to Contaminate Groundwater

Our 2019 report[83] demonstrated that coal plants caused widespread groundwater contamination from both landfills and ash ponds, and that many contaminants exceed safe levels at most sites. Since our 2019 report was published, monitoring data became available for new sites, and we have additional years of monitoring data for all sites. In 2019, we reported on data for more than 477[84] disposal units at 265 power plants or offsite disposal areas. We now have data for more than 548 disposal units at 292 power plants or offsite disposal areas. The details of our updated analysis are presented in Appendix A. In short, we continue to find that 91 percent of coal plants are contaminating the groundwater with unsafe levels of contamination, as shown in **Table 1** below, though we now know of over twenty additional contaminated sites.

TABLE 1: UNSAFE GROUNDWATER CAUSED BY COAL ASH

Pollutant	Health-based threshold	Number of plants exceeding threshold	% of plants with unsafe levels of this pollutant
Antimony	6 µg/L	19/289	7%
Arsenic	10 µg/L	152/290	52%
Barium	2 mg/L	12/289	4%
Beryllium	4 µg/L	32/290	11%
Boron	1.8 mg/L	184/290	63%
Cadmium	5 µg/L	16/289	6%
Chromium	100 µg/L	6/290	2%
Cobalt	6 µg/L	133/290	46%
Fluoride	4 mg/L	22/292	8%
Lead	15 µg/L	29/290	10%
Lithium	40 µg/L	176/289	61%
Mercury	2 µg/L	12/290	4%
Molybdenum	40 µg/L	151/290	52%
Radium	5 pCi/L	55/288	19%
Selenium	50 µg/L	42/290	14%
Sulfate	500 mg/L	162/292	55%
Thallium	2 µg/L	35/290	12%
Any of the above		265/292	91%
Four or more of the above		170/292	58%

Source: Public disclosures of data by power companies to comply with 2015 Coal Ash Rule. Symbol "µg/L" means micrograms per liter.

C. Industry Data Exposes Widespread Noncompliance

Earthjustice compiled a database that tracks information publicly posted by the industry about each coal ash disposal unit's compliance with the Coal Ash Rule. The database is available here: https://earthjustice.org/coalash/data-2022. From the national database, we conclude that the majority of coal plants are delaying and avoiding compliance with the requirements of the federal rule.

An aerial view of Dominion Virginia Power's coal ash pond at Possum Point.

Information tracked in this database includes closure status, groundwater monitoring status, cleanup status, location restriction compliance, liner and hazard rating, and current unit volume. Compiling these data into one database allows us to report on the national trends in compliance across all 746 regulated ash ponds and landfills.[85] Such statistics are relied upon heavily in subsequent sections of the report. Additionally, this database allows us to state that over 2 billion cubic yards of coal ash are currently sitting in regulated landfills and ponds.[86] Finally, interested communities can use this database as a tool to understand the status of compliance with the Coal Ash Rule, including closure and cleanup, as well as the seriousness of the pollution generated by the ponds and landfills at their local power plant.

It is important to note that compliance details are constantly changing, and there is a time lag between when documents are posted and when they are reflected in the Earthjustice database. The database is now current as of roughly the spring and summer of 2022.

It is also important to note that the issues generally described in this report as noncompliance with the Coal Ash Rule are in fact violations of state coal ash rules in the three states with EPA-approved programs: Georgia, Oklahoma and Texas. These programs must be at least as stringent as the Coal Ash Rule, and in practice they are virtually identical, so the same observations about noncompliance apply to both the federal program and approved state programs. For ease of reading, these issues are simply described as violations of the Coal Ash Rule.

As detailed in the background section of this report, each coal ash landfill or pond is in one of the following regulatory stages: detection monitoring, assessment monitoring (which includes monitoring for more toxic metals), or corrective action (cleanup).[87] Even though 91 percent of coal plants are contaminating groundwater at unsafe levels, only 13 percent of power plants (which include 9 percent of regulated disposal units) have selected a remedy, and less than a third of the selected remedies include groundwater treatment. Of the 11 plants that did select a remedy with groundwater treatment, 10 suffer from a variety of other problems that undermine the remedy and prevent site-wide groundwater quality restoration. These 11 plants are summarized in Appendix E. In the final analysis, only one power plant in the country is planning a comprehensive cleanup that includes source control and groundwater treatment for all leaking units.

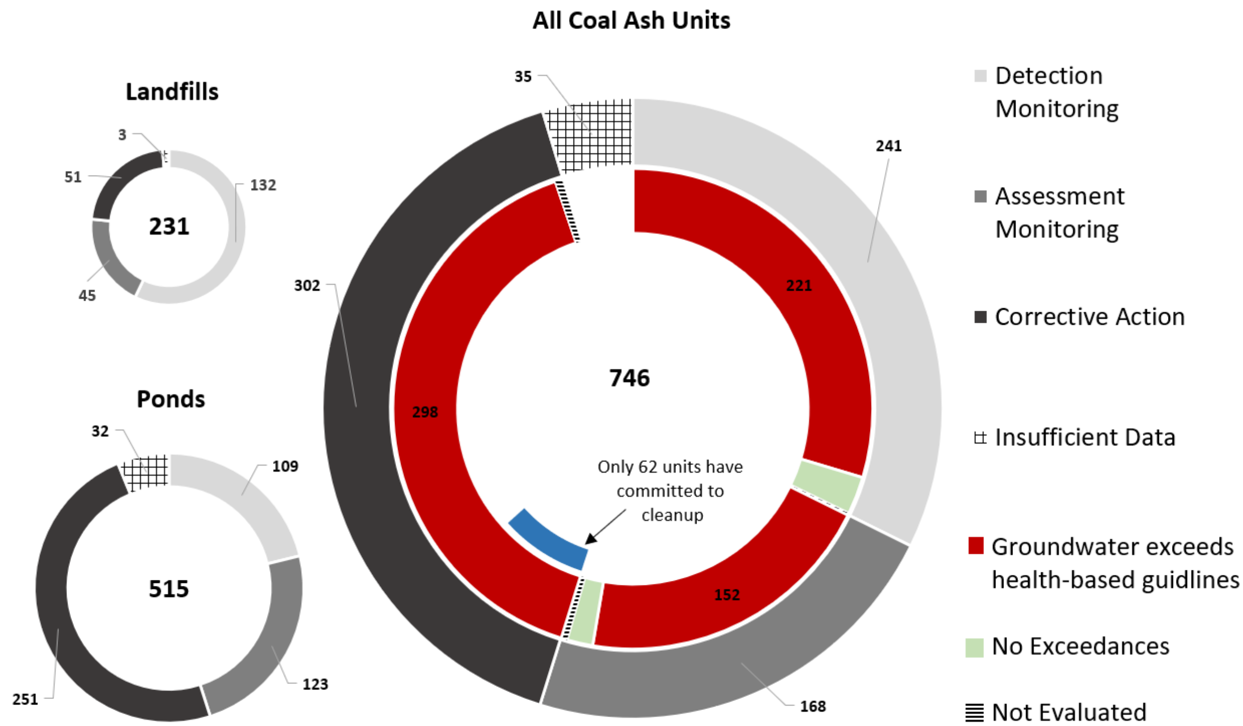
Table 2 summarizes the number of landfills and ponds in each stage of implementation and also details the number of units that have committed to cleanup activities.

TABLE 2: IMPLEMENTATION SUMMARY

	Ponds	Landfills	Total Units	Fraction of units in each stage
Total number of waste units	515	231	746	
Insufficient data	32	3	35	5%
Detection monitoring (not monitoring for most toxic metals)	109	132	241	34%
Assessment monitoring (monitoring for more toxic metals)	123	45	168	24%
Corrective action required, but no remedy selected	206	34	240	34%
Corrective action required and remedy selected	45	17	62	9%

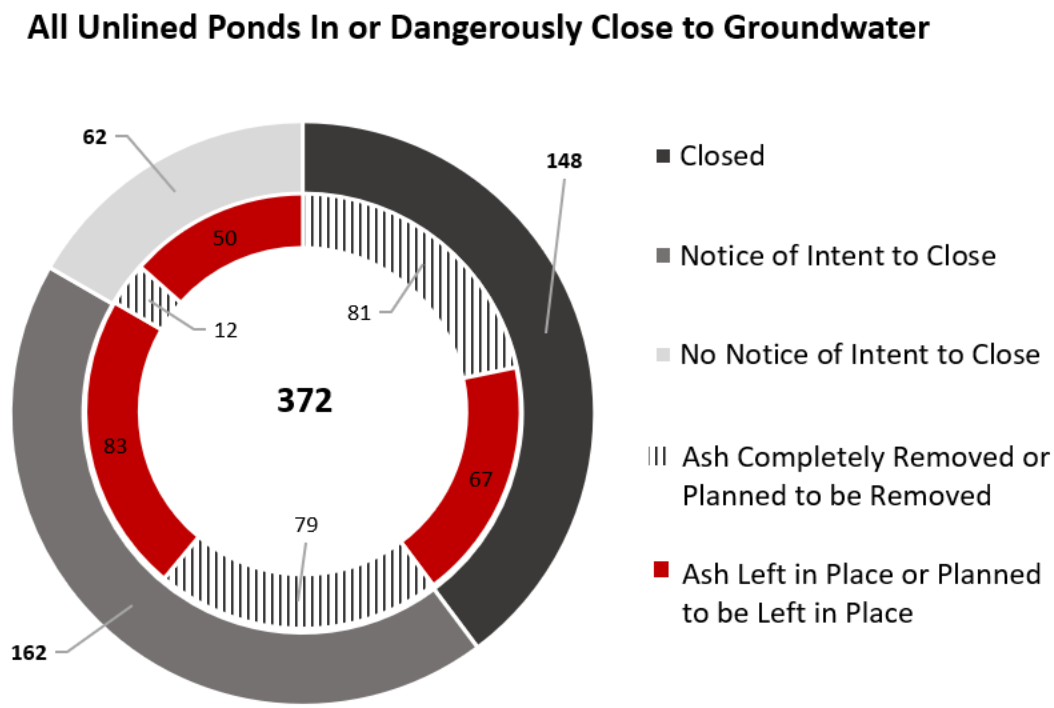
Figure 1 below visually summarizes the current groundwater monitoring status of all ash ponds and landfills in the compliance database. The inner circle displays how many of these units, despite being in early stages of monitoring, are located at plants where groundwater exceeds health standards. As is shown in the figure, many waste units that remain in the detection monitoring stage are also contaminating groundwater.

FIGURE 1: IMPLEMENTATION OF THE COAL ASH RULE



The compliance database also allows us to understand how many landfills and ponds have been closed since the Coal Ash Rule was written, and how they were closed (in place or by removal). This becomes especially important in the context of ash ponds that are too close to groundwater (and often *in* groundwater). Figure 2 below summarizes the closure status of the 372 ash ponds that appear to be within five feet of groundwater.[88] Less than half of these ponds (172) are being closed by removal. Of these, 81 have already been removed. But most of these ponds (200 ponds) are being left in place. If any of these units are actually sitting in groundwater, and we suspect that many of them are, then their closure plans violate the Coal Ash Rule.

FIGURE 2: CLOSURE STATUS OF COAL ASH PONDS WITHIN FIVE FEET OF GROUNDWATER (OR IN GROUNDWATER)



D. Widespread Industry Violation of the Coal Ash Rule Thwarts Cleanups and Safe Closures

In every state where coal is burned, the utility industry is blatantly violating the Coal Ash Rule. To save money and avoid liability, coal plant owners ignore critical requirements and employ common tricks to avoid mandatory cleanup requirements. We started identifying these problems shortly after Coal Ash Rule implementation began,[89] and EPA has now started to flag this illegal activity in recent compliance letters and determinations.[90] We briefly discuss each form of noncompliance here, and they come up again in the case studies of the nation's most contaminated sites described in the next section.

1. Ignoring Half of the Problem by Selectively Applying the Rule

The Violation: Since the Coal Ash Rule is self-implementing, coal plant owners make the initial determination about which coal ash disposal units are subject to the rule. Utilities save money and avoid cleanup obligations by reducing the number of regulated ash disposal units they admit to having. Yet the federal rule is clear. Any pond or landfill that received ash after October 2015 is subject to the rule. In addition, any pond that contained coal ash and water after that date (but did not receive any new ash) is characterized as an "inactive surface impoundment" and is also subject to the rule.

Multiple owners have failed to identify all inactive surface impoundments at their sites. As EPA noted in its letter to Duke Energy regarding the Gallagher Generating Station in Indiana,

- An "impoundment" is a unit "designed to hold an accumulation of CCR and liquid." 40 C.F.R. § 257.53, and
- "If a CCR surface impoundment contains liquid because its base (or any part of its base) is in contact with groundwater, it would meet the definition of an inactive CCR surface impoundment."[91]

Any coal ash pond that continues to contain groundwater or wet ash is therefore subject to the Coal Ash Rule, regardless of when it stopped receiving new ash.

Other owners artificially divide their disposal areas to exclude large portions of their coal ash from regulation. For example, GenOn has divided the large coal ash landfill at their Brandywine facility in Brandywine, Maryland into four areas or "phases." GenOn is only complying with the Coal Ash Rule with respect to Phase II, which makes up just 29 acres of the 219-acre landfill. In other words, GenOn is failing to comply with the Coal Ash Rule with respect to nearly 90 percent of the site. However, the facts show that the Brandywine landfill is a single landfill:

- EPA identifies the site as a single landfill.[92]
- The prior owner of the site described it as a single landfill in legal briefing.[93]
- The landfill operates under one NPDES permit with a single leachate treatment system and discharge outfall.[94]

GenOn is therefore violating the Coal Ash Rule by artificially treating one landfill as multiple landfills to avoid the requirements of the rule.

Finally, utilities are allowed to ignore old ponds and landfills that are not covered by the Coal Ash Rule. The Rule exempts landfills that have not received waste after the effective date of the regulation (October 17, 2015).[95] It also exempts ash ponds that stopped receiving ash and removed all liquid before that date.[96] Based on industry reporting, we estimate that there are at least 300 older disposal units that are currently exempt. Consequently, the Rule's dangerous loophole leaves nearly as much toxic coal ash unregulated as regulated.

Harm Caused: If plant owners exclude coal ash dumps from the scope of the Coal Ash Rule, these dumps will not be monitored or cleaned up, and the public may not even know that they exist. In addition, efforts to restore local groundwater quality will be undermined by a patchwork approach to coal ash deposits.

2. Leaving Coal Ash in Groundwater

The Violation: According to EPA, "surface impoundments or landfills cannot be closed with coal ash in contact with groundwater."[97] Yet scores of coal plant owners have proposed exactly that. For example, at the Clifty Creek plant in Indiana, the Indiana Kentucky Electric Corporation plans to close two ash ponds without removing the ash, even though, according to EPA, "the base of the CCR impoundments intersects with groundwater."[98] Closure with ash below the water table is prohibited because,

> [i]n situations where the groundwater intersects the CCR unit, water may infiltrate into the unit from the sides and/or bottom of the unit because the base of the unit is below the water table. In this scenario, the CCR will be in continuous contact with water. This contact between the waste and groundwater provides a potential for waste constituents to be dissolved and to migrate out of (or away from) the closed units.[99]

At Clifty Creek, EPA determined that the closure plan was insufficient. In order for these ponds to be closed in place, the owner would have to remove all of the groundwater from the coal ash and prevent groundwater from re-entering the impoundments in the future.[100]

The Scope of the Violation: A large number of utilities are running afoul of the law. Industry reports and EPA analysis reveal that 200 unlined surface impoundments in 30 states plan to close without removing the ash, even though the ash is within five feet of groundwater.[101] At many of these sites, the ash is actually sitting in groundwater, and toxic releases will continue for generations. The list of these units is provided in Appendix D of this report.

Seventy percent of the plants where coal ash might be left sitting in groundwater after closure are located in disproportionately low-income neighborhoods or communities of color, where residents typically lack resources to address noncompliance or test their water sources.[102]

The Coal Ash Rule does not require owners of existing landfills to disclose the distance between the landfill and groundwater, so the extent to which this problem affects landfills is unknown.

Harm Caused: When ash remains in contact with groundwater, toxic chemicals like arsenic continue to leach into the groundwater as it moves laterally through the ash, even if the ash dump is capped. The contaminated groundwater will flow off-site and may end up in drinking water wells or in nearby water bodies at dangerous levels that harm human health or aquatic life. A coal ash dump that sits in groundwater may leak for decades and poison water sources long after the pond is closed. In fact, an industry study found that contamination actually *increased* after one coal ash pond was closed without removing the ash, because groundwater started moving more slowly, remaining in contact with ash for longer periods of time.[103]

3. Deceptive Analyses of Groundwater Data

a. Inappropriate Background Wells that Hide Groundwater Contamination

The Violation: Some utilities use background wells that do not, as the Coal Ash Rule requires, "[a]ccurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit."[104] Some of the wells that owners use as background wells are not upgradient of the regulated unit and are therefore likely to be influenced by contamination leaching out of the unit. At the Calaveras power Station in Texas, EPA noted that five of the site's seven purported background wells were not upgradient of the disposal units they monitored, and therefore not "proper background monitoring well[s]."[105]

Some utilities install "background" wells directly through the coal ash at the edge of a unit. At the Clifty Creek plant in Indiana, EPA noted that two of the wells designated by the owner as upgradient of the West Boiler Slag Pond were installed in coal ash, contaminated by coal ash, and not reliable upgradient wells.[106]

Another example is the Stanton Energy Center in Orange County, Florida. For purposes of the Coal Ash Rule, the owners only monitor four wells. The most contaminated well, well MW-A, has very high levels of arsenic, cobalt, fluoride, lead, lithium, radium, and selenium. Although this well is clearly downgradient of the landfill,[107] the owners designated it as "upgradient." Since none of the other wells are as contaminated as MW-A, there are no statistically significant exceedances. But this is not the only problem at Stanton – the owners have also placed the other three wells over half a mile from the landfill, and according to the latest groundwater monitoring report, "[t]he groundwater travel time from the northern edge of active cell of the new landfill to any compliance monitoring well is expected to be greater than 17 years."[108] These wells cannot possibly provide evidence of whether the landfill is leaking. More importantly, there are no monitoring wells along the eastern downgradient edge of the landfill. The monitoring network for the Stanton landfill is useless; it violates the Coal Ash Rule in multiple ways, and it does not provide meaningful information.

Harm Caused: When plant owners illegally install "background" wells that are already contaminated by coal ash, they can avoid cleanup requirements. Cleanups are triggered, according to the rule, when downgradient wells (wells placed to detect water passing the boundary of a landfill or pond) show a statistically significant increase in coal ash contaminants when compared to wells reflecting the original condition of the groundwater. If the polluter intentionally compares downgradient well water to dirty background wells, there will be no statistically significant difference between the two, and consequently no cleanup mandate. If the system is gamed in this way, polluters can continue to pollute indefinitely.

b. Intrawell Analysis of Groundwater Data

The Violation: The Coal Ash Rule requires owners to look for contamination by comparing the groundwater potentially affected by a coal ash unit (in downgradient wells) to groundwater unaffected by a coal ash unit (in upgradient background wells).[109] This kind of comparison can be described as an "interwell" analysis, because it compares data between wells.

Many owners do something different, and it is almost always illegal. Instead of comparing downgradient wells to upgradient wells, they analyze the data for each well in isolation. In this type of "intrawell" analysis, owners look for changes in each well over time. The only statistical change that might trigger more monitoring or cleanup is a significant upward trend in pollutant concentrations. This does not work at most coal plants because the groundwater is already contaminated. For example, it is not uncommon to see boron or lithium concentrations five or ten times higher than background levels, but not changing significantly over time. This is a clear sign of ongoing contamination, but an intrawell analysis would not pick it up.

EPA recently affirmed that intrawell analyses are generally prohibited. The only situation in which they might be appropriate is a new disposal unit, where each well can be monitored prior to the introduction of any coal ash. As stated by EPA in reference to a bottom ash pond at Tecumseh Energy Center in Kansas,

> samples that characterize background groundwater quality must always be taken from a well unimpacted by releases from the CCR unit. Like many other CCR units, the [bottom ash pond] operated for decades (since construction in 1968) prior to becoming regulated by the CCR Rule. The 2019 Annual [groundwater monitoring report] indicates in a footnote to Table II that data collected through June 2019 were used to characterize background in the intrawell statistical analysis of the October 2019 groundwater data. Samples would need to have been obtained from these wells long before that time in order for them to be known to be unimpacted by the CCR unit. Therefore, intrawell data comparisons are inappropriate to demonstrate compliance with the requirements of the CCR Rule at the [bottom ash pond].[110]

In short, for existing disposal units, intrawell statistical comparisons cannot be used.

The Scope of the Violation: Of 746 coal ash dumps regulated by the Coal Ash Rule, at least 108 (14 percent) use intrawell analysis. Of the 20 sites reviewed by Downstream Strategies and GeoHydro, Inc, seven are using the practice. See Appendices B and C. Nearly 70 percent of the dumps that use intrawell analysis are still in detection monitoring, which means that they currently have no obligation to clean up contaminated groundwater and are not even monitoring the groundwater for heavy metals. To look at it another way, units that implement intrawell monitoring are over 2.5 times more likely to avoid assessment monitoring – thus avoiding cleanup obligations – than coal ash landfills and ponds that are complying with the Coal Ash Rule's monitoring requirements.

Harm Caused: At many coal plants, it is obvious from past industry monitoring that coal ash dumps have contaminated groundwater. Yet plants employing intrawell statistics usually avoid cleanup obligations.[111] Thus, a plant can indefinitely avoid cleanup and continue to pollute if it continues to use illegal intrawell statistical analysis.

4. Illegally Shifting the Blame Using Flawed Alternate Source Demonstrations

The Violation: The Coal Ash Rule allows owners to ignore statistical evidence of contamination if they can demonstrate that the contamination was caused by an "alternate source" and not by the regulated coal ash pond or landfill.[112] According to EPA,

> A successful ASD [alternate source demonstration] will demonstrate that a source other than the CCR unit is responsible for the SSI [statistically significant increase]. To rebut the site-specific monitoring data and analysis that resulted in an SSI, an ASD requires conclusions that are supported by site-specific facts and analytical data. Merely speculative or theoretical bases for the conclusions are insufficient.[113]

Many owners, however, take advantage of this exception by simply saying, in effect, "it isn't coming from the ash unit." This does not fulfil the Coal Ash Rule's mandate because it does not identify a source of contamination.

For example, at the Spurlock Station Landfill in Kentucky, the owner prepared Alternate Source Demonstrations, but according to EPA "[n]o alternative source was identified in any of the ASDs other than natural variability."[114] Similarly, the owner of the Calaveras plant in Texas claimed that "natural variability" was responsible for the contamination, but "did not identify a particular naturally occurring source."[115] In both cases, EPA determined that the ASDs were insufficient, and required each site to initiate assessment monitoring.

The Scope of the Violation: Of the 746 coal ash ponds and landfills regulated under the Coal Ash Rule, nearly one third (235 disposal units) have completed an Alternate Source Demonstration claiming that a source other than the coal ash pond or landfill is responsible for the coal ash constituents contaminating the plant's groundwater. Without reviewing each one in detail, it is hard to know whether any are legitimate, but we know of many that are not, including the Spurlock Station and Calaveras Station ASDs discussed above, and ASDs at over half of the sites (13 sites) reviewed by Downstream Strategies and GeoHydro, Inc. See Appendices B and C.

Harm Caused: When owners shift the blame with an Alternate Source Demonstration, they avoid any obligation to clean up the contaminated groundwater or the source of contamination. If they make this claim early in the process, the owners can avoid monitoring for the most dangerous contaminants of coal ash (the toxic metals sampled in assessment monitoring). In both scenarios, the coal ash dumps will continue to leak unabated. This is a serious problem because nearly a third of all coal plants are claiming an alternate source for the coal ash contaminants in their groundwater.

5. Flawed Cleanup Schemes that Fail to Restore Groundwater Quality

a. Failure to Characterize the Nature and Extent of Contamination

The Violation: When assessment monitoring shows significant evidence of contamination, sections 257.95(g)(1)(i) through (iii) of the Coal Ash Rule require owners and operators to "characterize the nature and extent of the release" by installing additional wells to define the contaminant plume, "collect data on the estimated quantity of material released," and install at least one additional well at the downgradient facility boundary, all generally within 180 days of detecting the contamination.[116] Many owners fail to do these things. For example, at the Clifty Creek multiunit system, EPA determined that "there are not enough wells installed to characterize the release from the [unit]," the owner "appears to have failed to estimate the mass of the release," and the owner also failed to "install a monitoring well at the downgradient facility boundary."[117]

In addition, section 257.95(g)(1)(ii) "requires that the investigation of a release include estimation of the mass of the release and collection of specific information about the levels at which Appendix IV constituents are present."[118] EPA recently faulted the owners of the Mountaineer plant in West Virginia for failing to estimate the quantity of lithium released from onsite ash disposal units.[119]

Harm Caused: An effective cleanup depends on thorough investigation of the nature and extent of both the contamination released and the source of the contamination. Polluters must determine the size of the contaminated groundwater plume, where the contamination is heading, the speed of the flow, and the amount of contamination that has leaked from the coal ash dump. It is also critical for the plant owner to determine if there are drinking water wells nearby that are impacted or threatened. Lastly, owners must determine whether off-site receptors (including nearby water bodies and the aquatic life they sustain) have been harmed. Knowing the extent of contamination is critical because the majority of coal plants are within 500 feet of a waterbody, because many fenceline communities rely on groundwater and other vulnerable water sources for their drinking water, and because a remedy will only be successful if it is designed to address the full extent of contamination.

b. Inadequate consideration of required factors in developing a remedy

The Violation: The Coal Ash Rule requires owners, when selecting a final remedy, to consider a number of factors including effectiveness, protectiveness, the reduction of existing risks, any residual risks, time until full protection is achieved, reliability, and "ease or difficulty of implementing a potential remedy."[120] Many owners fail to consider all of these factors, or they prepare a pro forma review that only superficially addresses the factors. This is particularly true with regard to the "time until full protection is achieved," something that owners very rarely estimate.

For example, at Clifty Creek the owner merely stated that "[a] groundwater model would be useful to more accurately predict the anticipated time required to complete the remediation,"[121] and "as groundwater modeling has not been performed for the site, an accurate estimate cannot be developed at this time."[122] In other words, the owner doesn't know how long it would take to achieve full protection because it failed to perform the necessary groundwater modeling. The owner could have and should have done so, and it should have provided a more meaningful assessment of time frames.

Harm Caused: Most coal plant owners have not developed an assessment of corrective measures (a menu of cleanup options) that meets the requirements of the Coal Ash Rule. Owners' failure to develop complete, compliant, and feasible cleanup options delays the effective cleanup of coal ash contamination. In addition, the development of the cleanup options is intended to be a public process. The Rule includes a requirement that the plant owner convene a public meeting to discuss the options and a requirement that the owner take the views of the community into consideration before selecting a final remedy.[123] The failure to include critical information, such as the length of time it will take to restore groundwater to original conditions, leaves the public in the dark as to the magnitude of the harm occurring in their community, and prevents a thoughtful assessment of various cleanup options.

6. Delaying Cleanup by Failing to Select a Final Remedy

The Violation: The Coal Ash Rule requires owners to select a remedy "as soon as feasible" after completing an assessment of corrective measures (cleanup plan).[124] Most owners are not doing this. At Clifty Creek, according to EPA, "it was feasible to select a remedy as soon as December 2019." Yet the owner has still not done so. Instead, the owner argued that there were "data gaps" that precluded them from selecting a remedy and stated that they would wait until after the coal ash unit was closed. Neither excuse is legal or holds water. According to EPA, much of the missing data could have been collected earlier, and the owner "presented no evidence of any progress toward collecting any of these data," but in any case, "it was feasible to select a remedy prior to gathering the data."[125] Regarding the owner's plan to wait until after closure of the leaking unit to select a remedy, EPA observed that "[c]losure of a CCR unit is not progress toward selection of a remedy. Delaying remedy selection until after closure of the LRCP does not comply the requirement to select a remedy 'as soon as feasible.'"[126]

The Scope of the Violations: For 302 ash dumps at 144 plants, plant owners have submitted plans discussing cleanup options. But plant owners have only committed to cleanup actions for 62 of these 302 dumps. Further, the majority of these cleanup plans do not actually call for remediating groundwater, as explained in the section below. It is also important to remember that hundreds of coal ash dumps have avoided the cleanup process altogether (as described elsewhere in this section), even when the data show clear evidence of contamination.

Harm Caused: Despite the clear mandate of the Coal Ash Rule to select a remedy "as soon as feasible," very few plant owners have selected remedies and initiated cleanup. Most owners are allowing hazardous chemicals from coal ash dumps to continue to contaminate the groundwater and are simply sitting by as contaminated groundwater flows offsite. In fact, for 82 percent of the 240 coal ash dumps where industry is has violated the rule by failing to select a remedy "as soon as feasible," three or more years have passed without the polluter selecting a final remedy.

7. Using Do-Nothing "Remedies" that Fail to Restore Groundwater

The Violation: Once owners select a remedy, the question becomes whether that remedy is adequate to restore groundwater quality. Utilities frequently claim that they will address contamination with something called Monitored Natural Attenuation, or MNA. But what industry calls MNA is typically nothing more than indefinite groundwater monitoring without a cleanup. In other words, the companies are just watching pollution leak out of the units and flow away. This is not really a remedy.

MNA, viewed correctly, is a term of art that describes the final stage of site remediation that uses natural processes to reduce (or "attenuate") residual contamination. Elements of a proper MNA plan include biodegradation, radioactive decay, chemical or biological stabilization, transformation, destruction, or other natural process that "under favorable conditions . . . reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater."[127]

Regardless of the type of MNA, it is not a stand-alone remedy, but a rather component of a remediation process that must begin with controlling the source of the pollution (the coal ash dump). According to EPA, "[s]ource control measures include removal, treatment, or containment, or a combination of these approaches."[128]

MNA is not effective for cleaning up coal ash contamination. As EPA observes, MNA through degradation "is not a viable process for most inorganic contaminants in groundwater," including the metals commonly found near coal ash sites, because these metals simply do not degrade.[129] MNA through immobilization is also not very effective, because several abundant coal ash contaminants, such as boron[130] and lithium,[131] have high mobility – they cannot be trapped by soil particles. The Coal Ash Rule requires polluters to "remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible,"[132] and MNA cannot accomplish that.

In short, MNA is simply not an "appropriate" part of a remedy at coal ash sites.[133] As EPA recently stated in its Proposed Denial for the Ottumwa Generating Station:

> MNA . . . would not be assessed favorably in either the ACM [cleanup plan] or any remedy selection report with respect to 40 C.F.R. § 257.97(b)(4), which requires that remedies "remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible.[134]

Moreover, most coal ash cleanup plans that claim to be using MNA are only doing the "M" part – monitoring. What industry calls "attenuation" is in fact dilution and dispersion, or effectively abandoning treatment to allow contamination to gradually spread out in the environment. According to EPA, "dilution and dispersion generally are not appropriate as primary MNA mechanisms," because they are not really attenuating the contamination.[135] In situations like this, source control and active remediation become paramount, and the dilution and dispersion must be seen as no more than a "polishing step."[136]

As an example of how industry misuses MNA, consider the Clifty Creek station in Indiana again. Here, where molybdenum is a major pollutant of concern, the owner's consultant states that "dispersion and dilution of molybdenum would likely be a major factor in natural attenuation."[137]

According to EPA, this is not good enough:

> [T]he constituents in Appendix IV to part 257 [] are atoms, and atoms do not degrade in nature. Dispersion or dilution serves to expand the area of contamination, albeit at lower concentrations. This spread of groundwater contamination is precisely the type of environmental impact the CCR corrective action program was developed to address. Because dilution and dispersion do not degrade the contaminants or change them to a less toxic form and do not remove them from the environment, MNA through dilution and dispersion fails to comply with 40 C.F.R. § 257.97(b)(4).[138]

Any cleanup plan that includes MNA must also include source control and active remediation. Simply waiting for the contamination to go away is not a remedy.

The Scope of the Violation: Of the very small number of plants (37) that have chosen a final remedy for at least one disposal unit, 26 are not planning to treat the groundwater, but are instead relying on MNA.

Harm Caused: If owners choose MNA as a remedy, without also implementing effective source control and active remediation, then groundwater will not be restored and contamination will continue indefinitely. If anything, passive MNA will make the situation *worse* by allowing contaminants to migrate from a relatively contained unit like a coal ash pond or landfill into uncontained groundwater, surface water, and potentially drinking water.

E. The Most Contaminated Sites in the U.S.

We worked with Downstream Strategies and Geo-Hydro, Inc. to review implementation of the Coal Ash Rule at 20 highly contaminated sites, including the ten most contaminated coal ash sites in the country. Their reviews are attached to this report as Appendices B and C. To briefly summarize what they found:

- None of the twenty sites had an adequate monitoring well network, usually because there were too few wells and large unmonitored gaps;
- Most sites appear to be using upgradient or background wells that are contaminated by coal ash, which makes them unsuitable for comparisons with downgradient monitoring data and results in an avoidance of adequate monitoring and cleanup;

- Most sites rely on flawed alternate source demonstrations to stay out of assessment monitoring and avoid cleanup;
- Roughly half of the sites have at least one disposal unit closing in place despite being dangerously close to, or in, groundwater;
- Seven plants are using intrawell data analysis, which is not allowed for existing units, to hide evidence of contamination;
- Several sites have failed to select a remedy, failed to estimate the mass of contaminants released, and failed to estimate how long a remedy will take to restore groundwater;
- At least five sites have one or more coal ash units that should be regulated, but are not acknowledged by the owners; and
- Several sites are relying heavily on monitored natural attenuation as a remedy or component of a remedy.

We also ranked all 292 coal plants by severity of contamination, as we did in 2019. Our ranking methodology is described in Appendix A, and a complete ranking is contained in Table A4. It is important to note that the lower-ranked sites are not necessarily "clean." In many cases, the data are distorted by too few wells (which fail to characterize the contaminant plumes) and/or by contaminated upgradient wells, and the evidence of contamination is hidden. See, for example, the discussion of the Curtis Stanton station in Florida in section D.3(a) of this report, and in Appendix A, Section 1. If we took the owner's designation of upgradient wells at face value, then Curtis Stanton would be the lowest-ranked site on our list. Given the very clear evidence that the so-called upgradient well is actually downgradient, we treated it as such, and the site is now ranked 118th.

Table 3 briefly summarizes the ways in which the ten most contaminated plants may be out of compliance with the Coal Ash Rule. The "top ten" list has changed slightly since our last report in 2019 (new data from the Reid Gardner plant in Nevada have placed that site in the top ten). The severity of contamination, including the pollutants that exceed health-based guidelines and by how much, is summarized in Table A4.

In sum, none of these plants are on track to complete an adequate, comprehensive remedy. In fact, the selection of a final remedy has been delayed in most cases. Moreover, all ten sites appear to be violating the Coal Ash Rule with inadequate groundwater monitoring and analysis, failing to address all known sources of contamination, or otherwise avoiding comprehensive cleanup.

TABLE 3: THE TEN MOST CONTAMINATED SITES IN THE UNITED STATES

Plant	Coal Ash Disposal Unit	Pollutants of concern and magnitude of exceedance above health-based guidelines[139]	Rule Implementation Stage	Remedy Selected	Areas of noncompliance / Notes
San Miguel (TX)	Ash Pile	Arsenic (x8), Beryllium (x127), Cadmium (x114), Cobalt (x488), Fluoride (x2), Lithium (x90), Radium (x3), Selenium (x8)	Detection Monitoring	No	High levels of contamination in groundwater near ash pile may be from lignite (coal) pile
	Ash Ponds	Arsenic (x5), Beryllium (x76), Boron (x35), Mercury (x3), Radium (x6), Thallium (x4)	Remediation Underway	Yes	Incomplete monitoring network; insufficient assessment of corrective measures
	Equalization Pond	Boron (x41), Thallium (x4)		Yes	
Reid Gardner (NV)	Impoundment 4B	Antimony (x1), Arsenic (x121), Boron (x84), Cadmium (x2), Cobalt (x16), Fluoride (x3), Lead (x8), Lithium (x161), Molybdenum (x87), Selenium (x1), Thallium (5)	Detection Monitoring/ Coal Ash Removed in 2017	No	Missing groundwater data; intrawell data analysis; contaminated upgradient wells; flawed alternate source demonstrations
	Impoundment E1	Thallium (x4)		No	
	Mesa Impoundments		Detection Monitoring	No	
	Mesa Landfill	Boron (x5)	Detection Monitoring	No	
Naughton (WY)	South Ash Pond	Arsenic (x5), Beryllium (x2), Cobalt (x2), Lithium (x185), Selenium (x150), Thallium (x9)	Assessment Monitoring	No	Although these ponds are likely leaking, the owners attribute contamination to FGD Pond 2, and are not pursuing cleanup
	North Ash Pond	Cobalt (x3), Lithium (x121), Radium (x1), Selenium (x24)	Detection Monitoring	No	
	FGD Pond 1	Boron (x16), Selenium (x54)	Remediation Underway	Yes	
	FGD Pond 2	Cobalt (x2), Lithium (x195), Radium (x1), Selenium (x54)	Assessment of Corrective Measures	No	Remedy selection overdue
	FGD Pond 4	Thallium (x9)	Detection Monitoring	No	
	FGD Pond 5	Boron (x2), Cobalt (1), Lithium (x155), Selenium (x24), Thallium (x2)	Detection Monitoring	No	New unit, so contamination may be from other sources
Jim Bridger (WY)	Ash Landfill	Antimony (x1), Boron (x9), Cadmium (x1), Lead (x2), Molybdenum (x2), Selenium (x3), Thallium (x11)	Detection Monitoring	No	Alternate Source Demonstrations attribute contamination to the adjacent FGD ponds

	FGD Pond 1	Arsenic (x4), Cadmium (x3), Cobalt (x92), Fluoride (x3), Lithium (x164), Molybdenum (x10), Radium (x2), Selenium (x85), Thallium (x3)	Assessment of Corrective Measures	No	Remedy should have been selected by now
	FGD Pond 2	Arsenic (x4), Boron (x1), Cadmium (x1), Cobalt (x6), Lead (x4), Lithium (x164), Molybdenum (x10), Selenium (x85), Thallium (x11)	Assessment Monitoring	No	Upgradient wells are very contaminated, which hides any statistical evidence of downgradient contamination from this large, unlined impoundment
Allen (NC)	Multi-unit system	Arsenic (x7), Beryllium (x6), Boron (x1), Cadmium (x1), Cobalt (x466), Lithium (x12), Selenium (x5), Thallium (x1)	Remediation Underway	No	Duke is removing the ash from the old impoundment and moving it to a lined landfill nearby
New Castle (PA)	Ash Landfill	Arsenic (x372), Boron (x4), Cobalt (5), Lithium (54), Molybdenum (1)	Detection Monitoring	No	Owners attribute contamination to historic ash pond located beneath the landfill
	North Ash Pond	Arsenic (x8)	Coal Ash Removed in 2018	No	
	Historic Ash Pond	[same as *Ash Landfill above – unclear how much contamination is coming from each unit*]	[*owner believes the unit is exempt from the Coal Ash Rule*]	No	This unit is subject to the Coal Ash Rule as an "inactive surface impoundment"
Brandywine (MD)	Landfill	Arsenic (x5), Beryllium (2), Boron (x29), Cobalt (x47), Lithium (x222), Molybdenum (x111), Selenium (x9)	Detection Monitoring	No	Artificially narrow application of the Coal Ash Rule and impermissible use of intrawell data analysis
R.D. Morrow (MS)	Landfill	Beryllium (x2), Boron (x19), Lead (x1), Lithium (x167), Molybdenum (x176), Thallium (x1)	Assessment of Corrective Measures	No	Remedy selection is overdue; inadequate groundwater monitoring
	Surface Impoundments	Arsenic (x3)	Coal Ash Removed in 2021	No	
Hunter (UT)	Landfill	Boron (x16), Cobalt (x28), Lithium (x210), Molybdenum (x11), Radium (x2), Selenium (x7)	Remediation Underway	Yes	Persistent contamination despite implementation of a remedy
Allen (TN)	East Ash Disposal Area	Arsenic (x294), Boron (x4), Fluoride (x1), Lead (x3), Molybdenum (x9)	Remediation Underway	Yes	TVA has failed to implement the Coal Ash Rule at the West Ash Pond, though it is closing that unit by removal
	West Ash Pond	Arsenic (x9), Boron (x11), Chromium (x1), Cobalt (x2), Molybdenum (x55) [*see note*][140]	[*owner believes the unit is exempt from the Coal Ash Rule*]	No	

1. San Miguel (TX)

San Miguel Electric Cooperative's San Miguel Electric Plant, located south of San Antonio, Texas, has three regulated coal ash units. The two larger units – known as the Ash Ponds unit and the Equalization Pond – are being remediated according to a plan that the owner selected in 2020. The remedy includes retrofitting the ash ponds, closing the equalization pond, and pumping contaminated groundwater back into the ash ponds. But the equalization pond has been closed in place, despite the fact that it may be in contact with groundwater (according to the EPA).[141] If there is contact between ash and groundwater, then the remedy will not work.

In addition, the underlying groundwater monitoring network is flawed in ways that might miss parts of the contaminant plume and inflate the "background" concentrations used to set site-specific cleanup standards. Appendix B includes a more thorough discussion of these issues. The owners have also failed to estimate how long it will take to restore groundwater, saying only that it will "likely exceed 10 years."[142]

The third disposal unit is a relatively small (1 acre) "ash pile." The groundwater around the ash pile shows extremely high levels of contamination that may be coming from other sources. In 2018, the owners prepared an Alternate Source Demonstration suggesting that some of the detection monitoring results could be attributed to the large lignite pile immediately adjacent to the ash pile.[143] As a result of this process, the owners have not initiated assessment monitoring, and have not attempted to explain the high concentrations of Appendix IV constituents like arsenic, beryllium and lithium. It is possible that these constituents are coming from the lignite pile, but regardless of the source the owner should be addressing the contamination through site-wide corrective action.

2. Reid Gardner (NV)

NV Energy's retired Reid Gardner station in Nevada is located adjacent to the Moapa Indian Reservation. It is also situated on both sides of the Muddy River, which is home to eight endemic species of fish and invertebrates.[144] Contaminated groundwater from Reid Gardner generally flows in the direction of the Muddy River.[145]

Despite having some of the most contaminated groundwater in the country, including lithium concentrations as high as 9.7 mg/L (243 times greater than the groundwater protection standard),[146] the owner of Reid Gardner (NV Energy) has so far failed to initiate corrective action pursuant to the Coal Ash Rule. This is the result of several forms of noncompliance and an incomplete assessment of sitewide contamination.

To begin with, NV Energy has never conducted baseline sampling for Appendix IV constituents (arsenic, cobalt, lithium, etc.) at the Mesa Landfill or the Mesa Surface Impoundments, in violation of section 257.94(b) of the Coal Ash Rule. This means that we have no information about the levels of most toxic metals in these wells. This not only violates the Coal Ash Rule and deprives the public of important information about groundwater quality, it also makes it harder to determine whether contamination is related to the regulated units, other onsite sources of coal ash, or some other source.

It appears that some of the purportedly upgradient wells are either not upgradient, or they are otherwise contaminated by coal ash. For example, the concentrations of arsenic, boron, lithium and sulfate in well P23-SR near Surface Impoundment E1 are all hundreds of times higher than health-based guidelines and much higher than concentrations found anywhere else on the site. This well is located in the middle of a complex of coal ash disposal areas, immediately between Pond D and Pond E.[147] The well could have been installed directly in ash, but even if it wasn't, it is so close to the edges of both Ponds D and E that it is likely to be influenced by one or both units.

Next, NV Energy fails to properly analyze the groundwater monitoring data because intrawell statistics are used to mask spatial evidence of contamination. As discussed above, this plainly violates the Coal Ash Rule – NV Energy should be comparing data from downgradient wells to data from suitable upgradient wells. If it did so, it would find evidence of contamination that would lead to corrective action.

Even when using the wrong statistical approach, NV Energy routinely finds evidence of contamination. For example, at the Mesa Landfill, NV Energy has found statistically significant increases (SSIs) for boron, fluoride, pH, and TDS. This means that these pollutants are increasing in concentration. Yet it avoids assessment monitoring in two ways:

- First, NV Energy routinely engages in a "resampling" process – if it finds statistical evidence of an exceedance (i.e., in detection monitoring, a "statistically significant increase"), it resamples the groundwater to see if they find the same thing a second time. This is not how the Coal Ash Rule works. Any sampling event that shows evidence of contamination should trigger the next phase of the groundwater monitoring and corrective action process.[148]

- Second, for SSIs that remain after resampling, NV Energy uses flawed Alternate Source Demonstrations to attribute the contamination to natural sources. At the Mesa Landfill and Impoundments, groundwater monitoring data for Appendix IV constituents would help establish whether contamination is coming from the regulated units, other onsite sources of coal ash, or something else. But NV Energy has failed to collect the data, even though it was required to do so. NV Energy's alternate source demonstrations fail to show where the contamination is coming from and cannot be used to justify the owner's noncompliance.

Surface Impoundments 4B and E1 have been closed by removal, yet the groundwater near these impoundments remains highly contaminated, due to legacy contamination from the former ponds, contamination from adjacent ponds, contamination from other onsite sources of coal ash, or some combination of the above. NV Energy has walked away from this problem by discontinuing groundwater monitoring after 2019. This violates section 257.102(c) of the Coal Ash Rule, which states that "CCR removal and decontamination of the CCR unit are complete when constituent concentrations throughout the CCR unit and any areas affected by releases from CCR unit have been removed and groundwater monitoring concentrations do not exceed [groundwater protection standards]."

Finally, we know that NV Energy's implementation of the Coal Ash Rule has only been a spotty approach to site-wide contamination. The site has had over 100 groundwater monitoring wells (see EIP's Ashtracker website at https://ashtracker.org/facility/72/reid-gardner-generating-station), and roughly 20 landfills and surface impoundments that may have contained coal ash, yet it is currently implementing the rule at just one landfill and four ponds, and only collecting data from 37 monitoring wells.

In short, the groundwater at Reid Gardner is grossly contaminated with coal ash constituents, almost certainly coming from various onsite sources of coal ash. Again, the groundwater at this site is generally migrating toward the Muddy River,[149] which is home to eight endemic species of fish and invertebrates, and the river is likely to be severely impacted by this contamination. It is incumbent upon NV Energy to clean up the plant property through a site-wide corrective action process that accounts for all sources of coal ash and restores groundwater and surface water quality.

3. Naughton (WY)

There are six regulated coal ash units at PacifiCorp's Naughton Power Plant near Kemmerer, WY, including two ash ponds (the South Ash Pond and the North Ash Pond) and four FGD ponds (FGD Ponds 1, 2, 4, and 5). All six units show some signs of contamination, but each unit has unique characteristics that affect how the Coal Ash Rule applies. In general, the site suffers from an inadequate monitoring network, some units may be closing in place despite being in contact with groundwater, and remedy selection for the most problematic unit (FGD Pond 2) is behind schedule. See Appendix B.

PacifiCorp is actively remediating one unit, FGD Pond 1, by capping in place with groundwater pumping and treatment (which consists of routing contaminated groundwater to FGD Pond 5).[150] PacifiCorp expects this to attain compliance with groundwater protection standards within eight years.[151]

At FGD Pond 2, which is thought to be the source of much of the contamination near the adjacent ash ponds (see below), PacifiCorp has completed an Assessment of Corrective Measures, but has not yet selected a remedy.[152] PacifiCorp's three-year delay in selecting a remedy since completion of the Assessment of Corrective Measures in 2019 violates the Coal Ash Rule's requirement to select a remedy as soon as feasible.

Detection monitoring around FGD Pond 4 has not produced any statistically significant increases, so this unit remains in detection monitoring.

FGD Pond 5 is a new unit, built in 2017 and first used in November 2017. PacifiCorp is using intrawell data analysis for this unit, comparing data from each well to older data from the same well to look for changes in groundwater quality over time. While this kind of analysis is generally prohibited the Coal Ash Rule, this is one situation where it may be appropriate. This is because the first few rounds of monitoring data pre-date the use of the ash pond and therefore reflect the condition of local groundwater before the unit was put into service. Groundwater monitoring has shown increases in chloride and total dissolved solids, but the owners attribute this to FGD Pond 2, and have not initiated assessment monitoring.

At the South Ash Pond, PacifiCorp went through detection monitoring and assessment monitoring, found exceedances in both phases, and initiated an Assessment of Corrective Measures. Yet the document entitled "Corrective Measures Assessment" is not what it appears to be. Instead, it concludes that the contamination is coming from FGD Pond 2, and states that "[t]he South Ash Pond will continue with Assessment monitoring but will not proceed with corrective measures."[153] This plainly violates the CCR rule, which lists numerous requirements for an Assessment of Corrective Measures, all of which are lacking here.[154] Along the way, PacifiCorp's consultants make contradictory statements about lithium, arguing that samples from the pond itself both do and do not exceed the groundwater protection standard (in fact, they do).[155] Since the South Ash Pond appears to be leaking unsafe levels of cobalt, lithium and selenium into local groundwater, PacifiCorp should be remediating the unit.

At the North Ash Pond, where downgradient concentrations of multiple Appendix III and Appendix IV constituents exceed upgradient concentrations (suggesting that the ash pond is leaking), the owners prepared alternate source demonstrations attributing the contamination to FGD Pond 2.[156]

In sum, Pacificorp is illegally delaying cleanup action at the site's biggest polluting dump, FGD 2, and has illegally failed to complete a cleanup plan for the South Ash Pond. As a result of these violations, toxic ash constituents continue to pollute groundwater at high levels and polluted groundwater continues to flow offsite.

4. Jim Bridger (WY)

PacifiCorp's Jim Bridger power plant near Point of Rocks, WY has three actively regulated coal ash units, including FGD Ponds 1 and 2 and a landfill. A third FGD pond is in the process of being built. There is compelling evidence of contamination at all three existing coal ash units, yet the owners are only remediating one.

PacifiCorp dewatered and closed FGD Pond 1 over the 2016-2020 time period, though it noted in 2020 that "additional dewatering is planned for FGD Pond 1 to address impacts to groundwater due to seepage through the FGD Pond 1 clay liner system."[157] As of May 2022, PacifiCorp had installed horizontal groundwater capture wells, but had not yet selected a final remedy.[158]

FGD Pond 2 is a large, 260-acre pond located immediately adjacent to FGD Pond 1. PacifiCorp acknowledges that this pond is unlined (it does not even have a rudimentary soil liner) and that "[s]eepage from the current FGD Pond 2 has created a groundwater plume beneath the general area of the disposal ponds (FGD Ponds 1 and 2)."[159] In addition, the site has been in assessment monitoring since 2018 because detection monitoring found evidence of leakage – elevated concentrations of boron, chloride and pH.[160]

Even though FGD Pond 2 is clearly leaking, PacifiCorp has not initiated corrective action for the pond. This is because it has not found any assessment monitoring exceedances ("statistically significant levels" or SSLs). However, the absence of SSLs is an artifact of the highly contaminated upgradient wells used in analyzing downgradient groundwater quality. In particular, purportedly upgradient wells JB-N11-L and JB-N12-L, which are located in the narrow space between FGD Ponds 1 and 2, have very high concentrations of lithium, molybdenum, and selenium, and elevated concentrations of beryllium, cobalt, lead, sulfate, and thallium. FGD Pond 1 has been largely dewatered for several years, which suggests that these wells may be impacted by FGD Pond 2 (and are not, therefore, upgradient). If PacifiCorp treated these as downgradient wells, or omitted them from its analysis altogether, it would find SSLs for multiple pollutants in multiple downgradient wells and would have to initiate corrective action.

At the landfill, PacifiCorp found evidence of contamination (elevated concentrations of boron, calcium and pH in downgradient wells during detection monitoring) but prepared an Alternate Source Demonstration (ASD) attributing the contamination to FGD Pond 2.[161] The ASD, however, fails to explain why boron concentrations in wells downgradient of the landfill are much higher than boron concentrations anywhere else at the site, including all wells closer to FGD Pond 2. If PacifiCorp were to conduct assessment monitoring at the landfill, it would find SSLs for multiple pollutants and would have to initiate corrective action.

In the bigger picture, this site shows why site-wide corrective action is necessary. PacifiCorp's unit-by-unit approach produces an absurd scenario where the landfill is not being cleaned up because, according to PacifiCorp, the contamination is coming from FGD Pond 2. But FGD Pond 2 is not being cleaned up because its purportedly upgradient wells are contaminated (by FGD Pond 2 and/or FGD Pond 1).

There is no question that FGD Pond 2 is leaking, it seems self-evident that the landfill is also leaking, and PacifiCorp should be remediating all of these units.

5. Allen (NC)

Duke Energy's Allen Steam Station is located in Belmont, North Carolina on the shore of the Catawba River (Lake Wylie). The site has one regulated "multi-unit," which means that Duke monitors the groundwater with a single well network surrounding three disposal units (the Active Ash Basin, the Retired Ash Basin, and the Retired Ash Basin Landfill, which is located within the footprint of the Retired Ash Basin). In our 2019 report, we critiqued Duke's plan to close the ash basin in place and argued that the only way to restore local groundwater was to excavate the ash and move it to lined, dry storage. Since then, Duke has improved its closure plan, and now intends to excavate the ash from the basins and move it to a new onsite landfill.[162] This is likely to result in improvements in local groundwater and surface water.

Although Duke has started the process of removing ash from the basins,[163] it has not yet formally selected a remedy, which would likely include some of the groundwater treatment options discussed in its 2019 Assessment of Corrective Measures.[164] Duke estimates that ash removal will take 5-20 years.[165] The amount of time required to restore groundwater remains unclear and will depend on the groundwater treatment method selected by Duke. In any event, Duke's selection of a groundwater remedy is years overdue in violation of the CCR Rule.

6. New Castle (PA)

GenOn, the current owner of the New Castle site in New Castle, PA (which stopped burning coal in 2016), is implementing the Coal Ash Rule with respect to two coal ash units – the North Bottom Ash Pond and an Ash Landfill. There is a third coal ash unit, an 80-year-old, 120-acre ash pond, located directly under the landfill. GenOn believes that this historic ash pond is the source of all onsite contamination, but also believes that it is not subject to the Coal Ash Rule.

The North Bottom Ash Pond was a relatively small, 2.3-acre impoundment that was closed by removal in 2018.[166] Although the pond was formally closed pursuant to the Coal Ash Rule, the owners also claimed that the arsenic contamination was not coming from the North Bottom Ash Pond, but instead from the site's historic ash pond.[167]

Even though the North Bottom Ash Pond was closed by removal, the Coal Ash Rule requires ongoing groundwater monitoring until groundwater no longer exceeds groundwater protection standards.[168] Yet GenOn appears to have stopped monitoring around this unit in 2019, even though arsenic concentrations in all three downgradient wells remained several times higher than the default groundwater protection standard. Specifically, all three downgradient wells had arsenic concentrations in the range of 60-90 μg/L between 2016 and 2019, with no sign of a decrease over time. This is much higher than the default groundwater protection standard of 10 μg/L, and also significantly higher than upgradient concentrations, which never exceeded 20 μg/L. GenOn must continue monitoring the North Bottom Ash Pond and should be doing more to clean up the groundwater near the site.

The New Castle Ash Landfill is approximately 50 acres in size and holds over three million tons of ash.[169] As mentioned above, this landfill was built directly on top of a much larger ash pond, and the two units together contain nearly 80 years' worth of coal ash. GenOn is artificially and impermissibly limiting its implementation of the Coal Ash Rule to a small subset of the ash in the area, which means that it is not pursuing comprehensive cleanup under the terms of the Coal Ash Rule. According to the owner:

> Prior to landfill development in this portion of the property, an impoundment existed (occupying an area of approximately 120 acres) that was used for the disposal of sluiced fly ash and bottom ash; these operations took place from approximately 1939 to 1978. From 1978 to 1984 and following the installation of electrostatic precipitators at the station, "dry" fly ash was disposed on the dewatered impoundment area. Beginning in 1984, CCR materials (including "dry" fly ash and dredged bottom ash) were placed in this area. In 1997, the Pennsylvania Department of Environmental Protection

> (PADEP) issued Solid Waste Permit No. 300818 for the Ash Landfill, addressing Stages 1, 2, and 3A. These stages are not part of the current monitored/regulated unit. In April 2008, a permit modification was issued for Stages 4, 5, 6, and 7, which together comprise a vertical expansion of the Ash Landfill over top of the previously permitted stages.[170]

GenOn believes that only the newer stages of the landfill are subject to the Coal Ash Rule, not the older stages of the landfill or the old ash pond. The Alternate Source Demonstration goes on to observe that:

> The downgradient groundwater monitoring wells (MP-10R, MP-12, MP-15, and MP-18) are generally located within the boundaries of the historic 120-acre ash impoundment, with the screened intervals of two of these wells (MP-12 and MP-15) being situated entirely within ash.[171]

The fact that the "screened interval" of the wells – meaning the section of the well bore from which groundwater is collected – is within ash shows that the coal ash is saturated with groundwater. This is confirmed by the well boring logs attached to the Alternate Source Demonstration, which show a coal ash layer at least 9 feet thick beneath the water table and "wet."[172] Since the historic ash pond clearly contains water, it must be regulated as an "inactive surface impoundment."

The Alternate Source Demonstration goes on to conclude that the historic ash pond is the source of the contamination downgradient of the landfill.[173]

The facts on the ground are clear. There is only one ash landfill at the site. The newer stages are a "vertical expansion," which simply means another layer of ash on top of the previously stacked ash. The vertical expansion is not a new landfill, and the older stages are not exempt. GenOn must apply the Rule to the landfill as a whole. More importantly, GenOn must apply the Coal Ash Rule to the historic ash pond, which is formally an "inactive surface impoundment" subject to the Rule. This approach is not only legally required, but also common sense – there is no way to restore groundwater at the site without addressing <u>all</u> of the coal ash known to be buried there.

7. Brandywine (MD)

The Brandywine landfill in Maryland is another GenOn site, and GenOn repeats the same fundamental mistake here by pretending that there are multiple landfills where there is in fact a single landfill. As discussed in our 2019 report, this landfill is contaminating local surface water through baseflow (contaminated groundwater flowing into streams), direct discharges from an onsite leachate collection system, and physical erosion of ash into streams. As a result, local streams are toxic to aquatic life.[174]
To repeat what was stated earlier in the report, GenOn is only applying the Rule to a small part of the landfill even though:

- EPA identifies the site as a single landfill.[175]

- The prior owner of the site described it as a single landfill in legal briefing.[176]
- The landfill operates under one NPDES permit with a single leachate treatment system and discharge outfall.[177]

GenOn is therefore violating the Coal Ash Rule by artificially treating one landfill as multiple landfills to avoid the requirements of the rule.

In addition, GenOn is violating the Coal Ash Rule by analyzing groundwater data on an intrawell basis. In the first annual groundwater monitoring report, GenOn appeared to analyze the data correctly, on an interwell basis, by calculating background concentrations from upgradient wells. For boron, GenOn calculated an "upper prediction limit" of 20 µg/L from the upgradient wells. In downgradient wells, GenOn found boron concentrations as high as 49,500 µg/L – nearly 2,500 times higher than the upgradient data. This is an obvious sign of contamination and GenOn should have proceeded to assessment monitoring. Instead, GenOn attributed the contamination to other parts of the landfill and began to hide the evidence of contamination by switching to intrawell data analysis (ignoring spatial patterns of contamination and instead looking at each well in isolation). Since then, GenOn has routinely found statistically significant increases on an intrawell basis, which means that the contamination is getting worse. However, GenOn also routinely prepares alternate source demonstrations attributing the contamination to other areas of the landfill – areas that it claims (incorrectly) are exempt from the Coal Ash Rule. As a result, GenOn is doing nothing to remediate the contamination at the site, even though boron, cobalt, lithium, and molybdenum concentrations are orders of magnitude higher than health-based guidelines.

GenOn must apply the Coal Ash Rule to the entire landfill and immediately initiate site-wide corrective action.

8. R.D. Morrow (MS)

The R.D. Morrow plant in Purvis, Mississippi stopped burning coal in 2018, but the site continues to suffer from high levels of contamination and the owner, Cooperative Energy, is not in compliance with the Coal Ash Rule.

When it stopped burning coal in 2018, the Morrow plant had two regulated coal ash units. The first was a surface impoundment unit that included a 1.4-acre Scrubber Supply Pond and a 0.5-acre Emergency Scrubber Supply Pond. Groundwater data around these ponds showed elevated levels of arsenic and lithium, but detection monitoring data never showed statistically significant increases, and the unit did not go through assessment monitoring. The two ponds were closed by removal in 2021.

The second regulated disposal unit at Morrow is a 46-acre landfill. Cooperative Energy acknowledged the contamination at the site, proceeded through assessment monitoring, and initiated an assessment of corrective measures in 2019. The landfill was closed by capping in place in 2021. Although the concentrations of coal ash constituents in groundwater have declined somewhat since 2015-2016, the groundwater is still extremely contaminated.

According to the most recent available data from 2021, lithium concentrations are as high as 2.46 mg/L (more than 60 times higher than the groundwater protection standard), molybdenum concentrations are as high as 3.25 mg/L (more than 80 times higher than EPA's lifetime health advisory), and groundwater also continues to have unsafe levels of boron, cobalt, and sulfate.[178]Cooperative Energy has not yet selected a remedy, which violates the Coal Ash Rule's requirement that owners must select a remedy "as soon as feasible."[179] It is not clear what it plans to do about existing contamination, but its most recent corrective measures report suggests that it plans to rely on Monitored Natural Attenuation (MNA).[180] As discussed above, MNA is generally not appropriate unless it is accompanied by more active forms of remediation. In its proposed denial of the alternative closure schedule for the Ottumwa plant in Iowa, EPA states that

> MNA . . . would not be assessed favorably in either the [Assessment of Corrective Measures] or any remedy selection report with respect to 40 C.F.R. § 257.97(b)(4), which requires that remedies "remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible.[181]

Cooperative Energy has also stopped monitoring several Appendix IV constituents,[182] which is another violation of the Coal Ash Rule. Assessment monitoring must continue until "all constituents listed in appendices III and IV to this part are shown to be at or below background values . . . for two consecutive sampling events."[183]

These and other violations of the Coal Ash Rule are discussed in more detail in the Downstream Strategies report attached as Appendix B to this report.

9. Hunter (UT)

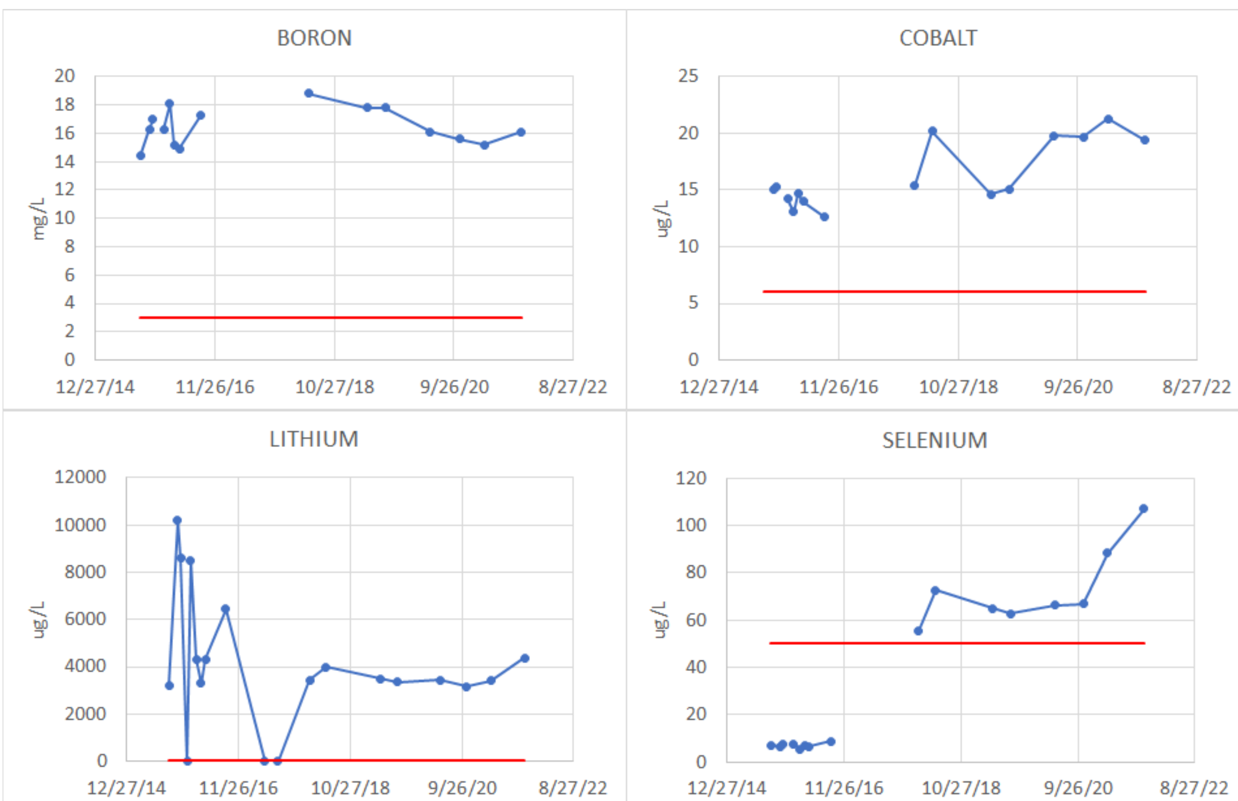
PacifiCorp's Hunter Power Plant is located near Castle Dale, Utah. The site's only regulated coal ash unit is a 340-acre landfill (of which 230 acres have been used for coal ash disposal). The risk assessment for EPA's 2015 Coal Ash Rule described the Hunter site as having two coal ash units – a 280-acre landfill and a 104-acre surface impoundment.[184] It is unclear whether these two units are both within the footprint of the regulated landfill. PacifCorp has acknowledged that the landfill is contaminating groundwater. It proceeded through detection and assessment monitoring to corrective action, and in 2020 PacifiCorp selected a remedy.[185] However, the remedy – which consists of horizontal groundwater collection wells used to collect leachate and contaminated groundwater – may not be adequate.

To begin with, PacifiCorp appears to have limited its focus to two pollutants – lithium and molybdenum – even though there are also unsafe levels of Appendix IV constituents, including cobalt, radium and selenium at the site (in addition to unsafe levels of boron and sulfate, which are Appendix III "detection monitoring" constituents).[186] According to the Coal Ash Rule, the remedy will not be complete until <u>all</u> Appendix IV constituents fall below groundwater protection standards for three years.[187]

PacifiCorp's failure to address some of these pollutants may stem from the fact that the purported upgradient wells are likely contaminated. Well WLF-2, for example, which is located right on the edge of the landfill, has a mean selenium concentration of 0.33 mg/L. This is much higher than the default groundwater protection standard for selenium (0.05 mg/L). The well also has elevated concentrations of boron and sulfate. The well's location makes it vulnerable to impacts from the landfill, and the groundwater data suggest that it is in fact affected. Using this as an upgradient well hides the significance of elevated selenium in downgradient wells.

Next, the remedy selection report implies that the remedy is already working, because concentrations of cobalt, lithium and molybdenum were declining as of 2019.[188] However, lithium concentrations still remain orders of magnitude higher than EPA's regional screening level of 0.04 mg/L (the default groundwater protection standard in the Coal Ash Rule) and appear to be stable or increasing after an initial decline. Meanwhile, other pollutants are increasing. As an example, consider well ELF-11, where lithium concentrations currently average about 4 mg/L (100 times higher than the regional screening level), and cobalt and selenium concentrations are increasing. Contrary to PacifiCorp's assertion, it does not appear that the remedy is working.

FIGURE 3: CONCENTRATIONS OF SELECTED POLLUTANTS IN HUNTER WELL ELF-11.[189]



Red lines show the health-based standards used in this report.

Finally, PacifiCorp claims that onsite pollution has not reached the property boundary.[190] The data suggest otherwise. Monitoring data from one of the newly installed property boundary wells, well ELF-14, show average lithium concentrations of 4.4 mg/L since the well was installed in 2018, along with average boron and cobalt concentrations of 2.6 mg/L and 9.3 micrograms per liter, respectively. Although these are within the range of data seen in some of the upgradient wells, as discussed above, the upgradient wells may be contaminated and therefore poor points of comparison. The data are consistent with the possibility that the contamination plume extends to the property boundary, and perhaps to Rock Canyon Creek.

If the onsite groundwater recovery system is not containing the plume and not reducing groundwater contamination, then PacifiCorp's estimated time until remedy completion (18-23 years)[191] is wrong. Moreover, it is not clear whether the landfill continues to leach coal ash constituents into groundwater. If it does, then groundwater pumping will have to go on indefinitely. Finally, as discussed in the Downstream Strategies report found in Appendix B, the use of contaminated upgradient wells means that site-specific groundwater protection standards are inflated. Since cleanup is deemed complete once the groundwater falls below these standards, the use of inflated standards means that the cleanup could be called of prematurely (before groundwater is restored to its true background condition).

10. Allen (TN)

The Tennessee Valley Authority (TVA) has acknowledged the contamination at the East Ash Pond at its retired Allen Fossil Plant in Memphis, TN and is now in the process of removing the ash and remediating the groundwater. Removal of the coal ash is critical because the coal ash pollution is threatening the Memphis Sands Aquifer, which serves as the drinking water source for the City of Memphis.

There is also another ash pond at Allen, the West Ash Pond. Although TVA is planning to remove the ash from this unit, it has not posted groundwater monitoring data or otherwise implemented the Coal Ash Rule at the unit, presumably because it believes the pond is exempt. However, the West Ash Pond is periodically inundated with floodwater and the ash in the unit is likely to be sitting in groundwater, so the West Ash Pond should be regulated as an "inactive surface impoundment." In addition, a 2013 Environmental Integrity Project report showed that there is groundwater contamination in the vicinity of the West Ash Pond. Indeed, TVA itself acknowledged as much in 2008, stating that elevated arsenic contamination in nearby wells

> is potentially due to ash leachate from the inactive West Ash Pond. Elevated levels of ash leachate analytes boron and sulfate detected in adjacent well P2 indicate probable ash impoundment releases and migration. Concentrations of arsenic, boron, and sulfate are historically higher than the background (well P1) data. Significantly higher levels of these ash leachate indicators and total dissolved solids were measured from 1988 to 2000, indicating an active period of contaminant transmission.[192]

In addition, TVA has in the past acknowledged the need for more groundwater monitoring around the West Ash Pond:

> Allen Fossil Plant will likely be subject to required monitoring of groundwater surrounding the two onsite ash impoundments. This will likely necessitate installation of two additional wells, including . . . a new downgradient well for the inactive West Ash Pond.[193]

TVA's failure to implement the Coal Ash Rule at the West Ash Pond is a clear violation of the Rule. We know that TVA has monitored the groundwater pursuant to state law, and that the data show ongoing contamination with high concentrations of boron, molybdenum, and other pollutants.[194] TVA should use these data to immediately confirm exceedances in both detection and assessment monitoring and proceed through the Coal Ash Rule's corrective action process.

TVA's removal of coal ash from the East and West Ash Ponds will result in offsite disposal of approximately four million tons of coal ash. This ash will be disposed in an environmental justice community in south Memphis over a 10-year period.[195] Residents have protested the disproportionate burden borne by their low-income community of color and the lack of a fair public process to determine a safe, equitable and appropriate permanent disposal area as required by the Coal Ash Rule.

F. Conclusions and Recommendations

This report confirms, after analyzing a larger universe of power plants and monitoring data, that 91 percent of coal plants are contaminating groundwater with coal ash pollutants. The vast majority of sites show contamination from active, regulated coal ash dumps, and many sites also show contamination coming from older, unregulated ash dumps. This report also confirms that most coal plant owners have used tricks and loopholes to avoid monitoring and cleanup obligations, and many are planning to illegally leave coal ash in groundwater after closure.

This is a critical window in time. Although some coal ash pollutants have seeped into the local environment, a huge amount of potential pollution is still sitting in coal ash ponds and landfills. If the coal ash is left in place without any corrective action, these pollutants will continue to seep into the groundwater for generations to come, harming local groundwater and surface water. In addition, a higher frequency of severe storms and flooding, driven by climate change, increase the risk that coal ash dumps will be inundated with water and release toxic contaminants or fail catastrophically if coal ash is not removed from vulnerable areas.

There are clear solutions. Coal plant owners could take steps to ensure that coal ash is "high and dry," elevated above groundwater, and sealed off from the local environment, while they treat the groundwater that has already been contaminated. This would avoid the kind of dispersed contamination that would be much harder to treat. Now is the time to prevent the current problems from ballooning into much bigger problems.

In order to accelerate coal ash cleanups, there are a few steps that EPA and the regulated industry should take:

- The coal power industry must comply fully with federal law. Pursuant to the Coal Ash Rule, plant owners must install an adequate number of monitoring wells, analyze their groundwater data correctly, stop producing unsupported alternate source demonstrations, and promptly take cleanup action that actually restores groundwater quality. As a starting point, the industry should identify all "inactive surface impoundments" – impoundments that still contain ash and groundwater – as subject to the Coal Ash Rule.

- EPA must increase its enforcement of the Coal Ash Rule. We are encouraged by its recent determinations and compliance letters, and the regulated industry must read these carefully and follow their clear directives. But this is just the tip of the iceberg. Most power plants are noncompliant, and most will remain that way until EPA steps in. Some sites may require sustained EPA involvement through enforceable consent decrees.

- EPA should increase enforcement of the remedy selection requirement of the Coal Ash Rule. The rule requires owners of sites in corrective action to select a remedy "as soon as feasible." EPA has recently started enforcing this requirement, but many owners are still exploiting this language to delay selecting cleanup plans. Where owners have waited too long, EPA should take action to impose both a penalty and a firm schedule for remedy selection and cleanup.

- EPA should revise the Coal Ash Rule so that it no longer exempts older coal ash units. The contamination at most coal plants is coming from a mix of disposal units, only some of which are regulated and subject to corrective action requirements. Cleaning up these regulated units will not, by itself, restore groundwater quality. Instead, these sites require comprehensive, site-wide corrective action.

- Federal and state authorities should pay immediate attention to contamination impacting communities of color and low-income communities and provide timely assistance to ensure safe drinking water and mitigate cumulative impacts.

- EPA and/or states should require testing of all drinking water wells within a certain radius of coal ash dumps, both active and inactive. If coal ash contamination is found above health standards, safe drinking water must be provided. The Coal Ash Rule only requires on-site testing of groundwater, but contamination from coal ash dumps can flow miles off-site and threaten the safety of residential drinking water wells. Unless private drinking water wells are tested, it is impossible to determine if the health of local communities is protected.

- EPA and/or states should require sampling of adjacent surface waters, including streams, rivers, lakes and reservoirs. Many common coal ash contaminants are bioaccumulative. The only way to ensure that coal ash does not pose a threat to aquatic life and the health of those consuming fish and wildlife is to test local waterways. Ideally this would include biological sampling (e.g., benthic macroinvertebrate surveys and fish tissue tests) and sediment testing. At the very least, surface water should be tested.

- Federal and state authorities should help affected communities by performing oversight of technical compliance documents, particularly those concerning groundwater monitoring, closure, and cleanup. When noncompliance is discovered, regulatory authorities should pursue timely enforcement actions.

- EPA regulations prohibit the closure in place of coal ash ponds where ash is sitting in groundwater. This prohibition must be enforced at the hundreds of ponds that are currently in the process of closure. All of these ponds are contaminating groundwater and most are also vulnerable to the increased storms and flooding brought by climate change. Contamination will continue unless ash is removed.

- EPA must prohibit the use of coal ash as fill. Coal ash fill sites are no different than unlined landfills, and they spread toxic waste to residential neighborhoods, rural areas and mining communities without the protections that would be required for regulated disposal areas.

- Finally, EPA should consider the cumulative impact of exposure to multiple coal ash pollutants. As indicated in this report, groundwater is often contaminated by multiple pollutants from coal ash. The threat to health and the environment from these chemical cocktails is likely to be significantly greater than the threat from any single pollutant.

Appendix A: Updated Analysis of Groundwater Monitoring Data

I. Methods

This Appendix is an update of our March 2019 report.[196] The methods that we used to collect and analyze the data are generally unchanged. Our 2019 report included initial rounds of groundwater monitoring for each coal plant with disposal areas regulated under the CCR rule. The dates of these initial rounds of sampling generally ranged from 2015 to 2017. This update adds groundwater monitoring data from 2018 and 2019 for all the sites in our initial report. In addition, we added data for 60 impoundments that were not included in our original analysis because they qualified for an EPA compliance extension and had not yet published any groundwater monitoring data. Our initial report included groundwater data from 265 coal plants while this report includes data from 292 coal plants.

Our primary method of identifying regulated sites was to use EPA's "List of Publicly Accessible Internet Sites Hosting Compliance Data and Information Required by the Disposal of Coal Combustion Rule."[197] We then downloaded annual groundwater monitoring reports from each owner's website. Extracting the groundwater data and well characteristics from these reports was the most time-consuming part of the process. We chose methods for each report that would minimize the potential for data entry errors, which was sometimes relatively straightforward. For example, some reports contained summary tables that could be easily converted into a spreadsheet. However, in most cases, it was more challenging. Summary tables did not always include all of the necessary information, while other summary tables contained inaccurate information.[198] Many reports omitted summary tables altogether, requiring analysts at EIP to go through thousands of pages of laboratory reports to find the monitoring results, which then needed to be hand-entered for analysis.

Once all the data were entered, we needed to look for and correct errors. Some of the errors originated with the groundwater reports (mainly typos), and in some cases there were errors in data entry (e.g. someone entered the wrong unit of measurement or forgot a decimal).

With all data entered and checked, we proceeded with the analysis. First, we needed to deal with "non-detects." When a chemical cannot be detected using a given laboratory method, the technician will record the result as less than the detection or reporting limit of the laboratory method—the lowest concentration that can be reliably detected. When a chemical is not detected, that does not mean that it is absent. For example, a lithium result of "<0.2 mg/L" means that there was less than 0.2 mg/L of lithium in that sample. The true lithium concentration is unknown, but could be as low as zero or as high as 0.19 mg/L. We followed a conventional approach to this problem and assumed that non-detects were present at one-half of the detection limit or reporting limit.[199]

We then calculated an average (mean) concentration for each constituent in each well across all sampling rounds. We excluded data that were potentially attributable to something other than the regulated coal ash unit by (a) removing upgradient wells and (b) removing any downgradient mean concentrations that were lower than the highest upgradient mean concentration for that pollutant and disposal area. What remained was a set of downgradient mean concentrations that were greater than "background" levels.[200]

We then compared the average downgradient concentrations to health-based thresholds. For constituents with EPA Maximum Contaminant Levels (MCLs), we used the MCL as the health threshold. For other constituents, we used EPA drinking water advisories or Regional Screening Levels. The thresholds we used to screen the data are generally identical to the groundwater protection standards in the Coal Ash Rule, with the exceptions being boron and sulfate (which do not have groundwater protection standards in the Coal Ash Rule), and molybdenum (for which we used a slightly more stringent health-based value).[201] One of the health-based thresholds used in our analysis has changed since our 2019 report: In 2019, we used EPA's ten-day "child health advisory" for boron (3 mg/L), which was listed in EPA's most recent compilation of drinking water advisories.[202] Since then, we have learned that EPA also has a "longer-term health advisory for children,"[203] which was not listed in the 2012 EPA compilation. This longer-term advisory is more appropriate for evaluating potential exposure to coal ash-contaminated groundwater, which might be consumed over several years of a child's life. We are therefore using the longer-term child health advisory of 1.8 mg/L in this report.

The thresholds we used in this report are shown in Table A1, below, alongside the groundwater protection standards found in the Coal Ash Rule.

TABLE A1: GROUNDWATER MONITORING POLLUTANTS AND THRESHOLDS USED IN THIS REPORT

Pollutant	Health-based threshold	Presumptive groundwater protection standard under CCR rule[204]
Detection monitoring constituents (40 CFR Part 257, Appendix III)		
Boron	1.8 mg/L[205]	
Calcium		
Chloride		
Fluoride		
pH		
Sulfate	500 mg/L[206]	
Total Dissolved Solids (TDS)		
Assessment monitoring constituents (40 CFR Part 257, Appendix IV)		
Antimony	6 µg/L	6 µg/L
Arsenic	10 µg/L	10 µg/L
Barium	2 mg/L	2 mg/L
Beryllium	4 µg/L	4 µg/L
Cadmium	5 µg/L	5 µg/L

Chromium	100 μg/L	100 μg/L
Cobalt	6 μg/L	6 μg/L
Fluoride	4 mg/L	4 mg/L
Lead	15 μg/L	15 μg/L
Lithium	40 μg/L	40 μg/L
Mercury	2 μg/L	2 μg/L
Molybdenum	40 μg/L[207]	100 μg/L
Selenium	50 μg/L	50 μg/L
Thallium	2 μg/L	2 μg/L
Radium 226 and 228	5 pCi/L	5 pCi/L

Note: ug/L means micrograms per liter

An example of unsafe groundwater might be a well with a mean arsenic concentration of 20 μg/L, which exceeds the Maximum Contaminant Level for arsenic of 10 μg/L. These could be thought of as "exceedances."

We only looked at "exceedances" of health-based thresholds for constituents of coal ash that are monitored pursuant to the Coal Ash Rule – the constituents listed in Appendices III and IV of the Coal Ash Rule.[208] There are several other coal ash constituents that frequently exceed safe levels in groundwater, including neurotoxins like aluminum and manganese,[209] but they are not monitored pursuant to the Coal Ash Rule, and we could not evaluate their prevalence in the environment.

In order to identify the nation's most contaminated sites, we looked at the extent to which each pollutant exceeded safe levels at each site, and then combined results for all pollutants at each site. This analysis started with the average (mean) concentration of each pollutant in each monitoring well. We then excluded upgradient wells, and also excluded downgradient wells with mean concentrations that were lower than corresponding upgradient levels (as described above). We then identified, for each site, the well(s) with the highest mean concentration of each pollutant. For example, the highest average arsenic concentration at the San Miguel plant in Texas was 76 micrograms per liter. This was the average concentration in monitoring well SP-32, a downgradient well. We then calculated the ratios of these 'highest average' concentrations to their respective health-based thresholds. For arsenic at San Miguel, the ratio would be 7.6 (76 μg/L divided by the arsenic MCL of 10 μg/L). Finally, we added the pollutant-specific ratios together to create a composite score for each site. These composite scores allowed us to rank the sites from most contaminated to least.

Table A4 includes the complete ranked list of sites. One important caveat is that the lower-ranked sites are not necessarily less contaminated. Our ranking system is based on the severity of contamination in downgradient wells, but only if downgradient concentrations exceed background concentrations. If sites have too few wells to accurately characterize the contamination plume, or they use contaminated wells as "background" wells, then our ranking algorithm might not work. For example, the Stanton Energy Center in Orange County, Florida was originally the lowest-ranked site in our database, but this was due to problems with the site's monitoring network: For purposes of the Coal Ash Rule, the owners only monitor four wells. The most contaminated well, well MW-A, has very high levels of arsenic, cobalt, fluoride, lead, lithium, radium, and selenium. Although this well is clearly downgradient of the landfill,[210] the owners designated it as "upgradient." Since our ranking algorithm only looks at downgradient wells, the contamination in Well MW-A is discounted. This is not the only problem at Stanton – the owners have also placed the other three wells over half a mile from the landfill, and according to the latest groundwater monitoring report, "[t]he groundwater travel time from the northern edge of active cell of the new landfill to any compliance monitoring well is expected to be greater than 17 years."[211] These wells cannot possibly provide evidence of whether the landfill is leaking. More importantly, there are no monitoring wells along the eastern downgradient edge of the landfill. For all of these reasons the monitoring network for the Stanton landfill is useless; it violates the Coal Ash Rule in multiple ways, and it does not provide meaningful information. This means that the original rank of Stanton relative to other sites was also meaningless. For Stanton, we ignored the owner's designation of well MW-A and treated it as downgradient, and Stanton is now ranked 118th. But there may be similar circumstances at many of the lower-ranked sites.

In sum, although we are confident that the high-ranked sites are dirty, we are not confident that the low-ranked sites are clean.

2. How Prevalent Is Unsafe Groundwater Contamination?

The short answer is the same as it was in 2019 – 91% of coal plants.[212] The difference is that we now have more sites in our database. In 2019, we reported that 242 out of 265 sites were causing unsafe levels of contamination. We now have data for 292 sites, and 265 of these appear to be contaminating groundwater to levels that are unsafe.

Table A2 shows the extent to which coal ash has caused unsafe levels of pollution, according to our analysis. The table also shows the number of coal plants with unsafe levels of one or more constituents of coal ash.

TABLE A2: UNSAFE GROUNDWATER CAUSED BY COAL ASH[213]

Constituent	Health-based threshold	Number of plants exceeding threshold		% of plants with unsafe levels of this constituent	
		2019	Updated	*2019*	Updated
Antimony	6 µg/L	*14/256*	19/289	*5%*	7%
Arsenic	10 µg/L	*134/257*	152/290	*52%*	52%
Barium	2 mg/L	*6/257*	12/289	*2%*	4%
Beryllium	4 µg/L	*27/256*	32/290	*11%*	11%
Boron	1.8 mg/L	*128/265*	184/290	*48%*	63%
Cadmium	5 µg/L	*15/257*	16/289	*6%*	6%
Chromium	100 µg/L	*8/257*	6/290	*3%*	2%
Cobalt	6 µg/L	*126/256*	133/290	*49%*	46%
Fluoride	4 mg/L	*19/265*	22/292	*7%*	8%
Lead	15 µg/L	*27/257*	29/290	*11%*	10%

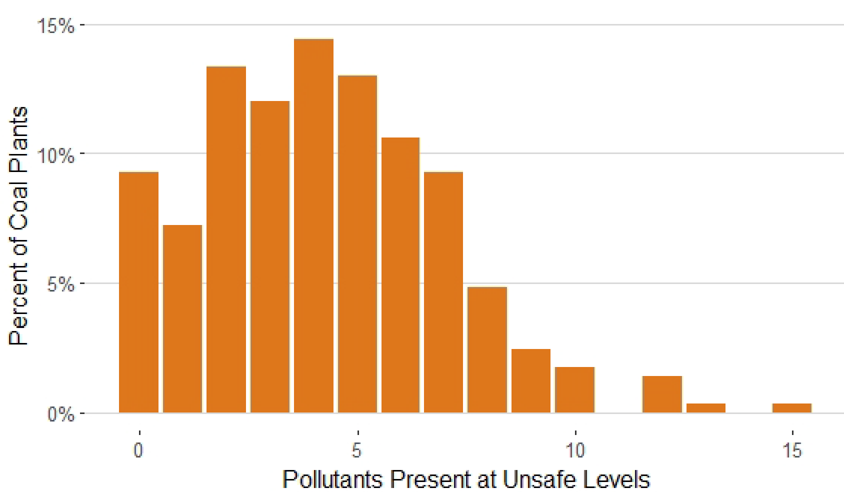
Lithium	40 µg/L	*154/256*	176/289	*60%*	61%
Mercury	2 µg/L	*9/256*	12/290	*4%*	4%
Molybdenum	40 µg/L	*128/256*	151/290	*50%*	52%
Radium	5 pCi/L	*48/253*	55/288	*19%*	19%
Selenium	50 µg/L	*34/257*	42/290	*13%*	14%
Sulfate	500 mg/L	*145/265*	162/292	*55%*	55%
Thallium	2 µg/L	*27/256*	35/290	*11%*	12%
Any of the above		*242/265*	265/292	*91%*	91%
Four or more of the above		*142/265*	170/292	*54%*	58%

3. Groundwater at Coal Plants Is Frequently Contaminated with Unsafe Levels of Many Coal Ash Pollutants

As shown in Table A2 and Figure A1, many coal plants have unsafe levels of at least four coal ash pollutants. In fact, there are a significant number of coal plants with unsafe levels of seven, eight, or even more constituents. This means that a large number of sites pose significant cumulative risks to human health and the environment.

Several common coal ash pollutants cause the same type of harm, thereby magnifying the risk of injury. For example, arsenic, fluoride, lithium, lead, manganese, and mercury are all neurotoxins; arsenic, chromium and radium are all carcinogens; cobalt and lithium both cause thyroid disease; lithium and cadmium harm the kidney; and multiple coal ash pollutants harm reproductive health. There are also many coal ash pollutants that present a threat to aquatic life, creating a cumulative ecological risk. The true risk experienced by any receptor, human or ecological, now or in the future, will be greater than the risk from any individual chemical.

FIGURE A1: COAL PLANTS SORTED BY THE NUMBER OF POLLUTANTS PRESENT AT UNSAFE LEVELS



4. Coal Ash Landfills Are Contaminating Groundwater Nearly as Often as Coal Ash Ponds

In the 2015 Coal Ash Rule, and in the risk assessment supporting the Rule, EPA made assumptions about the movement of pollutants from coal ash dumps into the environment, modeling landfills and impoundments (ash ponds) separately. Through its modeling, EPA assumed that landfills pose a much lower risk than impoundments.[214]

The data suggest that EPA was wrong about the risks of contamination from landfills. We looked at monitoring wells near landfills and impoundments separately (excluding wells and well networks that jointly monitor both types of coal ash disposal area). Table B2 shows the results for selected coal ash pollutants and confirms that landfills are nearly as likely to be causing unsafe levels of groundwater contamination (74 percent of landfills) as ash ponds (90 percent of ash ponds).

TABLE A3: UNSAFE LEVELS OF COAL ASH POLLUTANTS AT LANDFILLS AND PONDS

(Percent of waste sites showing unsafe levels of each pollutant)

	Arsenic	Boron	Cobalt	Lithium	Molybdenum	Sulfate	One or more
Landfills (203)	28%	33%	30%	45%	29%	35%	**74%**
Ponds (332)	42%	57%	41%	45%	39%	47%	**90%**

TABLE A4: SUMMARY OF CONTAMINATION BY SITE

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
1	San Miguel Plant	TX	Arsenic (x8), Beryllium (x127), Boron (x41), Cadmium (x114), Cobalt (x488), Fluoride (x2), Lithium (x90), Mercury (x3), Radium 226+228 (x6), Selenium (x8), Sulfate (x20), Thallium (x4)	3
2	Reid Gardner Generating Station	NV	Antimony (x1), Arsenic (x121), Boron (x84), Cadmium (x2), Cobalt (x16), Fluoride (x3), Lead (x8), Lithium (x161), Molybdenum (x87), Selenium (x1), Sulfate (x228), Thallium (x5)	4
3	Naughton Power Plant	WY	Antimony (x2), Arsenic (x10), Barium (x1), Beryllium (x2), Boron (x16), Cadmium (x2), Chromium (x3), Cobalt (x13), Lead (x16), Lithium (x242), Molybdenum (x3), Radium 226+228 (x1), Selenium (x150), Sulfate (x66), Thallium (x9)	6
4	Jim Bridger Power Plant	WY	Antimony (x1), Arsenic (x4), Boron (x9), Cadmium (x3), Cobalt (x92), Fluoride (x3), Lead (x4), Lithium (x164), Molybdenum (x10), Radium 226+228 (x2), Selenium (x85), Sulfate (x125), Thallium (x11)	3
5	Allen Steam Station	NC	Arsenic (x7), Beryllium (x6), Boron (x1), Cadmium (x1), Cobalt (x466), Lithium (x12), Selenium (x5), Sulfate (x3), Thallium (x1)	1
6	New Castle Generating Station	PA	Arsenic (x372), Boron (x4), Cobalt (x5), Lithium (x54), Molybdenum (x1), Sulfate (x3)	2
7	Brandywine Ash Management Facility	MD	Arsenic (x5), Beryllium (x2), Boron (x29), Cobalt (x47), Lithium (x222), Molybdenum (x111), Selenium (x9), Sulfate (x11)	1
8	R.D. Morrow, Sr. Generating Station	MS	Arsenic (x3), Beryllium (x2), Boron (x19), Lead (x1), Lithium (x167), Molybdenum (x176), Sulfate (x6), Thallium (x1)	2
9	Hunter Power Plant	UT	Boron (x16), Cobalt (x28), Lithium (x210), Molybdenum (x11), Radium 226+228 (x2), Selenium (x7), Sulfate (x62)	1
10	Allen Fossil Plant	TN	Arsenic (x294), Boron (x4), Fluoride (x1), Lead (x3), Molybdenum (x9)	1
11	Petersburg Generating Station	IN	Arsenic (x6), Beryllium (x1), Boron (x18), Cadmium (x2), Cobalt (x65), Lithium (x51), Molybdenum (x64), Sulfate (x2), Thallium (x12)	2
12	Ghent Generating Station	KY	Antimony (x1), Arsenic (x2), Beryllium (x1), Boron (x6), Chromium (x3), Cobalt (x8), Lead (x3), Lithium (x145), Molybdenum (x18), Radium 226+228 (x30), Sulfate (x3), Thallium (x1)	3

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
13	Trimble County Generating Station	KY	Arsenic (x4), Boron (x65), Fluoride (x1), Lithium (x54), Molybdenum (x68), Selenium (x9), Sulfate (x2)	1
14	J. Robert Welsh Power Plant	TX	Arsenic (x2), Beryllium (x3), Boron (x1), Cobalt (x133), Lead (x1), Lithium (x49), Radium 226+228 (x3), Sulfate (x10)	3
15	Plant McDonough-Atkinson	GA	Arsenic (x49), Beryllium (x6), Boron (x4), Cobalt (x127), Lithium (x3), Molybdenum (x5), Radium 226+228 (x1), Selenium (x2), Sulfate (x2)	2
16	Charles R. Lowman Power Plant	AL	Arsenic (x14), Beryllium (x1), Boron (x6), Cobalt (x156), Lithium (x4), Molybdenum (x5), Sulfate (x2)	1
17	Richmond Mill, Inc.	OH	Boron (x16), Cobalt (x1), Lithium (x116), Molybdenum (x38), Radium 226+228 (x15), Sulfate (x3)	1
18	Gibbons Creek Steam Electric Generating Station	TX	Antimony (x3), Arsenic (x1), Beryllium (x28), Boron (x5), Cadmium (x18), Cobalt (x97), Lead (x2), Lithium (x19), Mercury (x1), Radium 226+228 (x2), Sulfate (x6), Thallium (x4)	3
19	Four Corners Power Plant	NM	Boron (x74), Chromium (x1), Cobalt (x45), Fluoride (x6), Lead (x2), Lithium (x23), Molybdenum (x4), Radium 226+228 (x5), Selenium (x2), Sulfate (x22)	4
20	Sioux Energy Center	MO	Boron (x15), Cobalt (x2), Lithium (x1), Molybdenum (x162), Sulfate (x2)	4
21	Sebree Generating Station	KY	Arsenic (x2), Lithium (x35), Mercury (x135), Sulfate (x5)	3
22	Crystal River Energy Complex	FL	Arsenic (x144), Boron (x3), Lithium (x10), Molybdenum (x5), Radium 226+228 (x3), Sulfate (x2)	2
23	JB Sims Power Generation Plant	MI	Arsenic (x12), Boron (x75), Cobalt (x1), Fluoride (x4), Lithium (x50), Sulfate (x2)	1
24	R.M. Schahfer Generating Station	IN	Arsenic (x6), Boron (x17), Cobalt (x6), Fluoride (x10), Lithium (x7), Molybdenum (x76), Radium 226+228 (x2), Sulfate (x15)	3
25	Huntington Power Plant	UT	Boron (x28), Chromium (x1), Cobalt (x2), Lithium (x94), Molybdenum (x1), Selenium (x3), Sulfate (x10)	1
26	Roxboro Steam Electric Plant	NC	Arsenic (x2), Boron (x27), Cobalt (x6), Lithium (x29), Molybdenum (x56), Radium 226+228 (x1), Selenium (x3), Sulfate (x7)	2
27	Colstrip Steam Electric Station	MT	Boron (x47), Cobalt (x13), Lithium (x28), Molybdenum (x8), Radium 226+228 (x2), Sulfate (x28), Thallium (x1)	6
28	SIPC Marion Power Plant	IL	Arsenic (x5), Boron (x7), Cobalt (x63), Selenium (x2), Sulfate (x2), Thallium (x46)	1

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
29	William C. Gorgas Electric Generating Plant	AL	Arsenic (x20), Boron (x7), Cobalt (x72), Lithium (x11), Molybdenum (x4), Sulfate (x6)	5
30	Wateree Generating Station	SC	Arsenic (x113), Boron (x1), Cobalt (x2), Lithium (x2)	3
31	Valmont Station	CO	Arsenic (x2), Boron (x9), Cobalt (x4), Lead (x1), Lithium (x6), Mercury (x13), Molybdenum (x6), Selenium (x58), Sulfate (x11), Thallium (x2)	3
32	Harding Street Generating Station	IN	Antimony (x2), Arsenic (x45), Boron (x21), Lithium (x13), Molybdenum (x18), Sulfate (x3)	1
33	C.D. McIntosh Power Plant	FL	Antimony (x1), Arsenic (x10), Boron (x1), Lithium (x77), Radium 226+228 (x11), Sulfate (x3)	1
34	Plant Watson	MS	Arsenic (x52), Barium (x2), Boron (x12), Lithium (x2), Molybdenum (x30), Radium 226+228 (x4), Sulfate (x2)	1
35	Plant Hammond	GA	Arsenic (x38), Beryllium (x1), Boron (x10), Cobalt (x30), Fluoride (x2), Lithium (x5), Molybdenum (x12), Sulfate (x3)	4
36	Gibson Generating Station	IN	Arsenic (x10), Boron (x22), Cobalt (x3), Lithium (x24), Molybdenum (x35), Selenium (x2), Sulfate (x3)	4
37	Winyah Generating Station	SC	Arsenic (x62), Boron (x7), Lithium (x10), Mercury (x11), Molybdenum (x6), Radium 226+228 (x1), Sulfate (x2)	5
38	Cholla Power Plant	AZ	Arsenic (x2), Boron (x25), Cobalt (x13), Fluoride (x1), Lithium (x18), Molybdenum (x9), Radium 226+228 (x2), Selenium (x3), Sulfate (x23)	4
39	Nucla Generating Station	CO	Arsenic (x3), Fluoride (x1), Lithium (x83), Molybdenum (x1), Sulfate (x4)	1
40	Plant Gadsden	AL	Arsenic (x82), Cobalt (x9), Lithium (x2), Sulfate (x1)	1
41	New Madrid Power Plant	MO	Arsenic (x2), Boron (x10), Cobalt (x1), Lead (x1), Molybdenum (x76)	4
42	Clifty Creek Station	IN	Arsenic (x7), Boron (x5), Lithium (x14), Molybdenum (x64), Sulfate (x2)	2
43	Intermountain Generating Facility	UT	Arsenic (x32), Boron (x6), Lithium (x33), Mercury (x7), Molybdenum (x4), Sulfate (x9)	3
44	Hayden Station	CO	Boron (x27), Cobalt (x1), Molybdenum (x34), Sulfate (x27)	1
45	Belews Creek Steam Station	NC	Arsenic (x5), Beryllium (x1), Boron (x7), Cobalt (x40), Lithium (x24), Molybdenum (x8), Radium 226+228 (x1)	3
46	Gulf Power Company, Plant Crist	FL	Boron (x34), Cadmium (x1), Cobalt (x10), Mercury (x2), Molybdenum (x34), Radium 226+228 (x5), Sulfate (x1)	3

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
47	Somerset Operating Company	NY	Antimony (x4), Arsenic (x1), Boron (x69), Cobalt (x4), Lithium (x6), Sulfate (x4)	2
48	A.B. Brown Generating Station	IN	Arsenic (x2), Boron (x7), Cobalt (x1), Lithium (x2), Molybdenum (x38), Sulfate (x28), Thallium (x1)	3
49	Chesapeake Energy Center	VA	Antimony (x1), Arsenic (x21), Beryllium (x6), Boron (x2), Cobalt (x13), Lithium (x11), Molybdenum (x2), Radium 226+228 (x9), Selenium (x9), Sulfate (x4)	1
50	Wabash River Generating Station	IN	Arsenic (x2), Boron (x25), Cobalt (x3), Lead (x1), Lithium (x5), Molybdenum (x39), Sulfate (x3)	1
51	E.C. Gaston Steam Plant	AL	Arsenic (x2), Boron (x2), Cobalt (x1), Lithium (x14), Molybdenum (x54), Radium 226+228 (x3), Sulfate (x1)	2
52	H.F. Lee Energy Complex	NC	Arsenic (x61), Boron (x2), Cobalt (x4), Lithium (x9), Molybdenum (x2)	1
53	Cayuga Generating Station	IN	Arsenic (x5), Boron (x5), Cobalt (x4), Lead (x4), Lithium (x11), Molybdenum (x45), Sulfate (x2)	4
54	Monticello Steam Electric Station	TX	Arsenic (x3), Beryllium (x8), Boron (x4), Cadmium (x4), Cobalt (x55), Lithium (x1), Selenium (x2)	1
55	Kyger Creek Station	OH	Arsenic (x11), Barium (x33), Boron (x9), Cobalt (x5), Lithium (x11), Molybdenum (x4), Radium 226+228 (x2), Sulfate (x2)	3
56	R.M. Heskett Station	ND	Lithium (x54), Sulfate (x22)	1
57	Mill Creek Generating Station	KY	Arsenic (x37), Boron (x4), Lithium (x12), Molybdenum (x17), Sulfate (x3)	3
58	Plant Greene County	AL	Arsenic (x40), Boron (x1), Cobalt (x12), Lithium (x16), Molybdenum (x3), Sulfate (x2)	1
59	Coffeen Power Station	IL	Arsenic (x3), Boron (x6), Cadmium (x1), Cobalt (x50), Lead (x2), Lithium (x2), Sulfate (x6)	5
60	L.V. Sutton Energy Complex	NC	Arsenic (x44), Boron (x2), Cobalt (x4), Lithium (x13), Molybdenum (x7)	2
61	F.B. Culley Generating Station	IN	Arsenic (x9), Boron (x27), Cobalt (x1), Lithium (x6), Molybdenum (x24), Sulfate (x3)	2
62	Bonanza Power Plant	UT	Arsenic (x13), Beryllium (x1), Fluoride (x15), Molybdenum (x34), Selenium (x5)	2
63	Martin Lake Steam Electric Station	TX	Arsenic (x1), Beryllium (x3), Boron (x11), Cobalt (x31), Lithium (x4), Mercury (x12), Sulfate (x4)	3

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
64	Northeastern 3&4 Power Station	OK	Antimony (x1), Arsenic (x2), Barium (x2), Boron (x5), Cobalt (x2), Fluoride (x1), Lithium (x30), Molybdenum (x19), Radium 226+228 (x2), Sulfate (x2)	2
65	Elmer Smith Station	KY	Boron (x7), Lithium (x1), Molybdenum (x57), Selenium (x1), Sulfate (x1)	1
66	Edgewater Generating Station	WI	Arsenic (x2), Boron (x5), Cobalt (x1), Lithium (x1), Molybdenum (x55)	2
67	Westland Ash Management Facility	MD	Boron (x5), Lithium (x21), Molybdenum (x30), Selenium (x6), Sulfate (x2)	1
68	H.W. Pirkey Power Plant	TX	Arsenic (x1), Beryllium (x2), Boron (x1), Cadmium (x1), Cobalt (x47), Lithium (x4), Mercury (x4), Radium 226+228 (x2), Sulfate (x2)	4
69	AES Puerto Rico	PR	Boron (x2), Lithium (x18), Molybdenum (x12), Selenium (x4), Sulfate (x25)	1
70	Trenton Power Plant	MI	Arsenic (x38), Boron (x1), Lithium (x6), Radium 226+228 (x9), Sulfate (x7)	1
71	Cayuga Operating Company	NY	Boron (x4), Lithium (x28), Molybdenum (x25), Selenium (x1), Sulfate (x3)	1
72	Chesterfield Power Station	VA	Arsenic (x16), Boron (x3), Cobalt (x31), Lithium (x3), Molybdenum (x2), Radium 226+228 (x2), Sulfate (x1)	3
73	Hatfield's Ferry Power Station	PA	Boron (x8), Cobalt (x49), Sulfate (x4)	1
74	Rush Island Energy Center	MO	Arsenic (x29), Boron (x8), Molybdenum (x20)	1
75	JM Stuart Station	OH	Arsenic (x11), Barium (x1), Boron (x9), Cobalt (x4), Lithium (x4), Molybdenum (x26), Radium 226+228 (x2), Selenium (x1), Sulfate (x1)	7
76	Killen Station	OH	Boron (x4), Lithium (x19), Molybdenum (x35)	2
77	Cliffside Steam Station	NC	Arsenic (x9), Beryllium (x2), Boron (x1), Cobalt (x38), Radium 226+228 (x1), Selenium (x1), Sulfate (x1), Thallium (x1)	4
78	Conesville Plant	OH	Arsenic (x15), Beryllium (x4), Boron (x7), Cobalt (x7), Fluoride (x2), Lithium (x4), Molybdenum (x15), Radium 226+228 (x2)	2
79	North Omaha Station	NE	Arsenic (x22), Boron (x2), Cobalt (x2), Lithium (x3), Molybdenum (x23), Selenium (x2), Sulfate (x2)	1
80	Gallatin Fossil Plant	TN	Arsenic (x2), Boron (x6), Cobalt (x2), Lithium (x41), Molybdenum (x2), Sulfate (x1)	2
81	Gavin Power Plant	OH	Arsenic (x3), Boron (x2), Cobalt (x23), Fluoride (x2), Lead (x2), Lithium (x17), Molybdenum (x6)	3
82	Kingston Fossil Plant	TN	Arsenic (x16), Boron (x1), Cobalt (x20), Lithium (x10), Molybdenum (x5), Sulfate (x2)	3

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
83	Wood River Power Station	IL	Arsenic (x4), Boron (x33), Molybdenum (x15), Sulfate (x2)	2
84	Sibley Generating Station	MO	Arsenic (x20), Boron (x3), Molybdenum (x30)	3
85	Coal Creek Station	ND	Arsenic (x2), Boron (x15), Cobalt (x5), Lead (x2), Lithium (x16), Sulfate (x11)	3
86	Gallagher Generating Station	IN	Arsenic (x6), Boron (x11), Cobalt (x2), Lithium (x1), Molybdenum (x31), Sulfate (x1)	4
87	DE Karn Power Plant	MI	Arsenic (x45), Boron (x2), Lead (x2), Molybdenum (x1), Sulfate (x1)	1
88	Joliet #9 Generating Station	IL	Arsenic (x12), Boron (x6), Lithium (x4), Molybdenum (x27), Sulfate (x1)	1
89	Grand River Energy Center	OK	Arsenic (x3), Beryllium (x2), Boron (x1), Cobalt (x4), Lead (x2), Lithium (x4), Molybdenum (x27), Sulfate (x6)	1
90	Brunner Island Steam Electric Station	PA	Arsenic (x23), Cobalt (x14), Lithium (x5), Molybdenum (x8), Sulfate (x1)	2
91	Plant Scherer	GA	Boron (x2), Cobalt (x45), Sulfate (x1)	3
92	Walter Scott Jr. Energy Center	IA	Arsenic (x34), Boron (x2), Lithium (x4), Molybdenum (x2), Sulfate (x2)	3
93	Sunnyside Cogeneration Associates Facility	UT	Arsenic (x1), Lithium (x26), Selenium (x3), Sulfate (x13)	1
94	Calaveras Power Station	TX	Beryllium (x4), Boron (x3), Cadmium (x2), Cobalt (x24), Lead (x1), Lithium (x2), Radium 226+228 (x1), Selenium (x4), Thallium (x1)	4
95	Cross Generating Station	SC	Beryllium (x4), Boron (x12), Cobalt (x15), Lithium (x2), Radium 226+228 (x3), Sulfate (x4)	2
96	Lewis & Clark Station	MT	Arsenic (x4), Boron (x13), Cobalt (x1), Lithium (x6), Molybdenum (x3), Selenium (x2), Sulfate (x12)	1
97	JH Campbell Power Plant	MI	Antimony (x3), Arsenic (x29), Cobalt (x2), Lithium (x2), Molybdenum (x3), Selenium (x1), Thallium (x1)	4
98	Marshall Steam Station	NC	Arsenic (x5), Barium (x1), Beryllium (x1), Boron (x5), Cobalt (x22), Lithium (x2), Radium 226+228 (x2), Thallium (x1)	1
99	Asheville Steam Electric Plant	NC	Boron (x5), Cobalt (x17), Radium 226+228 (x14), Sulfate (x2)	1
100	Asbury Generating Station	MO	Boron (x26), Cobalt (x2), Lithium (x8), Sulfate (x4)	1
101	Bull Run Fossil Plant	TN	Arsenic (x7), Boron (x9), Cobalt (x2), Lithium (x13), Molybdenum (x5), Sulfate (x3)	2
102	Muscatine Power & Water CCR Landfill	IA	Barium (x22), Boron (x10), Sulfate (x2), Thallium (x1)	1

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
103	Bruce Mansfield Plant	PA	Arsenic (x7), Barium (x13), Boron (x2), Lithium (x8), Molybdenum (x1), Sulfate (x5)	1
104	Dolet Hills Power Station	LA	Boron (x4), Cobalt (x2), Lithium (x21), Radium 226+228 (x1), Sulfate (x8)	2
105	Sandy Creek Energy Station	TX	Arsenic (x2), Cobalt (x2), Lead (x2), Lithium (x19), Selenium (x3), Sulfate (x6)	1
106	Hugo Power Station	OK	Arsenic (x6), Boron (x5), Lithium (x8), Molybdenum (x11), Sulfate (x4)	2
107	Plant McManus	GA	Arsenic (x31), Boron (x1), Lithium (x2), Sulfate (x1)	1
108	Bailly Generating Station	IN	Arsenic (x8), Cadmium (x2), Lithium (x2), Molybdenum (x16), Thallium (x5)	3
109	La Cygne Generating Station	KS	Antimony (x1), Boron (x1), Cobalt (x1), Lithium (x20), Sulfate (x10)	3
110	Plant Wansley	GA	Boron (x3), Cobalt (x24), Lithium (x1), Radium 226+228 (x1), Sulfate (x1)	2
111	Big Sandy Plant	KY	Beryllium (x5), Boron (x1), Cobalt (x15), Lithium (x6), Radium 226+228 (x3), Sulfate (x1)	2
112	Meramec Energy Center	MO	Arsenic (x2), Boron (x13), Lithium (x4), Molybdenum (x11), Sulfate (x2)	1
113	Paradise Fossil Plant	KY	Arsenic (x9), Boron (x21), Molybdenum (x1)	3
114	Burlington Generating Station	IA	Arsenic (x8), Boron (x14), Lithium (x1), Molybdenum (x7), Sulfate (x1)	1
115	Cumberland Fossil Plant	TN	Arsenic (x1), Boron (x22), Cobalt (x3), Lithium (x2), Molybdenum (x1), Sulfate (x3)	2
116	Indian River Generating Station	DE	Beryllium (x1), Boron (x3), Cobalt (x4), Lithium (x14), Molybdenum (x6)	1
117	Miami Fort Power Station	OH	Arsenic (x4), Boron (x10), Cobalt (x2), Molybdenum (x12), Sulfate (x2)	3
118	OUC Stanton Energy Center	FL	Arsenic (x9), Cobalt (x3), Fluoride (x5), Lead (x1), Lithium (x4), Molybdenum (x1), Radium 226+228 (x3), Selenium (x2), Sulfate (x2)	1
119	Cardinal Plant	OH	Arsenic (x4), Boron (x3), Lithium (x11), Molybdenum (x9), Sulfate (x3)	3
120	Rawhide Energy Station	CO	Boron (x1), Cobalt (x2), Lithium (x14), Molybdenum (x1), Selenium (x2), Sulfate (x8)	2
121	Springerville Generating Station	AZ	Lithium (x26), Sulfate (x3), Thallium (x1)	1
122	Huntley Generating Station	NY	Antimony (x4), Arsenic (x3), Boron (x3), Lead (x2), Lithium (x2), Sulfate (x4), Thallium (x11)	2
123	Labadie Energy Center	MO	Arsenic (x4), Boron (x8), Lithium (x1), Molybdenum (x14)	3
124	Plant Bowen	GA	Antimony (x1), Arsenic (x2), Boron (x16), Cobalt (x3), Molybdenum (x3), Radium 226+228 (x1), Sulfate (x2)	4

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
125	Powerton Generating Station	IL	Arsenic (x21), Molybdenum (x2), Sulfate (x1), Thallium (x2)	2
126	Neal North Energy Center	IA	Arsenic (x8), Boron (x1), Cobalt (x1), Lithium (x6), Molybdenum (x3), Selenium (x5), Sulfate (x2)	3
127	Dave Johnston Power Plant	WY	Arsenic (x1), Boron (x4), Cadmium (x2), Cobalt (x3), Lead (x2), Lithium (x1), Molybdenum (x10), Sulfate (x2)	3
128	JC Weadock Power Plant	MI	Arsenic (x8), Beryllium (x3), Boron (x2), Cobalt (x2), Lithium (x6), Molybdenum (x3), Sulfate (x4)	2
129	James H. Miller, Jr., Electric Generating Plant	AL	Arsenic (x1), Boron (x2), Cobalt (x12), Lithium (x6), Molybdenum (x3), Sulfate (x3)	1
130	Plant Smith	FL	Arsenic (x2), Boron (x9), Lithium (x5), Radium 226+228 (x9), Sulfate (x2)	1
131	W.S. Lee Steam Station	SC	Arsenic (x2), Beryllium (x1), Boron (x1), Cobalt (x15), Lithium (x2), Molybdenum (x4), Radium 226+228 (x1)	1
132	Healy Power Plant	AK	Antimony (x1), Arsenic (x7), Fluoride (x3), Lithium (x1), Molybdenum (x6), Radium 226+228 (x2), Selenium (x2), Sulfate (x1)	1
133	TransAlta Centralia Mine	WA	Arsenic (x1), Cobalt (x15), Lithium (x4), Sulfate (x6)	1
134	Plant Yates	GA	Beryllium (x4), Boron (x10), Cobalt (x5), Lithium (x1), Selenium (x3), Sulfate (x2)	4
135	St. Johns River Power Park	FL	Boron (x17), Molybdenum (x2), Radium 226+228 (x2), Sulfate (x3)	1
136	Eagle Valley Generating Station	IN	Arsenic (x9), Boron (x4), Lithium (x3), Molybdenum (x6)	1
137	Montrose Generating Station	MO	Arsenic (x1), Boron (x4), Cobalt (x18)	2
138	M.L. Kapp Generating Station	IA	Molybdenum (x23), Sulfate (x1)	1
139	Dallman Power Generating Station	IL	Arsenic (x14), Boron (x10), Sulfate (x1)	1
140	E.W. Brown Generating Station	KY	Arsenic (x8), Boron (x3), Lithium (x5), Molybdenum (x4), Sulfate (x3)	1
141	Prairie Creek Generating Station	IA	Arsenic (x14), Boron (x3), Molybdenum (x7)	1
142	Bremo Power Station	VA	Boron (x1), Cobalt (x6), Lithium (x10), Molybdenum (x5)	3
143	Buck Steam Station	NC	Boron (x1), Cobalt (x12), Lithium (x7), Molybdenum (x1), Sulfate (x1)	2
144	White Bluff Plant	AR	Beryllium (x2), Boron (x4), Cobalt (x5), Lithium (x6), Molybdenum (x4), Sulfate (x1)	1
145	Laramie River Station	WY	Boron (x2), Lithium (x3), Molybdenum (x5), Sulfate (x9)	3

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
146	D.B. Wilson Generating Station	KY	Cobalt (x17), Lithium (x1), Sulfate (x4)	1
147	Stanton Station	ND	Arsenic (x17), Boron (x2), Lead (x1), Molybdenum (x2)	2
148	Mayo Steam Electric Plant	NC	Arsenic (x1), Boron (x3), Cobalt (x3), Lithium (x9), Molybdenum (x2), Radium 226+228 (x2)	3
149	Lawrence Energy Center	KS	Arsenic (x7), Boron (x4), Fluoride (x1), Lithium (x2), Molybdenum (x4), Sulfate (x4)	2
150	Hennepin Power Station	IL	Arsenic (x3), Boron (x4), Cobalt (x1), Lithium (x2), Molybdenum (x8), Selenium (x1)	4
151	Big Fork Ranch	OK	Arsenic (x2), Beryllium (x1), Boron (x5), Molybdenum (x2), Sulfate (x4), Thallium (x4)	1
152	Jeffrey Energy Center	KS	Boron (x1), Lithium (x2), Molybdenum (x12), Sulfate (x4)	4
153	Coyote Station	ND	Arsenic (x1), Boron (x2), Cobalt (x5), Selenium (x2), Sulfate (x10)	2
154	Duck Creek Power Station	IL	Arsenic (x2), Cobalt (x6), Lead (x6), Lithium (x2)	3
155	Conemaugh Generating Station	PA	Cobalt (x18), Sulfate (x2)	2
156	Sikeston Power Station	MO	Boron (x2), Molybdenum (x14)	2
157	H.B. Robinson Steam Electric Plant	SC	Arsenic (x10), Lithium (x2), Molybdenum (x1), Radium 226+228 (x3), Thallium (x1)	1
158	East Bend Electric Plant	KY	Lithium (x15), Sulfate (x2)	3
159	Choctaw Generation Limited Partnership, LLLP - Red Hills Operations	MS	Cobalt (x7), Lithium (x2), Molybdenum (x5), Sulfate (x2)	1
160	Escalante Generating Station	NM	Arsenic (x2), Lithium (x15)	1
161	Coronado Generating Station	AZ	Lithium (x14), Radium 226+228 (x1)	3
162	Rockport Plant	IN	Arsenic (x2), Boron (x13)	2
163	Edwards Power Station	IL	Arsenic (x2), Cobalt (x6), Lead (x2), Lithium (x4)	1
164	Tecumseh Energy Center	KS	Arsenic (x10), Cobalt (x4), Sulfate (x2)	2
165	Hudson Generating Station	NJ	Barium (x1), Cobalt (x1), Lithium (x2), Radium 226+228 (x4), Sulfate (x1), Thallium (x6)	2
166	Williams Generating Station	SC	Arsenic (x2), Boron (x10), Cobalt (x1), Radium 226+228 (x2)	2

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
167	Pleasants Power Station	WV	Barium (x4), Lithium (x2), Radium 226+228 (x9)	1
168	Johnsonville Fossil Plant	TN	Boron (x4), Cobalt (x9), Sulfate (x1)	1
169	Pawnee Station	CO	Lithium (x4), Sulfate (x10)	3
170	J.K. Smith Power Station	KY	Lithium (x12), Radium 226+228 (x1), Sulfate (x2)	1
171	Zimmer Power Station	OH	Boron (x3), Lithium (x6), Sulfate (x2)	4
172	Leland Olds Station	ND	Arsenic (x1), Boron (x2), Fluoride (x1), Lithium (x3), Molybdenum (x2), Sulfate (x4)	2
173	BC Cobb Power Plant	MI	Arsenic (x2), Boron (x6), Lithium (x3), Molybdenum (x2), Radium 226+228 (x1)	1
174	Mount Storm Power Station	WV	Beryllium (x1), Cobalt (x8), Fluoride (x1), Molybdenum (x2)	3
175	Sandow Steam Electric Station	TX	Chromium (x2), Lithium (x13)	1
176	Mountaineer Plant	WV	Boron (x5), Lithium (x3), Molybdenum (x2), Sulfate (x2)	2
177	James M. Barry Electric Generating Plant	AL	Arsenic (x7), Boron (x1), Cobalt (x5)	2
178	W.A. Parish Electric Generating Station	TX	Antimony (x2), Arsenic (x3), Lithium (x2), Sulfate (x3), Thallium (x1)	6
179	Oak Grove Steam Electric Station	TX	Chromium (x2), Cobalt (x4), Lithium (x3)	2
180	Deerhaven Generating Station	FL	Boron (x2), Lithium (x4), Molybdenum (x3), Radium 226+228 (x1)	2
181	River Rouge Power Plant	MI	Arsenic (x8), Boron (x1), Lithium (x1), Molybdenum (x1)	1
182	Nebraska City Generating Station	NE	Arsenic (x5), Boron (x2), Lithium (x1), Molybdenum (x2)	2
183	Possum Point Power Station	VA	Arsenic (x3), Boron (x1), Cobalt (x5)	3
184	Newton Power Station	IL	Arsenic (x7), Cobalt (x1)	2
185	Montour Steam Electric Station	PA	Cobalt (x3), Lithium (x4), Sulfate (x3)	2
186	W.H. Sammis Power Station	OH	Barium (x2), Cobalt (x8)	1
187	Plant McIntosh	GA	Boron (x2), Cobalt (x2), Lithium (x3), Selenium (x4)	2
188	Cherokee Station	CO	Boron (x2), Lithium (x3), Molybdenum (x1), Sulfate (x3)	2
189	Iatan Generating Station	MO	Arsenic (x2), Boron (x1), Cadmium (x2), Lithium (x1), Molybdenum (x2)	2

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
190	Boswell Energy Center	MN	Arsenic (x3), Boron (x3), Molybdenum (x1), Sulfate (x3)	1
191	Big Brown Steam Electric Station	TX	Boron (x2), Cobalt (x2), Selenium (x3)	2
192	Baldwin Energy Complex	IL	Boron (x3), Lithium (x3), Molybdenum (x1), Sulfate (x2)	2
193	Clinch River Plant	VA	Barium (x2), Cobalt (x2), Lithium (x4), Molybdenum (x4)	1
194	Mitchell Plant	WV	Arsenic (x1), Boron (x6), Molybdenum (x2)	2
195	Belle River Power Plant	MI	Boron (x1), Cobalt (x1), Lithium (x2), Molybdenum (x2)	3
196	John E Amos Plant	WV	Cobalt (x4), Molybdenum (x3)	3
197	Harrison Power Station	WV	Arsenic (x2), Mercury (x1), Molybdenum (x4), Sulfate (x3)	1
198	Neal South Energy Center	IA	Arsenic (x5), Boron (x2), Cobalt (x1)	1
199	Colbert Fossil Plant	AL	Arsenic (x4), Boron (x2), Cobalt (x4)	1
200	Michigan City Generating Station	IN	Arsenic (x4), Boron (x2), Selenium (x1), Thallium (x2)	2
201	Dan River Steam Station	NC	Arsenic (x3), Cobalt (x1), Lithium (x3)	2
202	Lansing Generating Station	IA	Arsenic (x4), Boron (x2), Molybdenum (x1)	1
203	Big Bend Power Station	FL	Molybdenum (x2), Radium 226+228 (x7)	1
204	Big Cajun II Power Plant	LA	Arsenic (x1), Boron (x2), Sulfate (x2), Thallium (x1)	1
205	Hollow Rock Facility	OH	Arsenic (x2), Cobalt (x2), Sulfate (x4)	1
206	Whitewater Valley Station	IN	Mercury (x6), Molybdenum (x3)	1
207	Ft. Martin Power Station	WV	Arsenic (x1), Boron (x2), Lithium (x1), Molybdenum (x1), Sulfate (x2)	2
208	Seminole Generating Station	FL	Boron (x2), Molybdenum (x2), Radium 226+228 (x2), Sulfate (x2)	1
209	H.L. Spurlock Power Station	KY	Boron (x2), Mercury (x2), Molybdenum (x3), Sulfate (x1)	2
210	Monroe Power Plant	MI	Boron (x1), Lithium (x3), Sulfate (x3)	2
211	Columbia Energy Center	WI	Arsenic (x2), Boron (x1), Molybdenum (x2)	4
212	Cane Run Generating Station	KY	Arsenic (x2), Boron (x2), Lithium (x3), Sulfate (x1)	1
213	Brame Energy Center	LA	Cobalt (x2), Lead (x3)	1

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
214	Cooper Power Station	KY	Lithium (x5), Molybdenum (x1)	1
215	Limestone Electric Generating Station	TX	Boron (x3), Sulfate (x2)	5
216	James DeYoung Power Plant	MI	Lithium (x3), Sulfate (x2)	1
217	Coleto Creek Power Station	TX	Boron (x4), Molybdenum (x3)	1
218	St. Clair Power Plant	MI	Boron (x1), Lithium (x2)	2
219	W.H. Weatherspoon Power Plant	NC	Boron (x1), Radium 226+228 (x3)	1
220	Ottumwa Generating Station	IA	Cobalt (x3), Sulfate (x2)	3
221	Nelson Dewey Station	WI	Boron (x2), Molybdenum (x1), Thallium (x1)	1
222	Flint Creek Power Plant	AR	Arsenic (x1), Molybdenum (x1)	2
223	Joppa Power Station	IL	Cobalt (x3), Lead (x1)	2
224	Fayette Power Project	TX	Lithium (x3), Sulfate (x3)	1
225	Dunkirk Generating Station	NY	Antimony (x3), Thallium (x2)	1
226	Lockwood Hills LLC	NY	Antimony (x1), Arsenic (x1), Boron (x2), Molybdenum (x1)	1
227	Brickhaven No. 2 Mine Tract "A"	NC	Lithium (x3)	1
228	Big Stone Plant	SD	Boron (x2), Cobalt (x1), Sulfate (x3)	2
229	Thomas Hill Energy Center	MO	Sulfate (x5)	1
230	Sheldon Station	NE	Lithium (x3), Sulfate (x3)	1
231	Plant Victor Daniel	MS	Lithium (x5)	3
232	Clear Spring Ranch	CO	Boron (x2), Selenium (x4)	1
233	Shawnee Fossil Plant	KY	Boron (x2), Molybdenum (x3)	1
234	JR Whiting Power Plant	MI	Cobalt (x1), Lithium (x2)	2
235	John W. Turk Power Plant	AR	Lithium (x3), Sulfate (x1)	1
236	City of Ames Municipal Electric System	IA	Molybdenum (x2), Sulfate (x2)	1

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
237	Pleasant Prairie Power Plant	WI	Molybdenum (x4)	1
238	Mercer Generating Station	NJ	Cobalt (x1)	1
239	Greenidge Generation	NY	Arsenic (x5)	1
240	Sutherland Generating Station	IA	Arsenic (x1), Boron (x1), Sulfate (x1)	1
241	Independence Plant	AR	Boron (x2), Lithium (x2)	1
242	Sherburne County Generating Plant	MN	No pollutants present at unsafe levels.	3
243	North Valmy Generating Station	NV	Boron (x3), Fluoride (x2)	1
244	Louisa Generating Station	IA	Molybdenum (x1), Sulfate (x1)	2
245	Platte Generating Station	NE	Cobalt (x3)	1
246	Homer City Generating Station	PA	Lithium (x5)	1
247	Will County	IL	Arsenic (x2), Molybdenum (x2)	1
248	Columbia Municipal Power Plant	MO	Boron (x1), Sulfate (x1), Thallium (x2)	1
249	John Twitty Energy Center	MO	Antimony (x1)	1
250	Cheswick Generating Station	PA	Boron (x1), Lithium (x1), Molybdenum (x2)	2
251	Antelope Valley Station	ND	Molybdenum (x1)	1
252	Brayton Point Power Station	MA	Arsenic (x1), Lithium (x2), Molybdenum (x1)	1
253	Weston Power Plant Disposal Site	WI	Cobalt (x2)	2
254	Clover Power Station	VA	Lithium (x2)	2
255	TS Power Plant	NV	Arsenic (x1), Lithium (x2)	1
256	Whelan Energy Center	NE	Lithium (x1), Molybdenum (x1)	1
257	Hoot Lake Plant	MN	No pollutants present at unsafe levels.	1
258	General Waste & Recycling, LLC	MN	Sulfate (x4)	1
259	Caledonia Ash Landfill	WI	Molybdenum (x1)	1
260	Shiras Steam Plant	MI	Cobalt (x1), Lead (x2)	1
261	Milton R. Young Station	ND	Unsafe groundwater, but source of contamination unclear.	1

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
262	John Sevier Fossil Plant	TN	Lithium (x1)	1
263	Gerald Gentleman Station	NE	Unsafe groundwater, but source of contamination unclear.	1
264	Kincaid Power Station	IL	Boron (x2)	1
265	Yorktown Power Station	VA	No pollutants present at unsafe levels.	1
266	Nearman Creek Power Station	KS	Boron (x1)	1
267	Joliet #29 Generating Station	IL	Cobalt (x1)	1
268	Lon D. Wright Power Plant	NE	No pollutants present at unsafe levels.	1
269	Roy S. Nelson Plant	LA	Lithium (x1)	1
270	James River Power Station	MO	No pollutants present at unsafe levels.	1
271	Prairie State Generating Company, LLC	IL	Unsafe groundwater, but source of contamination unclear.	1
272	Waukegan Station	IL	Sulfate (x1)	1
273	Virginia City Hybrid Energy Center	VA	Unsafe groundwater, but source of contamination unclear.	1
274	Apache Generating Station	AZ	No pollutants present at unsafe levels.	2
275	Plum Point Energy Station	AR	No pollutants present at unsafe levels.	1
276	Taconite Harbor Energy Center	MN	No pollutants present at unsafe levels.	1
277	Muskogee Power Plant	OK	No pollutants present at unsafe levels.	1
278	Merom Generating Station	IN	Fluoride (x1)	1
279	Havana Power Station	IL	No pollutants present at unsafe levels.	1
280	Halifax County Coal Ash Landfill	NC	No pollutants present at unsafe levels.	1
281	Keystone Generating Station	PA	Unsafe groundwater, but source of contamination unclear.	3
282	Plant Crisp	GA	No pollutants present at unsafe levels.	1
283	Navajo Generating Station	AZ	No pollutants present at unsafe levels.	1
284	Twin Oaks Power Station	TX	Unsafe groundwater, but source of contamination unclear.	1

Rank	Site Name	State	Pollutants Exceeding Safe Levels (and by how much)	No. of Regulated Disposal Units
285	Holcomb Common Facilities, LLC	KS	Unsafe groundwater, but source of contamination unclear.	1
286	Boardman Power Plant	OR	No pollutants present at unsafe levels.	1
287	Fort Armistead Road	MD	Unsafe groundwater, but source of contamination unclear.	1
288	Dairyland Power Cooperative	WI	No pollutants present at unsafe levels.	1
289	Laskin Energy Center	MN	Unsafe groundwater, but source of contamination unclear.	1
290	Presque Isle Power Plant	MI	Unsafe groundwater, but source of contamination unclear.	1
291	Cope Generating Station	SC	Unsafe groundwater, but source of contamination unclear.	1
292	Merrimack Station	NH	No pollutants present at unsafe levels.	1

Notes: Mixed disposal area monitoring networks include multiple disposal areas with both surface impoundments and landfills. There are also multi-unit systems that have multiple surface impoundments or multiple landfills (but not both), that are only counted as one of that type in the respective columns.

Appendix B: Downstream Strategies Analysis of 19 Power Plants

Compliance with the federal CCR Rule

Nineteen case studies

Meghan Betcher

Evan Hansen

Evan Fedorko

Downstream Strategies

Ideas that sustain.

October 19, 2022

911 Greenbag Road
Morgantown, WV 26508
downstreamstrategies.com

TABLE OF CONTENTS

ABBREVIATIONS

ACM	assessment of corrective measures
AEP	American Electric Power
AMSL	above mean sea level
ASD	alternate source demonstration
CCR	coal combustion residuals
FEMA	Federal Emergency Management Agency
FGD	flue gas desulfurization
GWPS	groundwater protection standard
HDPE	high density polyethylene
IP&L	Indianapolis Power & Light Company
LG&E	Louisville Gas and Electric
MCL	maximum contaminant level
MDE	Maryland Department of the Environment
MNA	monitored natural attenuation
NDEP	Nevada Department of Environmental Protection
OVEC	Ohio Valley Electric Corporation
PE	professional engineer
SSI	statistically significant increase
SSL	statistically significant level
TDS	total dissolved solids
TVA	Tennessee Valley Authority
UPL	upper prediction level
USEPA	United States Environmental Protection Agency
WDEQ	Wyoming Department of Environmental Quality

1. INTRODUCTION

In this report, we review compliance with the federal Coal Combustion Residuals (CCR) Rule for 19 of the most contaminated sites across the country. Our review includes the following components:

1. **Closure plans.** Closure notifications, reports describing plans for closing units, annual groundwater monitoring and corrective action reports, and reports describing chosen remedies were reviewed to determine if units have been or will be closed in place. Location restriction documents, unit construction plans and diagrams, and data describing depth to groundwater and potentiometric surface diagrams included in annual groundwater monitoring and corrective action plans, alternate source demonstrations (ASDs), and assessments of corrective measures (ACMs) were reviewed as available to determine whether the ash units are in contact with groundwater. The Federal Emergency Management Agency's (FEMA's) GIS-based floodplain mapping tool was used to identify ash units located within floodplains. This information was used to determine which units have been or will be closed in place in contact with groundwater.

2. **Groundwater monitoring.** Annual groundwater monitoring and corrective action reports, statistical methods certification documents, and groundwater monitoring system certification documents were reviewed to determine whether intrawell groundwater monitoring is being used, whether too few or inappropriate background or downgradient wells are being used, and whether monitoring was discontinued.

3. **Flawed ASDs.** Alternate source determinations that identified a source of contaminants other than the unit of concern were reviewed to determine if they include sufficient evidence to support the conclusions. As necessary, data and figures presented in annual groundwater monitoring and corrective action reports, construction documents, and groundwater monitoring network certification reports were also consulted.

4. **Flawed ACMs.** Assessment of corrective measures documents were reviewed to determine whether ACMs are artificially narrow in scope, fail to characterize the nature and extent of contamination, inadequately consider required factors, fail to estimate the time until full protection is achieved, fail to estimate the mass of pollutants released, or fail to characterize site conditions that may affect the remedy ultimately selected. As needed for a complete evaluation of ACMs, annual groundwater monitoring and corrective action reports, construction history reports, and groundwater monitoring network certification documents were reviewed.

5. **Deficiencies in selected remedies.** ACMs, annual groundwater monitoring and corrective action reports, and semi-annual remedy progress reports were reviewed to identify sites for which a remedy was expected to be selected and detect units for which a remedy was not selected within the required timeframe. For units for which a remedy had been selected, remedy selection documents were reviewed to determine whether monitored natural attenuation (MNA) or a risk-based remedy was the selected groundwater remedy. These documents were also reviewed for instances of failure to establish a meaningful implementation schedule with detailed activities, months, and years.

6. **Presence of unregulated ash disposal units.** Aerial imagery and the documents described above were used to identify any evidence indicating the presence of an unregulated unit.

The sites include:

1. Allen (Duke Energy),
2. Allen (TVA),
3. Amos,
4. Brandywine,
5. Ghent,
6. Hunter,
7. Jim Bridger,
8. Kyger Creek,
9. Martin Lake,
10. Naughton,
11. New Castle,
12. Petersburg,
13. Powerton,
14. RD Morrow,
15. Reid Gardner,
16. San Miguel,
17. Sioux,
18. Trimble, and
19. Welsh.

2. ALLEN (DUKE ENERGY)

The Duke Energy Carolinas Allen Steam Station is situated on the banks of Lake Wylie in Gaston County, North Carolina. The Retired Ash Basin (RAB), Active Ash Basin (AAB), and RAB Landfill comprise a CCR multi-unit. Assessment monitoring was completed for the multi-unit in spring and fall 2021. Statistically significant levels (SSLs) for the following Appendix IV constituents were identified during 2020 and 2021: arsenic (one well, 8 times the maximum contaminant level, or MCL), beryllium (two wells, up to 11 times the MCL), cadmium (two wells, up to 2 times the MCL), cobalt (13 wells, up to 960 times the default groundwater protection standard, or GWPS, in the CCR Rule), lead (one well, 3.6 times the MCL), lithium (six wells, up to 5.9 times the default GWPS), and thallium (one well, 1.2 times the MCL).

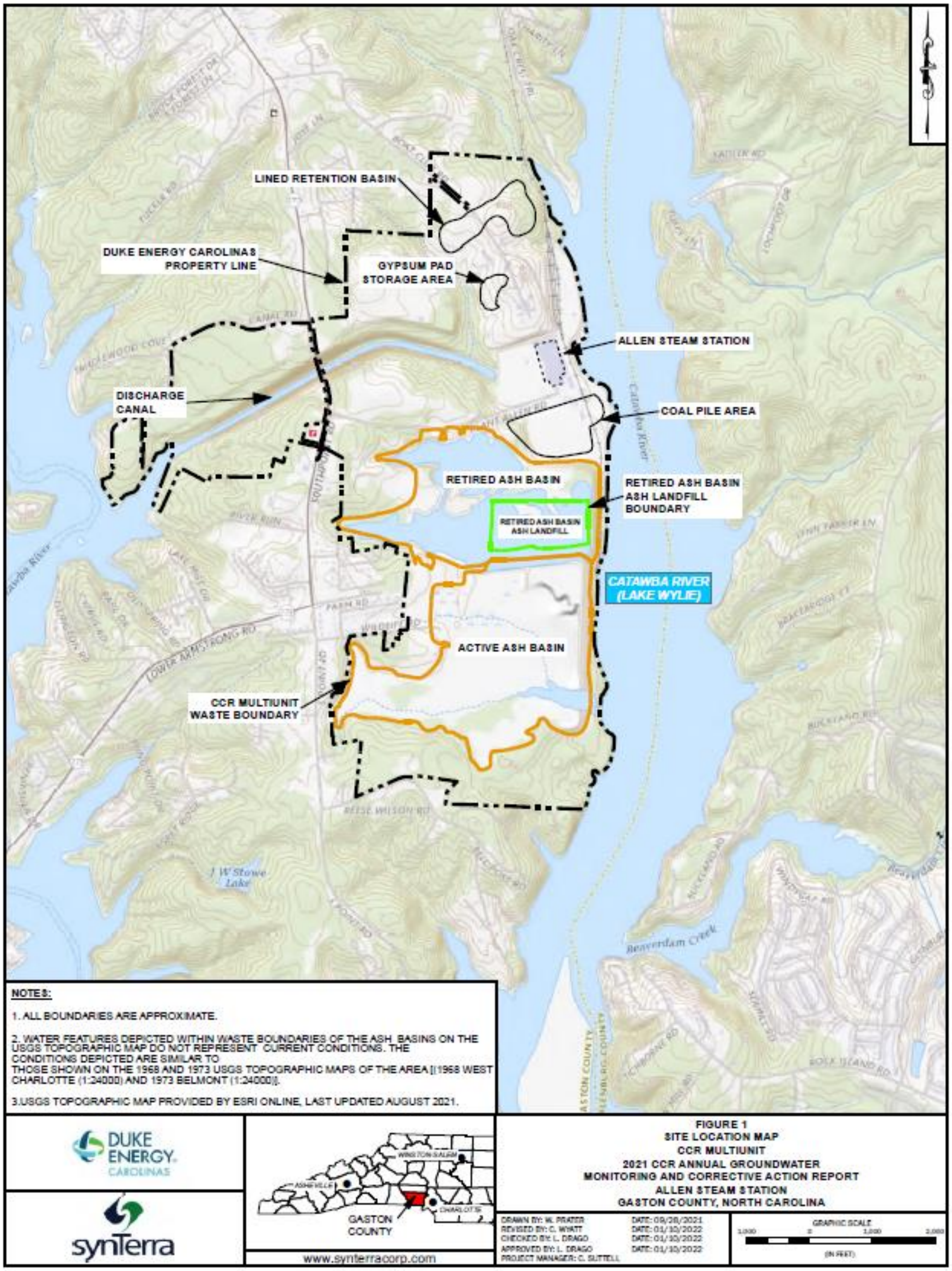
SSLs were initially identified during 2018 monitoring events, and an ACM was initiated in 2019. Dewatering of the AAB began in June 2020 and was ongoing as of the drafting of the 2021 Annual Groundwater Monitoring Report. A corrective action remedy has not been selected. Duke Energy's initial plan was to close the multi-unit in place, but on February 11, 2020, Duke posted an amended closure plan indicating that the CCR multi-unit would be closed by removal.

ASDs were not completed for this facility.

The groundwater at this site is known to contain numerous contaminants (arsenic, beryllium, cadmium, cobalt, lead, lithium, and thallium) at levels greater than relevant thresholds. Cobalt, which is known to cause thyroid damage, is present in concentrations more than 500 times the default GWPS. Yet, a remedy to address this extensive contamination has not been selected more than two years following completion of the initial ACM.

Violations of the CCR Rule at this site include:

- failure to calculate groundwater contamination loads,
- failure to provide a timeline for remediation, and
- failure to select a remedy in a timely manner.


LINED RETENTION BASIN
DUKE ENERGY CAROLINAS PROPERTY LINE
GYPSUM PAD STORAGE AREA
ALLEN STEAM STATION
DISCHARGE CANAL
COAL PILE AREA
RETIRED ASH BASIN
RETIRED ASH BASIN ASH LANDFILL BOUNDARY
RETIRED ASH BASIN ASH LANDFILL
CATAWBA RIVER (LAKE WYLIE)
ACTIVE ASH BASIN
CCR MULTIUNIT WASTE BOUNDARY
NOTES:
1. ALL BOUNDARIES ARE APPROXIMATE.
2. WATER FEATURES DEPICTED WITHIN WASTE BOUNDARIES OF THE ASH BASINS ON THE USGS TOPOGRAPHIC MAP DO NOT REPRESENT CURRENT CONDITIONS. THE CONDITIONS DEPICTED ARE SIMILAR TO THOSE SHOWN ON THE 1968 AND 1973 USGS TOPOGRAPHIC MAPS OF THE AREA [(1968 WEST CHARLOTTE (1:24000) AND 1973 BELMONT (1:24000)].
3.USGS TOPOGRAPHIC MAP PROVIDED BY ESRI ONLINE, LAST UPDATED AUGUST 2021.
GASTON COUNTY
www.synterracorp.com
FIGURE 1
SITE LOCATION MAP
CCR MULTIUNIT
2021 CCR ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
ALLEN STEAM STATION
GASTON COUNTY, NORTH CAROLINA
DRAWN BY: W. PRATER DATE: 09/28/2021
REVISED BY: C. WYATT DATE: 01/10/2022
CHECKED BY: L. DRAGO DATE: 01/10/2022
APPROVED BY: L. DRAGO DATE: 01/10/2022
PROJECT MANAGER: C. SUTTELL
GRAPHIC SCALE
(IN FEET)

2.1 Flawed ACMs

Duke began the corrective action assessment in 2019 and has continued monitoring to fully assess the nature and extent of contamination.

Flaws were found with the ACMs at this facility. The ACM includes broad time estimates for beginning and completing the considered remedies, but detailed timelines for these activities are not provided. Further, the mass of pollutants released has not yet been estimated. Additional monitoring wells have been installed and monitoring is ongoing; however, initial estimates of contaminant loads could have been completed given the data available. Failure to calculate the quantity of the contaminant load in groundwater and to provide a detailed timeline for remediation is a violation of the CCR Rule.

2.2 Deficiencies in selected remedies

The selection of remedies to address existing groundwater contamination is overdue. The CCR Rule requires that the owner/operator select a remedy as soon as feasible following completion of the corrective measures assessment. The Assessment of Corrective Measures Report was completed in April 2019, yet no remedies were selected at that time. A public meeting was held in 2021 concerning the ACM; still, no remedies were selected, in violation of the CCR Rule.

Duke amended its closure plan for the site in 2020, indicating that the site would be closed by removal of CCR. Dewatering of the Active Ash Basin began in June 2020 and is ongoing. Removal of ash will control the source; however, existing groundwater contamination must also be addressed.

2.3 Conclusion

The ACM does not calculate the extent of CCR contamination at this facility. Further, a remedy with a detailed timeline for actions has not been selected, in violation of the CCR Rule. Without an accurate picture of the mass and extent of groundwater contamination, an effective remedy cannot be determined. Failure to create an effective plan for remediation allows CCR contamination to remain in the aquifer.

3. ALLEN (TVA)

The Tennessee Valley Authority (TVA) Allen Fossil Plant is a retired 990-MW coal-fired power plant in the southwest corner of Tennessee, approximately four miles from downtown Memphis. TVA retired the plant in 2018. There is one regulated coal ash unit on site, a 100+-acre pond known as the East Ash Disposal Area. TVA has issued a notice of intent to close the unit, which contains more than 2.5 million cubic yards of coal ash.

The unit is on the banks of McKellar Lake, which is a popular lake used for both boating and fishing, although the State of Tennessee prohibits fish consumption due to contamination. The northern boundary of the unit is approximately 500 feet from the edge of the lake. It also sits above a deep, high-quality aquifer that supplies drinking water to Memphis and nearby areas.

Baseline monitoring of the site in 2016 and 2017 found concentrations of numerous Appendix III and Appendix IV constituents in excess of GWPSs in several wells. Exceedances were found for arsenic, boron, fluoride, lead, and molybdenum.

SSLs over background were detected in the first year of monitoring in four wells. TVA completed an ASD for these exceedances but failed to identify a source other than the CCR unit, resulting in a transition to assessment monitoring. Numerous other SSLs have been detected since that time for several constituents, including arsenic, fluoride, lead, and molybdenum. Concentrations of arsenic, in particular, have recently risen dramatically, reaching concentrations of 2,500 μg/L, a level 250 times greater than the GWPS.

Violations and potential violations of the CCR Rule include:

- The groundwater monitoring network excludes a large portion of the unit boundary along the western edge.
- The ACM has several deficiencies, including failing to estimate the mass of pollutants released, failing to provide a meaningful schedule for implementation, and failing to estimate the time any of the remedies being evaluated will require to achieve their aim.
- The operator engaged in a protracted process to select a remedy and has done so as of July 2022; however, this remedy was not selected in a timely manner as required by the CCR Rule.

3.1 Groundwater monitoring

The unit currently has two upgradient wells: ACC-5B and ALF-216. The initial groundwater monitoring system had just one upgradient well, ALF-210, but this well was later re-classified as a cross-gradient well. At the outset, the system included eight downgradient wells, spaced approximately 800 to 900 feet apart. A ninth well was added later. Several wells, including ALF-201, ALF-202, and ALF-204, are at least 200 feet from the unit boundary.

Groundwater flow conditions at this site are impacted by lake elevations. In early groundwater monitoring reports, TVA reported that the "gradient has been observed to reverse and flow south during periods of high surface water levels in McKellar Lake." The potentiometric surfaces and groundwater indicators in the groundwater reports reflect the variability of groundwater flow in the unit. The potentiometric surface maps show groundwater elevations dropping from south to north, towards the lake. Groundwater flow measurements, however, show that actual groundwater flow varies, often moving in the opposite direction. Thus, the southern edge includes several wells labeled as "downgradient," in recognition of the lake's effect on groundwater transport. Given the complex groundwater flow pattern at this site, it is notable that the western edge of the landfill has no monitoring wells. No data reported by TVA conclusively demonstrate that groundwater does not flow in this direction. As mentioned above, in 2020, TVA chose to reclassify its previous primary background well (ALF-210) as cross-gradient. This well lies to the west, suggesting that groundwater may flow in this direction. Taken together, these lines of evidence indicate that the absence of wells along the western edge is likely a violation of the CCR Rule.

3.2 Flawed ACMs

The initial ACM was published in 2019 in response to SSLs for arsenic, fluoride, lead, and molybdenum in four wells: ALF-202, ALF-203, ALF-204, and ALF-205. In April 2019, prior to the release of the ACMs, TVA released a notice of intent to close the unit. In addition to source control via closure, TVA evaluated three methods to address groundwater contamination on the site: MNA, hydraulic containment and treatment, and enhanced in-situ treatment. The final remedy of source control with hydraulic containment through groundwater extraction and treatment was selected three years later, in June 2022.

Following discovery of SSLs, and in response to a formal request from the Tennessee Department of Environment and Conservation, TVA engaged in an enhanced groundwater monitoring program to "define the horizontal and vertical extent of Appendix IV constituents greater than the GWPS." This involved the temporary construction of several geoprobe monitoring wells, piezometers, and monitoring wells. These wells were effectively added to the existing monitoring network and used to create "Potential Treatment Zones" along the north and south edges of the CCR unit. The actual results from the enhanced groundwater monitoring program are not provided by TVA and thus cannot be evaluated.

TVA provides estimates for the extent of pollution, but does not estimate the mass of pollutants released, in violation of the CCR Rule. The ACM also fails to provide a meaningful schedule for implementation or any indication of the time any of the remedies being evaluated will require to achieve their aim, both violations of the CCR Rule.

3.3 Deficiencies in selected remedies

TVA selected a final remedy but failed to do so in a timely manner, choosing instead to issue a notice of intent to close the unit after identifying exceedances in 2018. Four years later, in June 2022, TVA announced the selection of remedy for groundwater cleanup: hydraulic containment through groundwater extraction and treatment. This remedy was not selected in a timely manner, in violation of the CCR Rule.

3.4 Presence of unregulated ash disposal units

Historical aerial imagery shows a myriad of activity to the south of the site that looks similar to coal ash ponds or landfills. These are not mentioned in TVA's documents. During Allen's operation, coal ash was generated and stored on the Allen site in two locations: the East Ash Disposal Area and the West Ash Disposal Area. Both areas were surface impoundments.

According to the Final Environmental Impact Statement for this plant, the West Ash Pond project area encompasses approximately 40 acres, which includes the West Ash Pond and the Metal Cleaning Pond. As of 2015, the West Ash Pond did not receive CCR or flows. Consequently, TVA considered the West Ash Pond to be a "closed" surface impoundment and concluded that it is not subject to the CCR Rule. However, if there is any water in this unit, including groundwater, then it should be regulated as an inactive CCR surface impoundment.

Also according to the Final Environmental Impact Statement, the Metal Cleaning Pond is a lined pond that contains storm water and process flows previously received from the plant. It is not a CCR surface impoundment and was not designed to accumulate CCR. However, there is CCR underneath the Metal Cleaning Pond.

The West Ash Pond and Metal Cleaning Pond are both in the footprint of an older and larger impoundment. If that ash is saturated, then the older and larger impoundment may be subject to the CCR Rule, with implications for the West Ash Pond and Metal Cleaning Pond.

3.5 Conclusion

Although groundwater flows are highly variable, the western unit boundary is left unmonitored. This means contaminants may cross the unit boundary unnoticed and allowing TVA to evade responsibility for addressing the resulting impacts to groundwater. An ACM was completed, yet it does not calculate the extent and mass of CCR contamination resulting from the unit. Without an accurate picture of the mass and extent of groundwater contamination, an effective remedy cannot be determined. TVA did not select a remedy in a timely manner and allowed the unit to continue leaching contaminants to groundwater for three years. Further, the selected remedy does not include a detailed timeline for actions. Failure to create and initiate an effective plan for remediation allows CCR contamination to remain in the aquifer.

4. AMOS

The John E. Amos plant in Putnam County, West Virginia is owned and operated by Appalachian Power, an American Electric Power (AEP) subsidiary. It has been operating since 1971. Its three coal-fired electric generating units, with a total capacity of approximately 2,900 megawatts, make it the largest plant in AEP's fleet.

Coal ash is stored at three sites at the Amos Plant: the Bottom Ash Pond (BAP), Fly Ash Pond (FAP), and flue gas desulfurization (FGD) Landfill. The BAP and FGD Landfill are still in use; however, the FAP was capped and closed in 2017 because it is no longer required due to the plant's conversion to dry fly ash handling.

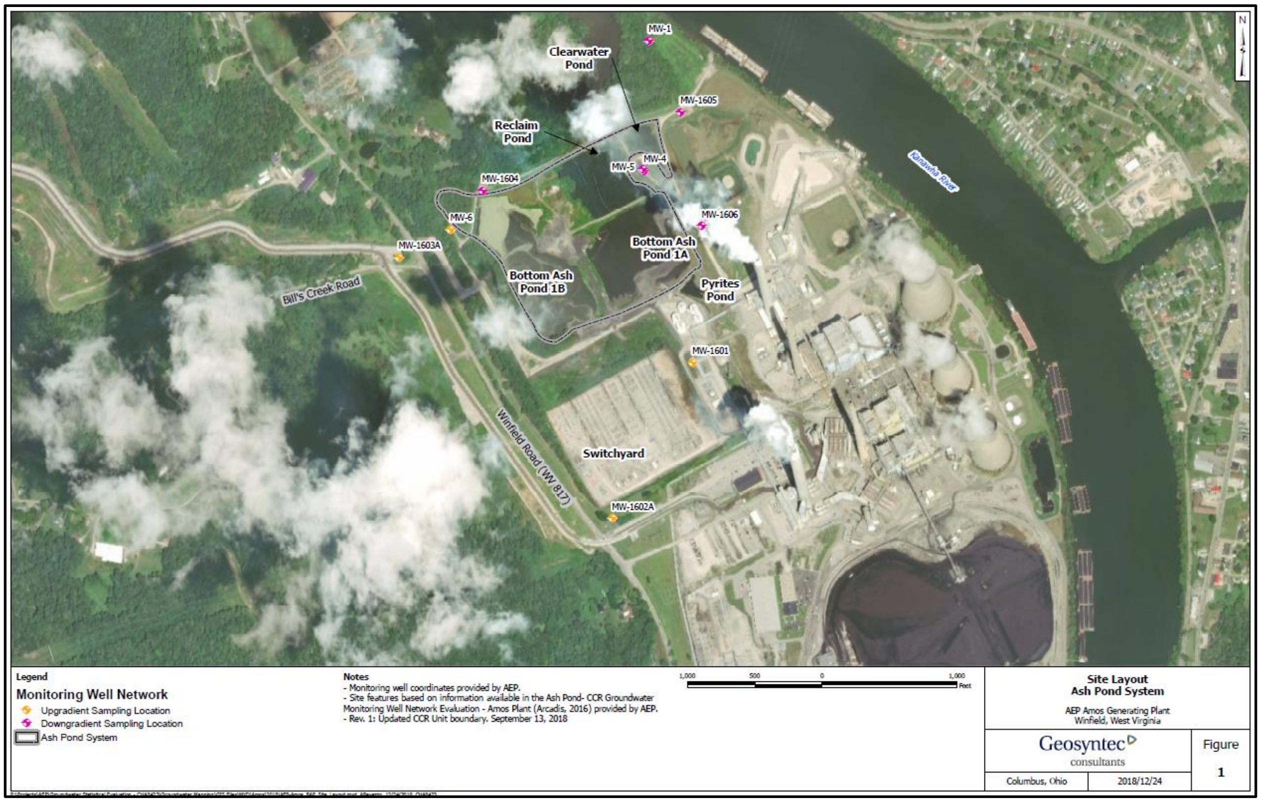
For the BAP, statistically significant increases (SSIs) were found in 2017 for calcium, chloride, sulfate, and total dissolved solids (TDS) (2019 Groundwater Monitoring Report). An ASD completed in 2018 did not successfully identify alternate sources for these contaminants and concluded that SSIs were potentially influenced by a release of leachate from the BAP to groundwater (ASD Memorandum, 4/13/2018). Thus, this site entered assessment monitoring in 2018. No SSLs have been identified during subsequent groundwater quality monitoring events; therefore, no corrective actions have been initiated at the BAP. However, SSIs have been identified during groundwater monitoring in subsequent years. Additional ASDs have not been completed, and this site remains in assessment monitoring.

The FAP is currently in detection monitoring. SSIs were identified for calcium, chloride, and sulfate in 2019 and for calcium and sulfate in 2020. An ASD was completed following each identification of SSIs. On each occasion, the ASD determined that SSIs were due to two factors: (1) natural variation of the constituent in groundwater and (2) issues with sampling procedures. Thus, the FAP has not entered assessment monitoring. No ACMs have been proposed, nor have any remedies been selected.

The FGD Landfill includes nine cells covering 192 acres and is permitted to accept 37 million cubic yards of CCR (Landfill Closure Plan, Revised 7/2019). It is currently in detection monitoring. SSIs of calcium were detected in 2019 and 2020. Subsequent ASDs determined that these increases were due to natural variation and did not result from releases from the unit; therefore, it has not entered assessment monitoring. No ACMs have been proposed, nor have any remedies been selected.

Violations of the CCR Rule include:

- The FAP has been closed in place in contact with groundwater.
- No monitoring wells exist in the area directly downgradient from the BAP.
- The use of intrawell methods for fluoride and pH at the BAP are not adequately justified.
- The background wells utilized for the FAP are separated from the FAP by the valley of Little Scary Creek and do not allow for determination of true upgradient influences on the FAP.
- ASDs completed for the FAP provide three alternate sources, none of which is conclusive.
- ASDs completed for the FGD Landfill assert that natural variation is the cause of SSIs, but the evidence provided is not conclusive.



4.1 Closure plans

The BAP will be closed by removal of the CCR material (BAP Closure Plan, Revised 11/2020). This unit is located within a Zone AE floodplain, meaning this area has a 1% annual chance of inundation. The CCR Rule prohibits facilities in floodplains that result in washout of CCR, so as to pose a hazard to human life, wildlife, or land or water resources. If a washout were to occur, this unit would be in violation of the CCR Rule.

As mentioned above, the FAP has been capped and closed in place (FAP Closure Plan, 10/2017 and AEP Letter to WVDEP, 1/10/2018). According to the potentiometric surface of the uppermost aquifer shown in several cross sections, the FAP is in contact with the uppermost aquifer (FAP Annual Groundwater Monitoring Report, 1/2021). Closing the FAP in place in contact with groundwater violates the CCR Rule.

4.2 Groundwater monitoring

BAP

The groundwater monitoring network at the BAP consists of ten monitoring wells, including:

- four identified as upgradient wells (MW-6, MW-1601, MW-1602A, and MW-1603A) and
- six identified as downgradient wells (MW-1, MW-4, MW-5, MW-1604, MW-1605, and MW-1606).

Three additional wells are utilized to help understand groundwater flow and hydraulic gradients. No monitoring wells exist in the area directly downgradient of the BAP; therefore, the monitoring network does not comply with the CCR Rule. Monitoring in this location is imperative as it is the area most likely to detect contamination released from the BAP. Wells MW-1, MW-4, MW-5, MW-1604, MW-1605, and MW-1606 are identified as downgradient; however, our assessment indicates that they measure crossgradient flow paths.

AEP presents potentiometric surface maps generated from water level data collected in February, May, and October 2020. Each of these maps indicates similar groundwater elevation contours and flow directions demonstrating that groundwater levels are consistent through the year. (2020 Annual Groundwater Monitoring and Corrective Action Report)

February 2020 data shows a strong flow component to the northwest through the BAP. According to AEP, no monitoring wells are present downgradient of the area between MW-1604 and MW-1605—except for P7, which is not monitored. (2020 Annual Groundwater Monitoring and Corrective Action Report)

Groundwater flow and the lack of monitoring wells in this location can also be observed in October 2020, in which a downgradient area extending between MW-1604 and MW-1605 and approximately 1,500 feet across is not monitored by an appropriate groundwater monitoring well. (2020 Annual Groundwater Monitoring and Corrective Action Report)

In addition to being located properly, downgradient wells must also be screened at appropriate depths to intersect contamination that may be migrating from the BAP toward the Kanawha River and Bill's Creek. Our analysis indicates that wells currently identified as downgradient wells are not screened at appropriate depths to adequately assess groundwater contaminants migrating from the BAP. If monitoring wells are screened too deep, they will not accurately measure contaminants released from the BAP. Once these contaminants reach the deeper geologic layers, significant dilution has occurred. Thus, wells screened in deeper geologic formations reflect contaminant levels after they have been diluted.

The company uses intrawell statistical methods at the BAP for fluoride and pH and interwell methods were used for other constituents (Statistical Analysis Summary, 1/15/2018). The company appears to have placed a preference for the use of intrawell tests. For fluoride and pH, they choose to use intrawell tests over interwell tests because the concentrations at compliance wells were determined not to be impacted by the CCR unit. No further explanation was provided why interwell tests could not have been used in this situation.

According to the United States Environmental Protection Agency (USEPA), intrawell comparisons are generally prohibited unless specific conditions are met, including that data must have been collected from the well when it was known to be uncontaminated by the CCR unit (Conditional Approval of an Alternative Closure Deadline for H.L. Spurlock Power Station, Maysville, Kentucky). The use of intrawell analyses for this unit is therefore a violation of the CCR Rule.

FAP

The current groundwater monitoring network at the FAP consists of 15 monitoring wells, including:

- five identified as upgradient or sidegradient wells (MW-1807A, MW-1807B, MW-1808A, MW-1809A, and MW-1810A) and
- ten identified as downgradient monitoring wells (MW-1, MW-2, MW-5, MW-6, MW-7, MW-8, MW-9, MW1801A, MW-1804A, and MW1806A).

Five wells located across the Little Scary Creek valley to the southeast of the FAP provide background monitoring data for the FAP. None of these wells are upgradient of the FAP. Rather, they are of similar elevation and screened within the same hydrostratigraphic units that immediately surround the FAP but are physically separated from the FAP by the valley of Little Scary Creek. Only one well (MW-10) within the uppermost aquifer immediately adjacent to the FAP is located hydraulically upgradient of the FAP. However, MW-10 was excluded from the monitoring program because of insufficient yield for sampling. Therefore, no upgradient wells are currently being utilized for groundwater monitoring at the FAP. (Fly Ash Pond CCR Groundwater Monitoring Well Network Evaluation) The background wells utilized by the company do not allow for determination of true upgradient influences on the FAP, and therefore violate the CCR Rule.

4.3 Flawed ASDs

FAP

ASDs were completed for the FAP in June 2020 to assess SSIs for calcium and sulfate at MW-5 and chloride and sulfate at MW-1804A and in November 2020 to assess SSIs for calcium and sulfate at MW-5 (Alternative Source Demonstration Report for Calcium, Chloride and Sulfate; Alternative Source Demonstration Report for Calcium and Sulfate).

The evidence presented for a source of elevated constituents in monitoring well samples is not conclusive enough to affirm the source. The company determined that alternate sources were reasonable, and thus determined that detection monitoring is adequate. In contrast, we interpret the inconclusive data to indicate that more extensive monitoring is necessary to accurately identify the source of constituents. The ASDs included three alternate sources.

First, they attributed SSIs to natural variation. However, the specific method used to purge wells during different sampling events may be responsible for the variation that was found. The maximum purge rate utilized during November 2019 sampling was between one-half and one-quarter the purge rate used during the eight background monitoring events. Additionally, the total volume purged during the November 2019 sampling at MW-5 and MW-1804A was lower than all other instances except October 2018 at MW-1804A. Benchmark values used to evaluate SSIs were formulated based on these historic data, which was generated using larger purge rates and volumes.

The company stated that:

> "In the case of MW-5, the excess pumping in the associated low-yield formation during SSI benchmark calibration sampling is expected to result in incursion of reducing, low sulfate, high TDS NaCl-type connate water into the well screen. Subsequent sampling at a lower purge rate and purge volume on November 2019 is expected to have minimized connate water incursion into the well and facilitated sampling of low TDS and sulfate bearing water with elevated Ca from above the connate water mixing interface." (Alternative Source Demonstration Report for Calcium and Sulfate, p. 143)

The company describes similar sampling-related influences on SSIs at MW-1804:

> "Conceivably, differences in the purge rate during sampling affected the relative contributions of different water bearing zones to the well, which resulted in groundwater geochemistry differences." (Alternative Source Demonstration Report for Calcium and Sulfate, p. 144)

Because of the differences in maximum purge rates and total purge volumes, the company's assertion that natural variation caused SSIs is not conclusively supported.

Second, the ASD describes an issue with the statistical evaluation:

> "Samples used to establish SSI benchmarks were obtained over a seven-month period between July 25, 2018 to February 18, 2019. For this reason, benchmark statistical calculations are qualified with 'Insufficient data to test for seasonality: data were not 'deseasonalized' (AEP 2020). Additionally, annual variations owing to high rainfall years are not accounted for, as detection monitoring began immediately following the establishment of

> SSI benchmarks. Therefore, periodic SSI exceedances related to seasonal and/or annual weather variations should be expected until a broader dataset is available that incorporates seasonal and annual weather patterns." (Alternative Source Demonstration Report for Calcium and Sulfate, p. 19-20)

We agree that more data are necessary to rule out anomalous weather impacts on sampling data. However, rather than identifying this as an alternate source, this lack of data justifies the continuation of the assessment monitoring program to bolster the dataset used in identifying anomalies.

Third, the ASD describes an extreme weather event as a potential cause for SSIs at MW-1804A. West Virginia experienced its highest annual rainfall ever in 2018. Background data used to calculate SSIs were collected between July 27, 2018 and February 21, 2019, and therefore, the company claims that constituent concentrations would have been impacted by the anomalous precipitation and would not necessarily represent average conditions. Due to its recharge timeframe of days to weeks, this extreme rainfall likely impacted samples used to calculate benchmark SSIs. The company states that:

> "Variable water level elevations in MW-1804A support potential changes in the relative contributions from different water-bearing zones to the November 2019 sample. Additionally, the lowest historical water level in November 2019 conceivably reflects relaxation of the water table back to typical levels with concomitant changes in groundwater geochemistry, thus, may be more reflective of typical conditions." (Alternative Source Demonstration Report for Calcium and Sulfate, p. 33)

Because the expected recharge rate at MW-5 is much longer than the time period contemplated in the ASD, the anomalous rainfall would not have impacted this well.

In summary, the FAP ASDs provide three alternate sources, none of which we find conclusive. Because the FAP ASDs do not contain sufficient factual or evidentiary basis to demonstrate that the SSIs were the result of alternate sources, they violate the CCR Rule.

FGD Landfill

ASDs were completed for the FGD Landfill in June 2020 to assess an SSI for calcium at MW-5 and in November 2020 to analyze an SSI for calcium at MW-2 (Alternative Source Demonstration Reports).

The evidence presented for sources of elevated constituents in monitoring well samples is not conclusive enough to affirm an alternate source. The ASD concludes that natural variation, rather than the Landfill, led to the SSIs identified at MW-5 in a sample collected in November 2019 and during verification sampling in January 2020 for the following reasons:

- Calcium concentrations at MW-8 and MW-9 are consistently above those at MW-5.
- These high concentrations of calcium at MW-8 and MW-9 indicate that the native geologic material (claystone and sandstone) contains calcium that may be released into solution at levels higher than typical at MW-5.
- MW-5's location in a perched zone makes it likely to be influenced by seasonal variations in groundwater migration and surface water intrusion. MW-5 was removed from the monitoring network for this reason.
- A duplicate sample collected at MW-5 during the verification sampling event had a calcium concentration that was below the upper prediction level (UPL).

Similarly, the ASD concludes that the SSI for calcium at MW-2 identified in May 2020 is attributed to natural variation based on the following:

- Calcium concentrations at upgradient wells MW-6 and MW-7R, both located on the southern side of the topographic divide, have consistently been above those at MW-2.
- High calcium concentrations at these wells indicate that the geologic material (claystone and sandstone) contains calcium that may be released into solution at higher concentrations than those at MW-2.

While the ASD's interpretations are plausible, the data do not indicate a definitive alternative source. Because they do not contain sufficient factual or evidentiary basis to demonstrate that the SSIs were the result of natural variation, they violate the CCR Rule.

4.4 Conclusion

Closing the FAP in place in contact with the aquifer will allow CCR contaminants to impact the aquifer for generations. The background monitoring network at the FAP is not capable of accurately reflecting background conditions; thus, it is not capable of revealing the true source of groundwater contamination. Because of this, AEP has evaded responsibility for cleaning up the contamination. The downgradient boundary of the BAP is not monitored; this means contaminants may cross the unit boundary unnoticed and AEP may again illegally evade responsibility for addressing the resulting impacts to groundwater. Intrawell analyses were used for selected constituents at the BAP. Use of intrawell analyses for groundwater monitoring when background data prior to waste disposal are unavailable allows contamination from the unit to go unnoticed and continue to impact groundwater resources. ASDs for contamination at both the FAP and FGD are inconclusive. Reliance on these ASDs allows AEP to avoid additional monitoring and remediation of existing groundwater contamination.

5. BRANDYWINE

The 217-acre Brandywine Ash Management Facility is located in Prince George's County, Maryland, 19 miles southeast of Washington, DC. It is currently operated by GenOn MD Ash Management, LLC. CCR has been landfilled at the facility since 1971. As of 2018, an estimated 7.7 million tons of CCR were placed at the site. (Nature and Extent of Contamination Study, Final Report, Brandywine Ash Management Facility, Brandywine, Maryland, 2018)

CCR placed at Brandywine has contaminated groundwater and surface water. This has led to legal action by the State of Maryland. A 2013 Consent Decree resulted in the development of a Corrective Measures Plan and a Nature and Extent of Contamination Study. According to the Consent Decree:

> "The original design of the disposal cells and operation of the disposal areas...has resulted in some leachate escaping the disposal cells via groundwater and constructed outfalls and entering surface waters..." (U.S. District Court for the District of Maryland, 2013, p. 5)

The Consent Decree further states:

> "Based on a review of the quarterly Discharge Monitoring Reports ...and other quarterly and annual monitoring reports submitted by GenOn, [Maryland Department of the Environment (MDE)] has determined that wastewater discharges from monitoring points at Brandywine have at times exceeded ambient surface water quality standards for cadmium and/or selenium. MDE has also determined that leachate has entered groundwater and is causing the MCL for cadmium to be exceeded at times at certain groundwater monitoring points, as were federally recommended secondary standards for manganese, sulfate, iron, TDS, aluminum and chloride." (U.S. District Court for the District of Maryland, 2013, p. 12-13)

This broader context—which is absent from documents submitted pursuant to the federal CCR Rule—is important for understanding the complexity of the Brandywine site and its impacts. For example, unsafe lithium levels hundreds of times higher than its default GWPS in the CCR Rule have been documented at groundwater monitoring wells, as have unsafe molybdenum levels up to approximately 80 times higher than its default GWPS. Some of these unsafe levels are found in monitoring wells not included in the network used to demonstrate compliance with the federal CCR Rule. (2022 Semi-annual Monitoring Report, First Quarter 2022, April 2022)

The Brandywine site includes four areas of interest: Historical Area 1, Historical Area 2, Phase I, and Phase II. CCR was placed in Historical Areas 1 and 2 through 1989. CCR was placed in the Phase I area from approximately 1988 through 2007. The Phase II area is subdivided into Phase 2A and 2B. Phase 2B received CCR from 2007 to 2010, and Phase 2A began accepting CCR in 2010. CCR disposal at Phase 2A is ongoing. (U.S. District Court for the District of Maryland, 2013) Of these four areas, only Phase II is regulated under the federal CCR Rule (2021 Groundwater Monitoring and Corrective Action Report).

The three inactive areas—Phase I, Historical Area 1, and Historical Area 2—are unlined (Nature and Extent of Contamination Study, Final Report, Brandywine Ash Management Facility, Brandywine, Maryland, 2018). From 2016 to 2018, these areas were capped with an engineering capping system under the Consent Decree with MDE. (Run On & Run Off Control System Plan, 2021, p. 3)

The Phase 2 cell, which is most recently operational, was built atop a geomembrane liner. Its size was reported as 33 acres in the 2021 Run On & Run Off Control System Plan and 29 acres in the 2021 Ground Water Monitoring and Corrective Action report. As of October 2021, approximately six acres of Phase 2A is active, and the remainder of Phase 2A and all of Phase 2B has been fully stabilized with soil cover and vegetation (Run On & Run Off Control System Plan, 2021). The Phase

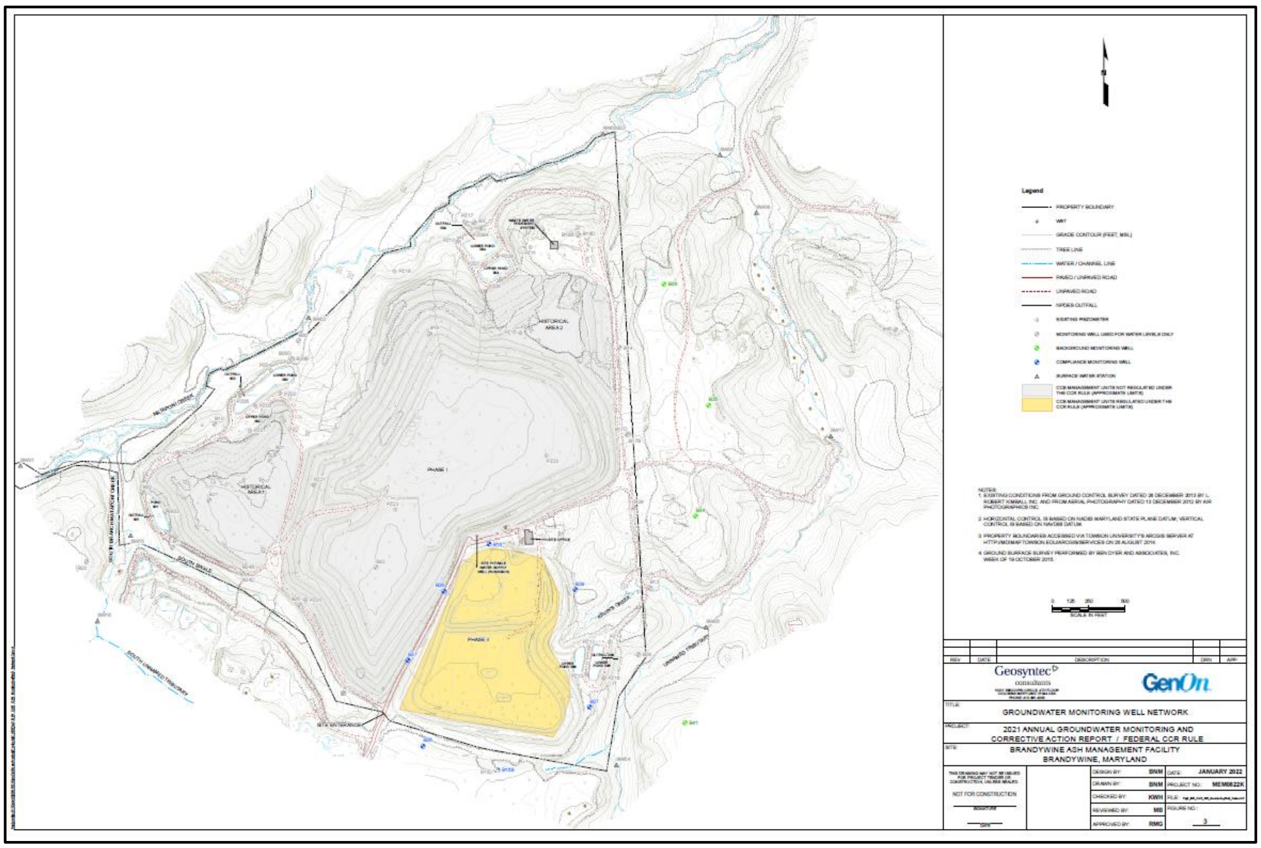
2 cell will be closed in-place with a low permeability geosynthetic cap (CCR Landfill Closure and Post-closure Care Plan, 2016).

Leachate from the landfill flows to either Pond 004 or Pond 006 via subsurface drainage systems. Water in Pond 006 is routed to Pond 004 and then to a wastewater treatment system, which was installed in 2017, before discharge via National Pollutant Discharge Elimination System Outfall 004. (2022 Semi-annual Monitoring Report, First Quarter 2022, April 2022)

SSIs were found for several pollutants over several years, but the site remains in detection monitoring based on ASDs.

Violations of the CCR Rule include:

- transitioning to intrawell analyses and
- ASDs that do not contain sufficient factual or evidentiary basis to support their conclusions.



5.1 Groundwater monitoring

The groundwater monitoring system used for compliance with the CCR Rule focuses on Phase II, the active, regulated unit. It uses several monitoring wells previously installed due to the state action against the facility. The monitoring network includes seven downgradient wells (B15S, B16, B26, B27, B37, B38, and B39) and four background wells (B34, B35, B36, and B41). (2021 Groundwater Monitoring and Corrective Action Report)

All four background wells are east of Phase II. The seven downgradient wells ring the Phase II area, with the largest distance between wells being approximately 800 feet between wells B39 and B27 along the eastern boundary of Phase II.

The Phase II unit has been in detection monitoring since 2017. Initially, interwell statistical analyses were used to calculate SSIs, and numerous SSIs were found based on data collected in 2017 and 2018. First, SSIs were found in five of the seven wells (all except B15S and B26) based on October 2017 samples, and these SSIs included all Appendix III constituents. Next, based on April/May 2018 samples, SSIs were again found in the same five wells. This time, SSIs were found for all Appendix III constituents except fluoride. Finally, in the next round of sampling in July/August 2018, SSIs were found in the same five wells plus B15S, and these SSIs were again found for all Appendix III constituents.

In 2018, after these SSIs were found, the company transitioned from interwell to intrawell analyses, and new background UPLs for the Appendix III constituents were used in the 2018 and subsequent Annual Groundwater Monitoring and Corrective Action Reports. (2021 Groundwater Monitoring and Corrective Action Report) According to USEPA, intrawell comparisons are generally prohibited unless specific conditions are met, including that data must have been collected from the well when it was known to be uncontaminated by the CCR unit (Conditional Approval of an Alternative Closure Deadline for H.L. Spurlock Power Station, Maysville, Kentucky). This transition to intrawell analyses is therefore a violation of the CCR Rule.

These new intrawell-based background UPLs for some pollutants are notably high, especially for Wells B16 and B38. For example, while USEPA's 10-day child health advisory for boron is 3,000 µg/L, the background UPL is 59,057 µg/L for Well B16 and 27,194 µg/L for Well B38 based on intrawell analyses. The interwell-based UPL for all wells for boron had been 25 µg/L, significantly lower than these intrawell-based UPLs.

Using intrawell statistics, background UPLs for sulfate are 791 mg/L for Well B16 and 2,540 mg/L for Well B38. The interwell-based UPL for all wells for sulfate had been 18.6 mg/L, again considerably lower than these intrawell-based UPLs.

Also, using intrawell statistics, background UPLs for TDS are 16,227 mg/L for Well B16 and 5,185 mg/L for Well B38. The interwell-based UPL for all wells for TDS was 239 mg/L, once again considerably lower than these intrawell-based UPLs.

Despite the use of such high UPLs in the intrawell analysis to determine SSIs, SSIs have continued to be found for calcium (Well B27 in 2019), fluoride (Well B16 in 2021), sulfate (Well B16 in 2018 and Wells B37 and B38 in 2020), and TDS (Well B15S in 2020).

As mentioned above, while only the Phase II unit is regulated under the federal CCR Rule, the State of Maryland has taken legal action against the site more broadly, which has resulted in additional monitoring and reporting requirements. The monitoring network currently in use as a result of the Consent Decree includes many more wells than the 11 used to document compliance with the federal CCR Rule.

According to the company's own data analysis of this expanded set of monitoring wells, concentrations of some constituents in some monitoring wells are increasing. In particular, Well B28, which is on the east side of the site between Kevin's Creek and the Unnamed Tributary and close to Outfall 006 from Pond 006, has increasing concentrations of boron, calcium, lithium, manganese, sodium, sulfate, and TDS. (2022 Semi Annual Report) Increasing concentrations of one or more constituent are also reported at wells B3, B16, B26, B31, and B39. These increases are not mentioned in reports or data submitted to demonstrate compliance with the federal CCR Rule.

5.2 Flawed ASDs

SSIs have been found over the years for calcium (2019), fluoride (2021), sulfate (2018 and 2020), and TDS (2020).

The ASD for the fluoride SSI in 2021 is a two-page letter asserting that the fluoride is not from the regulated Phase II unit. The ASD asserts that no SSIs were found for boron or sulfate, considered to be the primary indicators of CCR leachate. However, as mentioned above, the intrawell-based UPLs used to determine SSIs are notably high for boron and sulfate, making it less likely that SSIs would be found after transitioning to intrawell-based UPLs.

The 2021 ASD also asserts that SSIs were not detected for any constituents other than fluoride during the 2021 monitoring events at any compliance well, and an SSI for fluoride was not detected at any of the other compliance wells in 2021. Again, this lack of SSIs is likely due to the transition to intrawell-based UPLs.

Then, the 2021 ASD, without any analysis, assert that the fluoride SSI "might be due to natural variations in groundwater quality."

No analysis is provided to support the assertion related to natural variations in groundwater quality, nor is any analysis done to conclusively find that Phase II is not the source of the SSI. Further, no recognition is provided that the high intrawell-based UPLs make it unlikely that SSIs would be found. Because of these flaws, the ASD does not contain sufficient factual or evidentiary basis to support its conclusions, and it violates the CCR Rule.

All three of the 2020 SSIs were later "disconfirmed" after verification resamples were taken. Therefore, no ASDs were written, and the 2020 SSIs did not trigger progression into assessment monitoring.

The 2020 ASD for calcium to address the 2019 SSI was similar to the ASD for fluoride. The company refers to the lack of SSIs for boron and sulfate and to the fact that the calcium concentration dropped below the UPL in the subsequent monitoring period. This ASD, however, does not even hazard a guess as to what source caused the calcium SSI, failing to even assert that natural variation is the cause. Instead, the ASD simply states that "the SSI detected for calcium at the downgradient compliance monitoring well (B27) in the August 2019 sample is not due to a release of CCR leachate from the Phase II CCR unit." (2020 Annual Groundwater Monitoring and Corrective Action Report) Because of these flaws, the calcium ASD does not contain sufficient factual or evidentiary basis to support its conclusions, and it violates the CCR Rule.

5.3 Presence of unregulated ash disposal units

In addition to the Phase II area that is regulated under the CCR Rule, the site also includes three other coal ash disposal areas: Historical Area 1, Historical Area 2, and Phase I. These areas are inactive and not regulated under the CCR Rule; however, as documented by the legal action taken by the state of Maryland and the 2013 Consent Decree, the Brandywine site has polluted groundwater and surface water.

5.4 Conclusion

This unit transitioned to intrawell monitoring after identification of SSIs for multiple constituents. Use of intrawell analyses for groundwater monitoring when background data prior to waste disposal were unavailable allowed for higher background concentrations to be used in identifying exceedances. This transition relieved the operator of cleanup obligations although the groundwater is contaminated. In addition, reliance on inconclusive ASDs for calcium, fluoride, sulfate, and TDS contamination allows GenOn to avoid additional monitoring and remediation of existing groundwater contamination.

6. GHENT

The Kentucky Utilities Ghent Generating Station is located in Ghent, Kentucky near the Ohio River. Groundwater is contaminated across the site, with lithium at levels 154 times the default GWPS in the CCR Rule and radium at 31 times its MCL. Additionally, boron, calcium, chloride, fluoride, molybdenum, sulfate, and TDS have all been detected in monitoring wells across the site.

Six units at this facility are regulated by the CCR Rule: Ash Treatment Basin 1 (ATB-1), Ash Treatment Basin 2 (ATB-2), Secondary Pond, Reclaim Pond, Gypsum Stack, and the Landfill. Kentucky Utilities plans to close ATB-1, ATB-2, and the Landfill in place. This is particularly problematic for ATB-2 because it is in contact with groundwater. CCR is being removed from the Gypsum Stack, Reclaim Pond, and Secondary Pond; however, some of this waste is being moved to ATB-2 for disposal.

ATB-1, the Secondary Pond, the Gypsum Stack, and the Reclaim Pond are all monitored by a multi-unit system. SSIs for calcium, chloride, fluoride, sulfate, and TDS were identified in 2017, and the unit entered assessment monitoring in 2018. Following SSLs for lithium and molybdenum in 2018, an ACM for this multi-unit began in January 2019. Additional characterization wells were added to the monitoring network in 2020. An ACM initiated in 2019 is ongoing, and a remedy has not been selected. SSLs for lithium and molybdenum were identified again during 2020 monitoring events.

ATB-2 solely receives waste removed from the Gypsum Stack Pond (2020 Annual Groundwater Monitoring and Corrective Action Report). This report indicated plans to stop receiving waste in 2021, but this cannot be confirmed. If it did not stop receiving waste prior to April 2021, it would be in violation of the CCR Rule because ATB-2 is an unlined pond. ATB-2 entered assessment monitoring in 2018 due to an SSI for boron. An SSL for molybdenum was identified in 2020, which is the most recent monitoring event with data available for review. As of August 13, 2022, the annual groundwater monitoring report for 2021 had not been posted to the company's website. This is a violation of the CCR Rule. An ACM was initiated in 2019, and according to documents available on the company's website, a remedy has not been selected. Closure in place activities are underway at this unit.

The Landfill is currently in detection monitoring due to an ASD that identified background water quality as the source of SSIs identified in 2018 for boron, fluoride, and TDS.

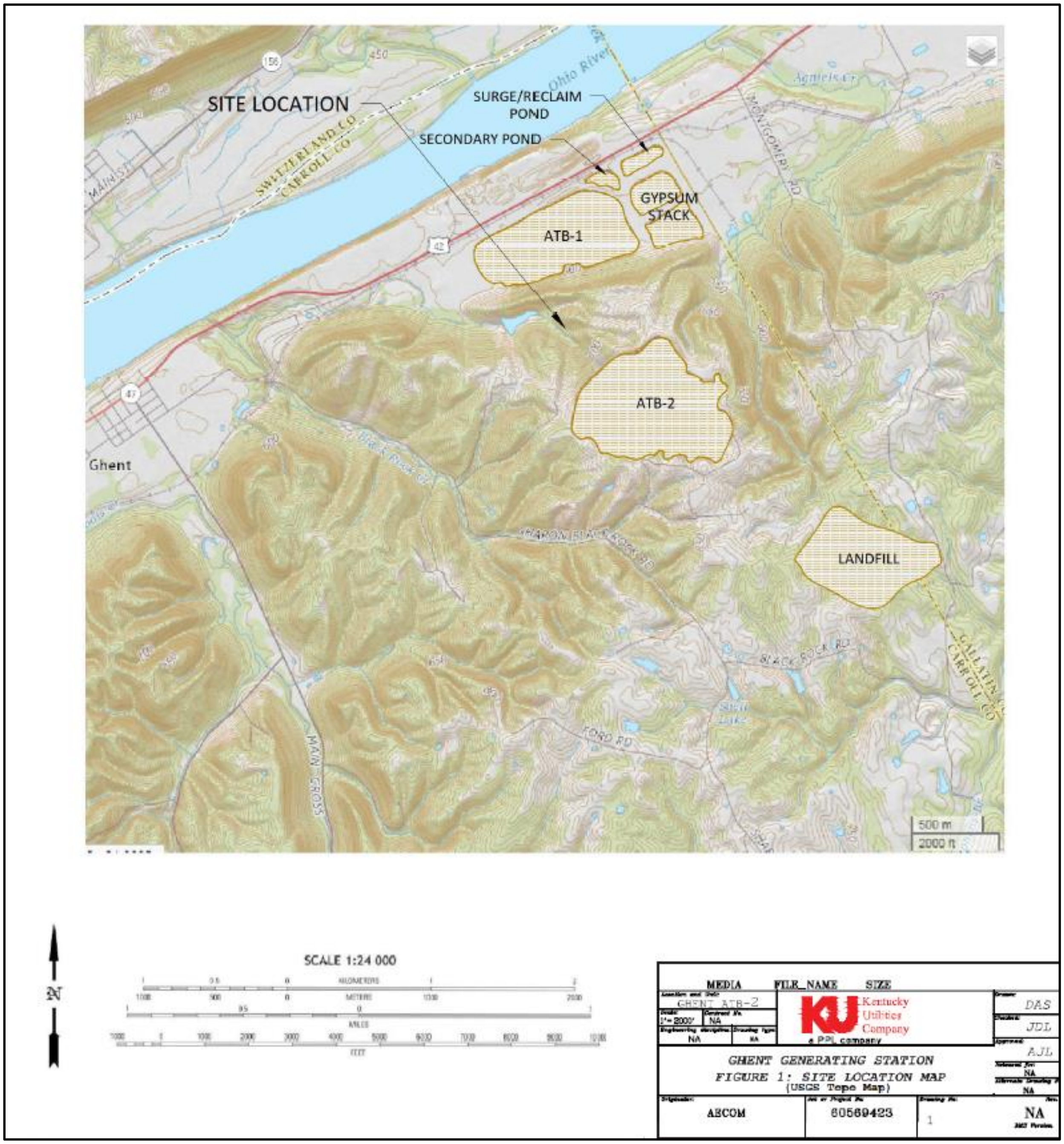
Groundwater contamination has been identified in monitoring wells associated with all three monitoring units at this facility, yet no remedies to address this contamination have been selected. Two units—ATB-1 and ATB-2—are undergoing closure in place. This is not sufficient; contaminated groundwater must also be remediated. Due to its location within the water table, removal of CCR from ATB-2 is the only method to ensure groundwater contamination does not continue long-term.

Further, the upgradient monitoring wells at each unit are flawed, leaving the monitoring networks incapable of adequately assessing contamination sources.

Violations of the CCR Rule at this facility include:

- closing a pond in place in contact with groundwater,
- insufficient monitoring networks,
- using an ASD that does not rule out the unit as the source of contamination to remain in detection monitoring,
- failure to post reports on the company's website,
- failure to characterize the nature and extent of the release,
- failure to estimate quantities of contaminants present in the ACM, and

- failure to select a remedy in a timely manner.



6.1 Closure plans

Pond ATB-2 is closing in place in contact with groundwater, a violation of the CCR Rule. The engineer-certified Location Restrictions Demonstration states that “Under ATB2, the aquifer is likely in direct contact with the base of the unit...ATB2 does not meet the requirements set forth in 40 CFR § 257.60(a) (p.1).” Closure plans indicate that this unit will be closed in place. Closing this unit in contact with groundwater will result in continued leaching of contaminants to groundwater.

6.2 Groundwater monitoring

The downgradient monitoring well networks at two of the three monitored units are flawed. For ATB-1, the entire southern border of the unit, approximately 5,000 feet, is left without a downgradient monitoring well. At ATB-2, multiple gaps of approximately 1,000 feet exist along all downgradient boundaries. Addition of wells to fill these gaps is necessary to accurately assess the quality of groundwater crossing unit boundaries. This is a violation of the CCR Rule.

6.3 Flawed ASDs

An ASD was completed in 2018 for SSIs for boron (two wells), chloride (one well), fluoride (one well), sulfate (four wells), and TDS (one well) at the Landfill. Inherent natural variability in groundwater concentrations was identified as the source of SSIs. While this conclusion is plausible, it does not rule out the Landfill as the source of contamination. Because the ASD does not contain sufficient factual or evidentiary basis to demonstrate that the SSIs were the result of natural variation, it violates the CCR Rule.

Additionally, this ASD confirms the need for improved monitoring networks for this unit.

Line of evidence 1: Siting data

Data collected during landfill siting prior to construction and placement of waste, which began in 2014, were compared to data collected during the background monitoring phase and in 2018 detection monitoring events. The highest value for each constituent across all wells sampled for each time period was used in the comparison. The siting phase concentrations for boron were greater than those identified during the baseline phase and 2018. The chloride, TDS, and sulfate concentrations during the siting phase were greater than the March 2018 monitoring event concentrations, but lower than the concentrations measured during the baseline phase and the May 2018 monitoring event. Fluoride was not measured during siting. Because these contaminants were present at similar levels prior to the presence of CCR, the ASD concluded that these contaminants are likely the result of groundwater interaction with shale and limestone bedrock.

While this line of evidence is reasonable, a much larger dataset is necessary to accurately rule out contamination from the landfill. The ASD states that "it may take years of monitoring to capture the full range of boron concentrations that can be derived from ambient (background) conditions." (ASD, 2019, p. 7) A more complete dataset spanning a longer time period is necessary to completely rule out contaminant contributions from the landfill.

Line of evidence 2: Potentiometric evaluation

A re-evaluation of the uppermost groundwater potentiometric surface and flow direction determined that well MW-123 is not positioned in the same down-valley flow environment. For flow from the landfill to reach this well, it would need to travel several hundred feet across the potentiometric surface gradient, which is unlikely. Because of this, MW-123 has been re-classified as an upgradient well. Re-classification of this well is rational but does not indicate that the landfill is not contributing to SSIs.

Line of evidence 3: Chemical signature evaluation

Eleven aqueous samples were collected from potential source materials and analyzed for Appendix III constituents. These results were compared to analyte concentrations in six monitoring wells collected one month later. The chemical signatures were compared using Piper and Stiff diagrams.

Wells MW-119, MW-123, and GWMP-01, all of which had SSIs for sulfate only, were most ionically similar to an underdrain sample and three stormwater samples. The ASD indicates that the results for MW-119 and MW-123 are inconclusive and that GWMP-01 has an ionic signature similar to uncontaminated samples. Wells MW-120 and MW-122 group with the background well GWMP-03D. The chemical signature of these two wells is similar to the background well, but constituent concentrations are higher. The ASD attributes the higher concentrations to the naturally occurring concentration from the deep, low flowing aquifer. They do not present evidence to rule out inputs from the landfill.

Results of these analyses are not conclusive and do not rule out the potential for contributions from the landfill to groundwater quality at monitoring wells.

6.4 Flawed ACMs

ATB-1 multi-unit

For the ATB-1 multi-unit, SSIs for Appendix III constituents were identified and triggered assessment monitoring, yet these constituents are not considered as contaminants of concern in the ACM.

The company asserts that the known extent of groundwater impact is in the northeast and southwest corners of the multi-unit extending toward the Ohio River (CCR Rule Remedy Selection Semiannual Progress Report, 5/15/2020). However, detection monitoring data indicate that Appendix III constituents have been identified at wells across the multi-unit (CCR Rule Remedy Selection Semiannual Progress Report. 12/16/2020); thus, the conclusion that the contamination is confined to the northeast and southwest corners is too narrow in scope. The remedy assessment must be based on the premise that groundwater in the entire multi-unit area is contaminated. Failure to characterize the nature and extent of the release is a violation of the CCR Rule.

Four monitoring wells were constructed to analyze the vertical and horizontal extent of the contaminant plume for the ATB-1 multi-unit. Each well contained molybdenum and lithium at levels above the GWPSs used to calculate SSLs at the site. Seven additional wells were installed in spring 2020, and monitoring of these wells was expected to begin in 2020. Monitoring results have not been posted to the company's website, in violation of the CCR Rule.

Due to the elevated concentrations of contaminants in wells surrounding the multi-unit and the numerous other potential sources at the site, potential sources other than the multi-unit must be included in the ACM.

No estimates of the quantity of contaminants in the groundwater resource from the ATB-1 multi-unit are provided, in violation of the CCR Rule.

General estimates for the time until a treatment technology would be in place and completion of treatment are provided in Appendix B of the ACM. However, the times included in this table are vague and do not include detailed estimates, in violation of the CCR Rule.

ATB-2

For ATB-2, the ACM is based solely on molybdenum contamination at a single well. Also, the fact that this unit is in contact with groundwater is not considered in proposed corrective actions.

The characterization of contamination at this unit is not thorough in scope and violates the CCR Rule. One characterization well was installed, and models were used to predict flow paths from the unit's Main Dam. The model indicated a flow path from the northeast corner of the dam to the west to MW-128, the downgradient well with molybdenum contamination. Kentucky Utilities proceeds as though the contaminant plume is focused at the northwest corner of the of the unit, using the lack of contamination at well MW-111 as evidence of the plume boundary. However, models predict that this well would not be impacted by identified flow paths from the unit. Further investigations to determine the extent of contamination along the identified flow path are needed.

Also, estimates of the quantity of contaminants in the groundwater resource from ATB-2 are not provided. This is required by the CCR Rule, and thus, this is in violation of the CCR Rule.

Closure in place is expected to be completed in 2024. No detailed time estimates are provided for remediation of contaminated groundwater because a remedy has not been selected, in violation of the CCR Rule.

6.5 Deficiencies in selected remedies

Remedies for both the ATB-1 multi-unit and ATB-2 are long overdue. Progress toward closure in place of ATB-1 and ATB-2 and ash removal at the Gypsum Stack Pond, Reclaim Pond, and Secondary Pond are underway. Closing units does not suffice as a remedy. Plans for restoration of groundwater must also be made. Failure to select a remedy in a timely manner is a violation of the CCR Rule.

For the ATB-1 multi-unit, a remedy had not been selected as of the most recent report available on the company's website (CCR Rule Remedy Selection Semiannual Progress Report, 12/16/2020). Kentucky Utilities is in the process of closing the Secondary Pond, the Gypsum Stack, and the Reclaim Pond by removal and has initiated closing ATB-1 in place. These closures will be a primary component of the remedy selected (CCR Rule Remedy Selection Semiannual Progress Report dated 12/16/2020).

For ATB-2, no remedy had been selected as of the most recent Remedy Progress Report (12/16/2020). Kentucky Utilities intends to close this unit in place and predicts cap placement to be completed by the end of 2024 (2020 Annual Groundwater Monitoring Report and Corrective Action Report). A remedy must be selected to address groundwater contamination, which is imperative at this unit due to its placement less than five feet from the uppermost aquifer.

6.6 Conclusion

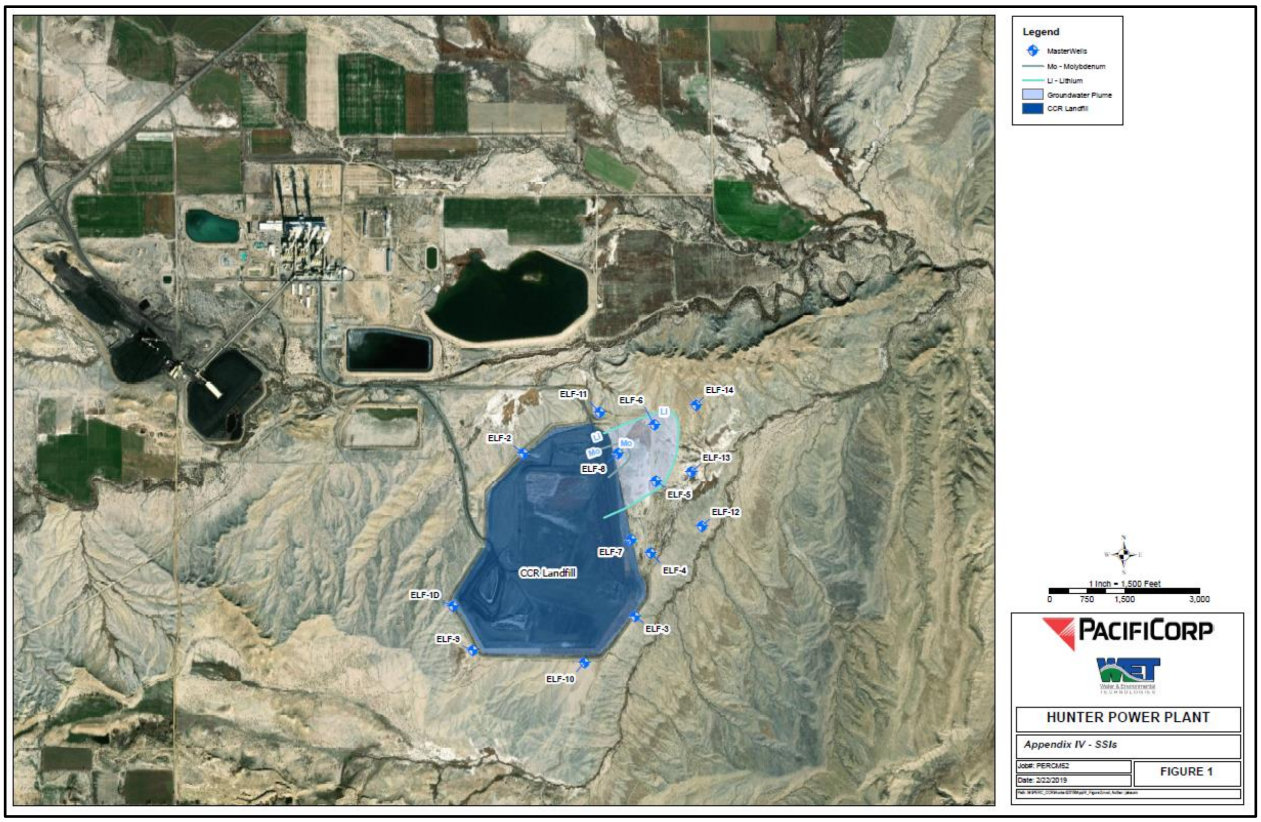
Due to numerous violations of the CCR Rule, CCR contaminants are expected to persist in the aquifer. Closing the unit in place in contact with the aquifer will allow CCR contaminants to impact the aquifer for generations. Large gaps exist in the downgradient monitoring system; this means contaminants may cross the unit boundary unnoticed and Kentucky Utilities may illegally evade responsibility for addressing the resulting impacts to groundwater. Reliance on an inconclusive ASD for contamination at the Landfill allows the unit to avoid additional monitoring and remediation of existing groundwater contamination. The ACM does not calculate the extent of CCR contamination resulting from the unit. Further, a remedy with a detailed timeline for actions has not been selected. Without an accurate picture of the mass and extent of groundwater contamination, an effective remedy cannot be determined. Failure to create an effective plan for remediation allows CCR contamination to remain in the aquifer.

7. HUNTER

The PacifiCorp Hunter Power Plant is located near Castle Dale, Utah. One 340-acre landfill accepts FGD waste, fly ash, and bottom ash. SSIs for Appendix III constituents boron, calcium, chloride, fluoride, pH, sulfate, and TDS were identified in 2017. The unit transitioned to assessment monitoring in 2018, and SSLs for cobalt, lithium, and molybdenum were identified. An ACM was completed in 2019 and a remedy selected in 2020. Corrective measures monitoring began in November 2020. Supplemental monitoring to augment the remedy began in summer 2021 and is ongoing currently.

Although PacifiCorp has taken steps to remediate contamination at this site, it is still highly contaminated. In 2021, lithium concentrations up to 116 times its default GWPS in the CCR Rule, molybdenum concentrations up to 4 times its default GWPS, and cobalt concentrations up to 33 times its default GWPS were still present in groundwater near the landfill. (2021 Annual Groundwater Monitoring and Corrective Actions Report)

Violations of the CCR Rule at this facility include a flawed monitoring network.



7.1 Groundwater monitoring

The groundwater monitoring network contains four background monitoring wells. However, issues have been identified at each well. Potentiometric surface maps included in Annual Groundwater Monitoring Reports show wells ELF-9 and ELF-10 are sidegradient wells rather than true upgradient wells. ELF-1D was often dry at the time of sampling, and samples were only collected during four of 17 sampling events between 2015 and 2021. Boron concentrations at ELF-2 were above USEPA's 10-day child health advisory in each sample collected from September 2015 through October 2021, which indicates that this well may be contaminated. (2021 Annual Groundwater Monitoring Report)

Because each of the existing background wells is flawed, the monitoring network does not accurately depict groundwater quality upgradient of the site and violates the CCR Rule.

7.2 Deficiencies in selected remedies

The remedy selected includes current management of contaminated inputs through removal of free liquid from waste streams and improving a horizontal well system that will remove impacted leachate/stormwater and impacted groundwater from the landfill. PacifiCorp has installed additional downgradient monitoring wells and determined that the extent of contamination is contained near the landfill boundary. Concentrations of contaminants including lithium, cobalt, and boron in boundary well ELF-14 are within the range of concentrations of these contaminants in upgradient wells. Because of this, it is not possible to definitively determine the extent of contamination. Contaminant trends since the installation of remedial practices showed some initial improvements, but concentrations of some contaminants—boron, lithium, and selenium—have begun to rise in more recent years. Further, lithium and molybdenum concentrations are still greater than their default GWPSs in the CCR Rule. Lithium concentrations ranged from 1.34 to 4.66 mg/L (116 times its default GWPS), and molybdenum concentrations ranged from non-detectable levels to 0.421 mg/L (4 times its default GWPS).

The GWPSs used to determine the extent of contamination are much greater than the default GWPSs in the CCR Rule due to high levels of background contamination. The GWPS for lithium is 113 times its default, and the molybdenum GWPS is 1.6 times its default.

Therefore, lithium concentrations were present at concentrations up to 116 times its default GWPS in downgradient wells in 2021. Because the GWPSs are used to determine attainment, lithium and molybdenum concentrations will still exceed their default GWPSs when remediation is complete.

7.3 Conclusion

The background monitoring network at the landfill is not capable of accurately reflecting background conditions; thus, it is not capable of revealing the true source of groundwater contamination. Therefore, PacifiCorp has evaded responsibility for cleaning up the contamination. Because background concentrations of contaminants are used to determine attainment following remediation, and groundwater in background wells is contaminated, PacifiCorp may not be held responsible for returning groundwater quality to safe levels.

8. JIM BRIDGER

The Jim Bridger Power Plant is located eight miles northeast of Point of Rocks, Wyoming in Sweetwater County. This 2,120-megawatt, four-unit, coal-fired power plant is owned by PacifiCorp. There are three CCR units at the site.

Fly ash and bottom ash from the plant are placed in the Ash Landfill for disposal. Most Ash Landfill cells are unlined, and it will be closed in place. Detection monitoring at the Ash Landfill in 2017 found SSIs for boron, calcium, fluoride, and pH. An ASD published in 2019 concluded that FGD Pond 2 was source of SSIs; therefore, the Ash Landfill has continued in detection monitoring.

FGD Pond 1, which was built as a permanent disposal area for spent liquor solids, was removed from service in 2003. Then, from 2010 through 2016, bottom ash was placed on the pond. The pond was graded, a dewatering system was installed, and it was covered with a liner and cover soil. (FGD Pond 1 Post-Closure Plan, 10/21/2021)

For FGD Pond 1, detection monitoring in 2017 found SSIs for all Appendix III parameters: boron, calcium, chloride, fluoride, pH, sulfate, and TDS. (FGD Pond 1 2021 Groundwater Monitoring and Corrective Action Report, 1/2022) Assessment monitoring then began in 2018, and multiple exceedances of GWPSs were found from 2018 through 2021 for arsenic, beryllium, cadmium, cobalt, fluoride, lead, lithium, molybdenum, radium, selenium, and thallium (FGD Pond 1 CCR Semiannual Assessment Monitoring Second Half 2021 Appendix IV Ground Water Protection Standard Notification, 4/18/2022). In 2019, the company completed an ACM. Since then, corrective measures monitoring has proceeded, a supplemental investigation has been initiated, and interim corrective measures have been implemented. However, remedy selection is still in progress. (FGD Pond 1 2021 Groundwater Monitoring and Corrective Action Report, 1/2022) Numerous SSIs of Appendix III constituents above background levels, and numerous SSLs of Appendix IV constituents above GWPSs, continue through 2021 (FGD Pond 1 2021 Groundwater Monitoring and Corrective Action Report, 1/2022).

FGD Pond 2 was built in 1990 and expanded in 2002, and it is still open. The pond covers 270 acres but was permitted for 402 acres. Closure in place is expected to be initiated in 2023. (FGD Pond 2 Closure Plan, 10/23/2020)

Detection monitoring at FGD Pond 2 found SSIs above background concentrations for boron, chloride, and pH; this unit therefore switched to assessment monitoring in 2018 and has continued in assessment monitoring through 2021. Since transitioning to assessment monitoring, no SSLs above GWPSs have been recorded. PacifiCorp has requested an extension under the CCR Rule to be able to continue placing waste in FGD Pond 2 while it develops additional storage capacity at FGD Pond 3. (FGD Pond 2 2021 Groundwater Monitoring and Corrective Action Report, 1/2022)

Various company documents acknowledge groundwater contamination at the site and assign blame for this contamination to one of the FGD ponds. For example, the company states that "Seepage from FGD Pond 1 has created a groundwater plume beneath the general area of the disposal ponds (FGD Ponds 1 and 2). This plume is presently controlled by a series of groundwater pump back wells which discharge the pumped water back into FGD Pond 2." (FGD Pond 2 Closure Plan, 10/23/2020) A different document assigns blame to FGD Pond 2: "Seepage from the current FGD Pond 2 has created a groundwater plume beneath the general area of the disposal ponds (FGD Ponds 1 and 2)." (FGD Pond 2 CCR Rule Operating Criteria §257.71 Liner Design Criteria, 9/13/2016)

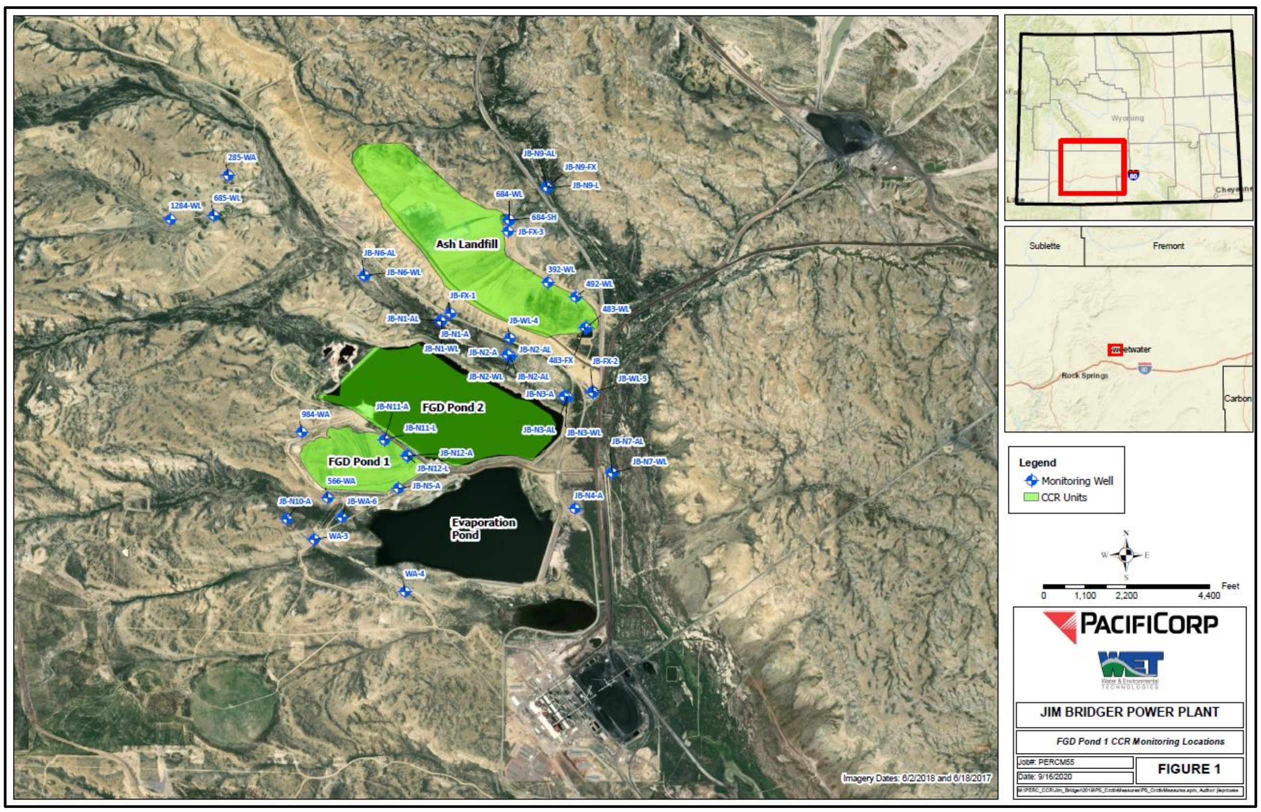
In 2007, a dewatering system at FGD Pond 1 was installed and the extraction wells began pumping at full capacity. According to the company's data, FGD Pond 1 was clearly interacting with groundwater. Prior to dewatering, the hydraulic gradient resulted in flow from the pond to the

Almond Formation beneath the pond. After pumping, the gradient reversed, and flow went from the Almond Formation to the pond. A separate pumpback system was then built to draw water down in the Almond Formation in order to "prevent seepage and eliminate re-wetting of the spent liquor solids in FGD Pond 1." Further, the company has identified a sulfate plume emanating from the southwest side of FGD Pond 1 and migrating to the southeast. (FGD Pond 1 Closure Design Report, 9/2015)

A new pond, FGD Pond 3, received a Permit to Construct from WDEQ in December 2021, and an alternative composite liner system is planned (FGD Pond 3 Pre-Construction Composite Liner Design Certification for a New CCR Surface Impoundment, 1/11/2022).

Violations of the CCR Rule include:

- FGD Pond 1 has been closed in place in contact with groundwater, and FGD Pond 2 will be closed in place, apparently in contact with groundwater.
- The downgradient monitoring network for the Ash Landfill is inadequate and leaves almost half of the downgradient edge of the unit unmonitored.
- The operator engaged in a protracted process to select a final groundwater remedy and has still not done so as of May 2022. A final remedy has not been selected in a timely manner.
- The company has not estimated the mass of pollutants released.
- No precise estimate is given for the time until full protection will be achieved, nor is a detailed schedule of activities provided.



8.1 Closure plans

FGD Pond 1 has been closed and capped. However, groundwater seepage has since been documented: “Although FGD Pond 1 has been dewatered sufficiently to support the final cover, additional dewatering is planned for FGD Pond 1 to address impacts to groundwater due to seepage through the FGD Pond 1 clay liner system.” (Stantec letter to WDEQ, 2/24/2020)

FGD Pond 1 is in contact with groundwater. According to the company, “…groundwater elevations in the Almond formation in the vicinity of FGD Pond 1 vary between 6660 and 6670 feet. Based on past geotechnical borings, the bottom clay liner pond floor is located at approximately 6664 feet in the deepest part of the pond.” (FGD Pond 1 Closure Design Report, 9/2015) Closing FGD Pond 1 in place, in contact with groundwater, violates the CCR Rule.

The plan for FGD Pond 2, which is still open, is to close the pond in place (FGD Pond 2 Closure Plan, 10/23/2020). A professional engineer (PE) has certified that this pond meets the CCR Rule location criteria for placement above the uppermost aquifer (FGD Pond 2 CCR Rule – Siting Criteria §257.60 Placement Above the Uppermost Aquifer, 9/10/2018) However, FGD Pond 2 appears to be in contact with groundwater (Ash Landfill Alternate Source Determination, 1/2019, Appendix A, Cross Section B-B’) Closing FGD Pond 2 in place in contact with groundwater violates the CCR Rule.

GIS-based floodplain maps are not available for this site. However, based on a comparison of the available floodplain map with aerial imagery, the evaporation pond (not a regulated unit) is clearly within the Zone A floodplain. This floodplain appears to extend north through FGD Pond 2, and it either crosses, or is immediately adjacent to, FGD Pond 1. Zone A identifies areas with a 1% annual chance of being inundated. The CCR Rule prohibits facilities in floodplains that result in washout of CCR, so as to pose a hazard to human life, wildlife, or land or water resources. If a washout were to occur, these units would be in violation of the CCR Rule.

8.2 Groundwater monitoring

Ash Landfill

Even before the CCR Rule was promulgated, PacifiCorp was monitoring groundwater quality at the site. Seven upgradient and downgradient wells were installed in 1984 near the landfill. In 2002, the monitoring system was expanded to 20 wells. These wells plus two new wells were used for CCR Rule compliance monitoring. (Ash Landfill Alternate Source Determination, 1/2019)

Another company document provides a somewhat different count of wells for the Ash Landfill monitoring network: eight background wells and 11 downgradient wells. According to the company, all but four wells are completed in the uppermost aquifer, the Fox Hills Sandstone, which dips to the northeast (Ash Landfill 2017 Groundwater Monitoring and Corrective Action Report).

The greatest distance between downgradient monitoring wells is approximately 1,750 feet between wells JB-FX-3 and 392-WL. This is inadequate and leaves almost half of the downgradient edge of the Ash Landfill unmonitored, in violation of the CCR Rule.

FGD Pond 1

The FGD Pond 1 monitoring network for detection and assessment monitoring included four background wells and 10 downgradient wells. Groundwater generally flows from the northwest to the southeast beneath FGD Pond 1. Based on the complexity of the geology, the monitoring network and statistical approach were modified in 2020; six background wells and 35 downgradient wells are in the new network. As of 2021, FGD Pond 1 was in assessment/corrective measures monitoring. (FGD Pond 1 2021 Groundwater Monitoring and Corrective Action Report, 1/2022)

In 2021, comparison of background and downgradient pollutant concentrations were done formation-by-formation. For the Almond Formation, SSIs above background for Appendix III constituents were found for boron, calcium, chloride, fluoride, pH, sulfate, and TDS, and SSLs above GWPSs for Appendix IV constituents were found for arsenic, beryllium, cadmium, cobalt, fluoride, lithium, and radium. For the Fox Hills Formation, SSIs above background for Appendix III constituents were found for boron, calcium, chloride, fluoride, pH, sulfate, and TDS, and SSLs above GWPSs for Appendix IV constituents were found for arsenic, beryllium, cadmium, cobalt, lead, lithium, molybdenum, radium, selenium, and thallium. For the Lewis Formation, SSIs above background for Appendix III constituents were found for boron, calcium, chloride, fluoride, pH, sulfate, and TDS, and SSLs above GWPSs for Appendix IV constituents were found for lithium, molybdenum, radium, and selenium. (FGD Pond 1 2021 Groundwater Monitoring and Corrective Action Report, 1/2022)

8.3 Flawed ACMs

An ACM for FGD Pond 1 was initiated in 2019 (PacifiCorp letter to WDEQ, 3/12/2019). In July 2019, the company held a public meeting to discuss the results of the ACM. Also, starting in 2019, the company designed and installed a horizontal well groundwater capture system. As of May 2022, the piping was complete and the pumps were installed, and as of July 2022, performance monitoring was supposed to have begun. As of May 2022, a remedy selection report had not yet been completed; a remedy will be selected after the supplemental investigation is completed. Completion is scheduled for 2022. (Semi-Annual Progress Report for Selecting and Designing Remedy, 5/15/2022)

As of early 2022, a nature and extent investigation found that the monitoring wells did not bound the extent of impacts. The adjacent property owner, the Bureau of Land Management, was notified, and three additional wells were installed on this adjacent property in 2021. (FGD Pond 1 2021 Groundwater Monitoring and Corrective Action Report, 1/2022) The extent of contamination on adjacent BLM land has not yet been fully delineated.

8.4 Deficiencies in selected remedies

An ACM was completed in 2019 for FGD Pond 1, but only interim measures have been implemented so far. The operator engaged in a protracted process to select a final groundwater remedy and has still not done so as of May 2022. A final remedy has not been selected in a timely manner as required by the CCR Rule.

The company has not estimated the mass of pollutants released, in violation of the CCR Rule. Also, no precise estimate is given for the time until full protection will be achieved, nor is a detailed schedule of activities provided, in violation of the CCR Rule.

8.5 Presence of unregulated ash disposal units

Ash Landfill Cells 1 through 5 are excluded from the federal CCR Rule. These cells were closed in accordance with WDEQ regulations at the time.

8.6 Conclusion

FGD Pond 1 has been closed in place in contact with groundwater. FGD Pond 2 will be closed in place, apparently in contact with groundwater. Closing these units in place in contact with the aquifer will allow CCR contaminants to impact the aquifer for generations. The downgradient monitoring network at the Landfill is flawed; almost half of the downgradient boundary is left unmonitored. This means contaminants may cross the unit boundary unnoticed and PacifiCorp may illegally evade responsibility for addressing the resulting impacts to groundwater. The ACM completed for FGD Pond 1 does not calculate the extent of CCR contamination resulting from the unit. Further, a remedy with a detailed timeline for actions has not been selected. Without an accurate picture of the mass and extent of groundwater contamination, an effective remedy cannot be determined. Failure to create an effective plan for remediation allows CCR contamination to remain in the aquifer.

9. KYGER CREEK

Ohio Valley Electric Corporation's (OVEC's) Kyger Creek Station is located on the banks of the Ohio River south of Cheshire, Ohio. American Electric Power's Gavin Power Plant is just upstream. The Kyger Creek Station began operation in 1955, and CCRs have been managed at various units across the station since then. Current units regulated by the CCR Rule include the Class III Residual Waste Landfill, the Boiler Slag Pond (BSP), and the South Fly Ash Pond (SFAP).

Groundwater at this facility is heavily contaminated. Arsenic concentrations up to 20 times its MCL, lithium concentrations up to 12 times its default GWPS in the CCR Rule, barium concentrations up to 30 times its MCL, boron concentrations up to 6 times USEPA's 10-day child health advisory, cobalt concentrations up to 4 times its default GWPS, molybdenum concentrations up to 9 times its default GWPS, and radium up to 46 times its MCL have been identified across the site, primarily in the vicinity of the Landfill (2017 through 2021 Annual Groundwater Monitoring and Corrective Action Reports). Analytical results for Appendix III and Appendix IV constituents were only reported for the period of October 2015 through September 2017 for all samples collected. During years 2018 through 2021 analytical results were only included when an SSI or SSL was detected. This is a violation of the CCR Rule.

The Landfill occupies 98 acres and is capable of receiving 4,000 tons per day. This unit has remained in the detection monitoring program through 2021. SSIs have not been identified at this unit. However, the background monitoring system at this unit is heavily contaminated, making it impossible to accurately detect releases from this unit.

The BSP entered the assessment monitoring program in 2019 and remained in assessment monitoring through 2021. SSIs for boron, calcium, chloride, sulfate, and TDS were initially detected in March 2018 and continued to be detected at various wells during 2021. Arsenic was detected in one well during the initial assessment monitoring event in September 2018 and triggered completion of an ACM report and a public meeting in 2019. Arsenic continues to be detected at levels exceeding its MCL by up to 18 times at this well, yet a remedy has not been selected. OVEC plans to close this unit in place.

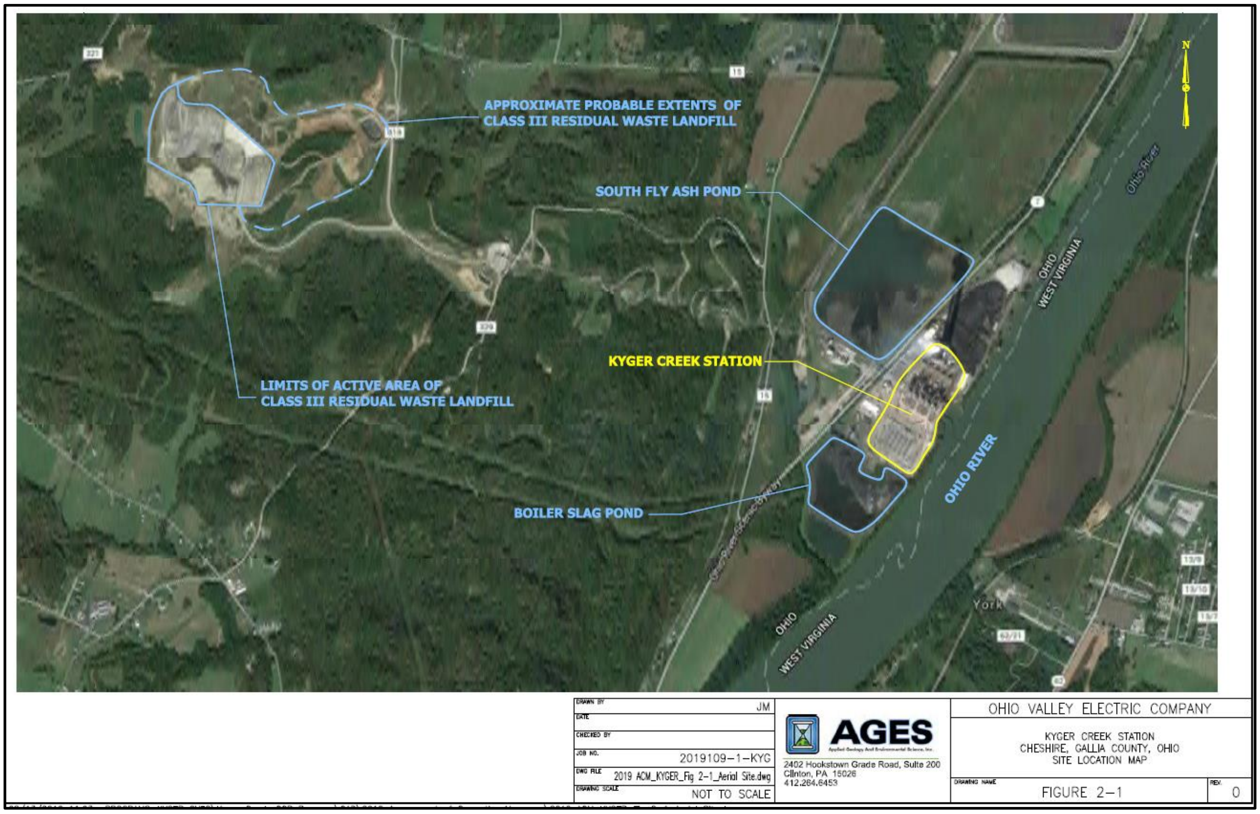
The SFAP is conducting monitoring under the assessment monitoring program. In 2021, SSIs for Appendix III constituents calcium, chloride, sulfate, and TDS were identified. No SSLs for Appendix IV constituents have been identified during monitoring events completed since the unit entered the assessment monitoring program in 2018. OVEC plans to close this unit in place.

Violations of the CCR Rule at Kyger Creek include:

- failure to post analytical results for semi-annual sampling events on OVEC's website,
- utilizing flawed background monitoring networks,
- failure to document the mass and concentration of the release of contaminants in the ACM,
- failure to estimate detailed timelines for potential remedies, and
- failure to select a remedy.

9.1 Closure plans

The BSP is located within a Zone AE floodplain, meaning this area has a 1% annual chance of inundation. The portion of this unit closest to the Ohio River is in an area designated as a Regulatory Floodway, which is the channel of the river and adjacent land that must be reserved to ensure safe discharge of the base flood without impacting upstream water levels. The SFAP is in an area designated as Zone X by FEMA. This means this area has a 0.2% annual chance of flooding. (FEMA, 2022) The CCR Rule prohibits facilities in floodplains that result in washout of CCR, so as to pose a hazard to human life, wildlife, or land or water resources. If a washout were to occur, this unit would be in violation of the CCR Rule.



9.2 Groundwater monitoring

For all units at this site, Appendix III and Appendix IV data were only included when SSIs or SSLs were identified. It is not possible to review water quality in the background monitoring wells. This failure to post analytical results for semi-annual sampling events on OVEC's website is a violation of the CCR Rule. Because of the lack of data transparency, citizens are not able to review data to ensure the facility is not impacting water resources.

The Landfill's background groundwater monitoring system is seriously flawed and in violation of the CCR Rule. Further, significant contamination in background wells masks potential contaminant contributions of the Landfill to groundwater. No SSIs have been detected at this unit, and it is not possible to determine if this is because the Landfill is truly not impacting groundwater or if contamination resulting from the Landfill is going undetected due to background well contamination.

The Landfill will be constructed in phases; thus, the monitoring system was designed to encompass the full extent of the Landfill. Currently, only the first phase of construction has been completed. Two temporary downgradient wells were installed at the boundary of the active phase (CCR-1BU and CCR-2BU). Due to their distance of greater than 1,000 feet from the current waste boundary, five wells (BUSW-8, BUSW-10, MW-3D, IMW-2BU, and MW-4D) were identified as "supplemental wells." In the Coal Combustion Residuals Regulation Monitoring Well Installation Report for the Kyger Creek Station, these five wells were identified as downgradient wells. Yet, in Annual Groundwater Monitoring and Corrective Action Reports for years 2017 through 2021, wells BUSW-8, MW-3D, and MW-4D are used as upgradient background wells and included in calculation of UTLs.

As indicated in the Coal Combustion Residuals Regulation Monitoring Well Installation Report for the Kyger Creek Station (Monitoring Report), groundwater flow at this unit is highly variable. According to this report, historic data indicate that groundwater flow tends to be variable with the main component of flow to the northwest, and flow in a radial direction away from IMW-1BU is also common. Due to variability in groundwater flow, a radial well network was determined to be appropriate for this unit. Because of this, selecting locations for upgradient wells that do not receive groundwater flow from the unit is challenging.

A review of potentiometric surface contours in Annual Groundwater Monitoring and Corrective Action Reports indicates that almost all wells identified as upgradient wells have potential to receive groundwater flow from under the Landfill. MW-3D and BUSW-8 are least likely to receive sidegradient flow from the Landfill. Potentiometric surface contours presented on the Potentiometric Surface maps in these reports often do not provide enough detail in the area between the unit boundary and the wells located greater than approximately 500 feet from the boundary to accurately assess potential groundwater flows.

In addition to the difficulty in placing true upgradient wells, all wells identified as background show signs of ash contamination except MW-4D, which was initially described as a downgradient supplemental well. Background well contamination documented in the 2017 Annual Groundwater Monitoring and Corrective Action Report is listed below. Analytical data for Appendix III and IV constituents collected at these wells for the period of October 2015 through September 2017 is included in the 2017 Annual Groundwater Monitoring and Corrective Action Report. No other analytical data for these wells is included in any other Annual Groundwater Monitoring and Corrective Action Reports.

Table 1: Ash contamination at wells

Well	Type	Documented contamination
BUSW-2	Background	Barium up to 2,190 µg/L (1.1 times its MCL) Lithium up to 0.093 mg/L (2.3 times its default GWPS in the CCR Rule) Radium up to 13.75 pCi/L (2.8 times its MCL)
BUSW-5	Background	Barium up to 55,800 µg/L (27.9 times its MCL) Lithium up to 0.406 mg/L (10.2 times its default GWPS in the CCR Rule) Radium up to 230 pCi/L (46 times its MCL)
IMW-1BU	Background	Barium up to 16,300 µg/L (8.15 times its MCL) Lithium up to 0.241 mg/L (6 times its default GWPS in the CCR Rule) Radium up to 98.7 pCi/L (19.7 times its MCL)
MW-3D	Downgradient	Barium up to 61,500 µg/L (30.8 times its MCL) Lithium up to 0.406 mg/L (10.2 times its default GWPS in the CCR Rule) Radium up to 231 pCi/L (46.2 times its MCL)
BUSW-8	Downgradient	Arsenic up to 24.4 µg/L (2.4 times its MCL) Barium up to 25,500 µg/L (12.8 times its MCL) Lithium up to 0.314 mg/L (7.9 times its default GWPS in the CCR Rule) Radium up to 206 pCi/L (41.2 times its MCL)

Note: Background wells were documented as upgradient in Coal Combustion Residuals Regulation Monitoring Well Installation Report for the Kyger Creek Station. Downgradient wells were identified as downgradient supplemental wells located at least 1,000 feet from Phase 1 waste limit in Coal Combustion Residuals Regulation Monitoring Well Installation Report for the Kyger Creek Station.

The BSP is monitored by three background wells and eight downgradient wells. One of the three background wells (KC-15-03) is contaminated with cobalt at concentrations almost twice its default GWPS in the CCR Rule (2017 Annual Groundwater Monitoring and Corrective Action Report).

Groundwater at this unit generally flows from the northwest to the south and southeast towards the Ohio River (Coal Combustion Residuals Regulation Monitoring Well Installation Report for the Kyger Creek Station). However, as evidenced in February 2018, groundwater flow reverses when the Ohio River level is high. Thus, the upgradient monitoring wells (KC-15-01, KC-15-02, and KC-15-03) may receive groundwater flowing across the unit. Well KC-15-03 is indicated as "variable" in the ACM, but it is included as an upgradient well in Annual Groundwater Monitoring and Corrective Action Reports. Because of this, no true upgradient monitoring wells are in place and the unit is in violation of the CCR Rule.

At the SFAP, groundwater flows are highly variable; thus, wells placed at the unit boundary designated as upgradient and used to calculate background concentrations of Appendix III and IV constituents often receive flow passing under the unit. Further, two upgradient wells are significantly contaminated with boron and cobalt. Because no wells capable of measuring background conditions are in place at this unit, it is in violation of the CCR Rule.

The Monitoring Report states that groundwater flow measurements collected during January, March, and May 2016 indicated that groundwater beneath the SFAP generally flows from the northwest towards the south and southeast. These data were used to designate wells as upgradient, variable, or downgradient at the onset of monitoring in accordance with the CCR Rule. However, the potentiometric surface contours for January 2016 show a flow path towards the wells at the northwestern unit boundary (KC-15-12 and KC-15-13) designated as upgradient wells.

Data collected in following years demonstrate highly variable groundwater flows at this unit. The potentiometric surface diagrams for 2017, 2020, and 2021 indicate that groundwater flows from the northwest towards the southeast and to the south. Potentiometric surfaces calculated during both semi-annual monitoring events in 2019 indicate flow from the southeast toward the north and northwest. During February 2018 monitoring, groundwater flowed from south to north, and in September 2018 groundwater flowed in the opposite direction, toward the southeast. (2017-2021 Annual Groundwater Monitoring and Corrective Action Reports)

Upgradient wells KC-15-13 and KC-15-14 and wells designated as "variable" showed signs of ash contamination in data collected during the background data collection phase from October 2015 through September 2017. KC-15-13 was contaminated with boron at concentrations up to 8.21 mg/L (2.7 times USEPA's 10-day child health advisory) and cobalt concentrations up to 9.17 µg/L (1.5 times its default GWPS in the CCR Rule). KC-15-14 contained boron concentrations as high as 17.1 mg/L (5.7 times the advisory) and cobalt concentrations ranged to 12.7 µg/L (2.1 times its default GWPS).

This unit remains in assessment monitoring, and SSLs have not yet been identified. Using a heavily contaminated background monitoring system lacking true upgradient wells does not allow for the accurate detection of exceedances at this unit.

9.3 Flawed ACMs

An ACM for the BSP began in May 2019 due to an SSL for arsenic. It was completed in September 2019 and revised in November 2020.

The nature and extent investigation included installation of three wells in March 2018 to provide supplemental data to evaluate conditions south of the BSP and installation of three additional wells in March 2019 at the property boundary downgradient of the BSP. Monitoring at these wells is ongoing.

The ACM describes plans to close and cap the unit, decant ponded water within the unit, and dewater pore-water within the unit. This will be followed by post-closure monitoring to determine the need for “more active remedial measures.” (ACM, September 2019, p. 12)

The ACM only provides broad time estimates for attainment of water quality. The ACM states that models necessary to determine the amount of time to reach complete remediation were not completed. This is in violation of the CCR Rule.

Estimates of the mass and concentration of the release of arsenic are not provided in the ACM. This is a violation of the CCR Rule.

9.4 Deficiencies in selected remedies

As documented in the June 2022 Semi-annual Selection of Remedy Progress Report, OVEC has not selected a remedy. Failure to do so in a timely manner is in violation of the CCR Rule.

9.5 Conclusion

Groundwater at this facility is heavily contaminated. The background monitoring networks at all units at this facility are contaminated with CCR waste. These background monitoring networks are not capable of accurately reflecting background conditions; thus, they are not capable of revealing the true sources of groundwater contamination. Therefore, OVEC has evaded responsibility for cleaning up the contamination and does not reflect true background levels, which means that this site’s monitoring system is not capable of revealing the true source of groundwater contamination. Therefore, OVEC may not be held responsible for cleaning up the contamination. The ACM does not calculate the extent of CCR contamination resulting from the unit. Further, a remedy with a detailed timeline for actions has not been selected. Without an accurate picture of the mass and extent of groundwater contamination, an effective remedy cannot be determined. Failure to create an effective plan for remediation allows CCR contamination to remain in the aquifer.

10. MARTIN LAKE

Martin Lake Station is a generating facility in Beckville, Texas operated by Luminant. The facility has three regulated CCR units: two ponds ("Ash Ponds" and Permanent Disposal Pond 5, or "PDP5") and a landfill. All three units are polluting nearby groundwater.

The Ash Ponds unit is very close to the Martin Lake and is made up of three adjacent ponds. This unit is currently going through the final phase of a liner retrofit; one pond is being retrofitted at a time, with the last pond currently being retrofitted. These ponds were previously all unlined. Two wells (H-28 and H-31) downgradient of the Ash Ponds unit exhibited concentrations of boron significantly greater than nearby wells during background monitoring, far in excess of the site's eventual statistical background value for boron. SSIs were subsequently detected for Appendix III constituents in 2017, and the program transitioned to assessment monitoring in 2018. Beginning in the latter half of 2018, SSLs were consistently identified for beryllium and cobalt through 2021, as well as a single SSL for lithium in 2018. SSLs of cobalt exceeding the GWPS have been identified in every well surrounding this unit. The unit began the ACM process in 2019 and completed it within 120 days. As of January 2022, a remedy has been selected.

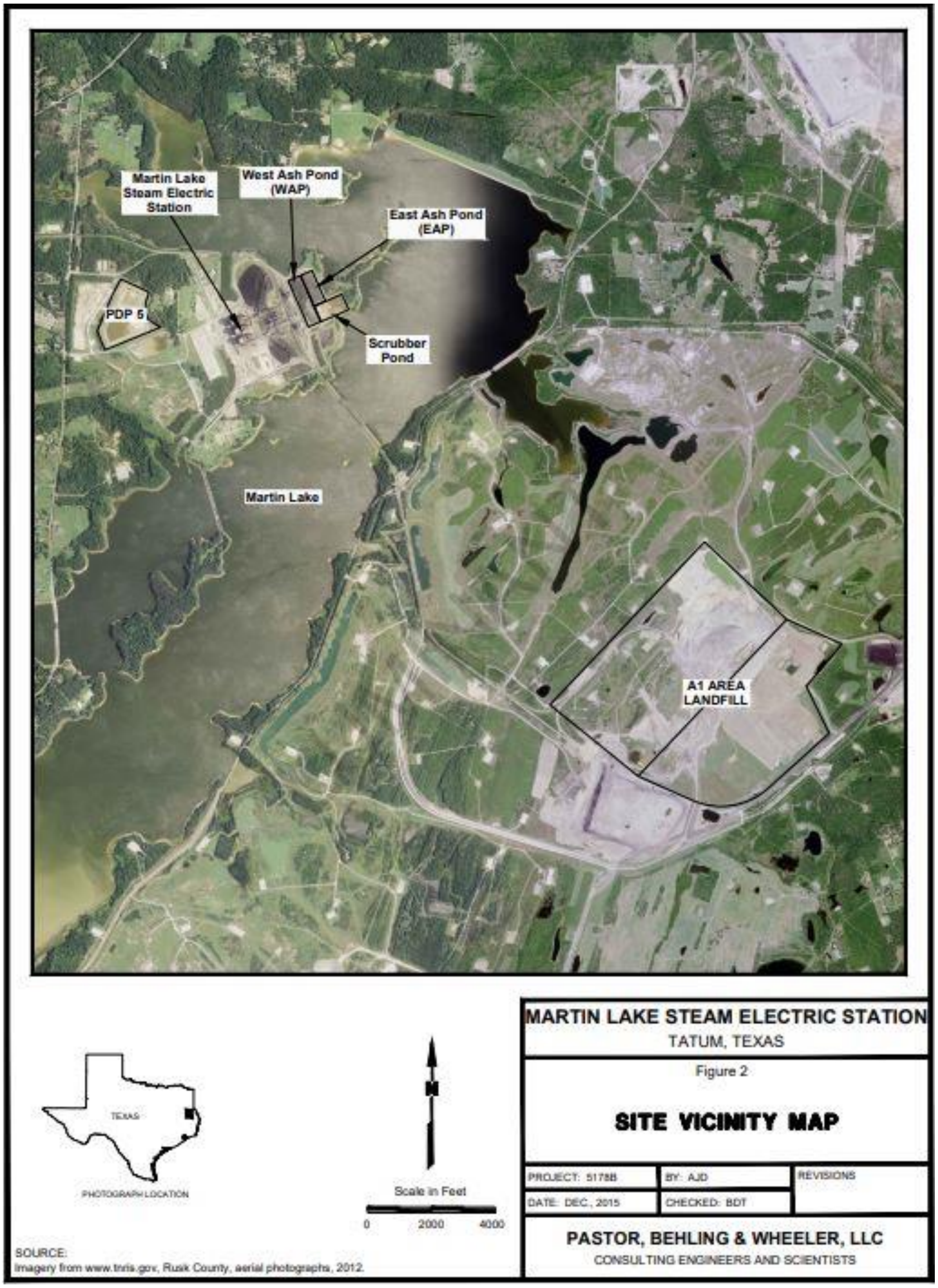
PDP5 is an unlined pond built on top of three closed and capped landfills. Background monitoring in 2015–2016 found one well (PDP-24) to have unsafe concentrations of boron for nearly every sample. During this time period, monitoring of Appendix IV constituents revealed preexisting levels over GWPSs for cobalt (PDP-24 and PDP-25) and lithium (PDP-25). These results, which are from two wells along the southern edge of the unit, suggest that the unit is polluting groundwater. SSIs for chloride and calcium were found in every year of monitoring, but ASDs have been utilized to prevent the unit transitioning to assessment monitoring. There is strong evidence to support the assertion that the groundwater around this unit is polluted by coal ash, as discussed in the "Flawed ASDs" section.

The Landfill unit is offsite, approximately 1.5 miles to the southeast of the plant on the opposite side of Martin Lake. SSIs were detected here for Appendix III constituents in 2017, and the program transitioned to assessment monitoring in 2018. In that year, SSLs were found for arsenic, barium, cobalt, and lithium, with cobalt SSLs persisting through subsequent sampling events in 2019–2021. The ACM process was completed for the unit within 120 days, and remedy selection was completed as of January 2022.

Violations of the CCR Rule[1] include:

- PDP5 relies on intrawell statistical techniques.
- The groundwater monitoring network has significant gaps.
- All ACMs fail to estimate the mass of pollutants that have been released as well as the nature and extent of contamination.
- Following identification of SSLs, new monitoring wells to define the extent of the contaminant plume were not installed.
- MNA has inappropriately been selected as a remedy, even though it will not be effective in cleaning up groundwater.

[1] The issues identified as noncompliant with the CCR Rule are in fact violations of state coal ash rules in the three states with USEPA approved programs: Georgia, Oklahoma, and Texas. These programs must be at least as stringent as the CCR Rule, and in practice they are virtually identical, so the same observations about noncompliance apply to both the federal program and approved state programs.


Martin Lake Steam Electric Station
West Ash Pond (WAP)
East Ash Pond (EAP)
PDP 5
Scrubber Pond
Martin Lake
A1 AREA LANDFILL
TEXAS
PHOTOGRAPH LOCATION
N
Scale in Feet
0 2000 4000
SOURCE:
Imagery from www.tnris.gov, Rusk County, aerial photographs, 2012.
MARTIN LAKE STEAM ELECTRIC STATION
TATUM, TEXAS
Figure 2
SITE VICINITY MAP
PROJECT: 5178B
BY: AJD
REVISIONS
DATE: DEC., 2015
CHECKED: BDT
PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

10.1 Closure plans

The closure plans for the Ash Ponds unit indicate that they will eventually be closed in place. All ponds were retrofitted with 60-mil high density polyethylene (HDPE) liners prior to the start of the CCR Rule, but these ponds were still considered to be unlined because those liners do not meet the CCR Rule standard. The company has pursued an Alternative Closure Demonstration for these ponds in order to retrofit them with compliant liners. To date, two of the unit's three ponds have been temporarily closed, retrofitted, and brought back into service. This process is currently ongoing for the third pond.

Per FEMA's National Flood Hazard Layer data, the Ash Ponds unit is entirely within the 100-year floodplain (Zone A). The CCR Rule prohibits facilities in floodplains that result in washout of CCR, so as to pose a hazard to human life, wildlife, or land or water resources. If a washout were to occur, this unit would be in violation of the CCR Rule.

10.2 Groundwater monitoring

The groundwater monitoring network for the Landfill is inadequate because there is nearly a mile between wells, with one downgradient edge (the 1.4-mile-long southern edge) effectively monitored by just one well. The unit initially had only one upgradient background well, but an additional upgradient well was added later.

For the Ash Ponds unit, the northern downgradient edge is un-monitored, in violation of the CCR Rule.

For PDP5, the groundwater monitoring network consists of nine wells. The company asserts that all of these wells are downgradient, because groundwater is mounded and flowing out from a region centered on the eastern edge of the pond. MW-18A could be upgradient based on groundwater elevations reported by the company.

Background values, against which SSIs are detected, are calculated using intrawell statistical methods. According to USEPA, intrawell comparisons are generally prohibited unless specific conditions are met, including that data must have been collected from the well when it was known to be uncontaminated by the CCR unit (Conditional Approval of an Alternative Closure Deadline for H.L. Spurlock Power Station, Maysville, Kentucky). This use of intrawell methods is therefore a violation of the CCR Rule.

Well spacing around most of the unit is too great, exceeding 1,000 feet between wells in numerous cases. Three of the wells (MW-20a, PDP-26, and MW-18a) are too far from the unit boundary to effectively monitor potential contamination.

10.3 ASDs

The PDP5 unit has experienced SSIs for Appendix III constituents for every year of monitoring but has utilized the ASD process to avoid transitioning into assessment monitoring. The first ASD in 2018 leaned heavily on natural variation as an explanation for SSIs. This trend continued in subsequent ASDs, but starting in 2019, the company began to acknowledge the construction history of the site; PDP5 is constructed on top of three closed and capped coal ash landfills.

By 2021, the ASDs routinely report that "All observed SSIs are attributed to natural variation in groundwater quality due to the heterogeneity of the groundwater system and to potential effects from the closed former non-CCR Rule coal ash surface impoundments in the vicinity of PDP 5." In other words, the site is contaminated, but the presence of pre-regulation contamination is being used as a shield to prevent the company from further assessing the potential for contamination from PDP5, which itself is an unlined pond out of compliance with the CCR Rule.

10.4 Flawed ACMs

The Ash Ponds unit entered and completed the ACM process in 2019, with one 60-day extension. No new wells were added to the monitoring network for this investigation, but one lake water sample site was utilized, and soil samples from the groundwater-bearing unit of interest were collected. The CCR Rule requires installation of additional monitoring wells to determine the extent of contamination following identification of Appendix IV exceedances. Because no new wells were installed, the ash ponds are in violation of the CCR Rule.

Through chemical analysis, the investigation also identifies “potential influences of Martin Lake on the groundwater” within two of the wells (H-26 and H-33) but finds neither cobalt nor beryllium in the lake water sample. The ACM fails to estimate the mass of release for any of the three constituents for which it is being completed, in violation of the CCR Rule. The ACM fails to define the extent of the contaminant plume. The ACM’s line of investigation seems primarily oriented around justifying the selection of MNA as the primary mode of remediation for the SSLs in these wells.

The Landfill unit entered and completed the ACM process in 2019, with one 60-day extension. At the outset of the ACM process, numerous wells were added to the monitoring network to help determine the nature and extent of contamination at the unit; however, the distribution of these wells around the unit was still likely far too sparse, with separation distances of over a mile and distance from the unit of 1,500–2,500 feet. The ACM fails to estimate the mass of release for any of the four constituents for which it is being completed, in violation of the CCR Rule. The ACM also fails to define the extent of the contaminant plume.

10.5 Deficiencies in selected remedies

For the Ash Pond area, the company issued a notice of remedy selection in January 2022. Source control via retrofitting of the ponds is already ongoing. After conducting a four-tier feasibility study in compliance with USEPA’s guidance, the company selected MNA as the sole groundwater remedy.

The Landfill ACM concludes with a selection of several remedies (cap and close the landfill) and a plan to further evaluate three other options to address groundwater contamination (MNA, groundwater extraction and treatment, and/or a vertical hydraulic barrier). After conducting a four-tier feasibility study in compliance with USEPA’s guidance, the company selected MNA as their sole groundwater remedy in January 2022.

Use of MNA will not remove the contaminants from groundwater; instead, they will be dispersed throughout the aquifer spreading further into the environment. Therefore, both remedies violate the CCR Rule.

10.6 Presence of unregulated ash disposal units

PDP5 is constructed on top of three closed and capped coal ash landfills that the company asserts are not subject to the CCR Rule. The company’s ASD for PDP5 acknowledges contamination from these old landfills. The company’s existing well network and analysis fails to isolate potential impacts from PDP5 or to distinguish between potential impacts from PDP5 and the underlying landfills.

10.7 Conclusion

Groundwater at this facility is known to be contaminated. Yet, due to flaws in the monitoring network and statistical analyses, an accurate assessment of the contamination is not possible. Large gaps exist in the downgradient monitoring systems at the Landfill and the Ash Ponds; this means contaminants may cross the unit boundary unnoticed and Luminant may illegally evade responsibility for addressing the resulting impacts to groundwater. Intrawell statistical methods are used to calculate background levels used in detection of exceedances. Use of intrawell analyses for groundwater monitoring when background data prior to waste disposal are unavailable allows contamination from the unit to go unnoticed and continue to impact groundwater resources. ACMs have been completed for both the Pond Units and the Landfill. Neither ACM quantifies the mass of contamination or defines the extent of the contaminant plume. Without an accurate picture of the mass and extent of groundwater contamination, an effective remedy cannot be determined. MNA was selected as the sole groundwater remedy for both units. Use of MNA will not remove the contaminants from groundwater; instead, they will be dispersed throughout the aquifer spreading further into the environment.

11. NAUGHTON

The PacifiCorp Naughton Power Plant in Wyoming was constructed in 1963 and contains six CCR disposal units. CCR is deposited into the South Ash Pond and North Ash Pond, both of which were expanded to their current configurations in 1993. FGD Pond 4 and FGD Pond 5 are still active. Two CCR ponds—FGD Pond 1 and FGD Pond 2—have been closed in place.

Numerous contaminants, including arsenic, cobalt, fluoride, mercury, molybdenum, selenium, and thallium, have been found in groundwater across the site and on adjacent properties to the south. Much of this contamination has been attributed to one unit: FGD Pond 2. While some measures to remedy the release have been taken, a remedy in compliance with the CCR Rule has not yet been identified. This pond is in contact with groundwater, making timely remediation crucial. Because of this widespread contamination, use of background monitoring wells free from ash contamination has not been possible.

The North Ash Pond has been in detection monitoring throughout 2021. It stopped receiving waste in 2011, and formal closure was initiated on May 7, 2021. Waiting this long to initiate closure is a violation of the CCR Rule. ASDs have been completed every year since 2018 and conclude that it is not the source of SSIs.

The South Ash Pond entered assessment monitoring in 2018 and continues in assessment monitoring.

FGD Pond 4 has been in detection monitoring since 2017, with no SSIs identified.

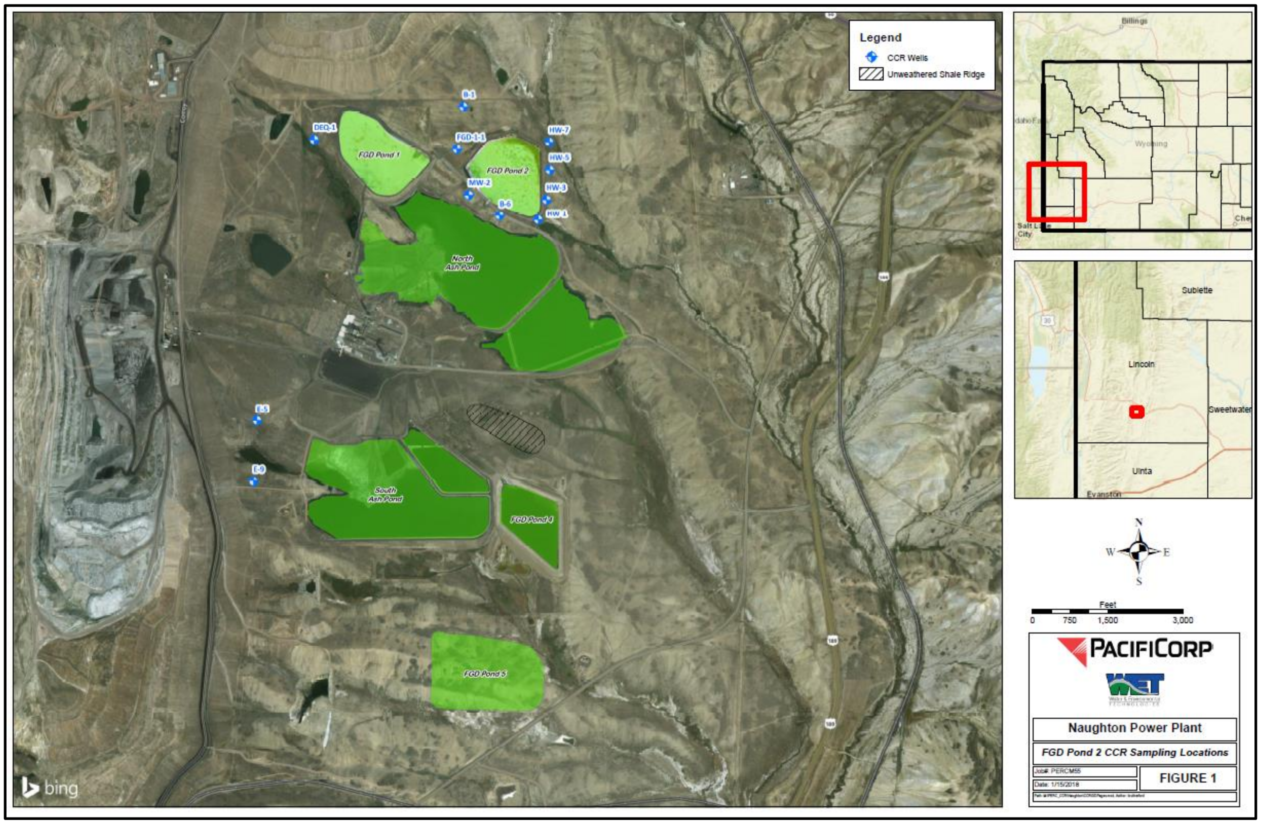
FGD Pond 1 was closed in place in March 2020. This unit was undergoing assessment monitoring and corrective measures during 2021. SSLs were first identified in 2018 and have been detected for arsenic (up to 21 times its MCL), cobalt (up to 280 times its default GWPS in the CCR Rule), fluoride (up to 6.5 times its MCL), mercury (up to 8 times its MCL), molybdenum (up to 78 times its default GWPS), selenium (up to 123 times its MCL), and thallium (up to 86 times its MCL) in years since. An ACM was initiated in 2019 and a remedy selected in April 2021. A corrective measures groundwater monitoring program was initiated in April 2021. The remedy selected to address contamination sourced from this pond is closure in place with installation of horizontal wells to capture and remove contaminated groundwater.

FGD Pond 2 has been closed in place. This unit was undergoing assessment monitoring and corrective measures during 2021. SSIs for Appendix III constituents were first identified in 2017, and assessment monitoring began in 2018. SSLs have been detected for arsenic (up to 24 times its MCL), boron (up to 2 times USEPA's 10-day child health advisory), cadmium (up to 3 times its MCL), calcium, chloride, chromium (up to 4 times its MCL), cobalt (up to 6 times its default GWPS), lead (up to 28 times its MCL), lithium (up to 238 times its default GWPS), molybdenum (up to 2 times its default GWPS), radium (up to 2 times its MCL), selenium (up to 174 times its MCL), thallium (up to 102 times its MCL), pH, sulfate, and TDS in years since. The ACM was initiated in 2019, and a remediation work plan and application for an updated permit were submitted to WDEQ. Additional investigations began in 2020, and contaminant plume characterization is ongoing. Interim corrective measures, including horizontal pumping of groundwater from below the unit, are ongoing.

FGD Pond 5 was in detection monitoring throughout 2021 and still receives waste. An SSI was identified for chloride in September 2019, and an ASD, completed in 2020, indicated an alternative source. No SSIs have been identified in 2021.

Violations of the CCR Rule at this site include:

- utilizing insufficient background and downgradient monitoring networks,
- closure of ponds in place with ash in contact with groundwater,
- failure to provide adequate ASDs,
- failure to provide a detailed timeline of remediation actions, and
- failure to select a remedy in a timely manner.



11.1 Closure plans

FGD Pond 1 and FGD Pond 2 have been closed in place and appear to be within five feet from the uppermost aquifer. Without removing the ash, it may continue to impact groundwater.

For FGD Pond 1, no PE certification was found stating that this pond is more than five feet from the uppermost aquifer, which is a violation of the CCR Rule. Available information suggests that it is closer than five feet. For example, the depth to water measured at monitoring well DEQ-1 was less than five feet in 2015, 2016, and spring 2017. This well is near the western boundary of the unit. Also, the History of Construction report shows the ground surface ranging from 6,900 to 6,930 feet AMSL from the northwest to southeast portions of the pond. The potentiometric contours in the 2021 Groundwater Monitoring Report show a similar range of groundwater elevations across the pond. This demonstrates that the pond is in contact with groundwater. Also, the Corrective Actions Report refers to pumping of groundwater to relieve groundwater mounding under the pond. Due to its closure in place in contact with groundwater, this pond is in violation of the CCR Rule.

Similar to FGD Pond 1, no PE certification was found stating that FGD Pond 2 is more than five feet from the uppermost aquifer, which is a violation of the CCR Rule. Pond drawings provided in the History of Construction report indicate that the bottom of the pond ranges from approximately

6,895 to 6,900 feet AMSL. Groundwater elevation contours depicted on figures in the 2018 and 2021 Annual Groundwater Monitoring Reports indicate groundwater at 6,890 to 6,910 feet AMSL in this area. This indicates that groundwater is in contact with ash. This is a violation of the CCR Rule.

Depth to water measured at monitoring well HW-1 was less than five feet in December 2016, spring 2017, and during 2021. Depth to water measured at monitoring well HW-7 was less than five feet in spring 2017, spring 2018, fall 2020, and all of 2021. Again, this suggests that groundwater is close to the bottom of FGD Pond 2.

Evidence suggests that these ponds may be closed in place in contact with groundwater, but it is not possible with the available information to make a definitive determination. Closing these ponds in place in contact with groundwater would be a violation of the CCR Rule.

11.2 Groundwater monitoring

Background wells

Almost all background wells utilized across this site contain significant concentrations of lithium and selenium. Additionally, many of the background wells are located close to one mile from unit boundaries.

North Ash Pond

At the North Ash Pond, boron and sulfate concentrations in at least two background wells (DEQ-1 and E-5) are within the same range as the downgradient wells; these background wells may be contaminated. Background wells DEQ-1, E-5, and E-9 also contain lithium at concentrations greater than its default GWPS in the CCR Rule and selenium at concentrations greater than its MCL—indicating that they are already polluted.

Well E-5 does not appear to be upgradient from the North Ash Pond—water depth is 6,885 feet AMSL and at the pond it ranges from 6,900 to 6,880 feet AMSL. Well E-9 is even further from the North Ash Pond than E-5 and has a water depth of 6,883 feet AMSL, so is likely not upgradient.

Well DEQ-2R may be contaminated by boron; however, a reporting error is likely the reason that high boron levels were documented in the 2021 Annual Groundwater Monitoring Report. Because of this, it is not possible to determine conclusively whether this well is contaminated. If it is indeed contaminated, the North Ash Pond would only be monitored by one background well that is not flawed, and the utility would not have provided information to rebut the presumption that one background well is insufficient, a violation of the CCR Rule.

South Ash Pond

At the South Ash Pond, at least two upgradient wells are contaminated by coal ash constituents. Boron concentrations in SAP-1 and SAP-2 are approximately four times USEPA's 10-day child health advisory in all samples collected since 2017. Molybdenum concentrations in these two wells were also above its default GWPS in all samples, and some samples contained selenium in concentrations greater than its MCL. Lithium concentrations at six upgradient wells have been greater than its default GWPS on at least one occasion, some in all samples collected since 2017. Selenium concentrations at these six wells have also been greater than the MCL during at least one sampling event.

Well SAP-2 has issues with water levels—the well has only had sufficient water for sampling on one occasion from May 2017 through August 2021.

Background monitoring well DEQ-1 is greater than one mile from the South Ash Pond boundary.

The background monitoring well network at this unit includes eight background wells. Each well shows signs of contamination. Therefore, this monitoring well network is not capable of accurately depicting background water quality and the unit is in violation of the CCR Rule.

Table 2: Background wells at Naughton

Well	Unit(s) monitored	Contaminant(s) present greater than threshold	Other flaws
DEQ-1	North Ash Pond, South Ash Pond, FGD Pond 4, FGD Pond 2	Boron, sulfate, lithium, selenium	Far from FGD Pond 4 and FGD Pond 2. Found to be influenced by ash constituents and removed from statistical evaluations during the ACM for FGD Pond 1.
DEQ-2R	North Ash Pond	Boron	
E-5	North Ash Pond, South Ash Pond, FGD Pond 4, FGD Pond 1, FGD Pond 2	Boron, sulfate, lithium, selenium	Not upgradient from North Ash Pond. Far from FGD Pond 4, FGD Pond 1, FGD Pond 2.
E-9	South Ash Pond, FGD Pond 4, FGD Pond 1, FGD Pond 2	Lithium, selenium	Not upgradient from North Ash Pond. Far from FGD Pond 4, FGD Pond 1, FGD Pond 2.
E-10	South Ash Pond	Lithium, selenium	
SAP-1	South Ash Pond	Boron, molybdenum, selenium, lithium	
SAP-2	South Ash Pond	Boron, molybdenum, selenium, lithium	Insufficient water for sampling.
MW-7	South Ash Pond	Lithium, selenium	
MW-10	South Ash Pond	Boron, lithium, selenium	
SAP-6	FGD Pond 4	Cobalt, lithium, selenium	
MW-8	FGD Pond 4	None (Appendix III constituents only monitored)	
MW-8R	FGD Pond 4	Lithium	Within FGD contaminant plume.
B-1	FGD Pond 1, FGD Pond 2	Lithium, selenium	
FGD 1-1	FGD Pond 2	Lithium	

Note: For the North Ash Pond, very high boron concentrations included in the annual groundwater monitoring report may be due to a unit conversion error. For cobalt, lithium, and molybdenum, the threshold is the default GWPS in the CCR Rule. For boron, the threshold is USEPA's 10-day child health advisory. For selenium, the threshold is the MCL. Sulfate is listed where its concentration in upgradient wells exceeds its concentration in downgradient wells.

FGD Pond 4

At FGD Pond 4, the current monitoring network includes five background wells. Four wells are contaminated and three are far from the unit. This leaves one well, FGD 4-1, as the only well capable of accurately assessing background water quality.

MW-8R is a downgradient monitoring well for the South Ash Pond where SSLs for lithium have been identified (South Ash Pond and FGD Pond 4 Annual Monitoring Reports).

Wells E-5, E-9, and DEQ-1 all show high levels of lithium and selenium. Also, these wells are far from FGD Pond 4; E-9 and E-5 are close to a mile away and DEQ-1 is approximately 1.25 miles away. (South Ash Pond and FGD Pond 4 Annual Monitoring Reports)

SAP-6 was included as a background monitoring well at the creation of the monitoring network. Since then, this well has been transitioned to a downgradient well. ASDs and the ACM indicate that well SAP-6 is contaminated by cobalt, lithium, and selenium originating from FGD Pond 2. (South Ash Pond and FGD Pond 4 Annual Monitoring Reports)

FGD Pond 1

The FGD Pond 1 monitoring network includes three background wells: E-5, E-9, and B1. E-5 and E-9 show levels of lithium and selenium greater than their respective MCLs. Also, these wells are far from FGD Pond 1—E-9 and E-5 are more than a mile away. B-1 also contains lithium and selenium at concentrations greater than MCLs. (South Ash Pond and FGD Pond 1 Annual Monitoring Reports) Because no wells capable of accurately depicting groundwater quality are in place at this unit, it is in violation of the CCR Rule.

FGD Pond 2

The FGD Pond 2 monitoring network includes five background wells. Wells B-1, DEQ-1, E-5, and E-9 contain concentrations of lithium and selenium greater than their respective MCLs. Lithium concentrations in FGD 1-1 are greater than the MCL.

Well FGD 1-1 is the only upgradient well without lithium or selenium concentrations exceeding MCLs. The utility has not provided information to rebut the presumption that one background well is insufficient, a violation of the CCR Rule.

Downgradient wells

All units would benefit from the addition of wells along the downgradient boundaries to decrease the spacing between wells. The CCR Rule requires that the downgradient monitoring network be able to accurately measure any contaminants leaving the unit boundary. Thus, portions of the downgradient boundaries left unmonitored constitute violations of the CCR Rule.

For the South Ash Pond, the southwestern boundary of the pond could receive downgradient flow and does not contain a monitoring well. An additional well should be added west of well SAP-3 to completely cover the potential extent of downgradient migration.

For FGD Pond 4, the southwestern boundary of the pond could receive downgradient flow and does not contain monitoring wells. Additional wells should be added northwest of well MW-13 to completely cover the potential extent of downgradient migration.

For FGD Pond 1, an approximately 1,000-foot portion of the downgradient boundary between wells FGD 1-1 and DEQ-3R is left unmonitored and should be supplemented with additional wells to capture contaminants crossing this boundary. Additionally, the southwestern boundary is left unmonitored. Additional wells west of well DEQ-2R are needed.

For FGD Pond 5, monitoring wells are placed along all boundaries of the unit; however, at the northwest portion, along the northern edge, and along the northeast portion of the pond, wells are spaced greater than 1,000 feet apart.

Because portions of the downgradient boundaries of these units are unmonitored, the groundwater monitoring system is in violation of the CCR Rule.

11.3 Flawed ASDs

ASDs completed at the North Ash Pond, South Ash Pond, and FGD Pond 5 identified FGD Pond 2 as the source of contamination. FGD Pond 2 has proven issues that are likely impacting these units. However, because the monitoring networks contain flaws, contamination originating from the units themselves should not be ruled out conclusively. Because the ASDs do not contain sufficient factual or evidentiary basis to demonstrate that a source other than the units are the source of the contamination, they violate the CCR Rule.

11.4 Flawed ACMs

ACMs have been completed for three units: South Ash Pond, FGD Pond 1, and FGD Pond 2. It was concluded that contamination at the South Ash Pond is sourced from FGD Pond 2 and, therefore, corrective measures specific to the South Ash Pond are not assessed. A complete source characterization of contamination at the South Ash Pond is needed.

The ACMs for FGD Pond 1 and FGD Pond 2 include general time estimates to meet groundwater standards; however, detailed implementation schedules are not provided, which is a violation of the CCR Rule.

11.5 Deficiencies in selected remedies

A remedy has not been officially selected for FGD Pond 2, although steps have been taken to clean up groundwater. The ACM was completed in 2019; thus, this selection is long overdue and constitutes a violation of the CCR Rule.

At FGD Pond 1, the selected remedy includes continued closure in place with installation of a horizontal well beneath the unit to capture contaminated groundwater and transfer it to FGD Pond 4. While a specific timeline of activities associated with implementing the remedy is not provided, the 2021 Groundwater Monitoring and Corrective Actions Report describes activities that occurred during 2021 and states that the groundwater capture system will be fully operational in 2022.

The remedy utilizes FGD Pond 4 for storage of contaminated groundwater. As described above, FGD Pond 4 is utilizing a monitoring system that is not capable of accurately identifying releases from the pond to groundwater. Without an adequate groundwater monitoring system in place, it is not possible to ensure that the contaminated wastewater is not contributing contamination to the groundwater at this unit. For this remedy to be sufficient, PacifiCorp must ensure that FGD Pond 4 is not releasing contaminated groundwater.

11.6 Conclusion

The background monitoring networks used across this site are contaminated with CCR waste and do not reflect true background levels, which means that these monitoring systems are not capable of revealing the true source of groundwater contamination. Therefore, PacifiCorp has evaded responsibility for cleaning up the contamination. Further, large gaps exist in the downgradient monitoring systems across the site; this means contaminants may cross unit boundaries unnoticed, and PacifiCorp may again illegally evade responsibility for addressing the resulting impacts to groundwater. ASDs have been completed for the North Ash Pond, South Ash Pond, and FGD Pond 5. Reliance on these inconclusive ASDs for contamination allows these units to avoid additional monitoring and remediation of existing groundwater contamination. The ACM for the South Ash Pond does not characterize contamination sourced from this unit, meaning that it will not be adequately remediated. A remedy with a detailed timeline of action items has not been selected for FGD Pond 2; thus, CCR waste at this unit remains in place. The remedy selected at FGD Pond 1 is insufficient; contaminated groundwater will be transferred to FGD Pond 4. This pond utilizes a contaminated background monitoring system; thus, it is not possible to determine whether this polluted water is contained within the unit or is leaching to the aquifer.

12. NEW CASTLE

The NRG Energy (subsidiary of GenOn) New Castle Generating Station, located in West Pittsburg, Pennsylvania, contains two CCR units regulated by the CCR Rule: the North Ash Pond and the Ash Landfill. The plant transitioned to natural gas in 2016 with minimal capacity to utilize coal; thus, CCR generation has been nominal in recent years. The North Ash Pond has been closed by removal, and the Ash Landfill continues to receive a small amount of CCR.

An SSI for chloride was found at the North Ash Pond and an ASD was unsuccessful; therefore, the unit proceeded to assessment monitoring (Email dated April 17, 2018, from Stephen Frank, GenOn).

An SSL for arsenic was found at the North Ash Pond. An April 2019 ASD identified a historic impoundment located north of this unit as the source of arsenic at the North Ash Pond and indicates that the pond will continue in assessment monitoring. (Email dated April 12, 2019, from Stephen Frank, GenOn)

The North Ash Pond was closed by removal before July 2, 2019. CCR was removed from the pond and disposed of in the Ash Landfill (Completion of Closure Certification). No monitoring reports have been posted to the company's website since the closure. Therefore, it is not possible to determine whether monitoring has continued.

A historic ash dump surrounding the current Ash Landfill has been identified as the source of extensive groundwater contamination across this site. This historic landfill is not regulated under the CCR Rule, and thus, no corrective actions or cleanup remedies are in place.

Violations of the CCR Rule at this site include:

- utilizing an insufficient monitoring network and
- failing to continue groundwater monitoring after closure.
- Failing to treat an inactive pond as regulated unit.

12.1 Groundwater monitoring

Only a single background well has been used for the North Ash Pond, and this well shows signs of contamination. Lithium, boron, calcium, sulfate, and TDS concentrations were greater in the background well than in the three downgradient wells from December 2015 through October 2017. Per 40 C.F.R. § 257.91(f), factual justification must be provided when the minimum number of wells is used. This unit is in violation of the CCR Rule because justification is not provided.

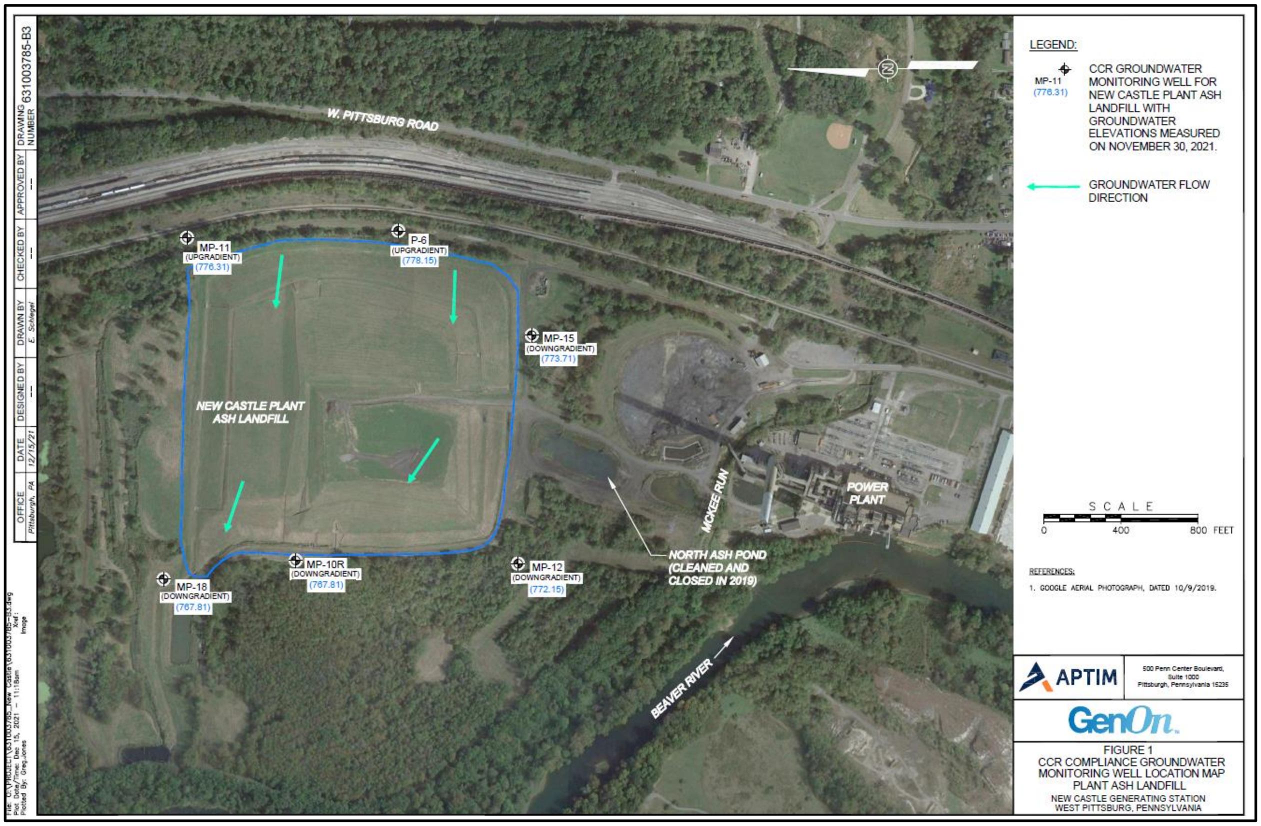
Arsenic and lithium concentrations are greater than their respective thresholds at the background well on all dates sampled. Lithium concentrations in 2018 were approximately 7 times its default GWPS in the CCR Rule. (Tables 1-4, 2018 Annual Groundwater Monitoring and Corrective Action Report)

While precise locations are not provided, the company describes the pond as being constructed within ash: "The North Ash Pond is underlain by fly ash and bottom ash that were disposed in a former impoundment constructed on top of glacial outwash." (Pond Location Restriction Documentation, p. 2) Because the upgradient monitoring well is located close to the unit boundary, it is likely that this monitoring well is also placed in residual ash.

The North Ash Pond's background monitoring network is not capable of accurately reflecting background conditions due its contamination with CCR constituents. This is a violation of the CCR Rule.

Additional wells along the western and southern downgradient boundaries of the Ash Landfill are needed to fully characterize the waste stream passing the unit boundaries. All wells should be located closer to the unit boundary.

Along portions of the Ash Landfill's western and southern unit boundaries, a distance of approximately 1,000 feet is left unmonitored by the current downgradient monitoring network. Only one of the downgradient wells at this unit is located within 500 feet of the unit, two are approximately 500 feet from the unit, and well MP-18 is almost 1,000 feet from the unit boundary. These wells are located along the boundary of a historic ash impoundment whose footprint enclosed the current Ash Landfill. Because of the unmonitored portions of the downgradient boundary, this monitoring network is not capable of capturing all contamination passing the unit boundary. Thus, this is a violation of the CCR Rule.



12.2 Failure to continue groundwater monitoring after closure

The most recent Groundwater Monitoring and Corrective Action Report for the North Ash Pond posted to GenOn's website for this facility is dated January 2020 and includes monitoring results through May 2019. In May 2019, all downgradient monitoring wells contained arsenic and lithium concentrations greater than respective thresholds. Arsenic was present at up to 9 times its MCL and lithium concentrations ranged up to 2.75 times its default GWPS in the CCR Rule.

The CCR Rule requires that groundwater must meet GWPSs for closure by removal to be considered complete. Because groundwater did not meet standards at the last monitoring event, this is a violation of the CCR Rule.

If monitoring continued, but results were not posted, the company is still in violation of the CCR Rule.

12.3 Presence of unregulated ash disposal units

The Ash Landfill is situated within an area that was used as a historic ash waste disposal site. The historic impoundment received wastes including sluiced fly ash, bottom ash, dry fly ash, and dredged bottom ash beginning in approximately 1939. In 2008, the company applied for a permit to cap the historic impoundment and construct the current landfill over 60 acres of the historic disposal site. (Annual Inspection Report 2019)

An ASD completed in 2019 for the North Ash Pond identified this historic disposal area as the source of arsenic detected in the North Ash Pond's monitoring wells. Similarly, this historic disposal site was identified as the source of contamination for all Appendix III constituents at the Ash Landfill in its 2018 ASD and subsequent Annual Groundwater Monitoring Reports. No corrective actions have taken place.

12.4 Conclusion

The background monitoring network at the North Ash Pond is not capable of accurately reflecting background conditions; thus, it is not capable of revealing the true source of groundwater contamination. Therefore, NRG Energy has evaded responsibility for cleaning up the contamination. Further, large gaps exist in the downgradient monitoring system at the Ash Landfill; this means contaminants may cross the unit boundary unnoticed and the company may again illegally evade responsibility for addressing the resulting impacts to groundwater. The North Ash Pond closed in 2019 and groundwater monitoring was discontinued even though groundwater was known to be contaminated at this point. Groundwater monitoring must be continued following closure to ensure that groundwater quality is once again safe. Failure to post monitoring results makes it impossible for concerned citizens to determine whether groundwater in their communities is safe.

13. PETERSBURG

Indianapolis Power & Light Company's (IP&L's) Petersburg Generating Station is near Petersburg in Pike County, Indiana along the banks of the White River. This facility contains two units regulated under the CCR Rule: a multi-unit containing the A, A', and C Ponds, and the Landfill. Ash Pond B and Ash Pond D are located within the multi-unit area but were taken out of commission prior to 2015 and are not subject to regulation under the CCR Rule, according to IP&L. IP&L plans to close all units in place. Ash Pond C was closed in 2021, and notifications to close were issued for Ash Ponds A and A' in 2019 and 2018 respectively. The Ash Pond multi-unit is in contact with groundwater; thus, without proper remediation, ash contributions to groundwater will continue after closure is completed.

The A, A', C Pond multi-unit entered assessment monitoring in 2018 and has continued in assessment monitoring through 2021. SSLs have been continually identified for cadmium (one well), cobalt (one well), and molybdenum (one well). In 2021, cadmium concentrations exceeded its MCL by 1.3 times, cobalt concentrations exceeded its default GWPS in the CCR Rule by 62 times, and molybdenum concentrations exceeded its default GWPS by 24 times. In 2019, an ASD identified a nearby historic mining operation as the source of cobalt and cadmium at monitoring well AP-8. However, the unit's "upgradient" wells are significantly contaminated with CCR constituents. Lithium concentrations up to 50 times its default GWPS and boron concentrations greater than 1.5 times USEPA's 10-day child health advisory have been identified in upgradient wells at this unit.

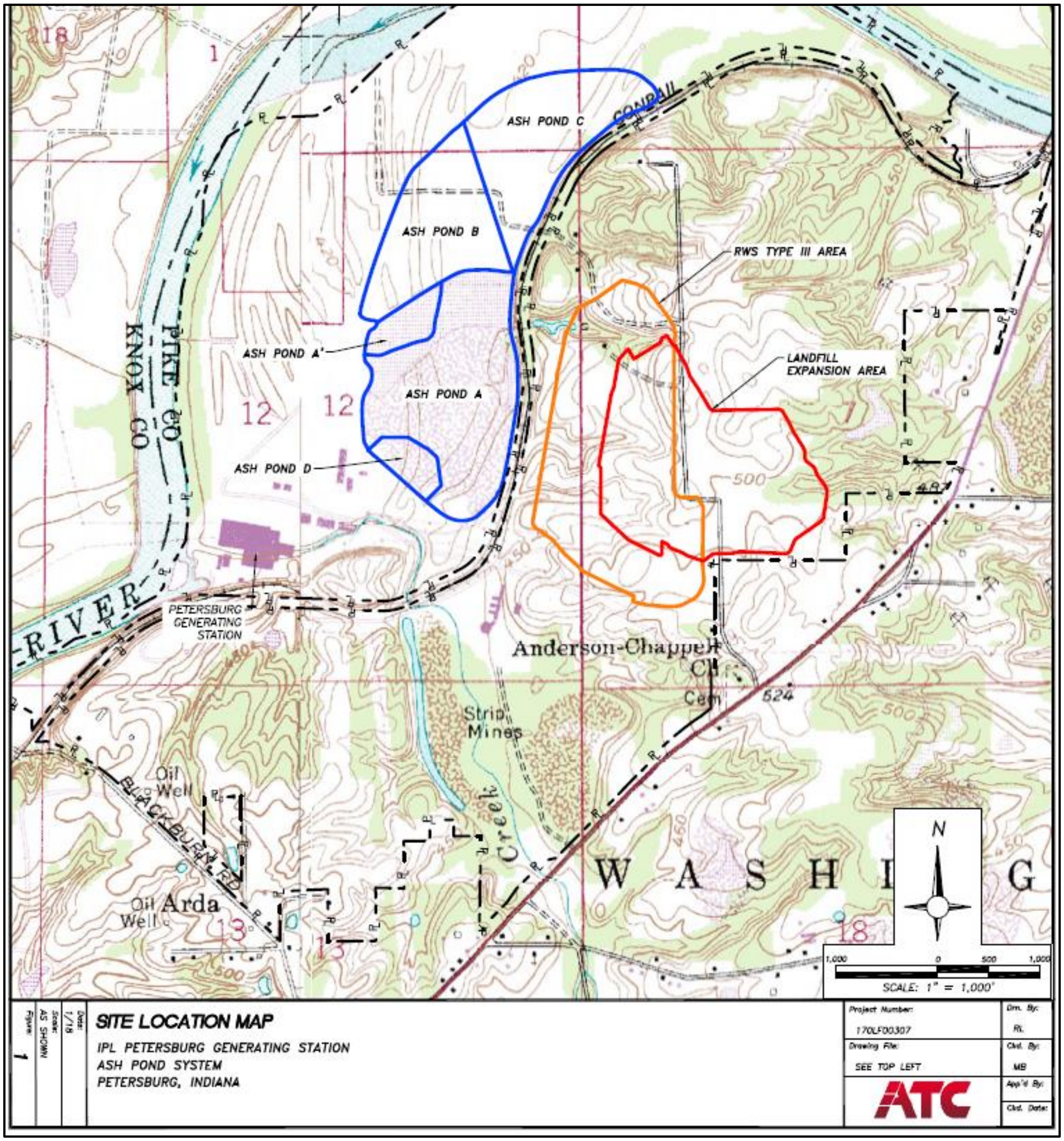
The Landfill entered assessment monitoring in 2018, and SSLs for arsenic (two wells), lithium (three wells), and molybdenum (one well) have been identified during years since. This unit has continued in assessment monitoring through 2021, when concentrations of arsenic exceeded its MCL by 10 times, lithium exceeded its default GWPS by 44 times, and molybdenum exceeded its default GWPS by 5 times. An ASD completed in 2019 for arsenic in monitoring well MW-10 identified historic coal mining as its source.

An ACM for the pond complex—including the Landfill and unregulated Ash Ponds B and D—was completed in September 2019 and amended in October 2019. However, a public meeting has not been held and a remedy has not been selected. A nature and extent investigation has been ongoing since 2019.

Contamination at this site was identified and reported under the CCR Rule as early as 2017, yet no plans for remediation are in place.

Violations of the CCR Rule at this facility include:

- closing ash ponds in contact with groundwater,
- insufficient background monitoring networks,
- reliance on ASDs that do not completely rule out the units as sources of contamination,
- failure to calculate the mass of groundwater contaminants,
- failure to determine a specific timeline for remediation, and
- failure to select a remedy.



13.1 Closure plans

Although no location restriction documents for the A, A', and C Pond multi-unit are available on the company's website, a review of available data indicates that at least portions of this pond complex have been constructed in groundwater. This is particularly problematic because these ponds will be closed in place, leaving CCR in contact with groundwater, which is a violation of the CCR Rule.

History of Construction documents for these ponds indicate that the bottoms of the ponds are at 419 feet AMSL. A review of data collected from 2017 through 2021 and reported in Annual Groundwater Monitoring and Corrective Action reports indicates that static water levels at five wells adjacent to the pond complex were much higher than the base of the pond. Groundwater elevation at wells AP-7, AP-8, MW-2 (2R), MW-3, and MW-4C ranged from 422 feet AMSL (3 feet above the pond's base) to 448 feet AMSL (29 feet above the pond's base) from 2016 through 2021. Thus, these ponds are constructed in contact with groundwater, and closure in place is a violation of the CCR Rule.

The A, A', and C Ponds are all constructed within the floodplain of the White River. FEMA identifies this area as Category A, meaning that this area has a 1% annual chance of flooding. The ACM for this site also indicates that the ash pond complex is constructed within the 100-year floodplain. The CCR Rule prohibits facilities in floodplains that result in washout of CCR, so as to pose a hazard to human life, wildlife, or land or water resources. If a washout were to occur, this unit would be in violation of the CCR Rule.

13.2 Groundwater monitoring

The groundwater monitoring network at the A, A', and C Pond multi-unit includes three upgradient monitoring wells. All three show potential for contamination by CCR constituents. Lithium concentrations range from approximately seven times the MCL to 50 times the MCL in these three wells. One well, MW-4C, also contains boron at levels greater than 1.5 times its MCL. Additionally, sulfate levels are elevated and similar to those found in downgradient wells.

These three wells are included in the Landfill's downgradient monitoring network. SSLs for lithium were identified at all three wells, and MW-3 had an SSL for molybdenum.

Because these wells show signs of contamination, they are not suitable for use in the groundwater monitoring network, and thus, this network is in violation of the CCR Rule.

The landfill's upgradient monitoring network includes only one upgradient monitoring well. Per 40 C.F.R. § 257.91(f), factual justification must be provided when the minimum number of wells is used. This unit is in violation of the CCR Rule because justification is not provided.

13.3 Flawed ASDs

For the A, A', and C Ponds, an ASD was completed in 2019 to assess the source of cadmium and cobalt at monitoring well AP-8. The ASD concluded that the contamination at this well is sourced from acid mine drainage from historic surface and underground mining. A slope entry into the Gladstone Mine is located adjacent to AP-8, and mine seeps have been identified across the area impacted by historic mining. A historic underground mine is present upgradient near monitoring well AP-8. pH values measured in this well are noticeably more acidic than those measured in other monitoring wells and are representative of acid mine drainage rather than coal ash.

A water sample was collected from a seep and analyzed for cobalt and cadmium. These results were compared with data collected at AP-8. Concentrations of cobalt and cadmium at the mine seep were lower than in AP-8. The ASD states that spring 2019, when the mine seep sample was collected, was wetter than usual and used this as explanation for the lower cobalt and cadmium concentrations at the mine seep. Further, the seep sample was collected much closer to AP-7, which does not show cobalt or cadmium SSLs.

While the ASD describes a plausible source of cobalt and cadmium contamination at well AP-8, it does not rule out the potential for contributions of these contaminants from the pond complex. Because the ASD does not contain sufficient factual or evidentiary basis to demonstrate that the coal ash contaminants are from a source other than the pond complex, it violates the CCR Rule. Thus, these contaminants at this well must be included in the ACM for this site. This is of the utmost importance due to the placement of the ponds in groundwater. Static water levels at this well are above the bottom of the ash ponds.

For the Landfill, arsenic at MW-10 is "associated with reductive dissolution of naturally occurring arsenic with the area downgradient from the unit." (2019 ASD Report, p. 3) Soil borings and groundwater samples collected at three nearby locations indicate that MW-10 was constructed in disturbed backfill material from historic mining and that reducing groundwater conditions exist. A review of historic coal mining activities indicates that this unit is situated in an area of historic coal mining.

The 2019 ASD also states that arsenic was not detected at other downgradient monitoring wells, which would be expected if the Landfill was the source. However, two years later, in 2021, an SSL for arsenic was detected at MW-3 in addition to MW-10. While the ASD describes a plausible source of arsenic contamination at well MW-10, it does contain sufficient factual or evidentiary basis to rule out the potential for contributions of arsenic from the Landfill and therefore violates the CCR Rule.

Further, the identification of an SSL for arsenic at another monitoring well located across the Landfill from MW-10 provides evidence that the Landfill may be contributing arsenic to groundwater. Therefore, arsenic must be included in the ACM and extent and nature investigations for this site.

13.4 Flawed ACMs

SSLs have been identified for arsenic, cadmium, cobalt, lithium, and molybdenum across the site. However, the ACM focuses only on SSLs for lithium and molybdenum due to ASDs indicating sources of cadmium, cobalt, and arsenic other than the Pond Complex and the Landfill. A comprehensive remedy would address all contamination at the site; thus, all groundwater contamination must be assessed when considering corrective measures.

The ASD for cadmium and cobalt presented an alternative source of these contaminants, but it did not conclusively rule out any inputs from the pond complex. Thus, a remedy must address these constituents.

Ten monitoring wells and three piezometers were installed to assess the nature and extent of groundwater contamination and groundwater flow and hydraulic connectivity at the site in 2019. Data have been collected, but the nature and extent of groundwater impacts have not been characterized three years later.

Underground mining within the facility's property boundary has been identified as impacting groundwater contamination in ASDs. The CCR Rule requires that site conditions that may affect the remedy ultimately selected must be characterized. The historic mining operations and associated acid mine drainage is not considered in the ACM; instead, it is treated as an alternative source rather than part of the groundwater contamination problem at this facility. The failure of the ACM to account for the site conditions is a violation of the CCR Rule.

The mass and concentration of contaminants have not been characterized, in violation of the CCR Rule. The time frame for each of the remedies considered is described as "long-term," and no specific time estimates for attainment of GWPSs are provided, also in violation of the CCR Rule.

13.5 Deficiencies in selected remedies

The ACM was completed in October 2019, yet a remedy has not yet been selected. Further, a public meeting is required within 30 days of the completion of the ACM, but a meeting has not been held. Remedy selection is long overdue.

The ACM determined that exposure to contaminated groundwater is negligible due to the primary hydraulic flow route to the White River and its ability to dilute contamination. IP&L believes that protection is already achieved for this reason. Failure to select and implement a remedy in a timely manner is in violation of the CCR Rule.

While a remedy has not been selected, MNA is included as part of two of five remedy alternatives.

13.6 Presence of unregulated ash disposal units

Ponds B and D stopped receiving CCR prior to 2015 and therefore are not regulated under the CCR Rule. Although these ponds are not directly monitored due to their location within the A, A', C Pond multi-unit, contamination leaching from these ponds would be captured in the multi-unit's downgradient monitoring system. The ACM completed for the multi-unit documents the presence of these ponds.

As described above, portions of the multi-unit are likely in contact with groundwater, and Ponds B and D have been closed in place. It is important that IP&L continue to consider these ponds as a source of groundwater contamination that must be remedied. While the History of Construction document does not discuss Ponds B and D specifically, it does indicate that the average height of the bottom of the pond complex averages 418 feet AMSL. Groundwater level data collected at wells along the eastern boundary of the pond complex indicates that water levels are above the base of the pond complex (Annual Groundwater Monitoring and Corrective Action Reports, 2017-2021). Thus, the eastern portion of Ash Pond B is likely in contact with groundwater, and Ash Pond D may also be in contact with groundwater. If these ponds are indeed in contact with groundwater, they would be considered inactive surface impoundments and subject to the CCR Rule.

13.7 Conclusion

This facility's pond multi-unit will be closed in place in contact with groundwater. Closing the unit in place in contact with the aquifer will allow CCR contaminants to impact the aquifer for generations. The background monitoring network at the pond multi-unit is contaminated with CCR waste and does not reflect true background levels, which means that this unit's monitoring system is not capable of revealing the true source of groundwater contamination. Therefore, IP&L has evaded responsibility for cleaning up the contamination. Reliance on inconclusive ASDs for contamination at the Landfill and pond complex allows these units to avoid additional monitoring and remediation of existing groundwater contamination. The ACM neglects to characterize all contaminants present in groundwater at this site. Further, a remedy with a detailed timeline for actions has not been selected. Without an accurate picture of the mass and extent of groundwater contamination, an effective remedy cannot be determined. Failure to create an effective plan for remediation allows CCR contamination to remain in the aquifer. At least two historic ponds not regulated by the CCR Rule are present at this facility. Because they are likely closed in contact with groundwater, these ponds will continue leaching CCR contaminants to the aquifer.

14. POWERTON

The 1,786-MW NRG Powerton Generating Station in Pekin, Tazewell County, Illinois is located along the Illinois River and utilizes three units that NRG acknowledges as regulated by the CCR Rule: the Ash Surge Basin (ASB), Ash By-pass Basin (ABB), and Former Ash Basin (FAB). Groundwater at the ASB and ABB is monitored as one multi-unit with a single monitoring network.

According to the documents posted by NRG on their CCR Rule compliance website, closure in place began at the FAB in 2019 and was expected to be complete in 2020 (Closure Plan FAB, May 2019). NRG indicates that the ABB will be closed by removal of CCR materials; closure is expected to be completed by 2030 (Preliminary Written Closure Plan for Bypass Basin, October 29, 2021). Closure by removal of CCR at the ASB is estimated to be completed by 2025 (Ash Surge Basin Closure Plan, April 9, 2021). NRG submitted a request for an alternative closure deadline for the ASB to USEPA due to its inability to initiate closure before April 11, 2021 (Demonstration for a Site-Specific Alternative Deadline to Initiate Closure, November 30, 2020). USEPA has not made a final decision. However, the above dates and actions are subject to change. NRG must receive closure construction permits from Illinois EPA for all three of these units prior to initiating closure activities.

Arsenic has been detected at this facility at levels up to 50 times its MCL, and thallium concentrations have exceeded its MCL by 3.8 times. Concentrations of barium, molybdenum, and selenium have also exceeded their respective MCLs or the default GWPS under the CCR Rule at levels approximately 1.5 times the thresholds.

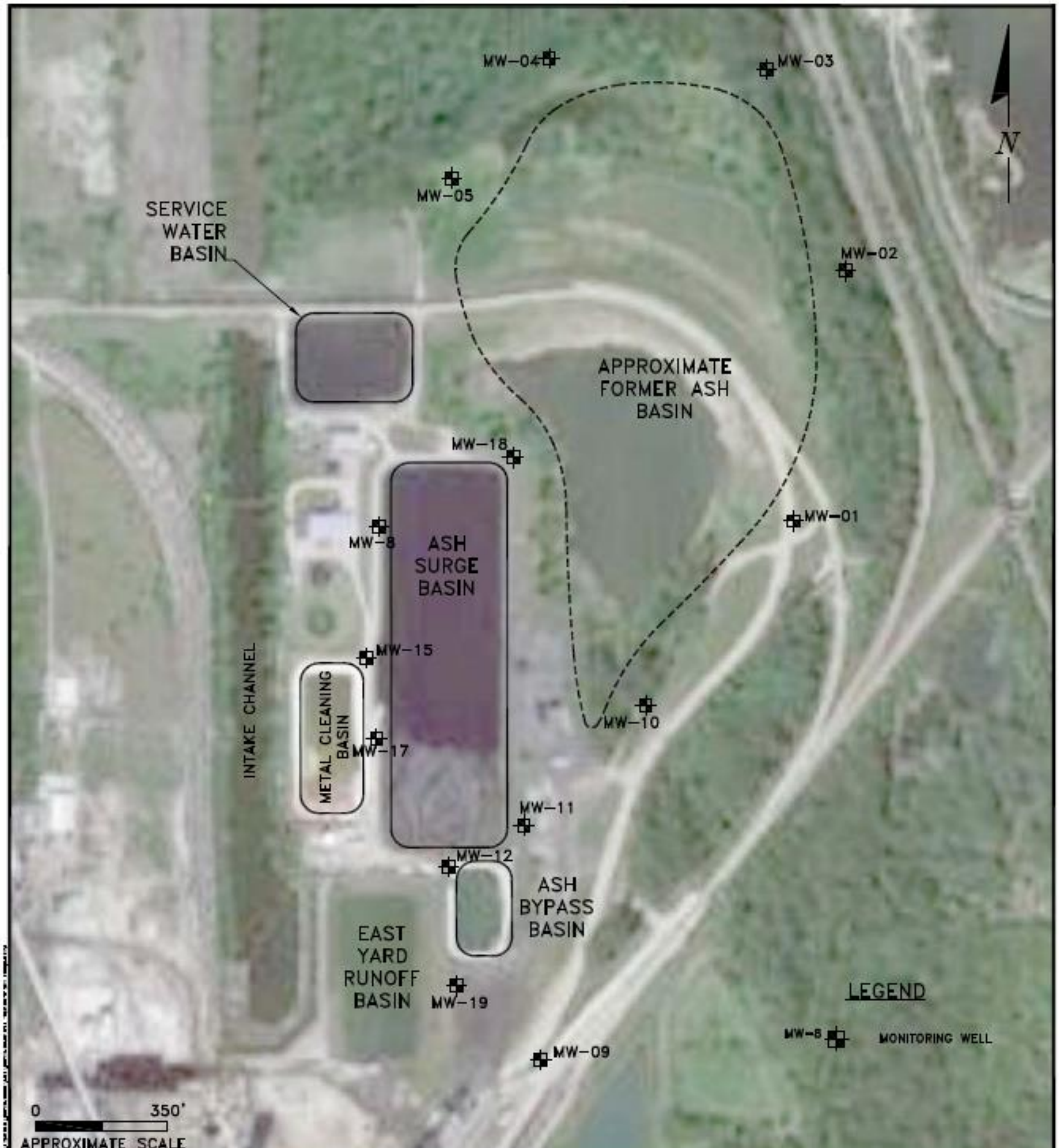
At the end of 2021, the ASB/ABB multi-unit was in assessment monitoring. Monitoring of Appendix III constituents is ongoing, and during the 2021 semi-annual sampling events SSIs were identified for the following Appendix III constituents: chloride (six wells), fluoride (six wells), sulfate (six wells), boron (two wells), TDS (five wells), and pH (two wells). SSIs have been identified during every monitoring event since the CCR Rule–required monitoring program was initiated in 2017. An ASD was completed for SSIs identified in 2017; however, an alternate source was not identified, and the multi-unit proceeded to assessment monitoring in April 2018. An ASD completed following SSLs identified during 2018 concluded that the multi-unit is not the source of selenium and arsenic. SSLs for these constituents continue to be identified.

The FAB completed monitoring in the assessment monitoring program during 2021. SSIs for fluoride at three wells and boron, chloride, pH, sulfate, and TDS at one well each were identified during 2021. No SSLs were identified during 2021 or during previous years. This unit entered the assessment monitoring program in 2020 following SSIs for these same constituents and completion of an ASD that did not conclusively confirm an alternate source for the SSIs. Ash contamination in background wells obstructs accurate identification of SSIs and SSLs. Because this unit utilizes contaminated background wells, it is possible that SSLs are going undetected.

Historic ash disposal areas are present in the vicinity of the regulated units. This ash is likely contributing to degraded groundwater quality at this site. Closure of the regulated units will not remedy the groundwater contamination resulting from historic CCR waste. Measures must be taken to address historic ash disposal areas and resulting groundwater contamination at this facility.

Violations of the CCR Rule include:

- Proposing to close a pond in place in contact with groundwater,
- insufficient background monitoring well networks, and
- reliance on an inconclusive ASD.



ENVIRONMENTAL CONSULTATION & REMEDIATION

KPRG

KPRG and Associates, Inc.

414 Plaza Drive, Suite 106 Westmont, Illinois 60559 Telephone 630-325-1300 Facsimile 630-325-1593

14665 West Lisbon Road, Suite 2B Brookfield, Wisconsin 53005 Telephone 262-781-0475 Facsimile 262-781-0478

CCR MONITORING WELL SITE MAP

POWERTON STATION
PEKIN, ILLINOIS

Scale: 1" = 350'	Date: December 19, 2018
KPRG Project No. 12313.1	FIGURE 1

14.1 Closure plans

The FAB will be closed in place (Closure Plan, Former Ash Basin, Powerton Station, May 2019). The location restrictions certification document (April 2020) indicates that the base elevation of this unit is below the uppermost aquifer. Because this unit is closing in place in contact with groundwater, it is in violation of the CCR Rule.

The FAB is within the AE floodplain of the Illinois River (FEMA's National Flood Hazard Layer viewer), meaning there is a 1% annual chance of flooding. The CCR Rule prohibits facilities in floodplains that result in washout of CCR, so as to pose a hazard to human life, wildlife, or land or water resources. If a washout were to occur, this unit would be in violation of the CCR Rule.

14.2 Groundwater monitoring

The background wells included in the monitoring networks for the ABB/ASB multi-unit and the FAB show signs of ash contamination.

The upgradient wells for the multi-unit are MW-01, MW-09, and MW-19. The 2018 ASD for the multi-unit states that MW-09 and MW-19 are installed in an area where CCR fill material was placed historically. Boron concentrations greater than 2 times USEPA's 10-day child health advisory have been identified in these wells. MW-01 is not an upgradient well. Groundwater flow lines and contours for the gravelly sand unit indicate that groundwater flows from the vicinity of the ABB, along the FAB, to MW-01. (Annual Groundwater Monitoring and Corrective Action Reports, 2017 through 2021)

The FAB groundwater monitoring network includes two background wells: MW-10 and MW-01. As described above, MW-01 is not a true upgradient well. MW-10 shows signs of ash contamination. Both boron and fluoride concentrations are elevated at this well.

Because no wells capable of accurately depicting background groundwater quality are in place at either unit, they are in violation of the CCR Rule.

For the ABB/ASB multi-unit, NRG did not utilize data from all background wells in calculation of UPLs for all Appendix III constituents. The UPLs used for fluoride, pH, and TDS are based on pooled values from MW-01 and MW-09. UPLs for all other Appendix III constituents used MW-01 data.

MW-19 is not used in comparisons for Appendix III constituents.

14.3 Flawed ASDs

An ASD was completed in March 2019 for arsenic, barium, molybdenum, selenium, and thallium SSLs at the ASB/ABB multi-unit identified in 2018 at multiple wells. The ASD presents data from Leaching Environmental Assessment Framework tests and concludes that the contamination identified in the groundwater monitoring system is not sourced from the multi-unit.

While these data do support the ASD's conclusion that the multi-unit is not releasing contamination to groundwater, it is not conclusive. Additional types of analyses would provide a more convincing conclusion. No data are provided to identify an alternative source of the contamination identified at this unit. Further, these SSLs continue to be identified and are not decreasing over time as would be expected if inputs were not continuing. Because the ASD does not contain sufficient factual or evidentiary basis to demonstrate that the SSLs were not sourced from the multi-unit, it violates the CCR Rule.

While the ASD does not document it as a source of contamination in the groundwater beneath the multi-unit, it does state that upgradient monitoring wells MW-09 and MW-19 and downgradient wells

MW-11 and MW-12 are installed in areas containing historic placement of fill material containing ash. Ash contamination of background wells interferes with accurate identification of sources of groundwater contamination.

14.4 Presence of unregulated ash disposal units

As noted above, upgradient wells MW-09 and MW-19 and downgradient wells MW-11 and MW-12 are installed in areas containing historic placement of fill material containing ash.

14.5 Conclusion

Closing the FAB in place in contact with the aquifer will allow CCR contaminants to impact the aquifer for generations. The background monitoring networks for the ABB/ASB multi-unit and the FAB are contaminated with CCR waste and do not reflect true background levels, which means that these monitoring systems are not capable of revealing the true sources of groundwater contamination. Therefore, NRG has evaded responsibility for cleaning up the contamination. Reliance on an inconclusive ASD for contamination at the multi-unit allows NRG to avoid additional monitoring and remediation of existing groundwater contamination. Historic ash material at this site likely continues to leach CCR contaminants to groundwater.

15. RD MORROW

Cooperative Energy's RD Morrow Power Plant was a coal-fired power plant located just southwest of Hattiesburg, Mississippi, in the southeastern corner of the state. In January 2019, the owner began the process of repowering the plant to use gas, and it is expected to be in service in early 2023. The facility has two regulated CCR units: a Landfill and a pair of ponds regulated as one unit.

Detection monitoring for the Pond unit found concentrations slightly greater than the GWPSs for arsenic and lithium. The Pond unit was closed via removal in 2021, so no further discussion of this unit is included.

The Landfill unit has been in assessment monitoring since 2018 based on SSIs over site-specific background levels observed in downgradient wells during 2017 sampling events. Every well in the Landfill's monitoring network has exhibited concentrations of at least one constituent greater than GWPSs since monitoring began. Constituents observed in excess of relevant thresholds during the first year of monitoring include boron (up to 13 times the 10-day child health advisory), cobalt (up to 25 times its default GWPS in the CCR Rule, found in the up-gradient well), lithium (up to 230 times its default GWPS), and radium (up to 1.2 times the MCL).

The site has numerous violations or potential violations of the CCR Rule, including:

- The groundwater monitoring network for the Landfill unit exhibits numerous deficiencies and violations of the CCR Rule, rendering it effectively non-functional.
- ACMs are deficient due to a failure to estimate the time until full protection is achieved and failure to estimate the mass of pollutants that has been released.
- The remedy has not been selected in a timely manner, in violation of the CCR Rule.

15.1 Groundwater monitoring

The groundwater monitoring network for the Landfill unit exhibits numerous deficiencies and violations of the CCR Rule. Concentrations of at least two constituents have been elevated since the beginning of monitoring. In 2017, cobalt concentrations in monitoring wells for the Landfill are well above the default GWPS in the CCR Rule, with the highest values coming from the upgradient/background well. In 2017, cobalt levels at this well averaged 0.137 mg/L, 22 times the default GWPS, strongly suggesting that the well is contaminated, in violation of the CCR Rule. Of the five wells around the landfill, four have average cobalt concentrations that exceed the default GWPS.

Also of note are elevated levels of radium in downgradient wells, and especially in MW-3, which had levels exceeding the MCL in four of nine samples in 2017. These and other exceedances suggest that the Landfill unit's monitoring wells—including the background well—were contaminated from the outset of the monitoring program by Appendix IV constituents.

The monitoring network utilizes only one upgradient well, the minimum number allowed by the CCR Rule. Per 40 C.F.R. § 257.91(f), factual justification must be provided when the minimum number of wells is used. This unit is in violation of the CCR Rule because justification is not provided.

The downgradient wells are approximately 1,000 feet apart, and as such likely provide inadequate coverage along the southern edge of the Landfill unit. One of the monitoring wells (MW-10) is approximately 800 feet from the unit boundary, which is too far and likely insufficient for monitoring this portion of the unit, in violation of the CCR Rule. The 2021 landfill groundwater report appears to be missing well data for wells added as part of an ACM. Those data are reported in the 2019 and 2020 reports, but not the 2021 report; this is likely a violation of the CCR Rule.

15.2 Flawed ASDs

Between 2017 and 2021, one ASD was completed and reported in 2020 for SSIs for lithium in two wells downgradient from the landfill unit: MW-3 and MW-4. The ASD asserts that the lithium variations are due to naturally occurring differences in soils and geology.

The ASD, however, does not provide any evidence to demonstrate that the lithium is not a result of release from the landfill unit. Also unusual is that the wells used to calculate site-specific background concentrations for lithium were changed after publication of the ASD. Further, a third downgradient well, MW-5, also experienced an SSL for lithium as well as molybdenum, but it is not included in the ASD.

Because the ASD does not contain sufficient factual or evidentiary basis to demonstrate that the SSL was the result of natural variation, it violates the CCR Rule.

15.3 Flawed ACMs

One ACM has been completed at this site, in response to SSLs for lithium and molybdenum at well MW-5.

Three additional downgradient assessment monitoring wells were installed as part of the ACM. These wells are roughly 1,000 feet apart. The monitoring network is thus insufficient for assessing the extent and level of contamination, in violation of the CCR Rule.

15.4 Deficiencies in selected remedies

No final groundwater cleanup remedy has been selected, and no estimate has been made of the time until full protection is achieved, in violation of the CCR Rule. The Landfill was closed and capped in October 2021, and the consultant reports that landfill closure has "resulted in an improvement of groundwater quality"—although no data are provided to support this assertion. (Semi-Annual Selection of Remedy Report, 3/11/2022)

The consultant suggests that MNA will follow the closing and capping of the landfill. Estimating the time until full protection is achieved is explicitly named as a "planned activity" in the 2022 update, but no schedule is provided. This does not comply with the CCR Rule.

Remedy selection is now in its third year, despite the requirement in the CCR Rule to select a remedy "as soon as feasible." According to the consultant, "preliminary analysis of the feasibility and efficacy of remedial measures" has been completed, but will continue to be updated" (Semi-Annual Selection of Remedy Report, 3/11/2022). This evaluation has not been made public.

Also, no estimate of the mass of pollutants released has been completed, in violation of the CCR Rule.

15.5 Conclusion

The monitoring network at the Landfill is not capable of accurately identifying contamination from this unit. The background monitoring network utilizes only one well, which is contaminated with CCR waste and does not reflect true background levels. This means that the unit's monitoring system is not capable of revealing the true source of groundwater contamination. Therefore, Cooperative Energy has evaded responsibility for cleaning up the contamination. In addition, large gaps exist in the Landfill's downgradient monitoring system; this means contaminants may cross the unit boundary unnoticed and the company may again illegally evade responsibility for addressing the resulting impacts to groundwater. The ACM does not calculate the amount of CCR contamination resulting from the Landfill. Further, a remedy with a detailed timeline for actions has not been selected. Without an accurate picture of the mass and extent of groundwater contamination, an effective remedy cannot be determined. Failure to create an effective plan for remediation allows CCR contamination to remain in the aquifer.

16. REID GARDNER

The Reid Gardner Generating Station is located in Moapa Valley, Nevada and operated by Nevada Energy (NV Energy). This plant no longer generates power; it was demolished in 2019, and the site is undergoing reclamation. Seven units have been regulated by the CCR Rule—the Mesa Landfill and surface impoundments M5, M7, 4B-1, 4B-2, 4B-3, and E-1. For the purposes of the CCR Rule, surface impoundments M5 and M7 and 4B-1, 4B-2, and 4B-3 are considered multi-units. The B multi-unit and E impoundment were closed by removal in 2019.

Groundwater at this site is known to be contaminated. Boron was reported in Annual Groundwater Monitoring Reports at levels up to 560 times USEPA's 10-day child health advisory, yet no units have entered Appendix IV monitoring and no corrective actions have been taken. Historic ash dumps have been identified as a main source of contamination and Nevada Department of Environmental Protection (NDEP) and NV Energy have entered a cleanup agreement to address this issue. Thus, assessment monitoring and corrective actions prescribed by the Rule have not been initiated at the B and E impoundments. Other units onsite (Mesa Landfill and M5/M7 impoundments) have identified elevated constituents during detection monitoring, but ASDs continue to identify sources other than these units, thus, they continue in detection monitoring.

The Mesa Landfill continued with detection monitoring throughout 2021. SSIs for fluoride, pH, and TDS were detected during both 2021 semi-annual monitoring events; however, ASDs attributed these results to natural variation.

The M5/M7 multi-unit also continued in detection monitoring throughout 2021. SSIs for fluoride were identified at one well during both semi-annual monitoring events. Again, an ASD identified natural variation in groundwater quality, and this multi-unit did not proceed to assessment monitoring or corrective measures.

The multi-unit containing surface impoundments 4B-1, 4B-2, and 4B-3 and surface impoundment E-1 were closed by removal in April 2019, and groundwater monitoring ceased following certification of the closure. However, closure certification documents describe groundwater contamination originating from historic ponds in the area where these ponds were constructed. The CCR Rule requires that groundwater must meet GWPSs for closure by removal to be considered complete. Because groundwater did not meet standards at the last monitoring event, this is a violation of the CCR Rule. If monitoring continued, but results were not posted, the company is still in violation of the CCR Rule.

No ACMs have been completed.

Violations of the CCR Rule at this site include:

- use of a contaminated background monitoring system and flawed ASDs and
- failure to continue monitoring after closure of a multi-impoundment unit.

16.1 Closure plans

The B impoundments are located in the Muddy River floodplain. As stated in the Groundwater Monitoring System Certification (2019): "The inactive CCR surface impoundments 4B-1, 4B-2, and 4B-3 in the Muddy River floodplain are located above this alluvial aquifer." (p. 3) Further, the 2019 Annual Groundwater Monitoring and Corrective Action Report states: "The areas outside of the pond berms can be inundated by streamflow from the Muddy River." (p. 8)

Impoundment E-1 is also in the Muddy River floodplain: "The inactive surface impoundment E-1 is on a floodplain area." (Groundwater Monitoring System Certification for E-1, 2019, p. 2)

The CCR Rule prohibits facilities in floodplains that result in washout of CCR, so as to pose a hazard to human life, wildlife, or land or water resources. If a washout were to occur, this unit would be in violation of the CCR Rule.

16.2 Groundwater monitoring

Several Issues were found with the monitoring well network. First, Well LMW-10—which is used as a background well for the Mesa Landfill and M5 and M7 impoundments shows signs of ash contamination, making this monitoring well ill-suited for evaluating whether elevated levels of pollutants are occurring above natural levels. Boron levels at this well are within a similar range as those detected at downgradient wells.

The Mesa Landfill utilizes two background wells in addition to LMW-10. The M5/M7 units are monitored by only one background well other than LMW-10.

The background monitoring networks utilized at the B and E impoundments are also contaminated with coal ash. For example, boron concentrations up to 1,680 mg/L (560 times USEPA's 10-day child health advisory) have been identified in one background well in the E-1 monitoring network, P-23SR. This well also contains arsenic at concentrations 250 times its MCL and lithium concentrations up to 1,200 times its default GWPS in the CCR Rule. The upgradient monitoring well MW-12SR contains boron up to 77 times USEPA's 10-day child health advisory and fluoride concentrations up to 4.5 times its MCL.

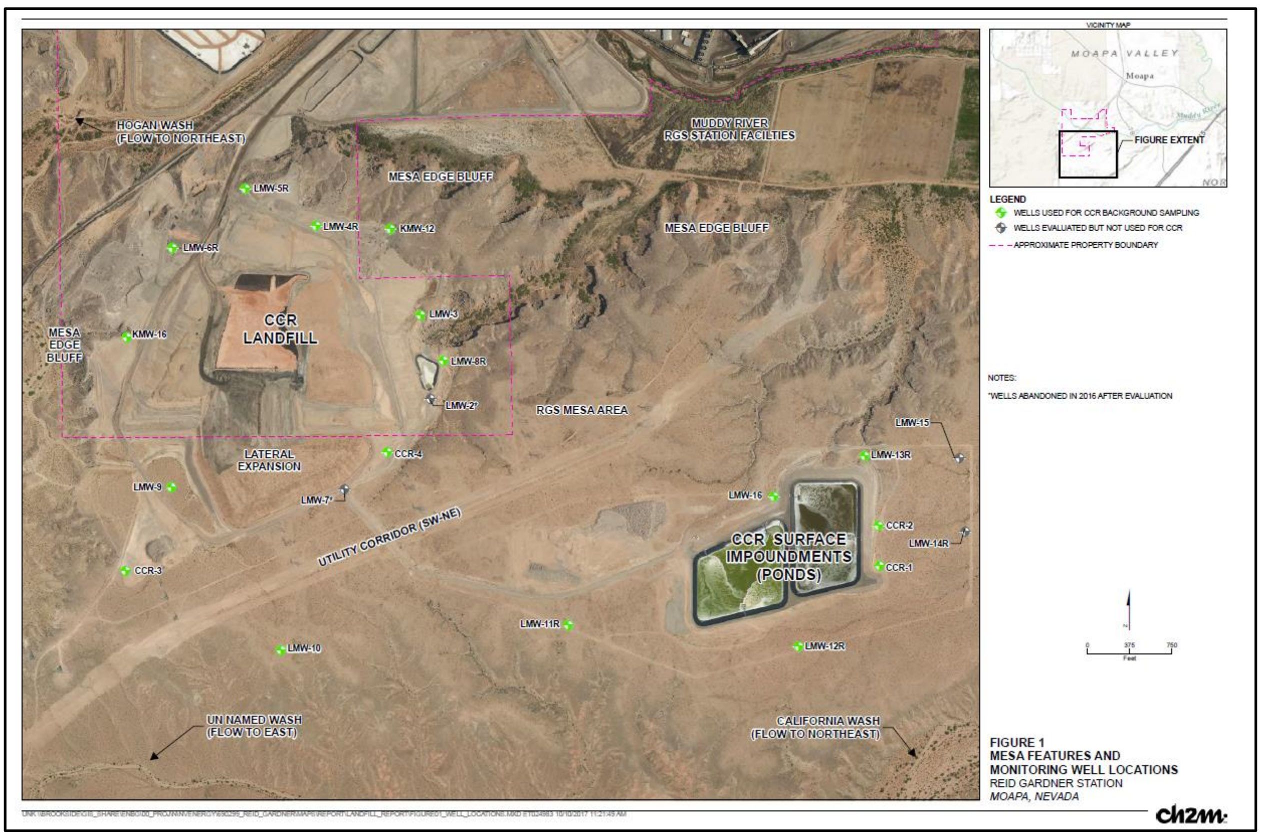
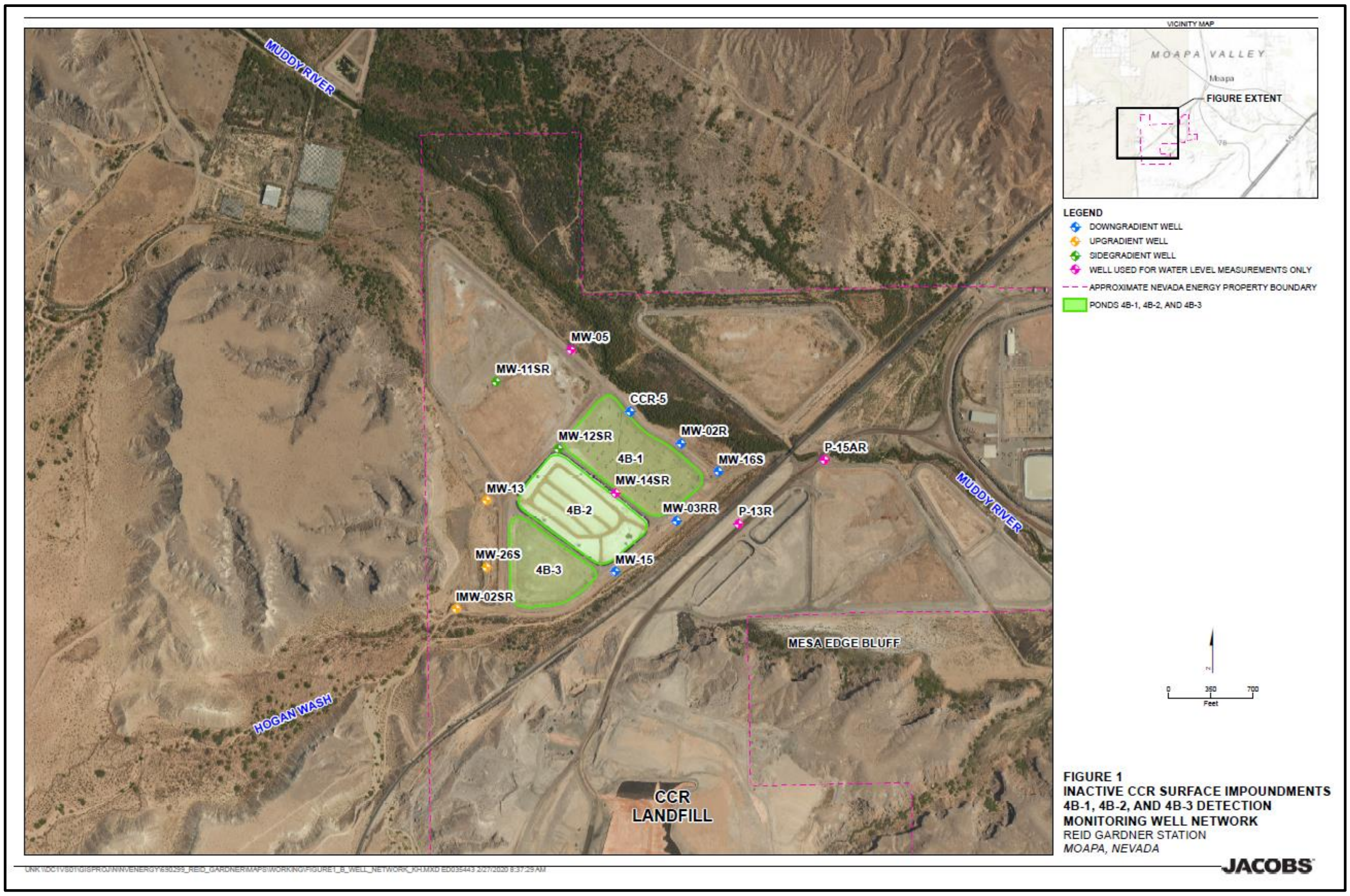


FIGURE 1
MESA FEATURES AND MONITORING WELL LOCATIONS
REID GARDNER STATION
MOAPA, NEVADA



The B and E ponds were constructed in an area that previously contained ash disposal ponds that were lined with either soil or clay and are therefore unlined by USEPA's definitions. These historic ash ponds contributed to groundwater contamination at the site, and NV Energy and NDEP entered an Administration Order on Consent (AOC) to address soil and groundwater impacts associated with past activities including the historic ponds. (Ponds 4B-1, 4B-2, 4B-3, and E-1 Closure Certification, 2019) Because the groundwater at the site was impacted by coal ash prior to construction of the B and E impoundments, the monitoring network is not capable of accurately assessing contributions to groundwater contamination of the B and E ponds. Therefore, these units are in violation of the CCR Rule.

Because of background well contamination, intrawell groundwater monitoring was used extensively at this site to identify SSIs at the Mesa Landfill, M5, M7, the B impoundments, and E-1. According to USEPA, intrawell comparisons are generally prohibited unless specific conditions are met, including that data must have been collected from the well when it was known to be uncontaminated by the CCR unit (Conditional Approval of an Alternative Closure Deadline for H.L. Spurlock Power Station, Maysville, Kentucky). Use of intrawell analyses is therefore a violation of the CCR Rule.

16.3 Flawed ASDs

For the Mesa Landfill, an ASD was completed following an SSI for TDS at one downgradient monitoring well, LMW-3, during the second half of 2021. A naturally occurring step-change in TDS at this site is identified as the cause of the increased levels of TDS at LMW-3.

For the M5 and M7 impoundments, fluoride SSIs were identified during the first and second halves of 2021 at CCR-1. The ASD cites natural contributions of fluoride to groundwater as its source in this monitoring well. The potential contributions from known historic ash dumps at this facility are not considered.

While these ASDs provide some analyses to support the conclusions that the SSIs are naturally occurring, these analyses are not convincing and do not adequately consider or analyze the possibility that the SSIs are linked to coal ash units at the site.

Because the ASDs do not contain sufficient factual or evidentiary basis to rule out the units as a source of groundwater contamination, they violate the CCR Rule.

16.4 Presence of unregulated ash disposal units

There is evidence of historic ash disposal ponds on the site, but specific units have not been identified. At the site of the B and E impoundments, groundwater contamination originating from historic ash disposal ponds was identified prior to the CCR Rule. NV Energy and NDEP entered into an AOC to address ongoing groundwater contamination at this location.

16.5 Conclusion

Groundwater at this facility is known to be contaminated, yet no remedial actions have been taken. The background monitoring networks utilized across this facility are contaminated with CCR waste and do not reflect true background levels, which means that they are not capable of revealing the true sources of groundwater contamination. Therefore, NV Energy has evaded responsibility for cleaning up the contamination. Reliance on inconclusive ASDs for contamination at two units allows NV Energy to avoid additional monitoring and remediation of existing groundwater contamination.

17. SAN MIGUEL

The San Miguel Electric Plant in Christine, Texas, is located south of San Antonio. Owned and operated by the San Miguel Electric Cooperative, the plant is home to three regulated CCR units. The first unit, the Ash Pile, is regulated as a landfill. The second unit, the Ash Pond, is actually two ponds separated by a dike. The third unit is the Equalization Pond. Both ponds immediately transitioned from detection to assessment monitoring in 2018. The Ash Pile remains in detection monitoring.

Numerous constituents were found in concentrations exceeding relevant thresholds from the outset of monitoring in 2018—in wells both up- and downgradient from CCR units. These constituents include arsenic (up to 7 times the MCL), beryllium (up to 112 times the MCL), boron (up to 28 times its 10-day child health advisory), cadmium (up to 83 times the MCL), cobalt (up to 360 times its default GWPS in the CCR Rule), lithium (up to 82 times its default GWPS), selenium (up to 16 times the MCL), and radium (up to 6 times the MCL).

Groundwater monitoring at this site has uncovered numerous SSIs in the concentration of several constituents. Both pond units are currently undergoing various activities as part of corrective action.

The site has numerous violations or potential violations of the CCR Rule, including:

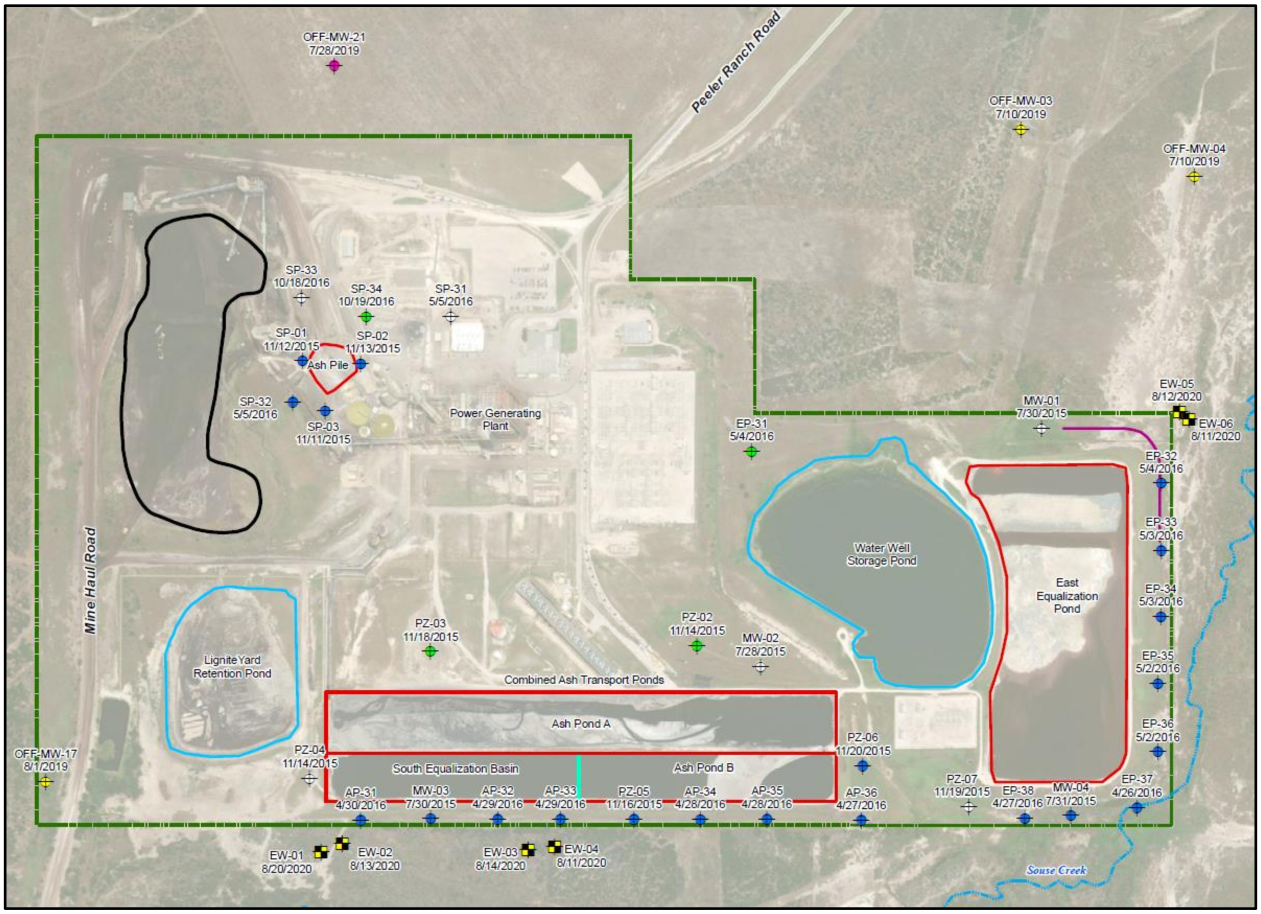
- The Equalization Pond is being closed in place in contact with groundwater, a violation of the CCR Rule.
- The groundwater monitoring network does not comply with the CCR Rule for numerous reasons detailed below.
- ASDs for the Ash Pile unit violate the CCR Rule for several reasons detailed below.
- ACMs violate the CCR Rule due to (1) failure to report the results of wells installed pursuant to the corrective action plan, and (2) failure to estimate the mass of pollutants released.
- Remedy selection also violates the CCR Rule because no precise estimate is given for the time until full protection is achieved, no detailed schedule of activities is provided, and portions of the remedies themselves violate guidance.

17.1 Closure plans

As described in the 2016 CCR Unit Closure and Post-Closure Plan, both ponds will be closed in place. For the Ash Pond, a geologic cross section shows that the potentiometric surface at Arias Well B-1, which is within the engineered barrier for the pond, is less than five feet from the top of the clay liner of the Ash Pond. Closing this pond in place in contact with groundwater would be a violation of the CCR Rule.

Cross sections also show possible contact between groundwater and the clay liner of the Equalization Pond. The eastern end of Cross Section C, which directly intersects the engineered fill around the Equalization Pond, shows the potentiometric surface at approximately 4–5 feet above the top of the pond's clay liner, placing coal ash below the level of groundwater. This pond is currently being closed in place in contact with groundwater, a violation of the CCR Rule.

Per FEMA's National Flood Hazard Layer viewer, both the Equalization Pond and the southernmost chamber of the Ash Pond intersect a Zone A floodplain, meaning there is a 1% annual chance of flooding each year. The CCR Rule prohibits facilities in floodplains that result in washout of CCR, so as to pose a hazard to human life, wildlife, or land or water resources. If a washout were to occur, these units would be in violation of the CCR Rule.



17.2 Groundwater monitoring

Based on groundwater monitoring results, the site's background wells for all CCR units appear to be heavily contaminated by coal ash. Numerous groundwater monitoring wells on the site—both upgradient and downgradient of their respective CCR units—have exhibited concentrations of various Appendix III and Appendix IV constituents above relevant thresholds since sampling began in 2018. Thus, the calculated site-specific background levels are likely much higher than the true background concentrations, and the utility is underestimating the amount of groundwater pollution generated by the coal ash units. Utilizing contaminated wells for establishing site-specific background values is a violation of the CCR Rule.

In the northeast corner of the Equalization Pond, groundwater sometimes appears to flow northeast, potentially missing the closest well to that area, EP-32.

The Ash Pile and Equalization Pond have only the minimum number of upgradient wells: one each. Per 40 C.F.R. § 257.91(f), factual justification must be provided when the minimum number of wells is used. These units are in violation of the CCR Rule because justification is not provided.

For the Ash Pile monitoring network, every well—both up and down-gradient—has regularly shown concentrations of Appendix III constituents over relevant thresholds, and the background monitoring of Appendix IV constituents conducted in 2018 showed elevated concentrations of several constituents, including arsenic, beryllium, cadmium, cobalt, lithium, radium, and selenium. The established background levels for this unit for boron and fluoride are both well in excess of relevant thresholds. The unit has experienced SSIs of Appendix III constituents, but thanks to ASDs (described below), the unit has evaded a transition to assessment monitoring—despite the fact that coal ash contamination appears to be substantial and endemic to the groundwater monitoring system.

17.3 Flawed ASDs

This site has a long history of statistically significant detections—including SSIs in Appendix III constituents and SSLs of Appendix IV constituents—and corresponding ASDs. Due to SSIs detected in 2018, the Ash Pond and the Equalization Pond were transitioned to assessment monitoring. Various SSIs have been detected since that time, and both units have moved through the entire process, including the implementation of a groundwater remedy. Numerous ASDs have been completed as the units moved through the process.

The 2018 Annual Groundwater Monitoring Report summarizes the ASDs completed for a number of SSIs for all three units. The ASDs for nearly every SSI were attributed to natural variation. These ASDs were based on monitoring data from offsite monitoring wells (the Unit 22 Wells at the nearby San Miguel Lignite Mine), rather than the background monitoring wells established at the site. Numerous SSIs were found to be "well below historical maximums" and, as such, were assigned an ASD of "natural variability."

Two other SSIs at the Ash Pile were attributed to the nearby lignite storage pile. As described in the previous section, the history of groundwater monitoring around the ash pile strongly suggests that:

- the upgradient background well (and the corresponding site-specific background values) are contaminated with coal ash, and
- numerous Appendix IV constituents are well above GWPSs.

Assigning blame for SSIs in Appendix III constituents to the lignite storage pile has allowed the operator to essentially ignore all future action for the Ash Pile unit. The Ash Pile's monitoring well network is, in fact, downgradient of both the Ash Pile CCR unit and lignite storage pile, but the ASD for these exceedances includes no additional investigations beyond two references to previous studies on groundwater and lignite storage piles. The company did not, for example, conduct any chemical analysis to distinguish between groundwater under the lignite pile and groundwater downgradient of the Ash Pile, nor did they collect any new data in support of their assertions.

Because the ASDs do not contain sufficient factual or evidentiary basis to demonstrate that the SSIs were the result of natural variation and the lignite storage pile, they violate the CCR Rule.

17.4 Flawed ACMs

Additional wells were constructed offsite in 2019 (Assessment of Corrective Measures Report, 2019) in order to determine the nature and extent of contamination from the Ash Pond CCR unit. A total of 21 wells were installed up-, down-, and cross-gradient from groundwater flow. Various reports indicate that sampling data from these wells are in the 2019 Annual Groundwater Monitoring Report, but this does not appear to be the case.

The ACM report concludes that "groundwater impacts from CCR units are likely generally localized to the vicinity of the plant." Sampling results from these additional wells were likewise not published in several other more recent reports. Without access to these results, it cannot be determined whether the nature and extent of contamination has been correctly characterized, in violation of the CCR Rule. Failure to report the results of wells installed pursuant to the corrective action plan is also a violation of the CCR Rule. Additionally, the plant operator does not estimate the mass of pollutants released, another violation of the CCR Rule.

17.5 Deficiencies in selected remedies

According to the Selection of Groundwater Remedy Report, the site will use "a combination of source control, hydraulic control (via groundwater extraction), MNA, and institutional controls." MNA is a component of a more robust remediation plan. Specifically, MNA via sorption-desorption, dilution-dispersion, and precipitation will be relied upon in areas where "metal concentrations are lower and are expected to decrease naturally once source control efforts are completed." MNA will also be utilized in higher concentration areas as a final step once groundwater extraction and source control have lowered concentrations "to such a degree that MNA can achieve GWPSs in a reasonable timeframe." No precise estimate is given beyond "a reasonable timeframe" for the time until full protection is achieved, in violation of the CCR Rule.

Remedies are currently being implemented on the site, but a detailed schedule of activities is not provided, in violation of the CCR Rule.

The remedy selection report, in describing the hydraulic control, contains several elements that are likely in violation of the CCR Rule. The rule states that, in addition to implementing the corrective remedy, the operator must "Take any interim measures necessary to reduce the contaminants leaching from the CCR unit, and/or potential exposures to human or ecological receptors." The hydraulic control plans that "Discharge lines will transport pumped groundwater directly from each well to the Ash Ponds and/or (until water discharges are terminated in late 2020) the Equalization Pond for storage." Given that this pond has already been established as contaminating local groundwater, pumping that contaminated groundwater into the pond is likely a violation of the CCR Rule. The description continues with an alternative, however: If the pond cannot receive water, "groundwater will be pumped to tanks or tank batteries for temporary storage...Water collected in these tanks will be collected by truck for reuse in dust suppression or other suitable on-site purpose." Again, given that the groundwater in question is contaminated, spreading it on the surface is likely a violation of the CCR Rule.

17.6 Presence of unregulated ash disposal units

The Emergency Ash Pit is a potentially unregulated unit.

17.7 Conclusion

Closing the Equalization Pond in place in contact with groundwater will allow CCR contaminants to impact the aquifer for generations. Background monitoring networks utilized at units across the facility are contaminated with CCR waste and do not reflect true background levels, and two units utilize only one upgradient well each. This means that each unit's background monitoring system is not capable of revealing the true source of groundwater contamination. Therefore, San Miguel Electric Cooperative has evaded responsibility for cleaning up the contamination. Reliance on inconclusive ASDs for contamination at the Ash Pile has allowed the operator to avoid additional monitoring and remediation of existing groundwater contamination at this unit. An ACM has been completed to address contamination at the Ash Pond; however, it is flawed. Results of sampling completed to address the nature and extent of contamination have not been reported, which does not allow for review of these data. Further, the ACM does not estimate the mass of pollutants released. While a remedy has been selected, it does not include a detailed timeline of remedial activities. Failure to create a detailed and effective plan for remediation allows CCR contamination to remain in the aquifer. The remedy selected will utilize the Ash Pond and/or Equalization Pond for storage of contaminated groundwater. These ponds are known to contribute to groundwater contamination; thus, pumping contaminated groundwater to these units will only exacerbate the problem and the aquifer will continue to be contaminated by CCR waste.

18. SIOUX

Ameren's Sioux Energy Center is located along the banks of the Mississippi River north of its confluence with the Missouri River in St. Charles County, Missouri. This facility uses two impoundments—Bottom Ash Basin (SCPA) and Fly Ash Basin (SCPB)—and two landfills—Gypsum Landfill (SCPC) and Utility Waste Landfill—to store CCR. This facility is uniquely situated between the Mississippi and Missouri Rivers. Due to its location, groundwater flow is influenced by both rivers.

The SCPA unit entered the assessment monitoring program in 2018 following SSIs for all Appendix III parameters at numerous wells (2018 and 2021 Annual Groundwater Monitoring and Corrective Action Reports). 2018 sampling events revealed SSLs for molybdenum at five wells. These same SSIs and SSLs have continued to be identified through 2021 sampling events. The ACM for this unit began in 2019, and a remedy was selected that year. The selected remedy includes installation of a low-permeability cover system to control the source, MNA, and "Supplemental Corrective Measures." Closure of this unit in place was initiated in 2021 and is expected to be completed in 2022. A groundwater treatment system is planned to be installed during 2022. Corrective action monitoring is ongoing. (2021 Annual Groundwater Monitoring and Corrective Action Report)

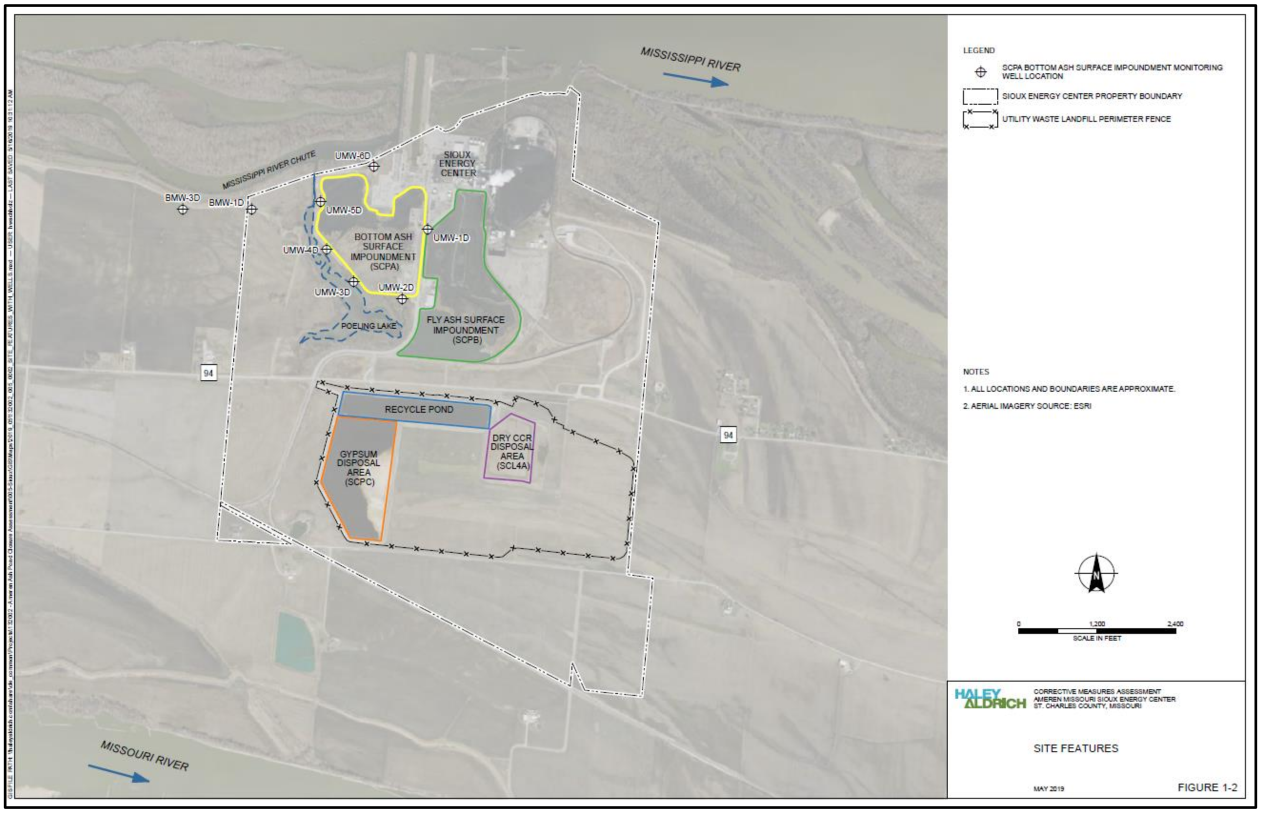
SSIs for all Appendix III parameters have been identified in numerous wells at the SCPB unit during semiannual monitoring events from 2017 through 2021. An ASD following the initial detection of SSIs was completed in 2018 and identified the SPCA as the source of contamination at SCPB wells. Updated ASDs have been completed after each sampling event. Each ASD makes the same conclusion. Therefore, the SCPB unit has remained in detection monitoring. Substantial progress towards closure was made in 2021; the geomembrane liner system was completed in December 2021.

At the SCPC, SSIs have been identified for fluoride at one well in November 2017, for calcium and chloride at one well and fluoride at another well in August 2019, for fluoride at one well in April 2020, for calcium and fluoride at one well each in November 2020, and for calcium and TDS at one well in April 2021. Statistical analysis of data collected in November 2021 is not yet available on Ameren's website. Following each SSI, an ASD has been completed and identified sources other than the SCPC unit; thus, the unit remains in detection monitoring. (2021 Annual Groundwater Monitoring and Corrective Action Report) Ameren submitted a "Request for Alternative Closure Requirement" to USEPA requesting approval for closure of this pond by October 15, 2023 rather than April 11, 2021. USEPA posted a proposed decision in response to this request in January 2022, which determined the demonstration is incomplete. (USEPA decision and 2021 Annual Groundwater Monitoring and Corrective Action Report)

Ameren documents plans to construct the Utility Waste Landfill in three phases. As of 2022 only one cell, the 14.5-acre Cell 4A (SCL4A), has been constructed. (SCL4A Closure/Post Closure Plans) This unit was constructed with a composite liner system consisting of two feet of compacted clay soil with a hydraulic conductivity of less than 1x10-7 centimeters per second overlain by a 60-mil HDPE geomembrane liner. (ASD in 2021 Annual Groundwater Monitoring and Corrective Action Report) The SCL4A unit has remained in detection monitoring since it began monitoring under this program in 2017. SSIs have been identified for chloride, sulfate, and TDS in May 2018; for boron, calcium, chloride, sulfate, and TDS in May 2019; for chloride, sulfate, and TDS in November 2019; for fluoride in April 2020; and for sulfate in April 2021. Each time SSIs were identified, an ASD was completed and identified an alternate source for the SSIs. (2018 and 2021 Annual Groundwater Monitoring and Corrective Action Reports) This unit will be closed in place. No closure date is set. (SCL4A Closure/Post Closure Plans)

Violations at this facility include:

- closing SCPA impoundment in place in contact with groundwater,
- using intrawell analyses for groundwater monitoring,
- using insufficient downgradient monitoring networks,
- utilizing flawed ASDs, and
- failure to quantify the mass and concentration of contaminants in groundwater.



18.1 Closure plans

The SCPA and SCPB impoundments are undergoing closure in place. The PE-certified location restrictions document states that both units are in violation of the CCR Rule's location standard because they are within five feet of the uppermost aquifer.

Figure 3 from the SCPA's Groundwater Monitoring Plan illustrates that the alluvial aquifer is in contact with the SCPA unit. The SCPA impoundment is closing in place in contact with groundwater, a violation of the CCR Rule.

It is not possible with the available information to make a definitive determination whether the SCPB impoundment is being closed in place in contact with groundwater. Closing this unit in place in contact with groundwater would be a violation of the CCR Rule.

The SCPC and SCL4A units are within the floodplain. FEMA floodplain data indicate that these units are located within Zone AE, indicating these areas have a 1% annual chance of being inundated. The CCR Rule prohibits facilities in floodplains that result in washout of CCR, so as to pose a hazard to human life, wildlife, or land or water resources. If a washout were to occur, these units would be in violation of the CCR Rule.

18.2 Groundwater monitoring

The CCR Rule Statistical Method Certification documents for the SCPC and SCL4A units describe the use of intrawell analysis for determination of UPLs (and LPLs for pH). The engineer-certified documents describe use of intrawell comparisons but do not provide a rationale for use of this method. The SCPC's 2021 Annual Groundwater Monitoring and Corrective Action report indicates that sampling results are added to the "background" calculation dataset once results for four to eight new samples are available. Table 3 shows that separate prediction limits were calculated for each well.

The SCPC's November 2020 ASD indicates intrawell calculations were used. The ASD indicates that data collected from monitoring wells at the SCPC prior to addition of waste demonstrated that the groundwater at the unit was impacted by CCR prior to operation of the unit, and thus, intrawell comparisons were used. The background wells identified in the monitoring network, which are located to the northwest of the unit, do not appear to be impacted based on water quality data. These wells are used without problem for interwell analyses at SCPA and SCPB.

Annual Groundwater Monitoring and Corrective Action Reports, including ASDs, for the SCL4A also show evidence of the implementation of intrawell monitoring at this unit.

According to USEPA, intrawell comparisons are generally prohibited unless specific conditions are met, including that data must have been collected from the well when it was known to be uncontaminated by the CCR unit (Conditional Approval of an Alternative Closure Deadline for H.L. Spurlock Power Station, Maysville, Kentucky). The use of intrawell analyses at this site is therefore a violation of the CCR Rule.

No wells have been installed along the eastern boundary of either the SCPC or the SCL4A. Groundwater flow at the facility fluctuates depending on water levels in the Mississippi River and Missouri River and can be towards the north, south, or east. Groundwater flow models indicate that flow is typically from north to south, and the overall net groundwater flow in the alluvial aquifer at the Sioux Energy Center was slightly to the east due to flow reversals resulting from fluctuations in river levels. (SCPC 2021 Annual Groundwater Monitoring and Corrective Action Report) These units are in violation of the CCR Rule because downgradient unit boundaries are left unmonitored.

18.3 Flawed ASDs

Historic groundwater contamination is present across this site and creates difficulty in pinpointing sources of current contamination. Because of the historic groundwater contamination and the use of intrawell comparisons, the ASDs do not contain sufficient factual or evidentiary basis to support its conclusions and violate the CCR Rule.

Four ASDs were reviewed in depth and found to present significant evidence of historic contamination, but do not prove conclusively that the units are not contributing to groundwater contamination. Investigations, including collection of additional samples, focused on determining the current sources of pollution are needed.

SCPB

An ASD for the SCPB was originally completed in 2018 following identification of SSIs for all Appendix III constituents at wells across the unit. Updated ASDs making the same conclusion are included in Annual Groundwater and Corrective Action Reports following each semi-annual monitoring event from 2018 through 2020. Reports describing 2021 data collection and ASDs are not yet available for review. All ASDs conclude that the SCPA is the source of contamination at SPCB wells. The ASD provides evidence to demonstrate that the SCPA is indeed contributing to contamination at the SCPB. However, the ASD does not completely rule out contributions from the SCPB. Because the unit has relied on an inconclusive ASD, it is in violation of the CCR Rule.

Pore water chemistry fingerprints were determined using Piper plots and FALCON analysis. Piper plots show ionic correlation with SCPA, but not conclusively. The FALCON analysis shows correlation of SCPB well samples with SCPA waste, but as stated in the ASD, some correlations with SCPB waste are not completely conclusive.

The analysis of groundwater flow presented indicates that it is likely that flow could travel from the SCPA to the SCPB.

The bottom elevation of the SCPA is deeper than the SCPB. Contamination is found in deep, intermediate, and shallow groundwater zones. If it originated from the SCPB it would likely be more concentrated in shallow zones. Thus, this demonstration supports contamination sources from the SCPA, but does not rule out contributions from the SCPB.

SCPC

At the SCPC unit, ASDs have been completed following SSIs identified in 2017, 2019, 2020, and the first monitoring event of 2021. All ASDs conclude that the SCPC is not the source of contamination and identify pre-existing contamination and natural variation as the source of SSIs. ASDs for the SSIs initially identified in November 2020 and April 2021 were reviewed in depth. Sufficient data is provided to support the conclusions of these PE-certified ASDs. However, due to the presence of background contamination and the fact that concentrations of these constituents do not show downward trends over time, it is not possible to completely rule out the fact that this unit is contributing to groundwater contamination. Thus, this ASD is inconclusive and in violation of the CCR Rule.

The November 2020 ASD addresses calcium at well DG-2 and fluoride at DG-4. The SSI concentrations were only slightly above UPLs. The ASD analyzed contaminant concentrations over time beginning with data collected at these wells in 2008 due to State of Missouri reporting requirements. The unit did not begin receiving waste until after 2010. While there is considerable variation in concentrations over time, the current contamination concentrations are not greater than levels prior to waste storage at the unit. However, concentrations have not diminished over time.

Intrawell analysis is used at this unit. Prediction limits were updated using data collected in recent years just prior to the November sampling events. If the previous prediction limits were used, SSIs would not have been detected. The ASD indicates that the calcium dataset cannot be normalized due to its small size. The intrawell prediction limits used in identification of the calcium and fluoride SSIs are similar to concentrations of these constituents in the background wells during the November 2020 sampling event. The use of intrawell analysis with updated datasets has made it difficult to accurately identify SSLs at this unit. The use of intrawell analysis obscures accurate detection of SSIs.

The SCPC receives FGD waste. Sulfate and boron are expected in FGD-derived groundwater contamination. Both sulfate and boron are currently present at concentrations lower than during the period prior to waste storage at the SCPC unit. Although concentrations have fluctuated, no upward trend in contaminant concentrations is present. Yet, these constituents are still present at elevated levels.

Geochemical modeling was used to compare major ion chemistry from recent and historical sampling events. Stiff and Piper diagrams indicate that groundwater chemistry at DG-4 and DG-2 in November 2020 was not significantly different from groundwater chemistry at these wells in June

2006 prior to construction of the SCPC unit. Small contaminant contributions from the unit may not be perceived due to the presence of background contamination.

The ASD completed for SSIs identified for calcium and TDS at SCPC in April 2021 again identified pre-existing contamination and natural variation as the source of SSIs. This ASD relies primarily on historical data trends. At well DG-4, calcium concentrations in years prior to construction are higher than current concentrations. A notable decrease in calcium is observed from approximately 2011 through 2016 following initiation of waste disposal at this unit in 2010. Following a recent set of decreased calcium concentrations, calcium concentrations appear to be trending up.

TDS concentrations at DG-4 are highly variable and appear to be currently trending up.

The same discussion as is included in the November 2020 ASD regarding the lack of increasing FGD-constituent concentrations is made in this ASD.

The intrawell prediction limits used in identification of the calcium SSI is similar to the calcium concentration in the background wells during the April 2021 sampling event. The prediction limit used at well DG-4 in April 2021 is higher than the TDS concentrations in background wells in April 2021.

Similar to the ASD completed in November 2020 for this unit, this ASD is inconclusive due to complications in separating background contamination from current unit contributions and intrawell monitoring.

SCL4A

At SCL4A, ASDs have been completed following identification of SSIs in May 2018, May and November 2019, November 2019, April 2020, and April 2021. The ASD completed for a sulfate SSI at one well, TMW-2, identified during May 2021 was reviewed. This ASD identifies pre-existing impacts from CCR as the source of sulfate at SCL4A. This ASD presents data to support pre-existing groundwater contamination but does not conclusively rule out contributions from SCL4A.

A time-series plot of sulfate concentration at TMW-2 and adjacent wells TMW-1 and TMW-3 from the initiation of CCR Rule sampling in 2016 indicates variability in sulfate concentrations across these wells. Sulfate at TMW-2 peaked in 2019 to 2020, then decreased, and increased again during April 2021.

Boron is a common indicator for fly ash and boiler slag/bottom ash impacts because it is highly mobile and non-reactive. Fly ash and boiler slag/bottom ash are disposed of at SCL4A. Thus, if this waste was contributing to groundwater contamination at the unit, boron levels would be expected to increase following initial waste disposal at the unit. Boron concentrations at SCL4A wells are highly variable, but do not show an increasing trend.

Box and whiskers plots compare the April 2021 sulfate SSI to nearby historic data ranges of sulfate. The April 2021 concentration is well below the UPL calculated using pre-CCR data. Historic sulfate concentration ranges for many of the wells included in the chart are below the SSI concentration. This analysis uses wells that are nearby, but not at the unit boundary.

18.4 Flawed ACMs

For the SCPA, Ameren completed an ACM in 2019 to address SSLs for molybdenum at five wells at the SCPA unit. Molybdenum concentrations reached 8,300 µg/L, 83 times its default GWPS in the CCR Rule. The ACM describes potential remediation strategies to address this molybdenum contamination at this unlined unit located in contact with groundwater. The nature and extent characterization included installation of 26 monitoring wells and collection of surface water samples in both the Mississippi and Missouri Rivers. This evaluation fails to quantify the mass and concentration of contaminants in groundwater and is thus in violation of the CCR Rule. (Corrective Measures Assessment, 2019)

Following completion of the ACM in May 2019, a remedy was selected in August 2019. The remedy selected for the SCPA includes “source control, stabilization, and containment of CCR by installation of a low-permeability geomembrane cap” followed by MNA of groundwater concentrations to address CCR impacts (Remedy Selection Report, 2019, p.1). Installation of the cap will control the source.

A detailed timeline for remediation activities is not provided; this is a violation of the CCR Rule.

18.5 Conclusion

At least one impoundment at this facility, the SCPA, will be closed in place in contact with groundwater. This will allow CCR contaminants to impact the aquifer for generations. Intrawell analyses are used at the SCPC and the SCL4 units. Use of intrawell analyses for groundwater monitoring when background data prior to waste disposal are unavailable allows contamination from the unit to go unnoticed, and Ameren may not be held responsible for removing this source. Large gaps exist in the downgradient monitoring systems at SCPC and SCL4; this means contaminants may cross the unit boundary unnoticed and Ameren may illegally evade responsibility for addressing the resulting impacts to groundwater. Reliance on inconclusive ASDs for contamination at three units allows Ameren to avoid additional monitoring and remediation of existing groundwater contamination at these units. The ACM for the SCPA does not calculate the extent of CCR contamination resulting from the unit. Without an accurate picture of the mass and extent of groundwater contamination, an effective remedy cannot be determined. The selected remedy does not include a detailed timeline with action items. Failure to create an effective plan for remediation allows CCR contamination to remain in the aquifer.

19. TRIMBLE

The Trimble County Generating Station is operated by Louisville Gas and Electric (LG&E) and located on the banks of the Ohio River, approximately 5.5 miles west of Bedford, Kentucky. CCR units at this plant include the Bottom Ash Pond (BAP), the Gypsum Storage Pond (GSP), and the Landfill. The GSP and BAP are included in one multi-unit for groundwater monitoring purposes. The GSP was equipped with a CCR Rule–compliant geosynthetic liner in 2010. The original clay liner is still in use at the BAP. (2021 Groundwater Monitoring and Corrective Action Report).

The BAP/GSP multi-unit entered the assessment monitoring program in 2018 due to SSIs for boron, calcium, chloride, fluoride, sulfate, and TDS in all 10 downgradient monitoring wells. Assessment monitoring has continued through 2020. An ACM was initiated in 2019 due to an SSL for arsenic, but an ASD was then completed and identified an alternative source for arsenic at the unit. The multi-unit returned to assessment monitoring, and the ACM was discontinued.

Closure by removal is planned for the GSP and was announced in 2020. The 2016 Closure Plan for the BAP indicates plans to close this unit in place. These units are in contact with groundwater, in violation of the CCR Rule, and ash must be removed to ensure no long-term contamination of groundwater occurs.

No groundwater monitoring, corrective action, or closure documents specific to the Landfill are available on the company's website, in violation of the CCR Rule. Therefore, it is not possible to review conditions at this unit. LG&E must make these data available to the public. If LG&E are not conducting the required groundwater monitoring, this would be a significant violation of the CCR Rule.

In 2020, Appendix III constituents boron (nine wells and up to 39 times USEPA's 10-day child health advisory), calcium (four wells), chloride (six wells), sulfate (six wells), and TDS (four wells) are present across the site at levels significantly greater than background concentrations. The two wells with the greatest concentrations of human health–related contaminants—lithium (60 times its default GWPS under the CCR Rule), molybdenum (25 times its default GWPS), and selenium (10 times its MCL)—were removed from the monitoring network. While these wells do not access the uppermost aquifer, groundwater monitored by these wells is contaminated. Still, the site continues in assessment monitoring with no plans for remediation of contaminated groundwater.

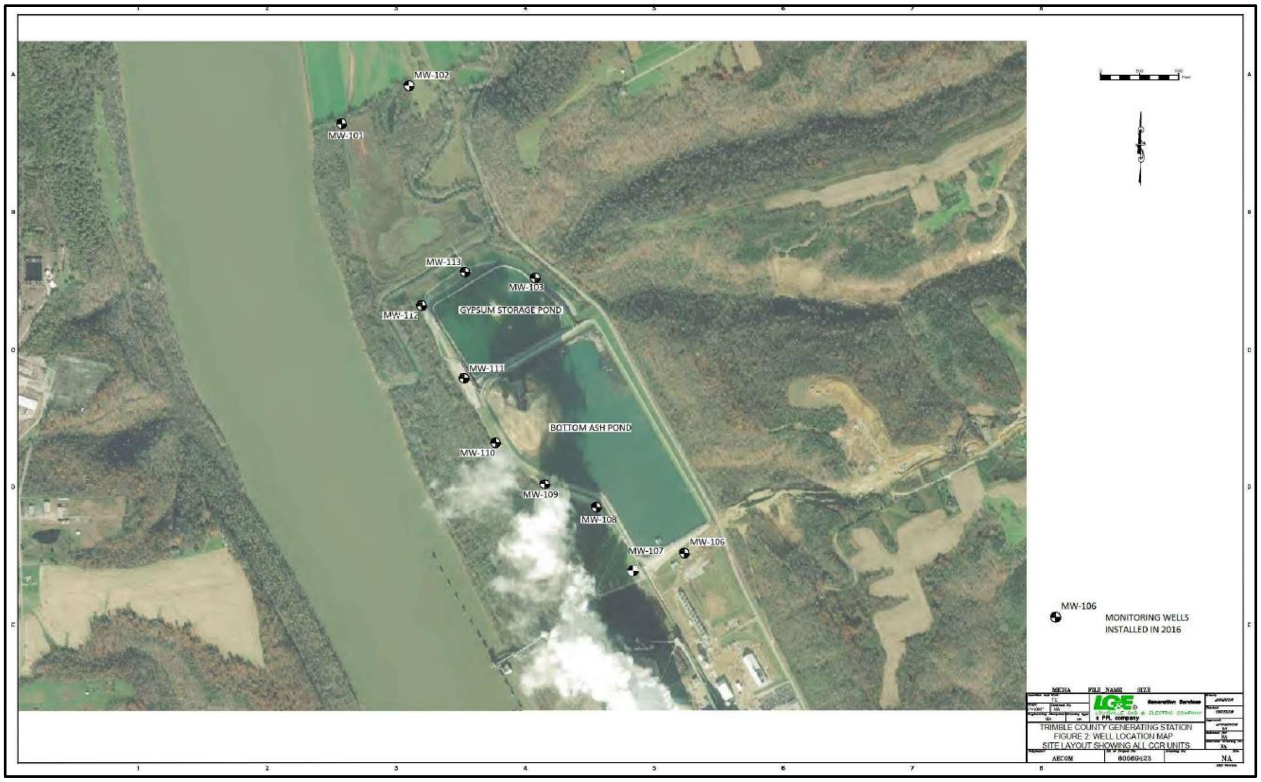
Violations of the CCR Rule at this facility include:

- closing the BAP in place in contact with groundwater,
- using an inconclusive ASD, and
- failure to post reports on the company's website.

19.1 Closure plans

Closure plans updated in 2020 for the GSP indicate ash will be removed from this unit.

The 2017 Location Restrictions Demonstration for Surface Impoundments documents for the BAP and GSP indicate that both units are located less than five feet from the uppermost aquifer. This is further illustrated by the cross-section diagram, which clearly shows that the BAP intersects the potentiometric surface and is thus in contact with groundwater (Modification Basis Report, Groundwater Monitoring System, CCR Assessment Monitoring BAP/GSP Multi-unit, MW-104 and MW-105). The BAP is closing in place in contact with groundwater, a violation of the CCR Rule.



19.2 Groundwater monitoring

The original groundwater monitoring system implemented in 2016 included two background wells and eleven waste boundary wells. Three waste boundary wells—MW-103, MW-104, and MW-105—were located along the upgradient boundary of the unit. Two of these wells have been removed from the monitoring system.

Monitoring wells MW-104 and MW-105 were removed from the downgradient monitoring system in 2019. These wells were removed from the monitoring system because it was determined that they were not accessing the uppermost aquifer (Modification Basis Report, Groundwater Monitoring System, CCR Assessment Monitoring BAP/GSP Multi-unit, MW-104 and MW-105). Instead, they were installed at elevations approximately 40 feet higher than the rest of the monitoring network in what LG&E maintains is a perched zone of saturation disconnected from the uppermost aquifer. MW-104 was determined to be constructed in ash materials used to construct the pond’s berm.

Appendix III constituents are present at higher concentrations in MW-104 and MW-105 than in the background wells utilized. The highest lithium concentrations (60 times its default GWPS under the CCR Rule) and molybdenum concentrations (26 times its default GWPS) were in well MW-104 prior to its removal from the network. Because this contamination has been determined to be in a perched aquifer rather than in the uppermost groundwater aquifer as defined by the CCR Rule, no plans for remediation have been considered.

Even though these wells have been removed from the monitoring system and the contamination is present in a perched aquifer, this contamination should still be addressed and remediated.

MW-103 remains in the monitoring network as a downgradient well, although its location is hydraulically upgradient from the multi-unit.

19.3 Flawed ASDs

An ASD was completed for an SSL for arsenic at one well at the multi-unit that was originally identified during 2018 assessment monitoring events:

> "The ASD determined that the source of impact was not the Multi-Unit. Instead, the chemistry of the groundwater indicated that buried organic materials present naturally within the unconsolidated alluvial sediments in and around the screen interval of MW-111 created oxygen reducing conditions that allowed dissolution of naturally-occurring arsenic in the sediments. The ASD determination confirmed Assessment Monitoring as the appropriate groundwater monitoring program for the Multi-Unit for the period." (2020 Groundwater Monitoring Report)

The ASD describes the creation of reducing conditions where underground organic material is decomposing. These reducing conditions caused arsenic to be released from alluvial sediments. Portions of the multi-unit were constructed over historic stream channels, as evidenced by 75 soil borings obtained during a geotechnical study of the site in 1976. Many of these borings describe organic matter including wood fragments, leaves, and other decayed organic material in boring logs. Figure 1 in the ASD depicts the historic stream channels, and MW-111 is within a stream channel. Figure 3 in the ASD includes geologic cross-section A-A'. This cross-section depicts significant pockets of organic material near MW-111's screened interval. Organic material is also present near MW-112, which is also located within a historic stream channel, but the organic material is much higher than the screened interval for this well. MW-112 is the only other well where arsenic has been detected from 2016 through 2021 other than well MW-104, which is now known to be constructed in ash. (2017-2020 Annual Groundwater Monitoring Reports) Oxidation-reduction potential values indicated reducing conditions at MW-111 and MW-112 but not at other wells.

Piper plots were used to compare the groundwater in well MW-111 to waste from the multi-unit. This evaluation concludes that groundwater at MW-111 is distinctly different from waste in the BAP/GSP multi-unit.

Appendix III constituents boron, calcium, sulfate, and TDS are consistently elevated at MW-111 in comparison to other downgradient monitoring wells. This is described as a characteristic of this well's chemical signature, but the source of these contaminants is not explained.

All Appendix III constituents continue to show SSIs in wells across the multi-unit, and attempts to address this contamination are lacking. The ASD only demonstrates that arsenic at one well is not derived from the multi-unit. The continued identification of Appendix III constituents provides evidence that the multi-unit is contributing to groundwater contamination and undermines the conclusions of the ASD. Because the ASD does not contain sufficient factual or evidentiary basis to demonstrate why constituents other than arsenic continue to show SSIs, it is inconclusive and violates the CCR Rule.

19.4 Conclusion

Closing the BAP/GSP multi-unit in place in contact with groundwater will allow CCR contaminants to impact the aquifer for generations. Rather than thoroughly investigating all evidence that the multi-unit is contributing to groundwater contamination, only the source of arsenic was examined in the ASD for the multi-unit. Therefore, this unit continues to leach CCR waste to the aquifer without further investigation into the source of contamination, and LG&E may be relieved of its responsibility to remediate groundwater contamination at this unit. LG&E has failed to make CCR Rule–required reports for the Landfill publicly available. Failure to post these reports makes it impossible for citizens to determine whether groundwater in their communities is safe.

20. WELSH

The 1,056-MW J. Robert Welsh Power plant is located near Pittsburg, Texas on the banks of the Welsh Reservoir. It has been open since 1977. The plant is operated by Southwestern Electric Power Company, a subsidiary of AEP.

Regulated units on this site include the Bottom Ash Storage Pond (BASP), Primary Bottom Ash Pond (PBAP), and a landfill. The BASP receives discharges from the PBAP. Two of the three units are polluting groundwater.

The BASP unit remains in detection monitoring, even though SSIs for many different pollutants have been reported over several years. An SSI for pH was reported in the 2019 Groundwater Monitoring Report, and an alternate source (natural variation) was identified in the same year. SSIs for chloride and sulfate were reported in the 2020 report, with alternative sources (natural variation) identified the same year. In the 2021 report, SSIs were reported for sulfate and TDS, and again, alternative sources (natural variation) were identified the same year. Finally, in the most recent report from 2022, sulfate, TDS, and calcium exceeded background values, and again, alternative sources (natural variation) were identified the same year. Based on the plethora of apparent natural variation at this site, background data were "reestablished" on December 8, 2021.

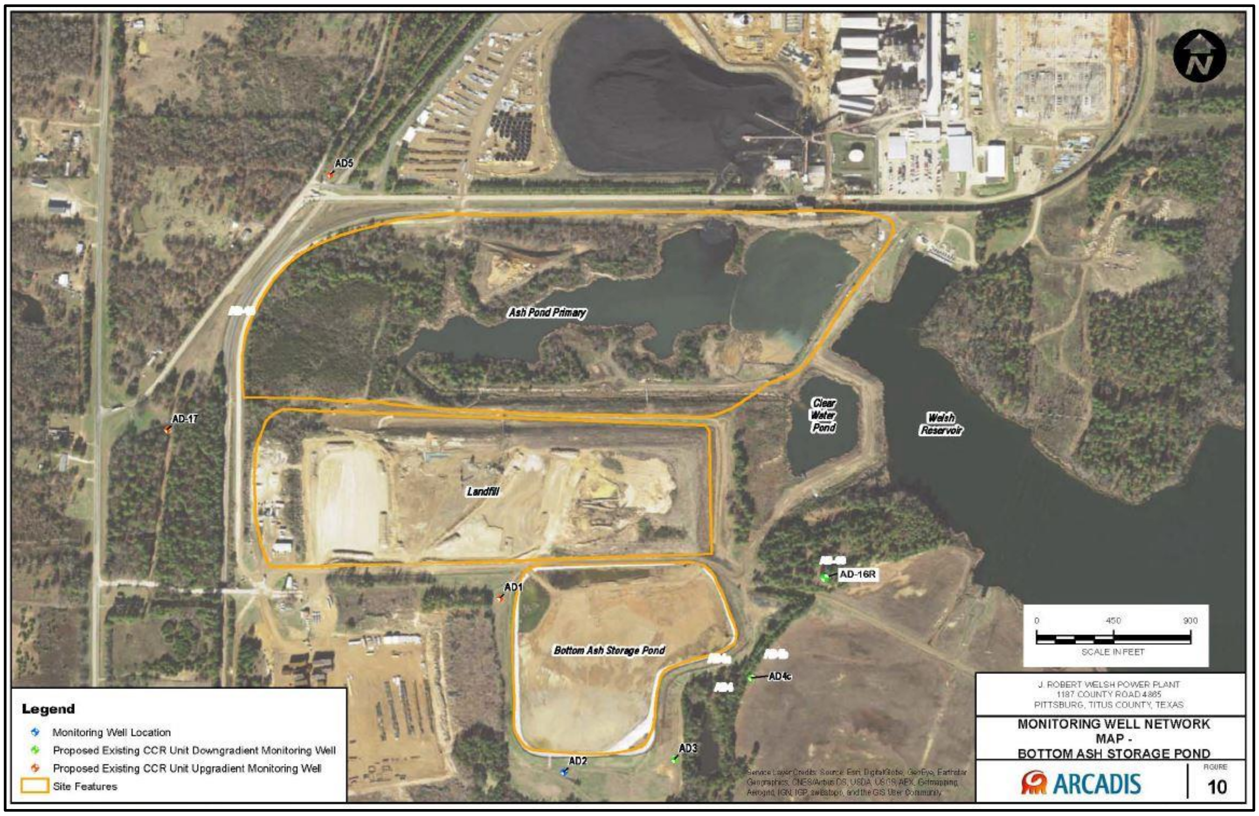
The landfill unit is in assessment monitoring. SSIs for boron, sulfate, and TDS occurred in 2017 and 2018, and an ASD failed to identify a source other than the landfill. This prompted the landfill to move from detection monitoring to assessment monitoring. SSIs for boron and calcium were detected in 2020 samples, as reported in the 2021 Groundwater Monitoring report. The ASD failed to find an alternate source for these SSIs. Subsequent sampling events identified SSIs for boron, fluoride, and pH (2020 samples, 2022 report) as well as boron and calcium (2021 samples, 2022 report). The site continues to be in assessment monitoring, but no SSLs have been detected.

The PBAP unit is also in assessment monitoring. An SSI for boron was observed in this unit in 2018. The ASD was not successful, and the unit entered assessment monitoring in April 2018. SSLs for lithium have been repeatedly detected (second monitoring event of 2018 and both monitoring events of 2019, as reported in 2020 Groundwater Monitoring report). Alternative sources were identified for all lithium SSLs, as reported in the 2020 and 2021 Groundwater Monitoring reports. And SSI for boron and an SSL for lithium were reported in the 2021 Groundwater Monitoring report. In the 2022 report, several more SSIs and SSLs were reported, including SSIs for boron, fluoride, and pH, and an SSL for lithium. The unit remains in assessment monitoring, and no Corrective Actions have been initiated.

Violations of the CCR Rule on this site include:

- The PBAP is being closed in place in contact with groundwater.
- Intrawell statistical methods are used in all units for all wells.
- Six of the site's wells have nearly always exhibited concentrations of cobalt in excess of its default GWPS in the CCR Rule since the inception of the monitoring program, with some wells also exhibiting frequent or semi-frequent concentrations of lithium and/or arsenic in excess of relevant thresholds. Due to use of intrawell statistical techniques, in which these elevated levels were used to calculate site-specific background values, this contamination has gone unaddressed.
- All three units have only three downgradient monitoring wells (the rule's minimum), but, per the rule's requirements, the utility does not provide information to rebut the presumption that three downgradient wells are insufficient; this is a violation of the CCR Rule.

- The downgradient groundwater monitoring networks utilized at the Landfill and BASP are not capable of accurately detecting contamination leaving the units due to unmonitored portions of the unit boundaries and placement of wells far from the unit boundaries.



20.1 Closure plans

The last published closure plan for the PBAP, from 2016, stated that the pond would be closed in place. According to data presented in the 2020 Groundwater Monitoring and Corrective Action Report for the PBAP unit, it is in contact with groundwater. Closing a pond in place in contact with groundwater is a violation of the CCR Rule.

20.2 Groundwater monitoring

For all three units—the BASP, the PBAP, and the Landfill—intrawell methods are used for Appendix III constituents for all years of groundwater monitoring. According to USEPA, intrawell comparisons are generally prohibited unless specific conditions are met, including that data must have been collected from the well when it was known to be uncontaminated by the CCR unit (Conditional Approval of an Alternative Closure Deadline for H.L. Spurlock Power Station, Maysville, Kentucky). The use of intrawell analyses is therefore a violation of the CCR Rule.

Initial descriptions of the monitoring well system report that there are four background monitoring wells on the site, shared between each CCR unit. One of them, AD-18, does not appear in more recent groundwater monitoring reports. The BASP and the PBAP utilize the three remaining background wells: AD-1, AD-5, and AD-17. The landfill initially used two (AD-1 and AD-5) but has since added AD-17.

AD-5 has exhibited levels of cobalt exceeding its default GWPS in the CCR Rule since sampling began, suggesting pre-existing contamination. The reported values are roughly double, on average, the default GWPS. Cobalt concentrations in AD-17 have also exceeded the default GWPS since sampling began, but by a much larger margin, averaging approximately 10 times the default GWPS.

The most recent company-provided map of the groundwater monitoring system, which includes groundwater elevation contours, suggests that AD-5 and AD-17 may be downgradient of CCR units. It is unclear whether it has been sufficiently demonstrated that this is not the case, especially given the elevated cobalt levels of both wells.

Several deficiencies are apparent in the downgradient groundwater monitoring system for all three units.

The BASP is in detection monitoring, despite numerous SSIs since monitoring started. The detection monitoring well network includes three wells, the minimum number: AD-3, AD-4C, and AD-16R. This does not comply with the CCR Rule, because the utility does not provide information to rebut the presumption that three downgradient wells are insufficient. The distance between AD-4C and AD-16R is approximately 750 feet, and AD-16R is approximately 500 feet from the BASP. Also, AD-16R is likely downgradient of the landfill, which would make it difficult to discern whether pollution at this well is generated by the BASP or the landfill. The CCR Rule requires that the downgradient monitoring system be installed at the unit boundary. Because none of the three wells in the downgradient monitoring system are within 100 feet of the unit boundary, this unit is in violation of the CCR Rule.

The Landfill unit has been in assessment monitoring since 2018. The detection monitoring network included the minimum number of three downgradient wells, all oriented around the eastern boundary of the unit: AD-11, AD-13, and AD-14. Again, this does not comply with the CCR Rule, because the utility does not provide information to rebut the presumption that three downgradient wells are insufficient. Of the three wells, only AD-13 is at the unit boundary. AD-11 is furthest from the boundary: approximately 350 feet. Because the downgradient monitoring system is not completely installed at the unit boundary and capable of monitoring all potential contaminant pathways, it is in violation of the CCR Rule. When the Landfill moved to assessment monitoring, no additional wells were installed. The three downgradient wells will only monitor groundwater flowing from west to east from the Landfill. However, according to the groundwater elevation maps provided by the company, groundwater may also flow in a northeast and southeast direction. Approximately 1,000 feet of the unit's northern and southern boundaries is not appropriately covered by the three downgradient wells. The Landfill's southern boundary is close to the BASP, possibly making well installation difficult. While the northern boundary is close to the PBAP, much of the unmonitored area appears accessible. Cobalt concentrations in one of the Landfill's downgradient wells, AD-11, have exceeded its default GWPS since the inception of the monitoring program. Concentrations during the background monitoring phase were, on average, four times greater than the default GWPS; cobalt levels have remained elevated since, exceeding the default GWPS for every sample. This suggests that groundwater at AD-11 was contaminated prior to the initiation of this monitoring program.

Assessment monitoring for the PBAP was initiated in 2018 due to an SSI for boron in well AD-8. No alternative source was identified. The downgradient monitoring network included three wells—AD-9, AD-15, and AD-8—which are all oriented around the eastern edge of the unit. As for the other two units, this does not comply with the CCR Rule, because the utility does not provide information to rebut the presumption that three downgradient wells are insufficient. When the PBAP moved to assessment monitoring, no additional wells were installed. This three-well network is inadequate for intercepting groundwater flowing from this pond because groundwater flows not just to the east, but also to the north. It is also notable that AD-9 is likely downgradient of the Landfill as well as PBAP.

This well, AD-9, has a history of elevated levels of lithium and cobalt. The default GWPS in the CCR Rule for lithium is 0.04 mg/L, and measured concentrations at this well have never fallen below that level, instead averaging 0.838 mg/L through June 2021. This value is more than 20 times the default GWPS. The concentration never dipped below 0.634 mg/L during the background monitoring phase, far above the standard. Similarly, cobalt levels in this well are extremely high. The default GWPS for cobalt is 6 µg/L. Concentrations in this well have never dipped below 11.1 µg/L and have averaged 20.4 µg/L, more than three times the standard. This suggests that groundwater at AD-9 was contaminated prior to the initiation of this monitoring program.

Due to use of intrawell statistical techniques, in which these elevated levels were used to calculate site-specific background values, the monitoring network is not capable of accurately determining whether the unit has caused groundwater pollution, in violation of the CCR Rule.

20.3 Flawed ASDs

ASDs have been completed for multiple units at this site.

Five ASDs have been completed for PBAP. The first was completed for an exceedance for lithium in well AD-9 (a downgradient well for PBAP) in response to an SSL for both 2018 observations and the first observation of 2019. As discussed above, however, this well shows extremely high levels of lithium throughout the history of reported results, including during the background assessment period. The initial ASD for lithium in this well makes the case that the elevated levels of lithium are due to naturally occurring soils on the site. The ASD is flawed because it does not also consider the potential release of lithium from the PBAP. The four subsequent ASDs is for lithium in well AD-9 suffer from the same flaw. Because these ASDs do not contain sufficient factual or evidentiary basis to demonstrate that the PBAP is not contributing to the SSLs, they violate the CCR Rule.

Four ASDs covering many SSIs have been completed for BASP. Each of these ASDs arrived at the conclusion that natural variation was to blame for the SSI in question. Over the course of these SSIs and ASDs, the utility has concluded that natural variation is responsible for SSIs of pH, sulfate (three SSIs), TDS (two SSIs), calcium and chloride – five of the seven Appendix III constituents. Many of these SSIs have been observed in a single well (AD-4C, which has SSIs documented in the 2019, 2020, 2021, and 2022 Groundwater Monitoring Reports).

Because these ASDs do not contain sufficient factual or evidentiary basis to demonstrate that the SSIs were the result of natural variation, and because of the use of intrawell statistical techniques, they violate the CCR Rule.

20.4 Conclusion

Closing the PBAP in place in contact with groundwater will allow CCR contaminants to impact the aquifer for generations. Intrawell statistical analyses are applied at all three units. Use of intrawell analyses for groundwater monitoring when background data prior to waste disposal are unavailable allows contamination from the unit to go unnoticed and continue to impact groundwater resources. Monitoring networks applied across this site are contaminated with CCR waste and do not reflect true background levels. In addition, portions of downgradient boundaries are unmonitored. Because of these flaws, these monitoring systems are not capable of accurately revealing sources of groundwater contamination. Therefore, AEP has evaded responsibility for cleaning up the contamination.

Appendix C: Analysis of Four Corners Power Plant by Geo-Hydro, Inc.

Four Corners Power Plant Compliance with the 2015 Coal Combustion Residuals Regulations

This document summarizes publicly available information about compliance with the requirements of the United States Environmental Protection Agency (USEPA) Coal Combustion Residual (CCR) regulations[1] at the Four Corners Power Plant (FCPP). Much of the information summarized in this document is detailed in an Expert Report on FCPP compliance prepared by Dr. Steven Campbell[2] (Campbell Report) and augmented with documents from the APS CCR Compliance website, including 2021 Annual Groundwater Monitoring and Corrective Action Report.[3]

Summary of Observations and Findings

Review of documentation pertaining to CCR storage, disposal, and site characterization practices utilized by APS at the FCPP leads to the following significant observations and findings:

- The total quantity of CCR produced at FCPP is not reported; it has been estimated[4] that 89 million tons of CCR generated at FCPP is disposed either on-site or in the adjacent Navajo Mine.
- The FCPP has generated CCR since 1963, and most of the waste disposed on-site at the FCPP prior to 2006 was placed in six unlined wet impoundments that have been abandoned in place, apparently with minimal engineering controls installed to limit groundwater contaminant generation and escape from those "closed" ponds. See discussion and Figure 2, below.
- Since 2006, APS has disposed of CCR in units that they consistently characterize as "lined." However, APS admits that those liners do <u>not</u> meet the minimum standards of USEPA's 2015 CCR Rule and thus are considered "unlined" for regulatory purposes.

[1] United States Environmental Protection Agency (USEPA), 2015, Hazardous and Solid Waste Management System, Disposal of Coal Combustion Residuals from Electric Utilities, Final Rule, 40 C.F.R. Parts 257 and 261, (aka, the CCR Rule)

[2] Campbell, S.K., 2021, Expert Report Assessing Compliance with 2015 Coal Combustion Residual (CCR) Regulations for Characterization of Groundwater Contamination, Assessment of Corrective Measures, and Corrective Actions at Four Corners Power Plant, New Mexico, Navajo Nation, August 6, 2021

[3] Wood Environment & Infrastructure Solutions, Inc. (Wood), 2022, Annual Groundwater Monitoring and Corrective Action Report for 2021, dated January 31, 2022

[4] Campbell (2021), p. 17

- APS has consistently worked to minimize the need for groundwater cleanup by claiming progressively higher concentrations of "background" concentrations of CCR constituents that supposedly represent ambient conditions at the site.
- There are numerous problems with the CCR Rule compliance and supplemental monitoring wells, including flawed construction, inadequate spatial distribution, selective inclusion of available monitoring wells into the compliance monitoring system, poor selection or justification for employing several "background" monitoring wells (including reliance on a well penetrating 43.5 feet of historically-disposed CCR), and failure to assess large areas lacking water-level or analytical data due to perennially "dry" wells and/or improper well placement.
- APS has generally ignored other areas of known or likely on-site CCR disposal (e.g., the "gridded disposal area" and the area at the shore of Morgan Lake near the CWTP), thus rendering their most important claims or assumptions concerning ambient "background" contaminant concentrations dubious.
- The areas contaminated by contaminant plumes are likely much larger than APS claims, in part because there are huge areas near the regulated CCR units with insufficient monitoring wells to define the full extent of the plumes.
- Investigations conducted in 2005 and 2007 indicated that substantial pollution by heavy metals originating from coal ash has degraded water quality in the Chaco River at and downstream of the FCPP. There is no indication that APS is monitoring water quality in the river.
- The Assessment of Corrective Measures (ACM) for the URS indicates that APS intends to rely on a combination of monitored natural attenuation (MNA) and low volume groundwater extraction to clean up that fluoride contamination. The viability of MNA has <u>not</u> been assessed for any portion of the FCPP.
- The ACM for Multiunit 1 proposes to rely on MNA to clean up groundwater contaminated by cobalt and molybdenum. Viability of MNA has <u>not</u> been assessed for any portion of the FCPP.
- The ACM for Multiunit 1 discusses removal of the contaminant mass from the aquifer, but provides no estimation of the mass of contaminants that have been released. It is unclear how the time required to complete remediation was evaluated without an estimate of the mass contaminant involved.
- Between 2011 and 2013, APS installed a deeply-buried 1.4-mile-long (7,600 foot) groundwater infiltration trench system (ITS) between the disposed CCRs and the Chaco River to attempt to capture contaminated groundwater migrating from the disposed CCRs toward the river. The reported trench construction and water-level data for the vicinity of the trench demonstrates that the ITS probably captures only a limited portion of migrating

groundwater contamination, and it does not stop pollution from migrating to the Chaco River. Groundwater monitoring data demonstrate that contaminated groundwater bypasses the ITS, and large gaps in the monitoring-well network probably mask how pervasive the contamination is west of the ITS.

- Although the infiltration trench system is integral to APS' remediation plans, they do not report on the progress of that remediation. Because some groundwater extraction wells are active, and APS appears poised to expand and upgrade operation of those pumping well clusters, the remediation system performance must also be addressed fully under the CCR Rule. A full description of the design, operation and performance of the infiltration trench and extraction well systems must be included in the ACM.
- APS has to date failed to select the remedy for groundwater contamination by CCR constituents even though the ACM was completed in 2019. The 2015 CCR rule requires that the owner or operator must select a remedy based on the ACM "as soon as feasible". There is no indication that APS is making progress in better characterizing the nature and extent of contamination, or that there are technical issues that are being addressed. There is no justification for a three-year delay in remedy selection when contamination of groundwater and surface water resources has been a known and ongoing problem at the site for decades.

Background and History

The FCPP is located on land leased from the Navajo Nation, and it is operated by the majority owner, Arizona Public Service (APS). The plant is located approximately midway between the towns of Farmington and Shiprock in northwestern New Mexico (Figure 1). The FCPP originally consisted of five power-generating units that came online between 1963 and 1970. APS was the owner and operator of Units 1 through 3, and they currently generate power solely from Units 4 and 5 (~1,540 megawatts) as the plant operator and majority owner in a consortium with four other entities.

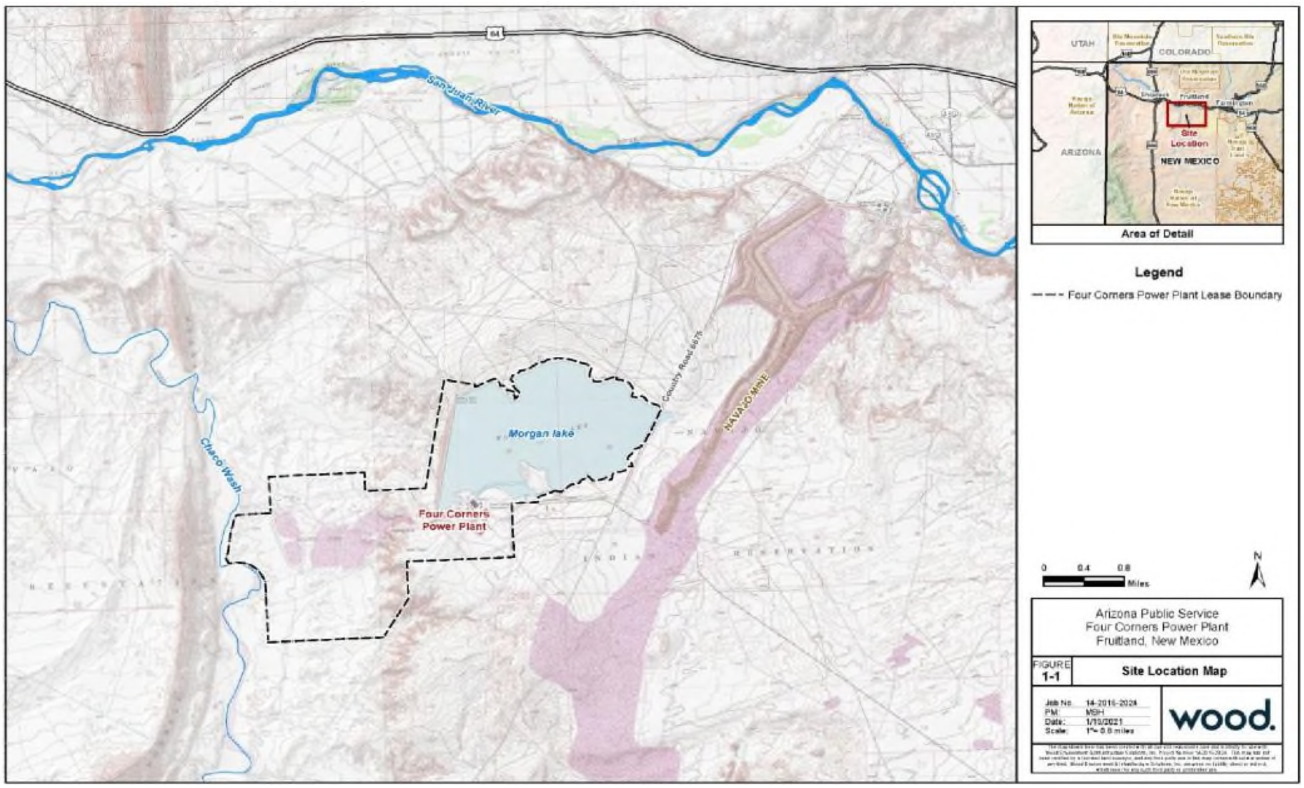
The portion of New Mexico where FCPP is located is semi-arid and receives approximately 8.35 inches of total precipitation annually[5]. The plant extracts 14.3 million gallons per day (~52.2 billion gallons/year) of makeup water from the west-flowing San Juan River, which is located approximately three miles north of the FCPP.[6] The power plant is located on the southwestern shore of an approximately 1,300-acre cooling pond called Morgan Lake (Figure 1). Morgan Lake

[5] https://www.usclimatedata.com/climate/fruitland/new-mexico/united-states/usnm0119

[6] https://www.epa.gov/sites/production/files/2019-10/documents/nn0000019-aps_four_corners_power_plant-fact_sheet_2019-09-30.pdf

was constructed by damming No Name Wash, a west-flowing tributary to the Chaco River, and has been shown to be contaminated with potentially harmful levels of selenium,[7] a common CCR-related contaminant. The Chaco River is a flowing stream at the FCPP, and it is a tributary to the San Juan River approximately 10 miles from the FCPP and upstream of the town of Shiprock. APS discharges an average daily volume of 4.2 million gallons (~1.53 billion gallons/year) of water to No Name Wash.[8] Contaminated water from the FCPP that enters either No Name Wash or the Chaco River will eventually discharge to the San Juan River.

Figure 1: Location of FCPP, APS' property lease boundary, Navajo Mine, surface water bodies, and other features of interest near the facility[9]



Although the total volume of CCR production at FCPP is not reported, it has been estimated[10] that 89 million tons of CCR has been generated at FCPP and disposed either on-site or in the adjacent

[7] https://www.researchgate.net/publication/306393525_Methylmercury_and_Other_Environmental_Contaminants_in_Water_and_Fish_Collected_from_Four_Recreational_Fishing_Lakes_on_the_Navajo_Nation_2004

[8] United States Environmental Protection Agency (USEPA), 2019, National Pollution Discharge Elimination System Permit Fact Sheet, Four Corner Power Plant, NPDES Permit No. NN0000019, p. 3.

[9] Wood, 2021a, Annual Groundwater Monitoring and Corrective Action Report for 2020, Coal Combustion Residuals Rule Groundwater Monitoring System Compliance, Four Corners Power Plant, Fruitland, New Mexico, (dated 1/31/2021), 19 pages plus attachments

[10] Campbell (2021), p. 17

Navajo Mine. Inadequate handling, storage and disposal of this immense volume of waste has resulted in contamination of New Mexico's water resources.

The FCPP has a long history of coal ash-related environmental contamination. The State of New Mexico initiated discussions with APS in 1971 about water contaminated by disposed CCRs impacting the Chaco River. In the early 1990s, APS began pumping groundwater at two areas located between disposed CCRs and the Chaco River, and some of those wells appear to have been pumping as recently as 2019. APS did not disclose the presence of those pumping wells prior to early 2021 in their CCR Rule reports. Further, the effectiveness of the extraction wells is not disclosed in any CCR compliance documents reviewed to date. Investigations conducted in 2005[11] and 2007 [12] indicated that substantial pollution by toxic heavy metals originating from the CCR disposal practices at FCPP and the Navajo Mine has degraded water quality in the Chaco River at and downstream of the FCPP, but there is no evidence that APS has fully assessed, or is monitoring, water quality in the Chaco River.

Between 2011 and 2013, APS installed a deeply-buried 1.4-mile-long (7,600 foot) infiltration trench system (ITS) between the disposed CCRs and the Chaco River to attempt to capture groundwater contamination migrating toward the Chaco River from the unlined coal ash impoundments and the active CCR units. The presence and effectiveness of the ITS at capturing CCR-related groundwater contamination has not been incorporated in CCR Rule reporting.

CCR Units and Related Infrastructure

Described below are the five active CCR disposal components, plus a groundwater remediation system that APS first disclosed in January 2021.

MultiUnit 1

The Lined Decant Water Pond (LDWP) and Lined Ash Impoundment (LAI) are collectively referred to as Multiunit 1. The locations of these units are indicated with purple shading on Figure 2. Multiunit 1 is a known source of groundwater contamination.[13] Although APS describes Multiunit 1 as "lined," they occasionally admit that the LAI and LDWP "do not meet

[11]Zimmerman, D.A., 2005. A Preliminary Evaluation of the Potential for Surface Water Quality Impacts From Fly Ash Disposal at the Navajo Mine, New Mexico, 2005

[12] Ross, L., 2007, Effects of Four Corners Power Plant Coal Combustion Waste Disposal on Surface and Groundwater Quality, 18 pages

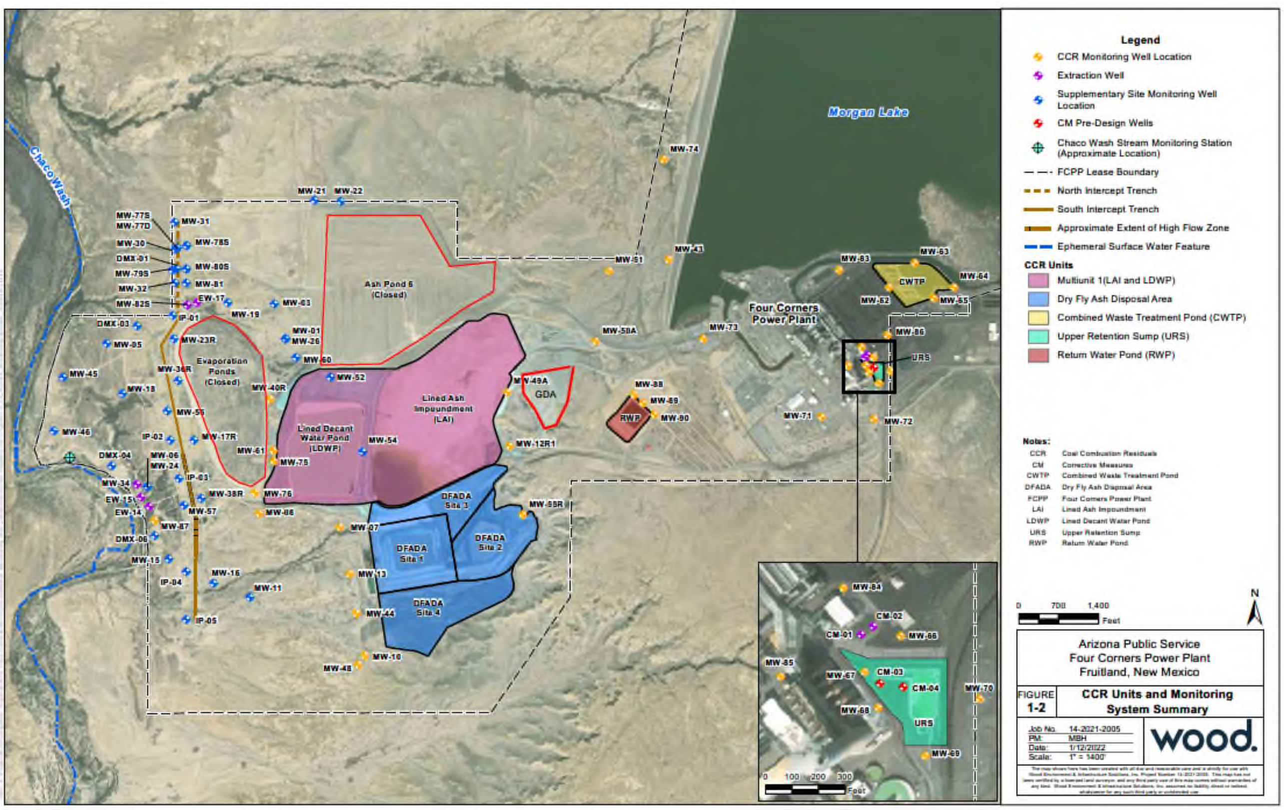
[13] Wood, 2020a, Annual Groundwater Monitoring and Corrective Action Report for 2019, Coal Combustion Residuals Rule Groundwater Monitoring System Compliance, Four Corners Power Plant, Fruitland, New Mexico, dated 1/31/2020

the liner design criteria for existing units required by Section 257.70(b) of the CCR Rule," and both components are "considered unlined for the purpose of the rule."[14]

Dry Fly Ash Disposal Area

The Dry Fly Ash Disposal Area (DFADA) consists of a series of four CCR disposal cells shown on Figure 2 with blue shading. The CCR disposed in the DFADA is not exclusively fly ash despite the unit's name. APS claims that there is no contamination associated with the DFADA, although that claim is only valid because they cannot sample persistently dry monitoring wells. Despite the documented presence of groundwater in the vicinity of the disposal areas, APS has failed to install other (or deeper) wells.

Figure 2: Locations of five regulated and three currently unregulated CCR disposal features, CCR-compliance groundwater monitoring wells (orange), URS extraction wells (red), western extraction wells (purple), 2020 supplemental monitoring wells (blue), and the groundwater intercept trench system (brown lines) (Wood, 2021a)



---

[14] Wood, 2019a, Assessment of Corrective Measures for Multiunit 1 and the URS, Coal Combustion Residuals Rule Groundwater Monitoring System Compliance, Four Corners Power Plant, Fruitland, New Mexico, page 6

Upper Retention Sump

The Upper Retention Sump (URS) is located at the power plant (green shading on Figure 2). Although the URS was replaced with a concrete tank in 2018 it remains a known source of CCR-derived groundwater contamination.[15]

Combined Waste Treatment Pond

The Combined Waste Treatment Pond (CWTP) is an earthen settling basin (shown with yellow shading on Figure 2) that collects and holds CCR-laden water, primarily bottom ash, prior to discharge of decanted water to Morgan Lake. The CWTP provides no active wastewater treatment function. APS has claimed that numerous contaminant concentration exceedances present at the CWTP reflect historic CCR dumping beneath the CWTP, and thus produce high "background" concentrations that eliminate CCR Rule remediation requirements for that contamination.[16] APS documents indicate that the CWTP stopped receiving new discharges in November 2020, and that water is now directed to a concrete tank.

Return Water Pond

The Return Water Pond (RWP) is a lined impoundment constructed in 2019 to "*temporarily store flue gas desulfurization (FGD) system waste and leachate from the disposal area seepage intercept system in anticipation of LAI and LDWP (Multiunit 1) closure.*"[17] APS disclosed installation of three CCR Rule compliance monitoring wells for the RWP in the 2020 Annual Monitoring Report.[18] However, all three wells are improperly located hydraulically upgradient of the RWP,[19] and all three wells are reportedly "dry" despite the known presence of groundwater in the area.

Currently Unregulated CCR Units

There are several other identified CCR units on the FCPP property that are not currently regulated by the 2015 CCR Rule. Despite the fact that the Historic Ash Ponds, Evaporation Ponds, and a landfill area called the "Gridded Disposal Area" all contain CCR and contribute to groundwater contamination, these pollution sources are not currently regulated. Each of these continuing sources are described below.

[15] Wood, 2020a, Annual Groundwater Monitoring and Corrective Action Report for 2019, Coal Combustion Residuals Rule Groundwater Monitoring System Compliance, Four Corners Power Plant, Fruitland, New Mexico, dated 1/31/2020

[16] Wood, 2020a

[17] Wood, 2020a, p. 8.

[18] Wood, 2021a

[19] Compare Figures 2 Unit and Well Locations to Figure 4 (Potentiometric Surface Map)

Historic Ash Ponds and Evaporation Ponds

Six "closed" ash ponds (1 through 6) are located in the area west of the FCPP that APS generically refers to as "the disposal area." Historic ash ponds 1 and 2 were covered in 1977 by four leachate evaporation ponds (APS, 2013) located immediately west of Multiunit 1 (outlined in red on Figure 2). Ash ponds 1 and 2, and the overlying evaporation pond complex, have been a major area of CCR leachate production, storage, and leakage to the subsurface since CCRs were first generated in 1963. [20] The Lined Decant Water Pond (LDWP) was built in 2003 atop closed ash pond 3, and the Lined Ash Impoundment (LAI) was constructed in 2004 on top of closed ash ponds 4 and 5.

Gridded Disposal Area

Prior to 2010, an unknown mass of CCRs was dumped in the Gridded Disposal Area (GDA) (outlined in red on Figure 2), in addition to asbestos, construction and other industrial debris, and oil/solvent-contaminated soil. [21] Aerial photographs of the GDA show that much of the deposited material consists of CCR and that the area remains uncapped and undoubtedly unlined. The photographs also document erosion of the disposed mass and transport of the waste westward. This unmonitored waste dump is located near and hydraulically upgradient of CCR compliance "background" monitoring wells MW-49A and MW-12R1.

<u>Groundwater Extraction Well Clusters and Intercept Trench System</u>

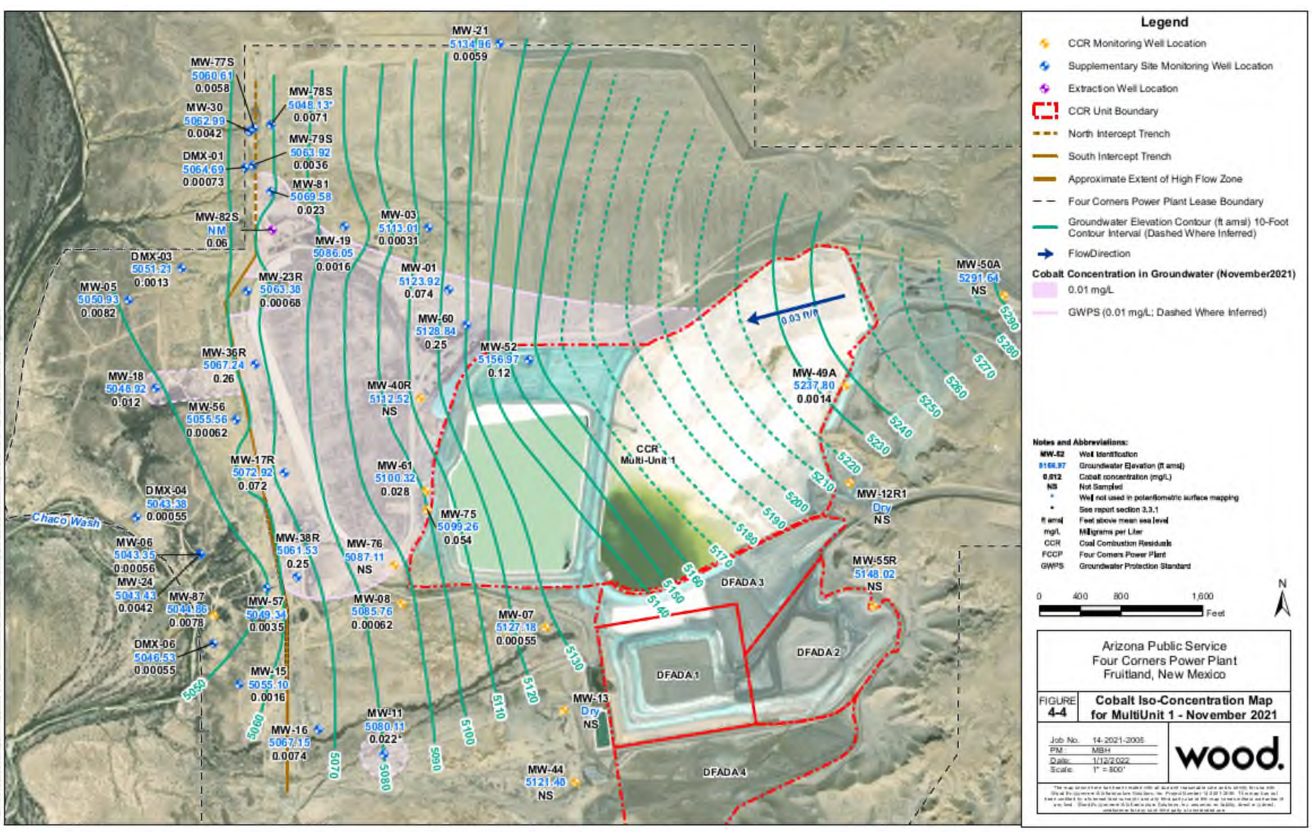
APS has constructed and operates multiple groundwater collection systems, including a 7,600-foot-long seepage intercept trench system (ITS) and groundwater extraction wells, in an apparent effort to minimize the spread of CCR-related contamination as it flows westward toward the Chaco River. Groundwater extraction wells located downgradient (west) of Multiunit 1 have been in operation since the early 1990s, and the seepage trench intercept system was constructed between 2011 and 2013. APS did not disclose the groundwater extraction wells in any reports produced for compliance with the CCR Rule prior to the 2020 Annual Groundwater Monitoring Report.[22] APS should fully disclose and evaluate the efficiency of all existing response infrastructure within their annual monitoring reports.

---

[20] Campbell, 2021, p. 14
[21] Campbell, 2021, p. 17
[22] Wood, 2021a

The actions taken by APS in an apparent attempt to minimize the spread of contamination demonstrate that they knew for decades that CCR-contaminated groundwater poses an imminent threat to the environment. APS' tacit admission is confirmed by (1) assessment of surface water and groundwater quality beginning in the early 1970s, (2) active groundwater extraction (pumping) efforts conducted between the early 1990s and at least 2019, (3) installation and operation of the ITS, (4) the first direct disclosure of the existing groundwater extraction wells in the CCR Rule 2020 annual monitoring report, and (5) addition of two additional pumping wells west of the ITS in 2020. Currently available information indicates that the APS trench system appears to capture only part of the migrating groundwater contamination, and that the existing systems do not stop contaminants from migrating toward and discharging into the Chaco River.[23] The lack of complete contaminant plume interception is shown graphically by APS' 2021 monitoring report map (Figure 3) showing the cobalt plume west of the trench system.

Figure 3: Cobalt Iso-Concentration Map from November 2021[24]



[23] Campbell, 2021, p. 4

[24] Wood, 2022, Figure 4-4

APS has belatedly disclosed the presence and operation of these systems even while using inappropriate and misleading statistical testing[25] to claim that their CCR units are not impacting groundwater. APS should fully disclose the presence and evaluate the efficiency of all preliminary or interim remediation systems.

1. Closure plans

a. Closing ash ponds in groundwater

N/A

b. Closing ash ponds in floodplains (location in floodplains + closure in place)

N/A

2. Groundwater Monitoring

a. Intrawell groundwater monitoring

APS is making a determined and ongoing effort to employ statistical and other arguments to minimize the need for groundwater remediation at FCPP. This effort is illustrated by the elimination of exceedances of boron, calcium, fluoride, and pH in CWTP monitoring wells. When their initial "background" values indicated contamination by those four contaminants of concern (COCs), APS altered the statistical testing procedures to utilize intrawell testing and establish alternatives to their "background" concentrations. Changing a monitoring program from interwell to intrawell comparisons after monitoring wells have already been impacted often results in false negative statistical testing. Intrawell testing can generally only be effective if testing predates the passage of the leading edge of a contaminant plume. Once the leading edge of a contaminant plume has passed a monitoring location, there is no reason to expect that the concentration of contaminants will appreciably change and trigger assessment monitoring.

Under the CCR Rule, boron, calcium, and pH are not Appendix IV constituents, so those exceedances would not drive cleanup actions at the CWTP. However, APS' intrawell monitoring is allowing APS to escape assessment monitoring requirements, and thus APS does not monitor the waste unit for most Appendix IV constituents, which include heavy metals. Fluoride is an Appendix IV constituent, but APS' intrawell testing results in "background" concentrations ranging from 1.5 mg/L in MW-64 to 2.3 mg/L at MW-63, thus avoiding a statistically significant

[25] APS is using intrawell statistical testing techniques in locations already impacted by CCR contamination, see Section 2a.

increase (SSI) in concentration. These high “background” values were reported regardless of the fact that APS previously established a single “background” value of 0.8 mg/L. Remediation of groundwater would be required had the appropriate single background value been used to evaluate data. Likewise, APS claims an order of magnitude increase for the upper limit of pH (from 7.04 to 8.27) based on this flawed approach. The end result of APS’ efforts to eliminate apparent exceedances of “background” is that APS went from identifying groundwater SSIs for boron, calcium, fluoride, and pH to claiming no concerns for any Appendix III or IV contaminant of concern.

b. Inappropriate background wells

The 2015 CCR Rule requires that the owner of a CCR facility must establish background monitoring wells that “accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit.”[26] **To date, APS has failed to develop adequate background data, and shows no apparent intention to do so in the future.** Examples of inappropriate background monitoring wells at FCPP include:

Inappropriate Background Wells for Multiunit 1 and the DFADA

Of the seven “background” wells sampled by APS between 2015 and 2017 for Multiunit 1 and the DFADA, only two wells (MW-49A and MW-74) met the USEPA’s minimum number of eight independent samples (AFW, 2018), and the remaining five “background” wells were sampled either once or not at all (i.e., they are “dry” wells). However, well MW-74 is located at the base of the dam for Morgan Lake and likely reflects water migrating from that contaminated lake rather than unaffected background. Analytical results from sampling well MW-74 has shown high concentrations of several targeted COCs that are typical CCR constituents (e.g., lithium and selenium), which confirm that these “background” water-quality analyses are suspect.

Well MW-49A is located at the eastern edge of Multiunit 1 near the northeast corner of former ash pond 4 and is also located near and hydraulically downgradient of the CCRs dumped at the unassessed “gridded disposal area.” In addition, well MW-49A is almost certainly impacted by the 43.5 feet of CCR that were reported penetrated by the well.[27] A well that penetrates 43.5 feet

[26] 40 C.F.R. § 257.91(a)(1)

[27] AECOM, 2017, CCR Monitoring Wells Network Report and Certification, Four Corners Power Plant, Fruitland, New Mexico, certified September 18, 2017, Appendix B

of CCR <u>cannot</u> represent groundwater quality that is <u>not</u> impacted by a CCR unit (per § 257.91(a)(1)). The impact of those historic CCRs located at and near well MW-49A is demonstrated by dramatically elevated concentrations of lithium (e.g., 1.8 mg/L, which is 4.5 times the CCR Rule's default groundwater protective standard of 0.40 mg/L[28]) detected since sampling began in 2016.[29] **Review of other contaminants show that inadequately characterized background groundwater quality allows APS to claim GWPS concentrations that are one or two orders of magnitude greater than the USEPA's Maximum Contaminant Level (MCL) or federal health standards established in the CCR Rule.**

It appears that only one well located on the eastern side of Multiunit 1 (MW-12R1) and one well at the DFADA (MW-55R) may potentially be appropriately located to establish local unimpaired water quality. Multiunit 1 "background" well MW-12R1 is considered to be located only potentially appropriately because it is relatively near and hydraulically downgradient of the open CCR and mixed waste dump at the "gridded disposal area" and may in actuality be located in an area of impacted groundwater.[30] The primary problem with both of these wells is however that APS reports that "background" well MW-12R1 is persistently "dry", and DFADA "background" well MW-55R seldom contains water, and APS has not taken steps to install new wells in locations or to depths capable of consistently providing background samples.

<u>Inappropriate Background Wells for the URS and CWTP</u>

Although the hydrologic positions of these wells were initially described as "unknown" or "varies," [31] APS now identifies wells MW-71, MW-72, and MW-73 as the "background" monitoring wells employed to establish ambient concentrations of targeted analytes.[32] Furthermore, the monitoring well network report [33] describes "*groundwater mounding*" around the URS that produces patterns of "*radial flow,*" and further states that the "*groundwater elevations*" measured in "background" wells

---

[28] 40 C.F.R. § 257.91(h)(2)(iii)

[29] Amec Foster Wheeler Environment & Infrastructure, Inc. (AFW), 2018, Annual Groundwater Monitoring and Corrective Action Report for 2017, Coal Combustion Residuals Rule Groundwater Monitoring System Compliance, Four Corners Power Plant, Fruitland, New Mexico, (dated 1/29/2018)

[30] Prior to 2010, an unknown mass of CCRs was dumped in the "gridded disposal area", in addition to asbestos, "*construction and other industrial debris*..(and)...*oil/solvent-contaminated soil*" (OSMRE, 2015, page 2-26).

[31] AFW, 2018, Annual Groundwater Monitoring and Corrective Action Report for 2017, Coal Combustion Residuals Rule Groundwater Monitoring System Compliance, Four Corners Power Plant, Fruitland, New Mexico, (dated 1/29/2018), Table 2-1

[32] Wood, 2020a

[33] AECOM, 2017, page 3-5

MW-71 and MW-72 "*suggest that these wells may be influenced by the mounding in the vicinity of the Upper Retention Sump.*" This pattern of radial groundwater flow is prominent on APS' equipotential (hydraulic head elevation) maps for 2016 and 2017, the period when initial "background" sampling and testing was conducted. However, contouring of radial flow is conspicuously absent in post-2017 equipotential maps because APS stopped using the unlined URS, and leaking leachate no longer produced a local groundwater mound. Radial flow of groundwater due to local hydraulic mounding beneath CCR units likely caused contaminated groundwater to migrate to areas that may appear to be hydraulically "upgradient" under current hydraulic conditions. Contaminated groundwater that flowed away from the CCR units during the long period of radial flow was likely still present in the subsurface and affecting detected groundwater quality during development of the background dataset. Regardless, power plant "background" wells MW-71, MW-72, and MW-73 were until recently demonstrably shown as hydraulically downgradient of the URS.

The switch to intrawell statistical testing described above[34] was accompanied by an APS acknowledgement of up to 20 feet of "anthropogenic" CCR deposition beneath the CWTP.[35] Using background wells impacted by CCR allows APS to establish much higher "background" concentrations. It is paradoxical that APS has appealed to <u>preexisting groundwater contamination</u> from a 20-foot layer of CCRs disposed beneath the CWTP and states that the previously-disposed CCRs are a cause of the groundwater contamination. Historic CCR contamination is likely reflected in the exceptionally high concentrations of sulfate and total dissolved solids detected at "background" wells MW-71, MW-72, and MW-73. The CCR Rule in states that a background well must "*Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit.*"[36] This condition of the CCR Rule is <u>not</u> met by APS' background wells.

c. Inappropriate downgradient wells, including too few wells

<u>The CCR Disposal Area Monitoring Well Network</u>

APS reports that some areas of the CCR disposal area are perennially "dry," such as downgradient of the DFAFA, although there are also several instances where APS failed to

[34] Described in Section 2(a) of this report

[35] Wood ,2020a, Appendix A

[36] 40 C.F.R § 257.91(a)(1)

monitor those wells to confirm persistent dryness. Significantly, DFADA "downgradient" wells MW-10, MW-44, and MW-48 are not likely to detect any contamination originating at the DFADA based on those well locations relative to disposed CCRs (Figure 2) and the prevailing groundwater-flow pattern (Figure 4) as well as the fact that these wells are consistently reported to be "dry."

The three CCR compliance monitoring wells installed in 2019 for the RWP are improperly located because they are hydraulically upgradient (east) of the RWP (Figures 2 and 4). The wells are reported to be "dry," and APS has not installed or assigned a "background" well for the RWP. Even if a dry well is installed, APS continues to call it a CCR compliance monitoring well (see MW-10, Figure 4) without attempting any further delineation by installing nearby or deeper wells. This is a violation of the CCR Rule requirement that requires upgradient and downgradient that yield groundwater samples from the uppermost aquifer and accurately represent the quality of groundwater both unaffected by leakage from a CCR unit and the quality of groundwater passing the waste boundary of the CCR unit. §§ 257.91(a)(1) and (2).

There are very large gaps in the monitoring-well network relative to the groundwater-flow patterns (Figure 4), including the entire northern margin of Multiunit 1 (4,000+ feet in length). Additionally, it appears that there are only three pairs of wells screened at different depths at the CCR disposal area, and APS does not use those wells to assess, quantify, or acknowledge vertical components of groundwater flow or contaminant distribution and transport.

Issues with Groundwater Contamination at Far-Downgradient Wells

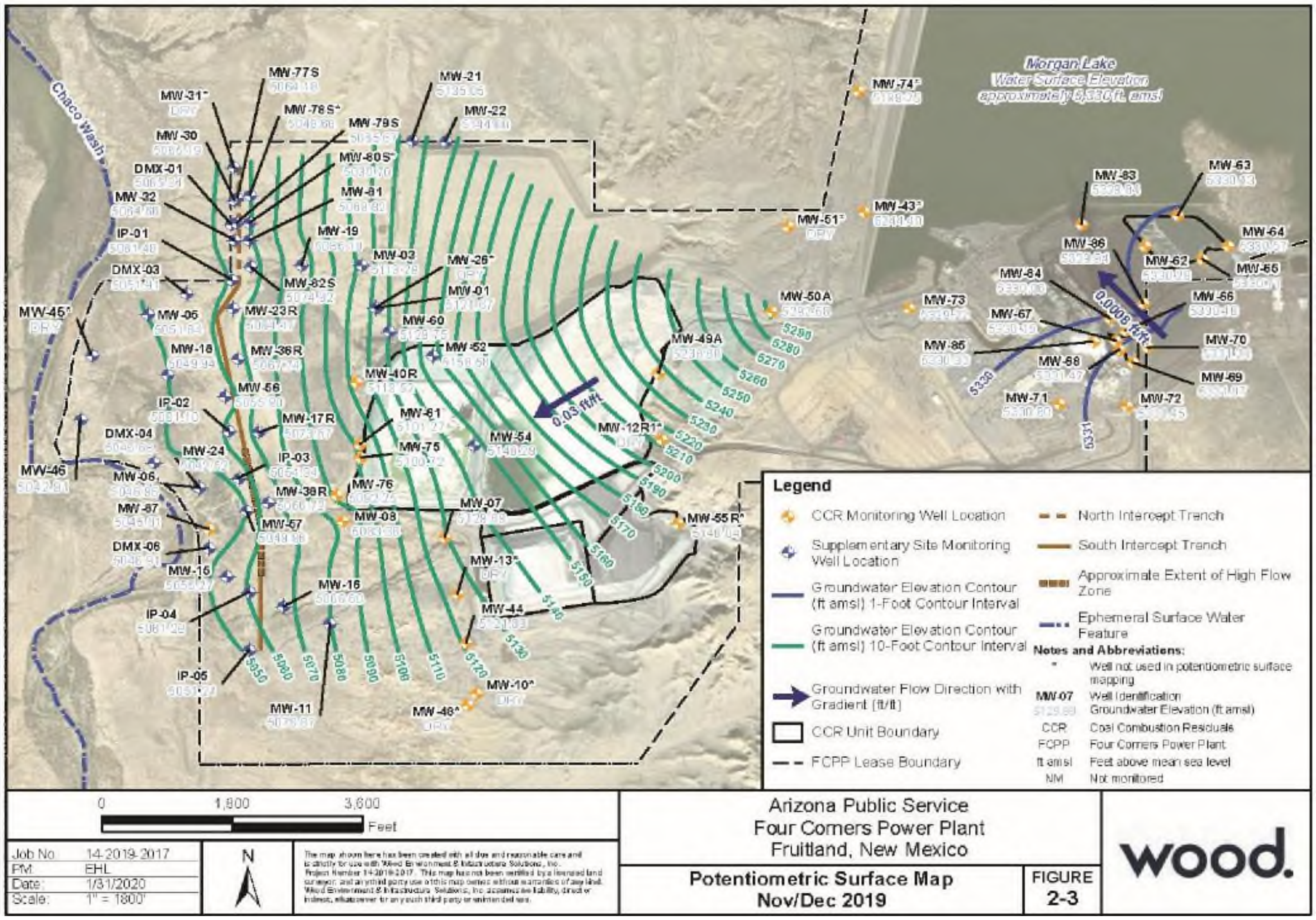
Exceedances of groundwater protection standards (GWPS) for cobalt, lithium, and molybdenum have been sporadically detected in samples from wells located downgradient of both Multiunit 1 and the ITS, confirming that CCR contamination has migrated past the ITS. Wells MW-18, MW-24, DMX-03, and MW-87 have all shown exceedances with the most consistent exceedance being for cobalt in MW-18.[37] APS has not determined the extent of CCR contaminants in groundwater downgradient of the ITS[38] and has failed to implement the most direct assessment

[37] Wood, 2022, Annual Groundwater Monitoring and Corrective Action Report for 2021 Coal Combustion Residuals Rule Groundwater Monitoring System Compliance, Four Corners Power Plant, Fruitland, New Mexico, January 31, 2022, p 15.

[38] As indicated by the dashed isoconcentration lines that are consistently shown on APS cobalt concentration maps the vicinity of MW-18

method available; installation and testing of additional wells, and sampling of the Chaco River and its sediments.

Figure 4: Groundwater equipotential map for November/December 2019 (Wood, 2020a)



3. Flawed Alternate Source Determinations (ASDs))

It is the responsibility of APS to definitively install a groundwater monitoring system that accurately characterizes the quality of water passing beneath the upgradient and downgradient monitoring locations. When exceedances of the GWPS are indicated, the CCR Rule requires the operator to investigate and definitively show that CCR is not the source of the exceedance. APS has submitted multiple ASDs that generally attribute statistically significant increases of various parameters over their respective GWPS to various combinations of 1) the impacts of CCR located outside of the regulated units on upgradient or downgradient groundwater quality, 2)

[39] e.g., table 2-1 of Wood, 2020a and 2021a

effects of variations in groundwater or surface water elevations on groundwater quality, 3) changes in groundwater flow directions, and/or 4) natural variation in groundwater quality. Multiple possible explanations are proposed but the findings are general statements such as,

> "The data and evaluation presented above indicate that the exceedances at the CWTP for boron and field pH **are not definitively attributable** to a release from the CWTP." (Emphasis added)[40]

APS must do more than suggest that water quality changes could possibly be from causes other than the known CCR sources. Sufficient characterization to actually identify the alternative source is necessary according to the requirements of the CCR Rule. The groundwater monitoring system installed by APS has failed if it is incapable of accurately providing the required groundwater quality data.

4. Flawed Assessments of Corrective Measures

a. Failure to Demonstrate Viability of Monitored Natural Attenuation

The failure of APS to assess the actual viability of Monitored Natural Attenuation (MNA) for use during remediation of any portion of the FCPP is a critical failure. APS acknowledges that fluoride-contaminated groundwater extends downgradient of the URS. The Assessment of Corrective Measures (ACM) for the URS states that APS intends to rely on a combination of natural processes or attenuation (MNA) and minimal groundwater extraction by pumping one or two wells at a rate of ~1 gallon per minute to clean up that fluoride contamination. Similarly, the ACM for Multiunit 1 proposes to rely on MNA to clean up groundwater contaminated by cobalt, lithium, and molybdenum, yet no assessment of the applicability of MNA to remediation of either Multiunit 1 or the URS has been conducted.

b. Failure to characterize the nature and extent of contamination

The methodology employed by APS for measuring and evaluating basic aspects of the distribution and migration of groundwater contamination often does not meet scientific or industry standards. There are numerous problems with the CCR Rule compliance pertaining to supplemental monitoring wells, including flawed construction, inadequate spatial distribution, selective inclusion or omission of available monitoring wells, poor selection or justification for

[40] Wood, 2022, Annual Groundwater Monitoring and Corrective Action Report for 2021, dated January 31, 2022, Appendix A

employing several “background” monitoring wells,[41] and failure to assess large areas lacking water-level or analytical data due to perennially “dry” wells and/or inadequate well placement or distribution.

APS’ claimed distributions of actionable contaminant concentrations are not supported by the available data. APS has a distinct tendency to ignore unfavorable data (e.g., MW-18 and MW-87) and to leave huge unassessed gaps across the FCPP (e.g., north margin of Multiunit 1). The aerial extents of both cobalt and molybdenum downgradient of Multiunit 1 are not delineated adequately by the monitoring-well network. Few data delineate the northern and southern extents of either contaminant plume, and the depiction that the bulk of the contaminant plume is being captured by the ITS is not proven because (1) there are large gaps in the well network (routinely more than 400 feet),[42] (2) APS fails to even acknowledge violations of the selenium GWPS (0.092 mg/L compared to the GWPS of 0.05 mg/L) reported in well MW-56 and (3) plume capture and extraction is inconsistent with the elevation of groundwater in numerous wells west of the ITS at elevations predictable by direct projection from the groundwater elevation gradient from east of the ITS. The absence of lowered groundwater elevations downgradient of the ITS indicate that it does not capture most of the fugitive groundwater contamination originating at the CCR units.

Groundwater capture by the ITS is incomplete, vertical separation of discrete water bearing zones are present in this area, preferred flow pathways bypassing monitoring wells are undoubtedly abundant across the FCPP, and APS has admitted that high-flow zones exist (e.g., southwest of the former evaporation pond complex).

c. Inadequate consideration of required factors

The ACM for Multiunit 1 discusses removal of the contaminant mass from the aquifer, but provides no estimation of the mass of contaminants that have been released, in violation of the CCR Rule. It is unclear how the time required to complete remediation was evaluated without an estimate of the mass contaminant involved.

[41] Including reliance on a well penetrating 43.5 feet of historically disposed CCRs.

[42] The unmonitored north-south distance between MW-56 and MW-77 on the downgradient (west) side of the ITS is approximately 1,750 feet (0.33 mile).

d. Failure to estimate the time until full protection is achieved

APS is proposing to rely on MNA to clean up groundwater contaminated by cobalt and molybdenum. The standard industry approach to employing monitored natural attenuation (MNA) for contamination cleanup includes rigorous chemical evaluations, realistic computer simulation(s) of groundwater flow, and performance of time-concentration simulations within that flow mode. The objectives of this standard approach are to (1) verify that contaminant attenuation is feasible and effective, (2) project the possible time period during which the contaminant source areas persist, (3) project patterns of contaminant plume migration through time, and (4) predict how long contaminant concentrations will remain above the remediation concentration goal (typically equal to the GWPS). In 2019, APS conducted a flawed computer simulation of groundwater flow in the vicinity of the URS, but no such flow simulation has been disclosed for the CCR disposal area. There is no indication that the necessary steps to estimate the time until full protection of groundwater quality could be achieved due to the data gaps identified above and to unaddressed contaminant sources that will continue to release metals to the groundwater far into the future.

e. Failing to select a final groundwater cleanup remedy

APS has to date failed to select the remedy for groundwater contamination by CCR constituents even though the ACM was completed in 2019. The 2015 CCR Rule requires that the owner or operator must select a remedy based on the ACM "as soon as feasible".[43] There is no indication that APS is making progress in better characterizing the nature and extent of contamination or that there are technical issues that are being addressed. There is no justification for a three-year delay in remedy selection when contamination of groundwater and surface water resources has been a known and ongoing problem at the site for decades.

f. Selecting monitored natural attenuation as the groundwater remedy

APS is proposing to rely on MNA to clean up groundwater contaminated by cobalt and molybdenum. Viability of MNA has <u>not</u> been assessed for any portion of the FCPP. APS intends to "remediate" Multiunit 1 by "dewatering" and capping the disposed CCRs, and implicitly by

[43] *See* 40 C.F.R. § 257.97(a)

continuing to operate the groundwater ITS. Remediation of contaminated groundwater associated with Multiunit 1 will allegedly be by "*monitored natural attenuation of COCs in the impacted aquifer*",[44] but there is no evidence that MNA is being adequately evaluated anywhere at FCPP.

The standard industry approach to employing monitored natural attenuation (MNA) for contamination cleanup includes rigorous chemical evaluations, realistic computer simulation(s) of groundwater flow, and performance of time-concentration simulations within that flow mode. The objectives of this standard approach are to (1) verify that contaminant attenuation is feasible and effective, (2) project the possible time period during which the contaminant source areas persist, (3) project patterns of contaminant plume migration through time, and (4) predict how long contaminant concentrations will remain above the remediation concentration goal (typically equal to the GWPS). MNA typically requires sampling and testing for a wide variety of field and laboratory parameters to characterize the aquifer's physiochemical ability to remediate targeted contaminants via natural processes (e.g., adsorption). MNA testing is usually conducted periodically (e.g., quarterly) over a period of at least one year to account for seasonal changes that may enhance or limit the ability of MNA to remediate contamination. In 2019, APS conducted a flawed computer simulation of groundwater flow in the vicinity of the URS, but no such flow simulation has been disclosed for the CCR disposal area (e.g., Multiunit 1). There is no indication that the necessary steps to show the utility of MNA in remediating groundwater at FCPP have been completed.

g. Selecting a risk-based remedy

N/A

5. Failure to identify all units that should be regulated

Until recently, APS has failed to divulge standard operational statistics (e.g., rates and volumes) and contaminant concentrations of groundwater extracted by their pumping wells and the 1.4-mile-long (7,600 foot) groundwater infiltration trench system (ITS). Both remediation systems are located between the disposed CCRs and the Chaco River, with the stated or implicit intent to capture contaminated groundwater migrating from the disposed CCRs toward the river. Although

[44] Wood, 2019a, Table 3-1

APS acknowledges that the ITS is integral to their remediation plans for the FCPP, they do not comply with CCR Rule requirements to report on the progress of that remediation. Because some groundwater extraction wells are active, and APS appears poised to expand and upgrade operation of those pumping well clusters, the remediation system performance should also be addressed fully under the CCR Rule.

Significant Observations and Findings

Review of documentation pertaining to CCR storage, disposal, and site characterization practices utilized by APS at the FCPP leads to the following significant observations and findings:

- The total quantity of CCR produced at FCPP is not reported, but it has been estimated[45] that 89 million tons of CCR were generated at FCPP and disposed either on-site or in the adjacent Navajo Mine.
- The FCPP has generated CCR since 1963, and most of the waste disposed on-site at the FCPP prior to 2006 was placed in six unlined wet impoundments that have been abandoned in place, apparently with minimal engineering controls installed to limit groundwater contaminant generation and escape from those "closed" ponds. APS considers these older units to be outside the CCR Rule so they are not currently subject to monitoring or remediation.
- Since 2006, APS has disposed of CCR in units that they consistently characterize as "lined". However, APS admits that those liners do not meet the minimum standards of USEPA's 2015 CCR Rule, and thus are considered "unlined" for regulatory purposes.
- APS has consistently worked to minimize the need for groundwater cleanup by claiming progressively higher concentrations of "background" concentrations of CCR constituents that supposedly represent ambient conditions at the site.
- There are numerous problems with the CCR Rule compliance and supplemental monitoring wells, including flawed construction, inadequate spatial distribution, selective inclusion or omission of available non-compliance monitoring wells, poor selection or justification for employing several "background" monitoring wells (including reliance on a well penetrating 43.5 feet of historically-disposed CCR), and failure to assess large areas lacking water-level or analytical data due to perennially "dry" wells and/or improper well placement.
- APS has generally ignored other areas of known or likely on-site CCR disposal (e.g., the "gridded disposal area" and at the shore of Morgan Lake near the CWTP), thus rendering

[45] Campbell (2021), p. 17

their most important claims or assumptions concerning ambient “background” contaminant concentrations dubious.

- The areas contaminated by contaminant plumes are likely much larger than APS claims, in part because there are huge areas near the regulated CCR units with insufficient monitoring wells to define the full extents of the plumes.
- Investigations conducted in 2005 and 2007 indicated that substantial pollution by heavy metals originating from coal ash has degraded water quality in the Chaco River at and downstream of the FCPP. There is no indication that APS is monitoring water quality in the river.
- The Assessment of Corrective Measures (ACM) for the URS indicates that APS intends to rely on a combination of monitored natural attenuation (MNA) and low volume groundwater extraction to cleanup that fluoride contamination. The viability of MNA has not been assessed for any portion of the FCPP.
- The ACM for Multiunit 1 proposes to rely on MNA to clean up groundwater contaminated by cobalt and molybdenum. Viability of MNA has not been assessed for any portion of the FCPP.
- The ACM for Multiunit 1 discusses removal of the contaminant mass from the aquifer, but provides no estimation of the mass of contaminants that have been released. It is unclear how the time required to complete remediation was evaluated without an estimate of the mass contaminant involved.
- Between 2011 and 2013, APS installed a deeply-buried 1.4-mile-long (7,600 foot) groundwater infiltration trench system (ITS) between the disposed CCRs and the Chaco River to attempt to capture contaminated groundwater migrating from the disposed CCRs and toward the river. The reported trench construction and water-level data for the vicinity of the trench demonstrates that the ITS probably captures only a limited portion of migrating groundwater contamination, and it does not stop pollution from migrating to the Chaco River. Groundwater monitoring data demonstrate that contaminated groundwater bypasses the ITS, and large gaps in the monitoring-well network probably mask how pervasive the contamination is west of the ITS.
- Although the infiltration trench system is integral to APS’ remediation plans, they do not report on the progress of that remediation. Because some groundwater extraction wells are active, and APS appears poised to expand and upgrade operation of those pumping well clusters, the remediation system performance must also be addressed fully under the CCR Rule.
- APS has to date failed to select the remedy for groundwater contamination by CCR constituents even though the ACM was completed in 2019. The 2015 CCR Rule requires that the owner or operator must select a remedy based on the ACM “as soon as feasible”.

There is no indication that APS is making progress in better characterizing the nature and extent of contamination, or that there are technical issues that are being addressed. There is no justification for a three-year delay in remedy selection when contamination of groundwater and surface water resources has been a known and ongoing problem at the site for decades.

Appendix D: COAL ASH PONDS CLOSING (OR CLOSED) IN GROUNDWATER OR DANGEROUSLY CLOSE TO GROUNDWATER

Name of Plant or Site	**CCR Unit**	**Operator**	**State**	**Closure Status**	**Industry Reported this Pond Is within 5 feet of Groundwater***	**Did EPA Determine This Unit May Be in Contact with Groundwater?**
Ames Electric Services Power Plant	Surface Impoundments	City of Ames	IA	Notice of Intent to Close	Yes	No
Asbury Power Plant	Asbury CCR Impoundment	Empire District Electric Co.	MO	Notice of Intent to Close	Yes	Yes
B.L. England Generating Station	Slag Ponds	RCCM	NJ	Closed	Yes, Industry Failed to Claim Otherwise	No
Baldwin Energy Complex	East Fly Ash Pond	Luminant (formerly Dynegy Inc.)	IL	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Baldwin Energy Complex	Old East Fly Ash Pond	Luminant (formerly Dynegy Inc.)	IL	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Baldwin Energy Complex	West Fly Ash Pond	Luminant (formerly Dynegy Inc.)	IL	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Baldwin Energy Complex	Baldwin Bottom Ash Pond	Luminant (formerly Dynegy Inc.)	IL	Open, Part A	No, Industry Claims More Than 5 feet	Yes
BC Cobb Power Plant	Bottom Ash Pond	Consumers Energy Co.	MI	Notice of Intent to Close	Yes	No
Big Cajun II Power Plant	Bottom Ash Pond	CLECO	LA	Open, Part A	No, Industry Claims More Than 5 feet	Yes
Big Cajun II Power Plant	Fly Ash Pond	CLECO	LA	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Big Sandy Plant	Fly Ash Pond	American Electric Power, Kentucky Power Co.	KY	Closed	Yes	Yes
Blue Valley Generating Station	Bottom Ash Pond	City of Independence	MO	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Blue Valley Generating Station	North Fly Ash Pond	City of Independence	MO	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Blue Valley Generating Station	South Fly Ash Pond	City of Independence	MO	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Boswell Energy Center	Unit 3 Impoundment	Minnesota Power	MN	Open, Part A	Yes	Yes

Name of Plant or Site	CCR Unit	Operator	State	Closure Status	Industry Reported this Pond Is within 5 feet of Groundwater*	Did EPA Determine This Unit May Be in Contact with Groundwater?
Boswell Energy Center	Unit 4 Impoundment	Minnesota Power	MN	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Brame Energy Center (formerly Rodemacher)	Bottom Ash Pond	CLECO	LA	Open, Part A	No, Industry Claims More Than 5 feet	Yes
Bruce Mansfield Plant	Little Blue Run Disposal Facility	Energy Harbor Generation LLC (formerly FirstEnergy)	PA	Notice of Intent to Close	Yes	Yes
Bull Run Fossil Plant	Main Ash Pond	Tennessee Valley Authority	TN	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	Yes
Bull Run Fossil Plant	Fly Ash Stilling Pond 2C and Sluice Channel	Tennessee Valley Authority	TN	Closed, no certification	Yes, Industry Failed to Claim Otherwise	No
Burlington Generating Station	Economizer Ash Pond	Interstate Power and Light Company	IA	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	Yes
Burlington Generating Station	Main Ash Pond	Interstate Power and Light Company	IA	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	Yes
Burlington Generating Station	Upper Ash Pond	Interstate Power and Light Company	IA	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	Yes
Cane Run Generating Station	Ash Pond	Louisville Gas & Electric Company	KY	Closed	Yes, Industry Failed to Claim Otherwise	No
Cardinal Plant	Fly Ash Reservoir II	Buckeye Power Co. & AEP	OH	Notice of Intent to Close	Yes	Yes
Charles R. Lowman Power Plant	Flue-Gas Desulfurization Waste (FGD) Pond	Power South Energy Cooperative	AL	Notice of Intent to Close	Yes	Yes
Charles R. Lowman Power Plant	Unit #2/3 Ash Pond	Power South Energy Cooperative	AL	Notice of Intent to Close	Yes	Yes
Cholla Power Plant	Bottom Ash Pond	Arizona Public Service Electric Company	AZ	Open, Part A	Yes	Yes
Cholla Power Plant	Fly Ash Pond	Arizona Public Service Electric Company	AZ	Open, Part A	Yes	Yes
Clifty Creek Station	Landfill Runoff Collection Pond	Indiana-Kentucky Electric Corp.	IN	Open, Part A	No, Industry Claims More Than 5 feet	Yes

Name of Plant or Site	CCR Unit	Operator	State	Closure Status	Industry Reported this Pond Is within 5 feet of Groundwater*	Did EPA Determine This Unit May Be in Contact with Groundwater?
Clifty Creek Station	West Boiler Slag Pond	Indiana-Kentucky Electric Corp.	IN	Open, Part A	No, Industry Claims More Than 5 feet	Yes
Clinch River Plant	Ash Pond Complex (1A, 1B, Reclaim)	American Electric Power	VA	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Coffeen Power Station	Coffeen Ash Pond No. 1	Luminant (formerly Dynegy Inc.)	IL	Notice of Intent to Close	Yes	Yes
Coffeen Power Station	Coffeen Ash Pond No. 2	Luminant (formerly Dynegy Inc.)	IL	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Colbert Fossil Plant	Ash Disposal Area 4 CCR Unit	Tennessee Valley Authority	AL	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Coleto Creek Power Station	Coleto Creek Primary Ash Pond	Luminant (formerly Dynegy Inc.)	TX	Open, Part A	No, Industry Claims More Than 5 feet	Yes
Colstrip Steam Electric Station	1&2 STEP, E Cell	Talen Energy	MT	Notice of Intent to Close	Yes	No
Colstrip Steam Electric Station	1&2 STEP, Old Clearwell	Talen Energy	MT	Notice of Intent to Close	Yes	No
Colstrip Steam Electric Station	3&4 EHP, B Cell	Talen Energy	MT	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Colstrip Steam Electric Station	3&4 EHP, C Cell	Talen Energy	MT	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Colstrip Steam Electric Station	3&4 EHP, G Cell	Talen Energy	MT	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Colstrip Steam Electric Station	Units 1&2 B Fly Ash Pond	Talen Energy	MT	Notice of Intent to Close	Yes	Yes
Colstrip Steam Electric Station	Units 1&2 Bottom Ash Pond	Talen Energy	MT	Notice of Intent to Close	Yes	No
Columbia Energy Center	Primary Ash Pond	Wisconsin Power & Light Co.	WI	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	No
Conesville Plant	Ash Pond	American Electric Power	OH	Open, No Notice of Intent Posted	Yes	No
Coronado Generating Station	Inactive Ash Slurry Settling Ponds	SRP	AZ	Closed	Yes, Industry Failed to Claim Otherwise	No

Name of Plant or Site	CCR Unit	Operator	State	Closure Status	Industry Reported this Pond Is within 5 feet of Groundwater*	Did EPA Determine This Unit May Be in Contact with Groundwater?
Cumberland Fossil Plant	Bottom Ash Pond	Tennessee Valley Authority	TN	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Cumberland Fossil Plant	Stilling Pond (Incl. Retention Pond)	Tennessee Valley Authority	TN	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Dallman Power Generating Station	Dallman Ash Pond	City Water, Light and Power	IL	Open, Part A	Yes	Yes
Dallman Power Generating Station	Lakeside Ash Pond	City Water, Light and Power	IL	Open, Part A	Yes	Yes
Dolet Hills Power Station	Ash Basin No. 1	CLECO	LA	Open, Part A	No, Industry Claims More Than 5 feet	Yes
Dolet Hills Power Station	Ash Basin No. 2	CLECO	LA	Open, Part A	No, Industry Claims More Than 5 feet	Yes
Duck Creek Power Station	Ash Pond No. 1	Luminant (formerly Dynegy Inc.)	IL	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Duck Creek Power Station	Ash Pond No. 2	Luminant (formerly Dynegy Inc.)	IL	Closed	Yes, Industry Failed to Claim Otherwise	Yes
E.C. Gaston Steam Plant	Plant Gaston Ash Pond	Alabama Power	AL	Notice of Intent to Close	Yes	Yes
Eagle Valley Generating Station	Pond A	Indianapolis Power & Light Company	IN	Notice of Intent to Close	Yes	No
Eagle Valley Generating Station	Pond B	Indianapolis Power & Light Company	IN	Notice of Intent to Close	Yes	No
Edgewater Generating Station	EDG B-Pond	Wisconsin Power & Light Co.	WI	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Edgewater Generating Station	EDG North A-Pond	Wisconsin Power & Light Co.	WI	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Edgewater Generating Station	EDG Slag Pond	Wisconsin Power & Light Co.	WI	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Edgewater Generating Station	EDG South A-Pond	Wisconsin Power & Light Co.	WI	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Edwards Power Station	Edwards Ash Pond	Luminant (formerly Dynegy Inc.)	IL	Open, Part A	Yes	Yes

Name of Plant or Site	CCR Unit	Operator	State	Closure Status	Industry Reported this Pond Is within 5 feet of Groundwater*	Did EPA Determine This Unit May Be in Contact with Groundwater?
F.B. Culley Generating Station	West Ash Pond	SIGECO, dba Vectren Power Supply	IN	Closed	Yes	Yes
Four Corners Power Plant	Lined Ash Impoundment	Arizona Public Service Co.	NM	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Four Corners Power Plant	Lined Decant Water Pond	Arizona Public Service Co.	NM	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Gallagher Generating Station	Primary Pond	Duke Energy	IN	Notice of Intent to Close	Yes	Yes
Gavin Power Plant	Fly Ash Reservoir	Gavin Power, LLC	OH	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Ghent Generating Station	Ash Treatment Basin 2	Kentucky Utilities Company	KY	Notice of Intent to Close	Yes	Yes
Gibbons Creek Steam Electric Generating Station	Ash Ponds	Texas Municipal Power Agency	TX	Open, No Notice of Intent Posted	No, Industry Claims More Than 5 feet	Yes
Gibbons Creek Steam Electric Generating Station	Scrubber Sludge Pond	Texas Municipal Power Agency	TX	Open, No Notice of Intent Posted	No, Industry Claims More Than 5 feet	Yes
Gibson Generating Station	North Ash Pond	Duke Energy	IN	Notice of Intent to Close	Yes	Yes
Grand Tower Energy Center	GTEC Ash Basin	Main Line Generation, LLC (a subsidiary of Rockland Capital, purchased from Ameren in 02/XX/2014)	IL	Closed	Yes, Industry Failed to Claim Otherwise	No
Greenidge Power Generating Station	C-Pond	Greenidge Generation LLC	NY	Open, ceased receipt of CCR	Yes	Yes
Harding Street Generating Station	Pond 1	Indianapolis Power & Light Company	IN	Notice of Intent to Close	Yes	No
Harding Street Generating Station	Pond 2A	Indianapolis Power & Light Company	IN	Notice of Intent to Close	Yes	No
Harding Street Generating Station	Pond 2B	Indianapolis Power & Light Company	IN	Notice of Intent to Close	Yes	Yes

Name of Plant or Site	CCR Unit	Operator	State	Closure Status	Industry Reported this Pond Is within 5 feet of Groundwater*	Did EPA Determine This Unit May Be in Contact with Groundwater?
Harding Street Generating Station	Pond 3	Indianapolis Power & Light Company	IN	Notice of Intent to Close	Yes	No
Havana Power Station	Havana East Ash Pond (Cells 1, 2, 3, and 4)	Luminant (formerly Dynegy Inc.)	IL	Open, No Notice of Intent Posted	Yes	Yes
Hennepin Power Station	Hennepin East Ash Pond	Luminant (formerly Dynegy Inc.)	IL	Notice of Intent to Close	Yes	No
Hennepin Power Station	Henepin Old West Ash Pond (Pond No. 1 and Pond No. 3)	Luminant (formerly Dynegy Inc.)	IL	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Hennepin Power Station	Hennepin Ash Pond No. 2	Luminant (formerly Dynegy Inc.)	IL	Closed	Yes, Industry Failed to Claim Otherwise	No
Huntley Generating Station	South Settling Pond	NRG	NY	Notice of Intent to Close	Yes	Yes
Intermountain Generating Facility	Bottom Ash Basin	Intermountain Power Service Corp.	UT	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	No
Intermountain Generating Facility	Waste Water Basin	Intermountain Power Service Corp.	UT	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	No
James H. Miller, Jr., Electric Generating Plant	Plant Miller Ash Pond	Alabama Power	AL	Notice of Intent to Close	Yes	Yes
James M. Barry Electric Generating Plant	Ash Pond	Alabama Power	AL	Notice of Intent to Close	Yes	Yes
Jeffrey Energy Center	Bottom Ash Area 1 Impoundment	Evergy	KS	Closed	Yes, Industry Failed to Claim Otherwise	No
JH Campbell Power Plant	Pond A	Consumers Energy Co.	MI	Closed, no certification	Yes	No
Jim Bridger Power Plant	FGD Pond 1	PacifiCorp Energy	WY	Closed	Yes, Industry Failed to Claim Otherwise	No
JM Stuart Station	Pond 5	Kingfisher Development LLC (formerly AES Ohio Generation)	OH	Open, No Notice of Intent Posted	Yes	Yes

Name of Plant or Site	CCR Unit	Operator	State	Closure Status	Industry Reported this Pond Is within 5 feet of Groundwater*	Did EPA Determine This Unit May Be in Contact with Groundwater?
JM Stuart Station	Pond 6	Kingfisher Development LLC (formerly AES Ohio Generation)	OH	Open, No Notice of Intent Posted	Yes	No
JM Stuart Station	Pond 7	Kingfisher Development LLC (formerly AES Ohio Generation)	OH	Open, No Notice of Intent Posted	Yes	Yes
John E Amos Plant	Fly Ash Pond CCR Management Unit	American Electric Power	WV	Closed	Yes, Industry Failed to Claim Otherwise	Yes
John Sevier Fossil Plant	Bottom Ash Pond	Tennessee Valley Authority	TN	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Johnsonville Fossil Plant	Active Ash Pond 2 CCR Unit	Tennessee Valley Authority	TN	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Joliet #9 Generating Station	Lincoln Stone Quarry	NRG	IL	Notice of Intent to Close	Yes	Yes
Joppa Power Station	Joppa East Ash Pond	Luminant (formerly Dynegy Inc.)	IL	Open, Part A	No, Industry Claims More Than 5 feet	Yes
JR Whiting Power Plant	Pond 6	Consumers Energy Co.	MI	Closed	Yes, Industry Failed to Claim Otherwise	Yes
JR Whiting Power Plant	Ponds 1 and 2	Consumers Energy Co.	MI	Closed	Yes	Yes
Killen Station	Ash Pond	AES Ohio Generation	OH	Open, No Notice of Intent Posted	Yes	Yes
Kincaid Power Station	Ash Pond	Luminant (formerly Dynegy Inc.)	IL	Open, Part A	Yes	Yes
Kingston Fossil Plant	Sluice Trench and Ballfield East of Sluice Trench	Tennessee Valley Authority	TN	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Kingston Fossil Plant	Stilling Pond	Tennessee Valley Authority	TN	Closed	Yes, Industry Failed to Claim Otherwise	Yes
La Cygne Generating Station	Lower AQC Impoundment	Evergy	KS	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes

Name of Plant or Site	CCR Unit	Operator	State	Closure Status	Industry Reported this Pond Is within 5 feet of Groundwater*	Did EPA Determine This Unit May Be in Contact with Groundwater?
Labadie Energy Center	LCPA	Ameren	MO	Notice of Intent to Close	Yes	Yes
Labadie Energy Center	LCPB	Ameren	MO	Notice of Intent to Close	Yes	Yes
Lansing Generating Station	Upper Ash Pond	Interstate Power and Light Company	IA	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	Yes
Leland Olds Station	Pond 2 Surface Impoundment	Basin Electric Power Cooperative	ND	Closed	Yes, Industry Failed to Claim Otherwise	No
Leland Olds Station	Pond 3 Surface Impoundment	Basin Electric Power Cooperative	ND	Closed	Yes, Industry Failed to Claim Otherwise	No
Louisa Generating Station	Impoundment	MidAmerican Energy Co.	IA	Closed	Yes	Yes
Martin Lake Steam Electric Station	Permanent Disposal Pond 5	Luminant Generation Co., LLC	TX	Open, Part A	No, Industry Claims More Than 5 feet	Yes
Martin Lake Steam Electric Station	West Ash Pond	Luminant Generation Co., LLC	TX	Open, Part A	No, Industry Claims More Than 5 feet	Yes
Meramec Energy Center	CCR Unit MCPA	Ameren	MO	Open, Part A	Yes	Yes
Meramec Energy Center	CCR Unit MCPB	Ameren	MO	Open, Part A	Yes	Yes
Meramec Energy Center	CCR Unit MCPC	Ameren	MO	Open, Part A	Yes	Yes
Meramec Energy Center	CCR Unit MCPD	Ameren	MO	Open, No Notice of Intent Posted	Yes	No
Meramec Energy Center	CCR Unit MCPE	Ameren	MO	Closed	Yes, Industry Failed to Claim Otherwise	No
Michigan City Generating Station	Michigan City Boiler Slag Pond	Northern Indiana Public Service Company	IN	Notice of Intent to Close	Yes	No
Michigan City Generating Station	Primary Settling Pond 2	Northern Indiana Public Service Company	IN	Notice of Intent to Close	Yes	No
Miami Fort Power Station	Miami Fort Basin B	Luminant (formerly Dynegy Inc.)	OH	Open, Part A	Yes	No

Name of Plant or Site	CCR Unit	Operator	State	Closure Status	Industry Reported this Pond Is within 5 feet of Groundwater*	Did EPA Determine This Unit May Be in Contact with Groundwater?
Mill Creek Generating Station	Ash Treatment Basin	Louisville Gas & Electric Company	KY	Closed	Yes	Yes
Milton L Kapp	Main Ash Pond	Interstate Power and Light Company	IA	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Missouri City Generating Station	Inactive CCR Surface Impoundment	City of Independence	MO	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Monticello Steam Electric Station	Northeast Ash Water Retention Pond	Luminant Generation Co., LLC	TX	Open, No Notice of Intent Posted	Yes	No
Monticello Steam Electric Station	West Ash Settling Pond	Luminant Generation Co., LLC	TX	Open, No Notice of Intent Posted	Yes	No
Montour Steam Electric Station	Ash Basin No. 1	Talen Energy	PA	Open, Part A	Yes	Yes
Naughton Power Plant	FGD Pond 1	PacifiCorp Energy	WY	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Naughton Power Plant	FGD Pond 2	PacifiCorp Energy	WY	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Naughton Power Plant	North Ash Pond	PacifiCorp Energy	WY	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Naughton Power Plant	South Ash Pond	PacifiCorp Energy	WY	Open, Part A	No, Industry Claims More Than 5 feet	Yes
Neal North Energy Center	Impoundment 3B	MidAmerican Energy Co.	IA	Notice of Intent to Close	Yes	No
Nelson Dewey Station	Slag Pond	Wisconsin Power & Light Co.	WI	Closed	Yes, Industry Failed to Claim Otherwise	Yes
New Madrid Power Plant	Pond 003	Associated Electric Coop.	MO	Open, Part A	Yes	Yes
New Madrid Power Plant	Lined Ash Pond	Associated Electric Coop.	MO	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Newton Power Station	Newton Primary Ash Pond	Luminant (formerly Dynegy Inc.)	IL	Open, Part A	No, Industry Claims More Than 5 feet	Yes
Northeast Power Station	NE Plant Pond	Austin Utilities	MN	Closed	Yes, Industry Failed to Claim Otherwise	Yes

Name of Plant or Site	CCR Unit	Operator	State	Closure Status	Industry Reported this Pond Is within 5 feet of Groundwater*	Did EPA Determine This Unit May Be in Contact with Groundwater?
Northeastern 3&4 Power Station	Bottom Ash Pond	American Electric Power	OK	Open, No Notice of Intent Posted	Yes	Yes
Oklaunion Power Station	Pond 21	Oklaunion Industrial Park	TX	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Oklaunion Power Station	Pond 22	Oklaunion Industrial Park	TX	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Oklaunion Power Station	Pond 23	Oklaunion Industrial Park	TX	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Oklaunion Power Station	Pond 6	Oklaunion Industrial Park	TX	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Oklaunion Power Station	Wastewater & Sludge Pond	Oklaunion Industrial Park	TX	Notice of Intent to Close	No, Industry Claims More Than 5 feet	Yes
Paradise Fossil Plant	Gypsum Disposal Area	Tennessee Valley Authority	KY	Notice of Intent to Close	Yes	Yes
Paradise Fossil Plant	Peabody Ash Pond	Tennessee Valley Authority	KY	Notice of Intent to Close	Yes	Yes
Paradise Fossil Plant	Slag Ponds Area	Tennessee Valley Authority	KY	Notice of Intent to Close	Yes	Yes
Paradise Fossil Plant	Slag Stilling Pond 2C	Tennessee Valley Authority	KY	Closed, no certification	Yes	No
Petersburg Generating Station	Pond A	Indianapolis Power & Light Company	IN	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	Yes
Petersburg Generating Station	Pond A'	Indianapolis Power & Light Company	IN	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	Yes
Petersburg Generating Station	Pond C	Indianapolis Power & Light Company	IN	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Plant Gadsden	Inactive CCR Surface Impoundment	Alabama Power	AL	Closed, no certification	No, Industry Claims More Than 5 feet	Yes
Plant Greene County	Ash Pond	Alabama Power	AL	Notice of Intent to Close	Yes	Yes
Plant Hammond	Ash Pond 3	Georgia Power Company	GA	Closed, no certification	Yes	Yes
Plant Jack McDonough	Ash Pond 1	Georgia Power Company	GA	Closed, no certification	Yes	Yes

Name of Plant or Site	CCR Unit	Operator	State	Closure Status	Industry Reported this Pond Is within 5 feet of Groundwater*	Did EPA Determine This Unit May Be in Contact with Groundwater?
Plant Jack McDonough	Ash Pond 3	Georgia Power Company	GA	Closed, no certification	Yes	Yes
Plant Jack McDonough	Ash Pond 4	Georgia Power Company	GA	Closed, no certification	Yes	Yes
Plant Scherer	Ash Pond 1	Georgia Power Company	GA	Notice of Intent to Close	Yes	Yes
Plant Smith	CCR Ash Pond	Gulf Power	FL	Notice of Intent to Close	Yes	Yes
Plant Wansley	Ash Pond	Georgia Power Company	GA	Notice of Intent to Close	Yes	Yes
Plant Watson	Ash Pond 1	Mississippi Power	MS	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Plant Yates	Ash Pond 3	Georgia Power Company	GA	Notice of Intent to Close	Yes	Yes
Plant Yates	Ash Pond B'	Georgia Power Company	GA	Notice of Intent to Close	Yes	Yes
Pleasants Power Station	McElroy's Run Disposal Impoundment	Allegheny Energy Supply Co.	WV	Open, Part A	Yes	Yes
Powerton Generating Station	Former Ash Basin	NRG	IL	Notice of Intent to Close	Yes	Yes
Prairie Creek Generating Station	PCS Discharge Pond	Interstate Power and Light Company	IA	Closed	Yes, Industry Failed to Claim Otherwise	No
Prairie Creek Generating Station	PCS Pond 1	Interstate Power and Light Company	IA	Closed	Yes, Industry Failed to Claim Otherwise	No
Prairie Creek Generating Station	PCS Pond 2	Interstate Power and Light Company	IA	Closed	Yes, Industry Failed to Claim Otherwise	No
Prairie Creek Generating Station	PCS Pond 3	Interstate Power and Light Company	IA	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Prairie Creek Generating Station	PCS Pond 4	Interstate Power and Light Company	IA	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Prairie Creek Generating Station	PCS Pond 5	Interstate Power and Light Company	IA	Closed	Yes, Industry Failed to Claim Otherwise	Yes
Prairie Creek Generating Station	PCS Pond 6	Interstate Power and Light Company	IA	Closed	Yes, Industry Failed to Claim Otherwise	Yes

Name of Plant or Site	CCR Unit	Operator	State	Closure Status	Industry Reported this Pond Is within 5 feet of Groundwater*	Did EPA Determine This Unit May Be in Contact with Groundwater?
Prairie Creek Generating Station	PCS Pond 7	Interstate Power and Light Company	IA	Closed	Yes, Industry Failed to Claim Otherwise	Yes
R.M. Schahfer Generating Station	Waste Disposal Area	Northern Indiana Public Service Company	IN	Open, Part A	Yes	No
Rockport Plant	Bottom Ash Pond	American Electric Power	IN	Open, Part A	Yes	No
Rush Island Energy Center	RCPA Surface Impoundment	Ameren	MO	Notice of Intent to Close	Yes	Yes
San Miguel Plant	Equalization Pond	San Miguel Electric Cooperative, Inc.	TX	Open, No Notice of Intent Posted	No, Industry Claims More Than 5 feet	Yes
Sebree Generating Station	Green Station Surface Impoundment	Big Rivers Electric Corporation	KY	Notice of Intent to Close	Yes	Yes
Sebree Generating Station	Reid/HMPL Station CCR Surface Impoundment	Big Rivers Electric Corporation	KY	Notice of Intent to Close	Yes	Yes
Sioux Energy Center	SCPA (Bottom Ash Pond)	Ameren	MO	Open, No Notice of Intent Posted	Yes	Yes
Sioux Energy Center	SCPB (Fly Ash Pond)	Ameren	MO	Open, No Notice of Intent Posted	Yes	Yes
Sunbury	Ash Basin No. 1	Sunbury Generation, L.P.	PA	Closed	Yes, Industry Failed to Claim Otherwise	No
Sutherland Generating Station	Main Pond	Interstate Power and Light Company	IA	Closed	Yes	Yes
Sutherland Generating Station	North Primary Pond	Interstate Power and Light Company	IA	Closed	Yes	Yes
Sutherland Generating Station	Polishing Pond	Interstate Power and Light Company	IA	Closed	Yes	Yes
Sutherland Generating Station	South Primary Pond	Interstate Power and Light Company	IA	Closed	Yes	Yes
Thomas Hill Energy Center	Cell 003	Associated Electric Coop.	MO	Open, Part A	Yes	Yes
Thomas Hill Energy Center	Cell 004	Associated Electric Coop.	MO	Open, Part A	Yes	No
Trimble County Generating Station	Bottom Ash Pond	Louisville Gas & Electric Company	KY	Notice of Intent to Close	Yes	Yes

Name of Plant or Site	CCR Unit	Operator	State	Closure Status	Industry Reported this Pond Is within 5 feet of Groundwater*	Did EPA Determine This Unit May Be in Contact with Groundwater?
Wabash River Generating Station	South Ash Pond	Duke Energy	IN	Notice of Intent to Close	Yes	Yes
Walter Scott Jr. Energy Center	North Surface Impoundment	MidAmerican Energy Co.	IA	Notice of Intent to Close	Yes	Yes
Walter Scott Jr. Energy Center	South Surface Impoundment	MidAmerican Energy Co.	IA	Notice of Intent to Close	Yes	No
Waukegan Station	East Ash Pond	NRG	IL	Open, Part A	No, Industry Claims More Than 5 feet	Yes
Whitewater Valley Station	P1, P2, P3, P4	Richmond Power & Light	IN	Notice of Intent to Close	Yes	Yes
Will County Station	Ash Pond 2 South	NRG	IL	Open, Part A	Yes	Yes
Will County Station	Ash Pond 3 South	NRG	IL	Open, Part A	Yes	Yes
William C. Gorgas Electric Generating Plant	Ash Pond	Alabama Power	AL	Notice of Intent to Close	Yes	Yes
Winyah Generating Station	South Ash Pond	Santee Cooper	SC	Notice of Intent to Close	Yes	No
Wood River Power Station	Wood River Primary East Ash Pond	Luminant (formerly Dynegy Inc.)	IL	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	No
Wood River Power Station	Wood River West Ash Pond 1	Luminant (formerly Dynegy Inc.)	IL	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	Yes
Wood River Power Station	Wood River West Ash Pond 2E	Luminant (formerly Dynegy Inc.)	IL	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	Yes
Wood River Power Station	Wood River West Ash Pond 2W	Luminant (formerly Dynegy Inc.)	IL	Notice of Intent to Close	Yes, Industry Failed to Claim Otherwise	Yes

* This means that either industry posted a certification pursuant to 40 CFR § 257.60(b) stating the pond was too close to (within 5 feet of) groundwater, or they failed to post any document and have thus failed to demonstrate that the pond is greater than 5 feet from groundwater.

Appendix E

Problems at the eleven power plants with remedies that include groundwater treatment

As described in our main report, we identified 265 power plants that appear to be contaminating local groundwater with coal ash, but we found that only 37 of these plants had selected a remedy, and only 11 of those remedies included groundwater treatment.

The owners of these 11 power plants have, in some ways, done more to address coal ash contamination than other sites – they have acknowledged the contamination, and committed to a plan for cleaning up both the ash and the groundwater. However, a closer look at each site's remedy reveals that all but one of these 11 plants have other issues that will undermine the selected remedy and prevent the restoration of groundwater quality. This appendix briefly summarizes some of the deficiencies at each site. Note that this list is not necessarily exhaustive and there may be additional deficiencies in Coal Ash Rule implementation (for example, the failure to apply the Rule to coal ash units that we are not aware of) or in the scope of the remedy at each site.

Allen Fossil Plant (TN)

The Tennessee Valley Authority has selected a remedy for the East Ash Pond at Allen, and plans to treat groundwater near that ash pond. It also plans to remove ash from the West Ash Pond at Allen. Yet TVA has not applied the Coal Ash Rule to the West Ash Pond, which means that it has not monitored the groundwater around that ash pond (or has failed to share that information with the public) and has not considered the need for groundwater treatment around that ash pond. As described in our main report, TVA acknowledged contamination coming from the West Ash Pond in 2008. We presume that the contamination continues, that the ash pond is an "inactive surface impoundment" subject to the Coal Ash Rule, and that TVA must therefore apply the Coal Ash Rule, monitor groundwater, and implement a remedy that includes groundwater treatment at the West Ash Pond.

Colstrip Steam Electric Station (MT)

Talen Montana, LLC has selected a remedy for three ash pond units at the Colstrip site, and the remedy includes groundwater treatment (groundwater capture and freshwater flushing). However, Talen is planning to close all regulated ash pond units in place, despite the fact that some of them are in contact with groundwater. Specifically, Talen concedes that the "Units 1&2 B Fly Ash Pond" and "Units 1&2 Bottom Ash Pond" are within five feet of groundwater,[1] and EPA additionally believes that the "3&4 EHP" B, C and G cells may be in contact with groundwater.[2] This means that the groundwater capture system will have to run indefinitely, and there is no prospect of imminent restoration of groundwater quality.

Gaston (AL)

[1] Geosyntec, Location Restrictions Compliance Demonstration Report, Colstrip Power Plant at 3 (Oct. 2018).
[2] U.S. EPA, Table, CCR Surface Impoundments Potentially with Waste Below the Water Table, Pers. Comm. From U.S. EPA to Lisa Evans on May 9, 2022.

Alabama Power has selected a remedy for the Gaston Ash Pond that relies heavily on monitored natural attenuation (see Section D.7 of this report for a discussion of why this is inappropriate).[3] More importantly, the Gaston Ash Pond is sitting in groundwater, so Alabama Power's plan to cap the unit in place violates the Coal Ash Rule and sets the stage for an indefinite post-closure period during which contaminants continue to seep out of the ash. Although the remedy also includes a measure called "permeation grouting," which means filling local bedrock with cement, the most that Alabama Power can say about the technique is that it will "reduce" (not stop) groundwater flow into and out of the unit. This does not fix the underlying problem – contact between coal ash and groundwater – it merely prolongs the process of toxic metals seeping out of the unit and into local groundwater. A far better remedy would involve the removal of coal ash from groundwater prior to closure.

Neal South (IA)

MidAmerican Energy Company's remedy includes closure in place, chemical injection to immobilize arsenic, and monitored natural attenuation.[4] There are at least three problems with this remedy. First, it only addresses arsenic, even though the site also has elevated and unsafe concentrations of boron and cobalt in downgradient wells. It is unclear whether the chemical injection would have any effect on boron and cobalt concentrations.

Second, the site-specific groundwater protection standard for arsenic is far too high. Arsenic concentrations in the two original upgradient wells (MW-4 and MW-15) never exceeded 3 µg/L. In 2018, the owners installed three new purportedly upgradient wells.[5] These new wells, in particular well MW-18, showed much higher arsenic concentrations, and the site's most recent annual groundwater monitoring report raised the groundwater standard from 22.4 to 70.1 µg/L on the basis of the data in well MW-18.[6] In that well, concentrations average around 29 µg/L (if you include a likely outlier of 224 µg/L) or 14 µg/L (if you exclude the outlier). Clearly the arsenic levels in well MW-18 are not like those in the original upgradient wells. That could be because the well is not consistently upgradient of the landfill. At least one potentiometric surface shows it as "sidegradient," which means it is neither up- nor down-gradient and could be affected by the landfill.[7] Whatever the cause, well MW-18 is not a reliable basis for setting a groundwater standard. A groundwater protection standard of 70.1 µg/L is certainly too high, as it is based on a data point that the owners themselves describe as an outlier.[8] But even a standard of 22.4 µg/L is too high, given the much lower arsenic levels seen in the original upgradient wells. In general, the problem with using a potentially contaminated well to establish the site-specific groundwater protection standard is that remedies are deemed complete when groundwater falls below the

---

[3] *See generally* Anchor QEA, LLC, Groundwater Remedy Selection Report for Plant Gaston (Nov. 2021).
[4] GHD, Remedy Selection Report for the Neal South CCR Monofill (Dec. 31, 2020).
[5] *Id*. at 2.
[6] GHD, Annual Groundwater Monitoring and Corrective Action Report for the Neal South CCR Monofill at 7 (Jan. 31, 2022); see also id. at Appendix E, page 2 ("[T]he updated site-specific GWPS for arsenic is 0.0701 mg/L").
[7] GHD, Annual Groundwater Monitoring and Corrective Action Report for the Neal South CCR Monofill at Figure 3-3 (Jan. 31, 2022).
[8] GHD, Annual Groundwater Monitoring and Corrective Action Report for the Neal South CCR Monofill at 7 (Jan. 31, 2022).

standard. If the standard is inflated, the cleanup may be terminated prematurely, leaving contaminated groundwater and perhaps a leaking coal ash dump in place.

Finally, we have the benefit of a "performance monitoring evaluation report" that evaluates the effectiveness of the chemical injection program that started in 2020.[9] Unfortunately, that report suggests that the chemical injection program is not working, at least not yet. One year after chemical injection started, some wells saw arsenic levels go down and then up, others saw arsenic levels go up and then down, but overall there is no pattern of improvement.[10]

In sum, the remedy is targeting only one of the contaminants of concern, using an inflated groundwater protection standard, and the remedy does not appear to be working as intended.

Greene County (AL)

Alabama Power plans to address contamination at the Plant Greene County Ash Pond by capping the ash in place, building a slurry wall around the consolidated ash, chemically treating groundwater to immobilize some contaminants, and Monitored Natural Attenuation (MNA).[11]

One problem at this site is contact between coal ash and groundwater. Up to ten feet of the coal ash is saturated with groundwater,[12] so closing this unit in place plainly violates the Coal Ash Rule, as discussed in our main report. According to the EPA, "surface impoundments or landfills cannot be closed with coal ash in contact with groundwater."[13]

In addition, the remedy relies heavily on Monitored Natural Attenuation (MNA), falsely claiming that MNA is already working at the site.[14] But MNA is <u>not</u> working at the site: Arsenic concentrations are increasing in at least three wells, including two wells with average arsenic concentrations in excess of 300 µg/L, the highest levels seen anywhere at the site (MW-1, MW-5 and MW-17), cobalt is increasing in well MW-1 (which has the highest on-site cobalt concentrations), and lithium is increasing in at least five wells (wells MW-5, 10, 11, 14, and 16), again including the well with the highest on-site lithium concentrations (MW-14, with an average concentration of 651 µg/L as of 2019). So the facts show that MNA is not working at Plant Greene County, which is consistent with EPA's position that MNA is generally not appropriate for coal ash constituents (see Section D.7 of our main report).

Although the remedy for Plant Greene County also includes slurry walls, which might partially contain contaminated groundwater, this does not "remove from the environment as much of the

---

[9] *Id*. at Appendix E, Performance Monitoring Evaluation Report.
[10] *Id*.
[11] Anchor QEA, Groundwater Remedy Selection Report for Plant Greene County (Sep. 2021).
[12] *See, e.g., Id*. at Figure 4 and Appendix B (Geologic Cross-Sections) Figure 12C.
[13] U.S. EPA, EPA Takes Key Steps to Protect Groundwater from Coal Ash Contamination (Jan. 11, 2022), https://www.epa.gov/newsreleases/epa-takes-key-steps-protect-groundwater-coal-ash-contamination (emphasis added); see also 40 C.F.R. § 257.102(d)(1).
[14] Anchor QEA, Groundwater Remedy Selection Report for Plant Greene County at 22 (Sep. 2021); Id. at Appendix D, Monitored Natural Attenuation Demonstration.

contaminated material that was released from the CCR unit as is feasible,"[15] and instead leaves it in place.

Huntington Power Plant (UT)

PacifiCorp's remedy for the coal ash landfill at the Huntington Power Plant involves "maintain[ing] . . . existing waste management practices," diversion and collection of stormwater, and collection of contaminated groundwater using horizontal wells and a groundwater pump system.[16]

The most obvious problem with PacifiCorp's remedy is that it includes a form of groundwater treatment, but no real source control. The current waste management practices – conditioning of flue gas desulfurization waste prior to placement in the landfill and removal of "all free liquids" – have been in place since 2007.[17] PacifiCorp claims that the existing waste management practices and groundwater collection system have reduced groundwater contamination, but with no evidence. The data provided pursuant to the Coal Ash Rule do not show any change in contamination between 2016 and 2021. For example, well HDP2, perhaps the most contaminated well at the site, shows persistently high and stable concentrations of boron, lithium, molybdenum, and selenium.[18] In sum, given the lack of evidence for the effectiveness of existing practices, PacifiCorp's plan amounts to indefinite treatment of groundwater that the landfill will continue to pollute. This is not a complete remedy.

In addition, it is not clear whether PacifiCorp is addressing all possible sources of coal ash contamination at the site. In EPA's risk assessment for the 2015 Coal Ash Rule, the agency listed two ash ponds and three landfills at the site.[19] Yet PacifiCorp is only applying the Coal Ash Rule to one landfill. Unless all five EPA-identified units were within the footprint of the one landfill, there may be more coal ash adding contamination to local groundwater. If this is the case, then the remedy will not be able to achieve the goal of the Coal Ash Rule (restoration of groundwater quality).

Intermountain (UT)

In 2021, Intermountain Power Service Corporation selected a remedy for all three regulated coal ash units at its Intermountain Generating Facility.[20] The remedy is essentially a "pump and evaporate" system that collects contaminated groundwater from the downgradient side of the site and pumps it to new evaporation ponds. Like the remedy for Huntington described above, this remedy lacks meaningful source control (at least through coal ash unit closure in 2028[21]), so it is

---

[15] 40 C.F.R. § 257.97(b)(4).
[16] Water & Environmental Technologies, Remedy Selection Report for CCR Landfill – Huntington Power Plant at 1 (Aug. 2020).
[17] *Id*.
[18] Water & Environmental Technologies, Groundwater Monitoring & Corrective Action Report – Huntington Power Plant at Table 1 (Jan. 2022).
[19] U.S. EPA, Human and Ecological Risk Assessment of Coal Combustion Residuals at Attachment A-1, page A-1-4 (Dec. 2014).
[20] Stantec, Selection of Remedy Report, Intermountain Generating Facility (June 16, 2021).
[21] *See id*. at 6.1 ("IPSC's November 2020 CCR Unit Closure Plans provide extensive details and element-specific

incomplete – Intermountain is not doing anything to stop contaminants from seeping out of its coal ash units.

In addition, the groundwater treatment plan, and the characterization of the extent of contamination, is tied to concentrations of Total Dissolved Solids (TDS) rather than the constituents that triggered corrective action (arsenic, lithium and molybdenum) or coal ash indicators like boron and sulfate. Intermountain states that TDS was selected as the indicator because it is "conservative," here meaning that it migrates at the same rate as groundwater,[22] but the same can be said about boron, sulfate and lithium.[23] Furthermore, according to the Coal Ash Rule, a remedy is only complete when groundwater protection standards have been attained, so Intermountain will eventually have to characterize the plume using arsenic, lithium and molybdenum. A successful plume characterization and remedy design should be based on constituents that matter – in this case, arsenic, boron, lithium, molybdenum, and sulfate.

Laramie River Station (WY)

The Laramie River Station is one site where the remedy appears to be adequate. The owner, Basin Electric Power Cooperative, has installed an adequate number of wells around all five onsite coal ash dumps, and the data suggest that only one unit – Bottom Ash Pond 1 – is causing groundwater protection standard exceedances. For that unit, Basin Electric is planning both source control (retrofitting the ash pond) and groundwater treatment (groundwater extraction) and estimates that the two activities will attain groundwater protection standards in 2 to 3 years.[24]

Mountaineer (WV)

There are two regulated units at AEP's Mountaineer Plant, a Bottom Ash Ponds unit and a Landfill. AEP has selected a remedy for the Bottom Ash Pond that consists of removing ash from the ponds and groundwater pumping, which together are expected to attain groundwater protection standards within 2 to 7 years. This could be an adequate remedy in the abstract, but unfortunately there are serious problems with the site's groundwater monitoring database, which means that the scope of the problem to be addressed is unclear and the remedy is unreliable

The noncompliance at Mountaineer is spelled out in detail in EPA's conditional approval of a deadline extension request.[25] To briefly summarize, AEP did not provide complete groundwater

---

schedules for closure of each of the three CCR units, no later than the end of 2028").

[22] *Id*. at 2.3.

[23] *See, e.g.*, U.S. EPA, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities, 80 Fed. Reg. 21302, 21456 (Apr. 17, 2015) (describing the "high mobility" of boron); U.S. EPA, Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; Amendments to the National Minimum Criteria (Phase One); Proposed Rule, 83 Fed. Ref. 11584, 11588 (Mar. 15, 2018) ("Out of all the coal ash constituents modeled by EPA, boron has the fastest travel time"); Sanborn Head, Assessment of Corrective Measures, AEP Mountaineer Plant Bottom Ash Ponds at 11 (June 24, 2019) ("Lithium is generally weakly or not taken up by soils (low Kd) . . . [and] lithium is relatively mobile under site conditions").

[24] AECOM, Groundwater Remedy Selection Report, Laramie River Station (July 2020).

[25] U.S. EPA, Proposed Conditional Approval of Alternative Closure Deadline for the Mountaineer Power (July 12, 2022), available at https://www.regulations.gov/document/EPA-HQ-OLEM-2021-0842-0001.

monitoring reports; did not properly analyze baseline groundwater data; used contaminated downgradient wells as background wells at the Landfill; inappropriately used sidegradient wells as background wells at the Bottom Ash Ponds; failed to install a sufficient number of wells downgradient of the Landfill; improperly excluded data purported to be outliers; improperly used intrawell data comparisons; failed to account for past ash disposal at neighboring sites; and failed to provide a remedial timeline. For all of these reasons, it is unclear whether the Landfill should also be cleaned up or whether the Assessment of Corrective Measures at the Bottom Ash Ponds adequately characterized the nature and extent of contamination. Until AEP properly assesses onsite contamination, there is no reason to expect that the remedy will restore groundwater quality.

Naughton (WY)

Noncompliance at Naughton is discussed in detail in Section E.3 and Appendix B of the main report. In short, the owner has only selected a remedy for one unit (FGD Pond 1) even though at least four units appear to be contaminating local groundwater. The remedy cannot restore groundwater quality unless it addresses all sources of coal ash contamination at the site.

San Miguel (TX)

Noncompliance at San Miguel is discussed in detail in Section E.1 and Appendix B of the main report. In short, the groundwater monitoring network around the two onsite ash ponds is flawed in multiple ways that might underestimate the scale of the contamination to be addressed, and the owner has not estimated how long it will take for the remedy to work. As a result, the remedy is inherently unreliable, and the public cannot be confident that groundwater quality will be restored.

ENDNOTES

[1] See American Coal Ash Association, 2020 Coal Combustion Product (CCP) Production and Use Survey Report, *available at* https://acaa-usa.org/wp-content/uploads/2021/12/2020-Production-and-Use-Survey-Results-FINAL.pdf.

[2] American Road & Transportation Builders Association, ACAA, Production and Use of Coal Combustion Products in the U.S.: Market Forecast Through 2023, at 11 & 14, Figs. 1-1 & 2-1 (June 2015); ACAA, Ash at Work: Applications, Science and Sustainability of Coal Ash, Issue 1, at 14, Chart 1 (2008); ACAA, Coal Combustion Product (CCP) Production & Use Survey Reports, 2014 – 2017, *available* https://acaa-usa.org/publications/production-use-reports/. Estimate based on U.S. coal ash generation of approximately 5 billion cubic yards to present day. The train car analogy assumes that each ton of coal ash occupies one cubic yard of space, that each train car holds 197 cubic yards, and that each train car is 60 feet long (coupled).

[3] 80 Fed. Reg. at 21,450. Note that EPA counts 157 damage cases, but the accurate number is 158, as EPA's damage case spreadsheet erroneously numbered two potential damage cases as number 16. *See* Alexander Livnat, U.S. Environmental Protection Agency, CCR Damage Case Database, Technical Support Document on Damage Cases, Docket No. EPA-HQ-RCRA-2009-0640 (Dec. 18, 2014) (Document No. EPA- HQRCRA-2009-0640-12123), https://www.regulations.gov/#!documentDetail;D=EPA-HQ-RCRA-2009-0640- 12123.

[4] 80 Fed. Reg. at 21,213.

[5] *Id.* at 21,457, fn. 219.

[6] U.S. EPA, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule, 80 Fed. Reg. 21302, 21404 (Apr. 17, 2015) (hereinafter "2015 Coal Ash Rule").

[7] Environmental Integrity Project & Earthjustice, Coal's Poisonous Legacy: Groundwater Contaminated by Coal Ash Across the U.S. ((Mar. 2, 2019, rev. July 11, 2019) (hereinafter "**Coal's Poisonous Legacy**"), *available at* https://www.environmentalintegrity.org/reports/coals-poisonous-legacy/ .

[8] This information was gathered in the US EPA Office of Water 2010 Steam Electric Power Generating Effluent Guidelines Questionnaire (https://www.epa.gov/eg/steam-electric-power-generating-effluent-guidelines-questionnaire). 287 of the 302 plants with regulated coal ash ponds or landfills responded with this information.

[9] *See* Coal's Poisonous Legacy at 44-46, fn. 7, *supra.*

[10] Todd Heywood, BWL discovers significant boron contamination in private wells, Lansing City Pulse (Feb. 11, 2022), https://lansingcitypulse.com/stories/bwl-discovers-significant-boron-contamination-in-private-wells,19865.

[11] The Coal Ash Rule does not require owners to state whether their ash ponds are in contact with groundwater. Instead, the rule requires owners to certify whether their ash ponds are "constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer." 40 C.F.R. §257.60.

[12] Of these 200, 165 are units where industry reporting shows the units are closing in place and are within five feet water table. The 35 additional units are where the industry has claimed that the pond is not close to groundwater, but the EPA identified them on a list of ponds closing in place close to groundwater.

[13] See Earthjustice database: https://earthjustice.org/coalash/data-2022.

[14] Z. Wang et al., *Legacy of Coal Combustion: Widespread Contamination of Lake Sediments and Implications for Chronic Risks to Aquatic Ecosystems*, Environmental Science & Technology (Oct. 3, 2022) (DOI: 10.1021/acs.est.2c04717).

[15] 40 C.F.R. §257.97(a).

[16] *Util. Solid Waste Activities Grp. v. EPA,* 901 F.3d 414, 420 (D.C. Cir. 2018).

[17] We estimated the total volume of coal ash in unregulated landfills by looking at information collected by the EPA in 2010. *See* EPA, Questionnaire for the Steam Electric Power Generating Effluent Guidelines, https://www.epa.gov/sites/default/files/2015-06/documents/steam-electric_questionnaire_052010.pdf (last accessed May 12, 2022); EPA, Steam Electric Power Industry Technical Questionnaire – Response Database (Access) (accdb), https://www.epa.gov/eg/steam-electric-power-generating-effluent-guidelines-questionnaire (last accessed May 12, 2022). Of the 285 inactive CCR landfills in the survey results, only twenty percent reported volume information. The volume associated with that subset was roughly 112 million cubic yards. Extrapolating this out to all 285 inactive landfills yields an estimate of over half a billion cubic yards. We also assumed, as EPA does, that the density of coal ash is one ton per cubic yard. *See, e.g.*, U.S. EPA, Regulatory Impact Analysis EPA's 2015 RCRA Final Rule Regulating Coal Combustion Residual (CCR) Landfills and Surface Impoundments at Coal-Fired Electric Utility Power Plants at Appendix D, page D-5 (Dec. 2014) (citing a density of 1,190 kg/m^3, which converts to 1 ton per cubic yard).

[18] 40 C.F.R. § 257.101(a)(1) generally required power companies to stop using unlined coal ash ponds by April 11, 2021 and initiate closure. Narrow extensions available under 40 C.F.R. § 257.103 allow some coal ash ponds to continue receiving ash until 2023 or 2024, or require complete closure by 2023 or 2028. Power companies requested extensions for 59 ash ponds, though 5 of those have already stopped receiving ash. See U.S. EPA, Coal Combustion Residuals (CCR) Part A Implementation, https://www.epa.gov/coalash/coal-combustion-residuals-ccr-part-implementation.

[19] *See,* Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Federal CCR Permit Program, 85 Fed. Reg. 9,940 (Feb. 20, 2020).

[20] U.S. EPA, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, 80 Fed. Reg. 21,302 at 21,303.

[21] *See* fn. 1*, supra.*

[22] *See* fn. 2, *supra.*

[23] *See* Coal's Poisonous Legacy, fn. 7, *supra*.

[24] U.S. EPA, Human and Ecological Risk Assessment of Coal Combustion Residuals (Final, Dec. 2014), hereinafter "**EPA Risk Assessment**."

[25] U.S. EPA (1998), Integrated Risk Information System, Inorganic Arsenic, available at https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=278; ATSDR (2007), Toxicological Profile for Arsenic; Grandjean and Landrigan (2014), Neurobehavioural Effects of Developmental Toxicity, Lancet Neurol. 13:330-338. One recent study in Maine found significant reductions in IQ and other neurological endpoints in children exposed to 5-10 micrograms per liter, a level that is below the current drinking water standard.

Wasserman et al. (2014), A Cross-Sectional Study of Well Water Arsenic and Child IQ in Maine Schoolchildren, Environ Health 13:23-32.

[26] EPA Risk Assessment at 5-5 to 5-6. In a preliminary screening analysis, EPA also identified a potential cancer risk associated with the consumption of arsenic-contaminated fish. Id. at 3-20.

[27] *See, e.g.*, U.S. EPA, Toxicological Review of Boron and Compounds (June 2004); Agency for Toxic Substances and Disease Registry, Toxicological Profile for Boron (November 2010); U.S. EPA, Drinking Water Health Advisory for Boron (May 2008).

[28] 83 Fed. Reg. at 11,589 ("[T]he 2014 risk assessment shows that boron can pose developmental risks to humans when released to groundwater and can result in stunted growth, phytotoxicity, or death to aquatic biota and plants when released to surfacewater bodies").

[29] *Id.*; EPA Risk Assessment at 5-8, fn. 23 *supra*.

[30] U.S. EPA, Integrated Risk Information System, Cadmium, https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=141.

[31] EPA Risk Assessment at 3-20, fn. 23, *supra*.

[32] *See, e.g.*, U.S. EPA, Environmental Assessment for the Effluent Limitations Guidelines and Standards for the Steam Electric power Generating Point Source Category at page 3-3 (Sep. 2015).

[33] EPA Risk Assessment at 5-8, fn. 23, *supra*.

[34] *See, e.g.*, ATSDR, Toxicological Profile for Cobalt (Apr. 2004). The most sensitive endpoint for intermediate oral exposure in the ATSDR analysis was the blood disorder polycythemia, which has been observed in humans. *See also* U.S. EPA, Provisional Peer Reviewed Toxicity Values for Cobalt (2008). The EPA document notes that polycythemia and thyroid effects occur at similar levels of exposure, but derives a health-based threshold from thyroid toxicity data.

[35] EPA Risk Assessment at 5-8, fn. 23, *supra*.

[36] *See, e.g.*, California EPA, Public Health Goal for Hexavalent Chromium (Cr VI) in Drinking Water (July 2011), https://oehha.ca.gov/media/downloads/water/chemicals/phg/cr6phg072911.pdf

[37] *See, e.g.*, A.L. Choi et al., *Developmental Fluoride Neurotoxicity: A Systematic Review and Meta-Analysis*, Environ Health Perspect 120:1362-1368 (2012); M. Bashash et al., *Prenatal Fluoride Exposure and Cognitive Outcomes in Children at 4 and 6-12 Years of Age in Mexico*, Environmental Health Perspectives 125(9):097017 (2017); P. Grandjean, *Developmental fluoride neurotoxicity: an updated review*, Environ Health 18:110 (2019); R. Green et al., *Association Between Maternal Fluoride Exposure During Pregnancy and IQ Scores in Offspring in Canada*, JAMA Pediatrics 173(10):940-948C (2019); Till et al., *Fluoride Exposure from Infant Formula and Child IQ in a Canadian Birth Cohort*, Environ Int. vol. 134 (2020).

[38] *See generally* NAS (National Academy of Sciences), Fluoride in Drinking Water: A Scientific Review of EPA's Standards (2006).

[39] *See, e.g.*, E.B. Bassin et al., *Age-specific fluoride exposure in drinking water and Osteosarcoma (United States)*, Cancer Causes Control 17:421-428 (2006); NAS (National Academy of Sciences), Fluoride in Drinking Water: A Scientific Review of EPA's Standards at 134 (2006) ("Perhaps the single clearest effect of fluoride on the skeleton is

its stimulation of osteoblast proliferation … Because fluoride stimulates osteoblast proliferation, there is a theoretical risk that it might induce a malignant change in the expanding cell population”).

40 U.S. EPA, Integrated Risk Information System, Lead and Compounds (inorganic), https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=277.

41 *See, e.g.,* U.S. EPA, Environmental Assessment for the Effluent Limitations Guidelines and Standards for the Steam Electric power Generating Point Source Category at page 3-3 (Sep. 2015) (“Lead contamination can delay embryonic development, suppress reproduction, and inhibit growth in fish”).

42 *See* World Health Organization, “Lead Poisoning and Health,” August 23, 2018, http://www.who.int/news-room/fact-sheets/detail/lead-poisoning-and-health

43 U.S. EPA, Provisional Peer Reviewed Toxicity Values for Lithium (2008).

44 EPA Risk Assessment at 4-17, 5-5, 5-8, fn. 23, *supra*.

45 *See, e.g.*, U.S. EPA, Environmental Assessment for the Effluent Limitations Guidelines and Standards for the Steam Electric power Generating Point Source Category page 3-4 (Sep. 2015).

46 EPA Risk Assessment at 3-20, 5-8, fn. 23, *supra*.

47 *See, e.g.*, U.S. EPA, Integrated Risk Information System, Molybdenum, https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0425_summary.pdf#nameddest=rfd; ATSDR, DRAFT Toxicological Profile for Molybdenum (2017).

48 EPA Risk Assessment at 4-17, fn. 23, *supra*.

49 U.S. EPA, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule, 80 Fed. Reg. 21302, 21404 (Apr. 17, 2015) (hereinafter “2015 Coal Ash Rule”).

50 *See, e.g.*, U.S. EPA, Environmental Assessment for the Effluent Limitations Guidelines and Standards for the Steam Electric power Generating Point Source Category page 3-4 (Sep. 2015).

51 *See, e.g.*, U.S. EPA, Integrated Risk Information System, Selenium, https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=472. https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0425_summary.pdf#nameddest=rfd

52 EPA Risk Assessment at 3-20, fn. 23, *supra*.

53 2015 Coal Ash Rule, 80 Fed. Reg. 21456.

54 *Id*.

55 *See, e.g.*, U.S. EPA, Environmental Assessment for the Effluent Limitations Guidelines and Standards for the Steam Electric power Generating Point Source Category page 3-4 (Sep. 2015).

56 EPA Risk Assessment at 5-5 and 3-20, fn. 23, *supra*.

57 *Id*. at 5-36 to 5-37.

[58] 80 FR 21,455, April 17, 2015.

[59] *Utility Solid Waste Activities Group v. Environmental Protection Agency,* 901 F.3d 414, 420 (D.C. Cir. 2018) (hereinafter "*USWAG v. EPA*").

[60] National Geographic, Coal's other dark side: Toxic ash that can poison water and people, February 19, 2019, Joel K. Bourne, available at https://www.nationalgeographic.com/environment/article/coal-other-dark-side-toxic-ash. See also, Austyn Gaffney, 'They deserve to be heard': Sick and dying coal ash cleanup workers fight for their lives, The Guardian, Aug 17, 22020, available at https://www.theguardian.com/us-news/2020/aug/17/coal-spill-workers-sick-dying-tva; 80 Fed. Reg. at 21,313.

[61] 80 Fed. Reg. at 21,327.

[62] Earthjustice filed the suit on behalf of Appalachian Voices, Chesapeake Climate Action Network, Environmental Integrity Project, Kentuckians For The Commonwealth, Montana Environmental Information Center, Moapa Band of Paiutes, Prairie Rivers Network, Physicians for Social Responsibility, Southern Alliance for Clean Energy, Sierra Club, and Western North Carolina Alliance. *Appalachian Voices v. McCarthy*, 989 F. Supp. 2d 30, 56 (D.D.C. 2013).

[63] 40 C.F.R. Part 257, Subpart D.

[64] 40 C.F.R. §§257.60-64, 70-74, 80-84, 90-98, 100-07.

[65] *See Util. Solid Waste Activities Grp. v. Env't Prot. Agency*, 901 F.3d 414 (D.C. Cir. 2018), judgment entered, No. 15-1219, 2018 WL 4158384 (D.C. Cir. Aug. 21, 2018) (hereinafter "USWAG v. EPA"). This was a case consolidating petitions for review from both industry and environmental organizations. Earthjustice filed a Petition for Review on behalf of Clean Water Action, Environmental Integrity Project, Hoosier Environmental Council, PennEnvironment, Prairie Rivers Network, Sierra Club, Tennessee Clean Water Network, and Waterkeeper Alliance.

[66] *See USWAG v. EPA*, Respondent EPA's Unopposed Motion for Voluntary Remand of Specific Regulatory Provisions (Apr. 18, 2016).

[67] *See* 42 U.S.C. §6945(d).

[68] U.S. EPA, Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Amendments to the National Minimum Criteria (Phase One, Part One), 83 Fed. Reg. 36435 (July 30, 2018).

[69] *Supra*, fn 11.

[70] U.S. EPA, Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; A Holistic Approach to Closure Part A: Deadline to Initiate Closure, 85 Fed. Reg. 53516 (Aug. 28, 2020).

[71] 40 C.F.R. §257.71(d).

[72] 40 CFR Part 257.

[73] Strictly speaking, the rule exempts landfills that stopped receiving waste before October 2015, and ash ponds that both (a) stopped receiving waste and (b) were completely dewatered before October 2015. Ash ponds that stopped receiving waste before October 2015 but continued to hold ash and water – which could be either standing surface water or groundwater saturating the ash – are regulated as "inactive surface impoundments." 40 CFR § 257.50 (c) and (d), 257.53 (definition of "inactive surface impoundment").

[74] 40 CFR §§ 257.90-257.98.

[75] 40 CFR § 257.91(a)(1).

[76] 40 CFR § 257.91(d).

[77] 40 CFR § 257.94(b).

[78] 40 CFR Part 257 Appendix III.

[79] 40 CFR § 257.94(e).

[80] 40 CFR § 257.95.

[81] 40 CFR § 257.96.

[82] Some coal ash ponds were eligible for an extension, and not required to complete baseline monitoring until April 17, 2019. 40 C.F.R. § 257.100(e)(5). Under the terms of the original 2015 Coal Ash Rule, if an owner or operator committed to closing an ash pond by April 17, 2018, then that "early closure" pond was exempt from other requirement of the Coal Ash Rule, including groundwater monitoring requirements. After being challenged in court, EPA voluntarily vacated this loophole in August, 2016. U.S. EPA, Hazardous and Solid Waste Management Systems: Disposal of Coal Combustion Residuals from Electric Utilities; Extension of Compliance Deadlines for Certain Inactive Surface Impoundments; Response to Partial Vacatur, Direct Final Rule, 81 Fed. Reg. 51802 (Aug. 5, 2016). EPA also extended many compliance deadlines in order to give these "early closure" owners time to catch up with all of the regulatory requirements to which they were not previously subject. For all "early closure" ponds, the first annual groundwater monitoring report must be completed by August 1, 2019 and posted online by August 31, 2019. 40 C.F.R. §§ 257.100(e)(5), 90(e), 105(h)(1), 107(d), and 107(h)(1).

[83] Coal's Poisonous Legacy, fn. 7, *supra*.

[84] The number of disposal units is complicated by the fact that some sites use "multi-unit" groundwater monitoring networks, which surround two or more individual disposal units. For purposes of analysis, given that a multi-unit system cannot identify which monitored unit is leaking, we treat each multi-unit monitoring network as a single potential source.

[85] The total number of regulated coal ash units tracked in the compliance database differs from the disposal units evaluated for groundwater contamination. As noted earlier, there are 537 disposal units at 292 sites evaluated for groundwater contamination in this report. We track information for 746 units at 302 sites in the compliance database. The discrepancy is due to two things. First, there are ten sites in the compliance database that did not post groundwater data prior to 2020, so there were no data for the period of analysis covered by the groundwater database. Second, the Coal Ash Rule allows for "multi-unit" groundwater monitoring systems, which are networks of wells that surround multiple disposal units. For the groundwater analysis, these multi-unit systems are treated as single units. For the compliance database, each unit is listed separately.

[86] This is true even though 104 of the 746 regulated units have been closed by complete removal in the last several years.

[87] A handful of landfills and ponds (35) have no recent groundwater monitoring reports posted. Many of these units closed by removal in late 2015 or early 2016. These coal ash units are excluded from Figure 1.

[88] According to 40 CFR § 257.60, owners are generally required to certify that their ash ponds are built at least five feet "above the upper limit of the uppermost aquifer" or close the ponds. We, like the Coal Ash Rule, treat the failure to post a certification as an admission that the ash pond is less than five feet from groundwater.

[89] *See, e.g.*, EIP and Earthjustice, Coal's Poisonous Legacy: Groundwater Contaminated by Coal Ash Across the U.S., at 38-42 (Rev. July 11, 2019).

[90] *See generally*, U.S. EPA, Coal Combustion Residuals (CCR) Part A Implementation, https://www.epa.gov/coalash/coal-combustion-residuals-ccr-part-implementation, and U.S. EPA Press Release: EPA Takes Key Steps to Protect Groundwater from Coal Ash Contamination (Jan. 11, 2022), https://www.epa.gov/newsreleases/epa-takes-key-steps-protect-groundwater-coal-ash-contamination.

[91] Letter from Edward Nam, U.S. EPA, to Own R. Schwartz, Duke Energy, regarding surface impoundments at Duke Energy's Gallagher Generating Station in New Albany, Indiana (Jan. 11, 2022).

[92] *See* U.S. EPA, Damage Case Compendium, Technical Support Document Volume IIb, Part One: Potential Damage Cases, at 113-118 (Dec. 2014) (discussing the "Brandywine Coal Ash Landfill" as "an active coal ash landfill . . . that has been receiving fly- and bottom ash since the early 1970s (8.5 million tons as of the end of 2009)" and also stating that the owner was planning to "cap and seal all closed cells in the landfill") (emphasis added).

[93] *See, e.g.*, In the Matter of Special Exception S.E. 4765 (Brandywine Fly Ash Storage Site), Circuit Court for Prince George's County, Maryland, CAL 18-11495, Petitioner's Rule 7-207 Memorandum in Support of Reversal at 2 (July 30, 2018) ("The larger site has been used as a landfill for ash disposal since the early 1970s") (emphasis added).

[94] Geosyntec Consultants, Inc., 2017 Annual Monitoring Report, First Quarter 2018, Brandywine Ash Management Facility (Apr. 2018) ("Leachate from the CCB management areas is designed to flow to one of three impoundment ponds (Ponds 002, 004, or 006) via subsurface drainage systems. More specifically, subsurface drainage from Phase I is designed to flow to Ponds 002 and 004, subsurface drainage from Historical Area 1 is designed to flow to Pond 002, subsurface drainage from Historical Area 2 is designed to flow to Pond 004, and subsurface drainage from Phase II is designed to flow to Pond 006. All water impounded in Pond 002 and Pond 006 is then routed to Pond 004, which is the location of the Site wastewater treatment system (WWTS), installed in 2017. Water routed to Pond 004 is treated by the WWTS and discharged through a single NPDES permitted outfall, Outfall 004.")

[95] 40 C.F.R. § 257.50(d).

[96] 40 C.F.R. § 257.53 (definition of "Inactive CCR surface impoundment").

[97] U.S. EPA, EPA Takes Key Steps to Protect Groundwater from Coal Ash Contamination (Jan. 11, 2022), https://www.epa.gov/newsreleases/epa-takes-key-steps-protect-groundwater-coal-ash-contamination (emphasis added); see also 40 C.F.R. § 257.102(d)(1).

[98] U.S. EPA, Proposed Denial of Alternative Closure Deadline for Clifty Creek Power Station at 39-40 (Jan. 2022), available at https://www.regulations.gov/document/EPA-HQ-OLEM-2021-0587-0023.

[99] *Id.* at 40-41.

[100] *Id*. at 38-41.

[101] The 200 unlined surface impoundments closing in place despite being within five feet of groundwater were compiled from the Earthjustice database, available at https://earthjustice.org/coalash/data-2022 and from an EPA

inventory of surface impoundments that the Agency believes to be in contact with groundwater. Pers. Comm. From U.S. EPA to Lisa Evans on May 9, 2022.

[102] https://earthjustice.org/coalash/data-2022.

[103] EPRI, Evaluation and Modeling of Cap Alternatives at Three Unlined Coal Ash Impoundments at vi (Sep. 2001) ("Groundwater quality did not improve at one of the three impoundments. This site differed from the other two in that a portion of the ash was below the current water table, the full extent of which was not known prior to closure of the site, and was not reflected in the closure modeling. Dewatering and closure were not effective at this site because leaching continued from the saturated ash. In this particular case, concentrations actually increased because the contact time of groundwater moving through the saturated ash increased when the hydraulic gradient of the pond was removed. A cap would have had little or no effect on this process").

[104] 40 C.F.R. § 257.91(a)(1).

[105] U.S. EPA, Proposed Conditional approval of Alternative Closure Deadline for the Calaveras Power Station at 47-55 (July 12, 2022), available at https://www.epa.gov/coalash/coal-combustion-residuals-ccr-part-implementation.

[106] U.S. EPA, Proposed Denial of Alternative Closure Deadline for Clifty Creek Power Station at 46 (Jan. 2022), available at https://www.regulations.gov/document/EPA-HQ-OLEM-2021-0587-0023.

[107] *See, e.g.*, CH2M Hill Engineers, Inc., 2021 Annual Groundwater Monitoring and Corrective Action Report: OUC Stanton Energy Center CCR at 4 through 6 (Jan. 28, 2022) ("The surficial groundwater near the horizontal expansion is generally flowing outward from an apparent local groundwater level high… the surficial groundwater gradient is toward the southwest initially").

[108] *Id*. at 14.

[109] 40 C.F.R. § 257.91(a).

[110] Letter from U.S. EPA Region 7 to Jared Morrison, Evergy Kansas Central, Inc., re: Notice of Potential Violations/Opportunity to Confer, Tecumseh Energy Center, Tecumseh, Kansas; Enclosure 1, pages 3-4 (Jan. 11, 2022).

[111] *See, for example*, monitoring results cited in "Coal's Poisonous Legacy: Groundwater Contaminated by Coal Ash Across the U.S." (2019) or historical monitoring data at many sites at Ashtracker.org.

[112] 40 C.F.R. §§ 257.94(e)(2), 257.95(g)(3)(ii).

[113] *See, e.g.,* U.S. EPA, Proposed Conditional Approval of an Alternative Closure Deadline for H.L. Spurlock Power Station, Maysville, Kentucky at 58 (Jan. 11, 2022), available at https://www.epa.gov/coalash/coal-combustion-residuals-ccr-part-implementation.

[114] *Id.*

[115] EPA, Proposed Conditional approval of Alternative Closure Deadline for the Calaveras Power Station at 56 (July 12, 2022), available at https://www.epa.gov/coalash/coal-combustion-residuals-ccr-part-implementation.

[116] 40 C.F.R. § 257.96(a).

[117] U.S. EPA, Proposed Denial of Alternative Closure Deadline for Clifty Creek Power Station at 51-55 (Jan. 2022), available at https://www.regulations.gov/document/EPA-HQ-OLEM-2021-0587-0023.

[118] U.S. EPA, Proposed Conditional Approval of Alternative Closure Deadline for the Mountaineer Power Plant at 49 (July 12, 2022).

[119] *Id*.

[120] 40 C.F.R. § 257.97(c).

[121] Clifty Creek Power Station Alternative Closure Demonstration, Amendment 2 (Nov. 30, 2020), Appendix E5 at 23.

[122] *Id.*

[123] 40 C.F.R. §§ 257,.96(e) and 257.97(c)(4).

[124] 40 C.F.R. § 257.97(a).

[125] U.S. EPA, Proposed Denial of Alternative Closure Deadline for Clifty Creek Power Station at 67-69 (Jan. 2022), available at https://www.regulations.gov/document/EPA-HQ-OLEM-2021-0587-0023.

[126] *Id*. at 70.

[127] U.S. EPA, Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Undergound Storage Tank Sites at 3 (Apr. 1999) (hereinafter "1999 MNA Guidance").

[128] *Id.* at 21; see also id. at 3 ("Source control and long-term performance monitoring will be fundamental components of any MNA remedy").

[129] U.S. EPA, Proposed Denial of Alternative Closure Deadline for Clifty Creek Power Station at 62 (Jan. 2022), available at https://www.regulations.gov/document/EPA-HQ-OLEM-2021-0587-0023.

[130] *See, e.g.*, U.S. EPA, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities, 80 Fed. Reg. 21302, 21456 (Apr. 17, 2015) (describing the "high mobility" of boron); U.S. EPA, Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; Amendments to the National Minimum Criteria (Phase One); Proposed Rule, 83 Fed. Ref. 11584, 11588 (Mar. 15, 2018) ("Out of all the coal ash constituents modeled by EPA, boron has the fastest travel time").

[131] *See, e.g.*, Sanborn Head, Assessment of Corrective Measures, AEP Mountaineer Plant Bottom Ash Ponds at 11 (June 24, 2019) ("Lithium is generally weakly or not taken up by soils (low Kd) . . . [and] lithium is relatively mobile under site conditions").

[132] 40 C.F.R. § 257.97(b)(4),

[133] 40 C.F.R. § 257.97(c)(1).

[134] Proposed Denial of Alternative Closure Deadline for Ottumwa Generating Station, Prepublication Copy (Jan. 11, 2022).

[135] U.S. EPA, Use of Monitored Natural Attenuation for Inorganic Contaminants in Groundwater at Superfund Sites at 14 (Aug. 2015) (hereinafter "2015 MNA Guidance").

[136] *Id*. "[D]ilution and dispersion generally are not appropriate as primary MNA mechanisms because they reduce concentrations through dispersal of contaminant mass rather than destruction or immobilization of contaminant mass. Dilution and dispersion may be appropriate as a "polishing step" for distal portions of a plume when an active remedy is being used at a site, source control is complete and appropriate land use and ground water use controls are in place."

[137] Clifty Creek Power Station Alternative Closure Demonstration, Amendment 2 (Nov. 30, 2020), Appendix E5 at 17. To be clear, the only kind of attenuation happening at Clifty Creek under IKEC's proposed MNA approach would be dilution and dispersion.

[138] U.S. EPA, Proposed Denial of Alternative Closure Deadline for Clifty Creek Power Station at 65 (Jan. 2022), available at https://www.regulations.gov/document/EPA-HQ-OLEM-2021-0587-0023 (emphasis added).

[139] Pollutants of concern are any constituents from Appendix IV of the Coal Ash Rule (assessment monitoring) or boron (which EPA has proposed adding to Appendix IV) exceeding both the relevant health-based threshold and background concentrations.

[140] These data were not included in our database because TVA is not reporting West Ash Pond groundwater monitoring data under the Coal Ash Rule. However, TVA is monitoring the groundwater at this unit pursuant to state law, and for this table we used data collected in 2019 and 2020. *See* TVA, Environmental Assessment Report at Table 6-8a (July 16, 2021).

[141] Pers. Comm. From U.S. EPA to Lisa Evans on May 9, 2022; see also Appendix D.

[142] GSI Environmental Inc., Selection of Groundwater Remedy: Ash Ponds and Equalization Pond, San Miguel Electric Cooperative, Inc., at Tables 4 and 9 (May 26, 2020).

[143] Pastor, Behling & Wheeler, LLC, Alternate Source Demonstration Report for the San Miguel Electric Cooperative (May 14, 2018) (attached to the 2018 Annual Groundwater Monitoring Report for San Miguel) ("The proximity of Ash Pile CCR wells SP-1, SP-3 and SP-32 to the lignite storage pile suggest that the lignite pile is the source of elevated sulfate concentrations and low pH levels in these wells. The SSIs reported for sulfate and pH in the Ash Pile CCR wells during the detection monitoring event were due to infiltration through the nearby lignite storage pile and not caused by a release from the Ash Pile").

[144] *See, e.g.*, Clark County, Nevada, Muddy River Reserve Unit, https://www.clarkcountynv.gov/government/departments/environment_and_sustainability/desert_conservation_program/muddy_river_reserve.php.

[145] Jacobs, Reid Gardner Generating Station Inactive CCR Surface Impoundment E-1, 2019 Annual Groundwater Monitoring and Corrective Action Report at Fig. 2A (July 31, 2019), available at https://www.brkenergy.com/ccr/assets/pdf/nve/RG/Pond_E-1/GW_Monitoring_and_Corrective_Action/Annual_GW_Monitoring_and_Corrective_Action_Report/RGS_Pond_E1.pdf.

[146] Specifically, well 12SR at Surface Impoundment 4B has a mean concentration of 6.4 mg/L, and maximum concentration of 9.7 mg/L. Lithium concentrations in purportedly upgradient wells are even higher, including concentrations as high as 48 mg/L in well P-23SR.

[147] *See* Jacobs, Reid Gardner Generating Station Inactive Coal Combustion Residual Surface Impoundments Ponds 4B-1, 4B-2, 4B-3, and E-1, Closure Certification, at Fig. 1 (Apr. 2019), available at https://www.brkenergy.com/ccr/assets/pdf/nve/RG/Pond_B-1/Closure_and_post-closure_care/Notify_of_Completion_of_Closure/Ponds_B123_E1_Closure.pdf; see also Jacobs, Reid Gardner Generating Station Inactive CCR Surface Impoundment E-1, 2019 Annual Groundwater Monitoring and Corrective Action Report at Fig. 1 (July 31, 2019), available at https://www.brkenergy.com/ccr/assets/pdf/nve/RG/Pond_E-1/GW_Monitoring_and_Corrective_Action/Annual_GW_Monitoring_and_Corrective_Action_Report/RGS_Pond_E1.pdf.

[148] *See, e.g.*, Proposed Clifty Creek Denial at 50 ("The CCR regulations do not provide for resampling to confirm SSLs").

[149] Jacobs, Reid Gardner Generating Station Inactive CCR Surface Impoundment E-1, 2019 Annual Groundwater Monitoring and Corrective Action Report at Fig. 2A (July 31, 2019), available at https://www.brkenergy.com/ccr/assets/pdf/nve/RG/Pond_E-1/GW_Monitoring_and_Corrective_Action/Annual_GW_Monitoring_and_Corrective_Action_Report/RGS_Pond_E1.pdf.

[150] Water & Environmental Technologies, Remedy Selection Report – FGD Pond 1 – Naughton Power Plant, at 1 (Apr. 2021).

[151] *Id*. at 8.

[152] Water & Environmental Technologies, Semi-Annual Progress Report for Selecting and Designing Remedy

Naughton Power Plant – FGD Pond 2 (May 15, 2022).

[153] Water & Environmental Technologies, Corrective Measures Assessment - South Ash Pond - Naughton Power Plant at 12 (May 2019) (emphasis added).

[154] 40 CFR §257.96.

[155] Water & Environmental Technologies, Corrective Measures Assessment - South Ash Pond - Naughton Power Plant at 11 (May 2019)

[156] *See, e.g.*, Water & Environmental Technologies, Groundwater Monitoring & Corrective Action Report, North Ash Pond – Naughton Power Plant at 4 (Jan. 2022).

[157] Stantec, Jim Bridger Power Plant Flue Gas Desulfurization FGD Pond 1 Notification of Completion of Closure (Feb. 24, 2020).

[158] Water & Environmental Technologies, Semi-Annual Progress Report for Selecting and Designing Remedy

Jim Bridger Power Plant – FGD Pond 1 (May 15, 2022).

[159] Tetra Tech, CCR Rule Operating Criteria, §257.71 Liner Design Criteria, FGD Pond 2, Jim Bridger Plant (Sep. 13, 2016).

[160] Water & Environmental Technologies, Groundwater Monitoring & Corrective Action Report, FGD Pond 2- Jim Bridger Power Plant at 18-19 (Jan. 2019).

[161] Water & Environmental Technologies, Groundwater Monitoring & Corrective Action Report Ash Landfill- Jim Bridger Power Plant at 19 (Jan. 2019).

[162] *See, e.g.*, Duke Energy, Allen Steam Station – Active Ash Basin, Retired Ash Basin, Closure Plan Rev. 1 (Feb. 10, 2020).

[163] SynTerra, CCR Rule Remedy Selection Semiannual Progress Report (Oct. 16, 2021 – April 15, 2022), CCR Multiunit, Allen Steam Station (June 17, 2022).

[164] SynTerra, CCR Assessment of Corrective Measures Report, Allen Steam Station (Apr. 10, 2019).

[165] *Id*. at Table 1A.

[166] Aptim Environmental & Infrastructure, LLC, CLOSURE CERTIFICATION REPORT, CLOSURE BY REMOVAL, NEW CASTLE NORTH BOTTOM ASH POND (June 2019).

[167] Email from Stephen M. Frank to Joel Fair, re: Federal CCR Notification - Notice of Appendix IV Detection Greater Than GWPS - 40 CFR 257.95(g) (Apr. 12, 2019), available at https://www.genon.com/s/Notice_of_App_IV_Det_Greater_Than_GWPS_40_CFR_257_95.pdf ("As described in our April 2019 ASD and as certified by a qualified professional engineer, a historic impoundment was, at one time, located just north of this unit and was demonstrated to be the source of the arsenic observed in the North Bottom Ash Pond CCR groundwater monitoring network").

[168] 40 C.F.R. § 257.102(c).

[169] CEC, CLOSURE & POST-CLOSURE PLANS, NEW CASTLE STATION ASH LANDFILL at 6 (Feb. 2022).

[170] Aptim Environmental & Infrastructure, Inc., Alternate Source Demonstration [for the New Castle Plant Ash Landfill] at 3 (Apr. 2018) (attached as Appendix A to GenOn's 2019 annual groundwater monitoring and corrective action report).

[171] *Id*. at 4.

[172] See id. at Appendix B (boring logs). Note that the boring logs for wells MW-12 and MW-15 show 9 and 8 feet of coal ash below the water level, but the wells do not necessarily extend to the bottom of the coal ash layer. The depth of saturated ash could therefore be greater than 9 feet.

[173] *Id*. at 6.

[174] Coal's Poisonous Legacy, fn. 7, *supra*.

[175] *See* U.S. EPA, Damage Case Compendium, Technical Support Document Volume IIb, Part One: Potential Damage Cases, at 113-118 (Dec. 2014) (discussing the "Brandywine Coal Ash Landfill" as "an active coal ash landfill . . . that has been receiving fly- and bottom ash since the early 1970s (8.5 million tons as of the end of 2009)" and also stating that the owner was planning to "cap and seal all closed cells in the landfill") (emphasis added).

[176] *See, e.g.*, In the Matter of Special Exception S.E. 4765 (Brandywine Fly Ash Storage Site), Circuit Court for Prince George's County, Maryland, CAL 18-11495, Petitioner's Rule 7-207 Memorandum in Support of Reversal at 2 (July 30, 2018) ("The larger site has been used as a landfill for ash disposal since the early 1970s") (emphasis added).

[177] Geosyntec Consultants, Inc., 2017 Annual Monitoring Report, First Quarter 2018, Brandywine Ash Management Facility (Apr. 2018) ("Leachate from the CCB management areas is designed to flow to one of three impoundment ponds (Ponds 002, 004, or 006) via subsurface drainage systems. More specifically, subsurface drainage from Phase I is designed to flow to Ponds 002 and 004, subsurface drainage from Historical Area 1 is designed to flow to Pond 002, subsurface drainage from Historical Area 2 is designed to flow to Pond 004, and subsurface drainage from Phase II is designed to flow to Pond 006. All water impounded in Pond 002 and Pond 006 is then routed to Pond 004, which is the location of the Site wastewater treatment system (WWTS), installed in 2017. Water routed to Pond 004 is treated by the WWTS and discharged through a single NPDES permitted outfall, Outfall 004.")

[178] Golder Associates, Inc., 2021 Annual Groundwater Monitoring & Corrective Action Report, RD Morrow Generating Station, at Tables 1 and 2 (Jan. 26, 2022).

[179] 40 C.F.R. § 257.97(a).

[180] Golder Associates, Inc., RD Morrow Generating Station – Landfill CCR Unit – First Semi-Annual 2022 Remedy Selection and Design Progress Report (Mar. 11, 2022).

[181] Proposed Denial of Alternative Closure Deadline for Ottumwa Generating Station, Prepublication Copy (Jan. 11, 2022).

[182] Golder Associates, Inc., 2021 Annual Groundwater Monitoring & Corrective Action Report, RD Morrow Generating Station, at Tables 1 and 2 (Jan. 26, 2022).

[183] 40 C.F.R. § 257.95(e). *See also* 40 C.F.R. § 257.104(b)(3), which requires owners to monitor the groundwater "in accordance with the requirements of §§ 257.90 through 257.98" throughout the post-closure period.

[184] U.S. EPA, Human and Ecological Risk Assessment of Coal Combustion Residuals (Final) at Attachment A-2 (Dec. 2014).

[185] Water & Environmental Technologies, Remedy Selection Report, CCR Landfill – Hunter Power Plant (Aug. 2020).

[186] *Id*. at 2 ("The nature of the release at the Hunter Power Plant consists of those Appendix IV metals that had statistically significant increases (SSI) over groundwater protection standards during 2018 assessment monitoring: lithium and molybdenum").

[187] 40 C.F.R. § 257.98(c).

[188] Water & Environmental Technologies, Remedy Selection Report, CCR Landfill – Hunter Power Plant at 2 (Aug. 2020) ("Results from the fall 2019 sampling event, revealed lithium, molybdenum, cobalt, and selenium exhibited SSIs. Lithium, molybdenum, and cobalt all exhibit downward trends coinciding with decreasing water levels").

[189] Data from Water & Environmental Technologies, Groundwater Monitoring & Corrective Action Report, CCR Landfill, Hunter Power Plant at Table 1 (Jan. 2022).

[190] Water & Environmental Technologies, Remedy Selection Report, CCR Landfill – Hunter Power Plant at 2 (Aug. 2020) ("As per Section 257.95(g)(1)(iii), three additional wells were installed along the eastern boundary of the Hunter facility in November of 2018: ELF-12, ELF-13, and ELF-14. They were placed to determine if groundwater impacts had reached and/or migrated beyond the facility boundary. All Appendix IV constituents were below groundwater protection standards, indicating the nature and extent investigation bounded the plume and it has not reached adjoining lands").

[191] *Id*. at 12.

[192] TVA, Groundwater Monitoring Report – Allen Fossil Plant – February 2008, at 2 (Aug. 22, 2008); cited by EIP, TVA's Toxic Legacy: Groundwater Contaminated by Tennessee Valley Authority Coal Ash at 25 (Nov. 2013), available at https://environmentalintegrity.org/reports/tvas-toxic-legacy-groundwater-contaminated-by-tennessee-valley-authority-coal-ash/.

[193] URS, TVA Gallatin Fossil Plant – Preliminary Ash Pond Closure Plan (Revision 0) – Prepared for TVA, Appendix B page 7 (Sep. 25, 2012).

[194] *See, e.g.*, TVA, Environmental Assessment Report at Table 6-8a (July 16, 2021) (showing boron concentrations up to 18.9 mg/L and molybdenum concentrations as high as 2.2 mg/L downgradient of the West Ash Pond).

[195] Fears, Darryl. "The TVA is dumping a mountain of coal ash in Black south Memphis." The Washington Post, August 19, 2022, ***available at*** https://www.washingtonpost.com/climate-environment/2022/08/19/tennessee-valley-authority-memphis-coal/

[196] Coal's Poisonous Legacy, fn. 7, *supra*.

[197] U.S. Environmental Protection Agency, "List of Publicly Accessible Internet Sites Hosting Compliance Data and Information Required by the Disposal of Coal Combustion Residuals Rule." Available at: https://www.epa.gov/coalash/list-publicly-accessible-internet-sites-hosting-compliance-data-and-informationrequired

[198] For example, some summary tables reported "non-detects" as ND without reporting the detection limit of the laboratory method. Inaccuracies were likely caused by typos or other data entry issues on the part of the report author.

[199] See, e.g., U.S. EPA, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance, EPA 530-R-09-007 at 6-36 to 6-37 (Mar. 2009).

[200] This is not a perfect method, with uncertainties that cut both ways. On one hand, there may be instances where downgradient wells show higher levels of a pollutant than upgradient wells by chance, even if the monitored ash dump is not leaking. This is unlikely to happen consistently over time, however. On the other hand, there may be instances where downgradient wells show lower levels than upgradient wells even if the unit is leaking. This can happen, for example, where an ash pond is leaking and there is an upgradient source of contamination. The 'signal' of the ash pond can be lost in the 'noise' of the other sources of contamination. Moreover, purportedly 'upgradient' wells are often contaminated by another onsite source of coal ash or are not truly upgradient of the regulated unit. All things considered, our approach will tend to underestimate the extent of coal ash contamination at coal plants.

[201] The groundwater protection standard for molybdenum is 100 µg/L, which is equal to EPA's Regional Screening Level for molybdenum. 40 C.F.R. § 257.95(h)(iv). EPA has also published a different health-based value for molybdenum, namely a "Lifetime Health Advisory," which is "[t]he concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for a lifetime of exposure." U.S. EPA, 2018 Edition of the Drinking Water Standards and Health Advisories Tables (March, 2018). EPA's Lifetime Health Advisory for molybdenum is 40 µg/L. We used this threshold in our analysis.

[202] U.S. EPA, 2012 Edition of the Drinking Water Standards and Health Advisories, EPA 822-S-12-001 (April 2012).

[203] U.S. EPA, Drinking Water Health Advisory for Boron, 822-R-08-013 at 30-31 (May 2008).

[204] The groundwater standard for each pollutant is either this presumptive standard or the site-specific background value, whichever is greater.

[205] U.S. EPA, Drinking Water Health Advisory for Boron, 822-R-08-013 at 30-31 (May 2008).

[206] U.S. EPA, 2012 Edition of the Drinking Water Standards and Health Advisories, EPA 822-S-12-001 (April 2012) (showing a Drinking Water Advisory of 500 mg/L for sulfate).

[207] *Id*. *See also supra* fn. 198.

[208] 40 C.F.R. Part 257, Appendices III and IV.

[209] U.S. EPA, Human and Ecological Risk Assessment of Coal Combustion Residuals (Final) at Appendix E, Table E1 (Dec. 2014)

[210] *See, e.g.*, CH2M Hill Engineers, Inc., 2021 Annual Groundwater Monitoring and Corrective Action Report: OUC Stanton Energy Center CCR at 4 through 6 (Jan. 28, 2022) ("The surficial groundwater near the horizontal expansion is generally flowing outward from an apparent local groundwater level high… the surficial groundwater gradient is toward the southwest initially").

[211] *Id*. at 14.

[212] To be clear, our analysis was looking at the 292 sites that were required to post groundwater monitoring data. Although almost all of these are coal plants, a few are actually offsite coal ash landfills that take ash from one or more power plants. For simplicity's sake, we refer to all of these sites as "coal plants" in this report.

[213] We consider a plant to exceed the threshold if one or more downgradient wells have mean values that exceed the threshold, after excluding downgradient results that are lower than relevant upgradient means. The total number of coal plants (the denominator in Table 1) varies by constituent, as not all constituents are monitored at all plants.

[214] *See, e.g.*, U.S. EPA, Human and Ecological Risk Assessment of Coal Combustion Residuals (Final) at E5 (Dec. 2014) (showing that cancer risks from landfills are 40-140 times lower than from surface impoundments and showing a lack of noncancer risks associated with landfills).