

IN HARM'S WAY: *Lack Of Federal Coal Ash Regulations Endangers Americans And Their Environment*



2010

**Thirty-nine New Damage Cases of Contamination from
Improperly Disposed Coal Combustion Waste**

Environmental Integrity Project, Earthjustice and Sierra Club

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EXECUTIVE SUMMARY

An investigation led by expert hydrogeologists has identified 39 more coal combustion waste (CCW) disposal sites in 21 states that have contaminated groundwater or surface water with toxic metals and other pollutants. Their analysis is based on monitoring data and other information available in state agency files and builds on a report released in February of 2010, which documented similar damage at 31 coal combustion waste dumpsites in 14 states.ⁱ When added to the 67 damage cases that the U.S. Environmental Protection Agency (USEPA) has already acknowledged, the total number of sites polluted by coal ash or scrubber sludge comes to at least 137 in 34 states. This total represents nearly a three-fold increase in the number of damage cases identified in EPA's 2000 Regulatory Determination on the Wastes from the Combustion of Fossil Fuels.ⁱⁱ

Drinking Water Standards Routinely Exceeded On-site, Sometimes by Orders of Magnitude

At every one of the 35 sites with groundwater monitoring wells, on-site test results show that concentrations of heavy metals like arsenic or lead exceed federal health-based standards for drinking water. For example, arsenic levels were above the 10 microgram per liter “maximum contaminant level” (MCL) at 26 of 35 sites, with concentrations reaching as high as 3,419 micrograms (over 341 times the standard) at the Hatfield’s Ferry site in Pennsylvania. Table A presents a summary of results for select contaminants.

Table A: Summary of On-Site Monitoring Results for Select Contaminants

Pollutant	# Of Sites Above MCL	MCL	Highest Value (µg/L)	Site	Owner/Operator
Alpha Particles	2	15 pCi/L	128 pCi/L	Muskingum (OH)	American Electric Power d/b/a Ohio Power Company
Arsenic	26	10 µg/L	3,419 µg/L	Hatfield’s Ferry (PA)	Allegheny Energy
Beryllium	3	4 µg/L	23 µg/L	Gallatin (TN)	Tennessee Valley Authority
Cadmium	9	5 µg/L	850 µg/L	Bruce Mansfield [Little Blue] (PA)	FirstEnergy
Chromium	4	100 µg/L	225 µg/L	Northeastern (OK)	American Electric Power d/b/a Public Service Company of Oklahoma
Lead	11	15 µg/L	2,690 µg/L	Bruce Mansfield [Little Blue] (PA)	FirstEnergy
Selenium	11	50 µg/L	1,320 µg/L	Big Cajun 2 (LA)	NRG Energy d/b/a Louisiana Generating
Thallium	2	2 µg/L	10 µg/L	Uniontown (OH)	Hyman Budoff / Merle & Charles Kittinger

Drinking Water at Risk

Where off-site sampling of private wells occurred, contaminated drinking water was found in every case.

States do not generally require off-site monitoring of drinking water wells beyond the fenceline, even when there is documented contamination at the property boundary. Nevertheless, at four of the five sites examined in this report for which such monitoring data are available, test results show violations of the federal MCL or a federal or state health advisory at one or more wells used for drinking water. At the fifth site (Joliet 9 (IL)), although off-site monitoring data are limited and consequently violation of federal or state standards are not confirmed, at least 18 nearby drinking water wells were closed due to boron contamination.

Table B summarizes the four sites where testing of off-site private drinking water wells occurred.

Table B: Heavy Metal Contamination in Off-Site Private Wells

Site	Number of Wells Contaminated/Abandoned	Containments	Response Action Taken
Bruce Mansfield [Little Blue] (PA)	22	aluminum, antimony, arsenic, barium, boron, cadmium, chromium (hexavalent), fluoride, iron, lead, manganese, selenium, and thallium	Alternative drinking water source provided
Cayuga Generation Plant (NY)	1	iron, lead, manganese, zinc.	Contaminated well purchased
Oak Creek Power Plant (WI)	12	molybdenum and boron	Provision of bottled water
Industrial Excess Landfill (OH)	Unknown number of private wells/11 off-site monitoring well clusters in residential areas were contaminated	antimony, arsenic, beryllium, cadmium, chromium, lead, nickel and thallium	100 homes placed on public water, Superfund action in progress

State records indicate the potential for more private wells to be contaminated.

Contaminated groundwater underneath at least 15 of the 39 sites is within two miles of private wells, according to monitoring data and public information on private well locations at the following CCW dumpsites: Independence (AR), Joliet 9 (IL), Lansing (MI), Cayuga (NY), Cardinal (OH), Gavin (OH), Muskingum (OH), Uniontown (OH), Northeastern (OK), Boardman (OR), Bruce Mansfield (PA), Hatfield's Ferry (PA), Big Stone (SD), Fayette Power Project (TX), and Oak Creek (WI). Public information on private drinking water wells is often incomplete or out of date, but for at least eight of these CCW disposal sites – Joliet 9, Gavin, Lansing, Muskingum, Uniontown, Bruce Mansfield, Fayette Power Project and Oak Creek – there are 25 or more private drinking water wells at or within two miles of the site. At Joliet 9 and Uniontown, there are 90 or more private drinking water wells within a mile of the contaminated CCW disposal sites.

CCW contaminants may threaten public water wells or intakes, potentially requiring expensive cleanup.

Public wells that serve local communities have tremendous pumping capacities that often change the direction of groundwater flow and pull contaminated water into the public's water supply. These pollutants must be removed at drinking water treatment plants, sometimes at great expense, to meet federal and state standards for safe drinking water. At least 18 of the 39 contaminated sites are located within five miles of a public groundwater well that could potentially be affected by CCW pollutants. In fact, there are at least five public water wells within a 5-mile radius of at least eight of those sites, namely: Flint Creek (AR); Montville (CT); Lansing (IA); George Neal North (IA); George Neal South (IA); Big Cajun (LA); Cardinal (OH); and Fayette Power Project (TX).

In several cases (e.g., Hatfield's Ferry (PA), Gallatin (TN), and Johnsonville (TN)), CCW disposal sites are leaking their toxic cargo into rivers just upstream from intakes for public water systems. Often, metals like arsenic are discharged to rivers through adjacent groundwater. For example, monitoring wells in an aquifer that flows from the Hatfield's Ferry (PA) site to the Monongahela River, less than half a mile away, have consistently measured arsenic at levels substantially above the MCL for the last five years. The contaminated groundwater discharges to the river are across from the water supply intake for the community of Masontown. Although historically, Pennsylvania has only required this public water system to test for arsenic every eight years, even in this limited testing, arsenic 2-3 times higher than the federal drinking water standard was found in the intake water at least twice since 2000. Groundwater discharges from CCW dumps may load drinking water sources with additional contaminants that must ultimately be removed from the water supply at public expense.

Illegal open dumping in violation of federal law may be occurring.

As many as 27 of the 35 sites where groundwater is contaminated may be illegal open dumps according to federal law, based on the high levels of metals found in the groundwater.ⁱⁱⁱ When concentrations of certain pollutants exceed limits established under "Subtitle D" of the Resource Conservation and Recovery Act, the law requires that the operator close the dump, stop the flow of contamination, or obtain a waiver from the state if certain criteria are satisfied. For example, at the two sites described above where off-site drinking water wells have been contaminated with arsenic, and other sites where monitoring wells hundreds of yards downgradient of the ash have been contaminated with heavy metals, such as the Spurlock (KY), Hatfield's Ferry (PA), and Northeastern (OK) sites, it is likely that federally prohibited "open dumping" has occurred. However, because open dumping regulations are part of subtitle D of the Resource Conservation and Recovery Act (RCRA), USEPA has no authority to enforce these standards. And even though states have the authority to enforce the prohibition, it appears that some states may have ignored the federal law and allowed illegal CCW dumps to operate and contaminate drinking water sources. The failure of states to enforce Subtitle D guidelines and the failure of plant operators to comply with those requirements indicate that "guidelines" under subtitle D of RCRA are insufficient to guarantee compliance with federal safeguards.

A Clear and Present Danger

Most damaged sites are still active and virtually all show recent evidence of contamination.

The contaminated CCW sites identified cannot be dismissed as a legacy of past practices that are no longer allowed today. Almost all of the facilities described in the report are active CCW disposal sites. The contamination is documented by recent data (from 2007 or later) at 32 of the 35 sites for which groundwater monitoring results are available. Even the few closed sites show that contamination often continues and even

worsens for generations after disposal ceases. For example, nearly 40 years after CCW disposal stopped at the Montville site (CT), average concentrations of arsenic in groundwater collected in 2007-2009 still exceed the MCL by 21 times and are higher than measurements taken ten years ago.

See No Evil, Hear No Evil

Many states require no groundwater monitoring at all.

The USEPA's 2000 Regulatory Determination noted that damages from CCW disposal sites were likely to be more widespread than the limited evidence available, due to the lack of groundwater monitoring at so many locations, especially coal ash ponds.^{iv} Ten years later, this basic deficiency is still widespread.

Large coal ash-generating states like Alabama, Arizona, Georgia, Indiana, Ohio, Mississippi, Missouri, New Mexico, and Tennessee, to name a few, require no monitoring by law at coal ash ponds, at least while they are still in operation. Although data were available for the Lower Colorado River Authority's ash pond, most CCW disposal sites in Texas are exempt from any regulation or monitoring by the state. States whose regulations fail to require monitoring at coal ash ponds, both old and new, accounted for approximately 70% of the coal combustion waste generated nationwide in 2008.^v A few of these states require monitoring only at new ponds, but since 75 percent of waste ponds are over 25 years old and 10 percent are over 50 years old, these state regulations leave a large and dangerous gap.^{vi}

Many states, such as West Virginia, had limitations in their data that made further examination useless. Mississippi, Alabama, and Georgia either require no monitoring of their numerous ash ponds or monitoring only after the ponds have been closed, a rare event as most ponds are operated perpetually as "storage" sites. Monitoring data from state files in Georgia were so minimal that no assessment of impacts could be made.^{vii} In Minnesota and Illinois, the state agency either refused to respond to our request for site files under the Freedom of Information Act or responded that no data were available, despite the presence of substantial data.^{viii} The regulation of CCW in these states is so weak, or the staff so uncooperative, that it is often impossible to determine the extent of contamination at CCW sites.

Even when the groundwater is periodically sampled for pollutants, state agencies usually fail to look beyond CCW property boundaries to see how far that pollution has traveled. Off-site data were available at only 8 of the 35 sites evaluated in this report, despite clear evidence at 28 of the sites that contaminants had migrated away from coal ash ponds or landfills and toward the property boundary, and despite the fact that private or public drinking water wells were located downgradient and in close proximity to sources of contamination at many of the sites.

Cleanup: Whose Responsibility?

States agencies have not required polluters to cleanup even as contamination increases.

Power companies that own or operate coal ash disposal sites that contaminate groundwater ought to be required to clean them up. At 21 sites examined in this study, the evidence of groundwater contamination was serious enough to cause a state agency to require additional monitoring and some assessment of its causes. But as noted earlier, monitoring beyond the operator's fence line was rare, and only at five sites have polluters attempted to determine how far the contamination has traveled and at what concentrations (at Montville (CT), Joliet 9 (IL) Uniontown (OH), Venice (IL), and Oak Creek (WI)).

At no site did a state require the power company to stop the contamination, let alone clean it up. In isolated cases, citizens were provided with alternative sources of drinking water, or groundwater may have been

cordoned off from further use as drinking water. At Uniontown (OH), many domestic well users have been left to fend for themselves, even though monitoring data documented flows heavily contaminated with metals from the Industrial Excess Landfill moving toward their wells until such monitoring was stopped in 2004.

Too often, state agencies routinely accept claims by utilities that contaminant increases are the result of sampling anomalies, or that “nature” is responsible for heavy metal concentrations that are in fact far above background levels. Without further investigation of the flimsy evidence, states let operators return to reduced monitoring or stop monitoring altogether. And in the meantime, power companies may quietly purchase surrounding property where wells are contaminated, often without alerting the state or the community that a danger exists.

Ecological damages have been ignored or not addressed in Clean Water Act permits.

Four sites in the report demonstrate clear damage to off-site aquatic life that has been documented in peer-reviewed research or by government scientists:

- A U.S. Fish and Wildlife Service study found that aquatic life in Lake Erie was harmed by discharges with high selenium, arsenic and other metal concentrations from an ash basin at the J.R. Whiting Plant in Michigan.
- A catastrophic release in June 1967 from a coal ash pond at the Clinch River Plant in Virginia killed an estimated 217,000 fish a distance of 90.1 miles downstream and left the river ecosystem damaged for 35 years.
- Fly ash pond discharges containing high concentrations of cadmium and selenium from the Glen Lyn plant in Virginia resulted in dramatically reduced diversity of benthic macroinvertebrates in a mountain stream.
- High concentrations of metals and sediments from ash ponds at Wisconsin's Columbia Station virtually eliminated aquatic insects for 2.2 miles downstream in the 1970s.

One of the most basic steps to protecting the off-site environment at CCW disposal sites is to set limits on the discharge of leachate or wastewater that are based on best available treatment standards, and which are also designed to protect rivers or streams. Few CCW sites are subject to Clean Water Act permits that monitor, much less limit, the full range of toxic metals that are discharged from CCW disposal sites. The limited data available show violations of the few discharge limits that are in place for the Hatfield's Ferry and Bruce Mansfield sites in Pennsylvania and the Cardinal and Gavin sites in Ohio. Water quality criteria for metals in waters receiving discharges from the Bruce Mansfield and Gavin sites are being exceeded, but most waterways next to power plants are not monitored enough to make such determinations.

Of the 39 sites examined in our report, we found two, Gavin and Hatfield's Ferry, where state agencies or operators examined the toxic effects of surface discharges on life in receiving waters. At both sites the discharges had adverse impacts on stream life. Yet PADEP has yet to require a treatment of the discharges at Hatfield's that will stop the impacts. Furthermore despite the acutely toxic effect of those discharges on insect and fish life at Gavin, Ohio EPA has implemented relaxed surface water quality standards for beryllium, cadmium, chromium, lead, selenium, and other pollutants in Kyger Creek that appear to accommodate contaminated discharges from the ash landfill and closed ash pond.

Lax regulation of coal ash disposal sites that drain into large rivers ignores the long-term build-up of metals from such discharges in river ecosystems. But discharges from TVA's Shawnee (KY), Gallatin, and Johnsonville (TN) sites along the Ohio, Cumberland, and Tennessee Rivers, respectively, the Big Cajun (LA) and Lansing (IA) sites along the Mississippi River or the Leland Olds (ND) site along the Missouri River, may contribute to harmful concentrations of metals that will be difficult to reverse.

Contamination Is a Warning for Use of Coal Ash as Structural Fill and Minefill

The finding of heavy metal contamination in onsite wells at all of the sites with groundwater monitoring should serve as a warning to USEPA and state regulators that use of coal ash as fill poses a real and substantial danger to drinking water sources. At fill projects, there are no liners or monitoring wells. Often fill sites are in or near residential areas where the contaminants need only travel a short distance to drinking water wells.^{ix} According to the American Coal Ash Association, use of coal ash as fill is pervasive -- over 20 million tons of coal ash per year are used as structural fill and minefill, representing more than a third of the total coal ash reused in the U.S.^x In light of the significant contamination described in this report, the USEPA must require every fill site to employ effective safeguards, such as liners, monitoring, and leachate collection systems, to prevent off-site migration of dangerous contaminants.

Conclusion: Federally enforceable regulations are necessary to stop the growing harm

The threat to public health and damage to the environment documented in this report provides additional evidence of the accumulating harm from poorly regulated CCW disposal sites. The quantum leap in coal ash sites with documented contamination from seven sites identified by EPA in its Report to Congress in 1999^{xi} to 137 sites today that are recognized by USEPA or presented in this and our previous report demonstrates that when adequate monitoring systems are established and their results are publicly accessible, contamination is invariably found at virtually every coal ash pond and landfill currently operating. Yet data from more than half (200) of the major disposal sites used by power plants in 25 states, could not be examined by EIP staff and experts, either because groundwater monitoring is lacking (8 states), agencies have refused to respond to Freedom of Information Act Requests (5 states), or due to time and resource constraints (12 states). Expecting monitoring data and other technical information at most CCW sites to be readily available to citizens when EIP's professionals had such difficulties obtaining it is unrealistic.

Our examination shows that contamination of the environment and water supplies with toxic levels of arsenic, selenium, lead, cadmium, boron, molybdenum, and other pollutants is pervasive at America's CCW disposal sites because states are not preventing it. When contamination is documented repeatedly in monitoring at these sites, state agencies do not respond, or they allow operators and their hired consultants to explain it away without substantiation as somebody else's fault, a sampling problem, or even nature's doing. The states almost never require the extent of the contamination to be determined, rarely sample off-site wells – even nearby private drinking water wells that are in the path of the contamination – and almost never require that contamination be cleaned up.

The avalanche of data should give the federal government the information it needs to set federally enforceable standards that protect the public health, guarantee citizens the right to know what is being dumped in their drinking water and the ability to do something about it, and take action to order cleanup of the worst sites. The evidence is in. It is past time for the U.S. Environmental Protection Agency to act.

ⁱ The Environmental Integrity Project (EIP) and Earthjustice. 2010. Out of Control: Mounting Damages from Coal Ash Waste Sites (Feb. 24, 2010), http://www.environmentalintegrity.org/news_reports/news_02_24_10.php.

ⁱⁱ U.S. Environmental Protection Agency (USEPA). 2000. Final Regulatory Determination on Wastes from the Combustion of Fossil Fuels, 65 Fed. Reg. 32,214, 32,225 (May 22, 2000).

ⁱⁱⁱ See 40 C.F.R. § 257.3-4 (providing that“(a) A facility or practice shall not contaminate an underground drinking water source beyond the solid waste boundary or beyond an alternative boundary specified in accordance with paragraph (b) of this section.”).

^{iv} USEPA, *supra* note ii.

^v USEPA. 2010a. Regulatory Impact Analysis for EPA’s Proposed RCRA Regulation of Coal Combustion Residues (CCR) Generated by the Electric Utility Industry (Apr. 30, 2010), (Appendix E and analysis of state regulations by Earthjustice, Environmental Integrity Project and Southern Environmental Law Center, August 2010).

^{vi} USEPA. 2010b. EPA’s Proposed Rule for Coal Combustion Residuals, Betsy Devlin, Associate Director, Materials Recovery & Waste Management Division, USEPA at 4 (Aug. 5, 2010), *available at* <http://www.epa.gov/osw/nonhaz/industrial/special/fossil/ccr-rule/ccr-webinar.htm>.

^{vii} Staff and volunteers of Greenlaw retrieved what monitoring data they could from files in Georgia for our researchers but it was so minimal that no assessment of impacts could be made.

^{viii} Staff of the Prairie Rivers Network found substantial monitoring data when they visited the file room at the Illinois Environmental Protection Agency.

^{ix} According to EPA, large fill sites are associated with 7 proven damage cases and 1 potential damage case. (See, for example, the Battlefield Golf Course in Chesapeake, VA, where 1.5 million yards of fly ash were used as fill for construction of a golf course and Town of Pines, IN). 75 Fed. Reg. 35155.

^x American Coal Ash Association, 2008 Coal Combustion Product (CCP) Production & Use Survey Report, available at <http://acaaffiniscape.com/displaycommon.cfm?an=1&subarticlenbr=3>.

^{xi} USEPA. 1999. Office of Solid Waste & Emergency Response, Report to Congress: Wastes from the Combustion of Fossil Fuels (Mar. 1999).

NATIONAL COAL COMBUSTION WASTE DAMAGE CASES MAPS



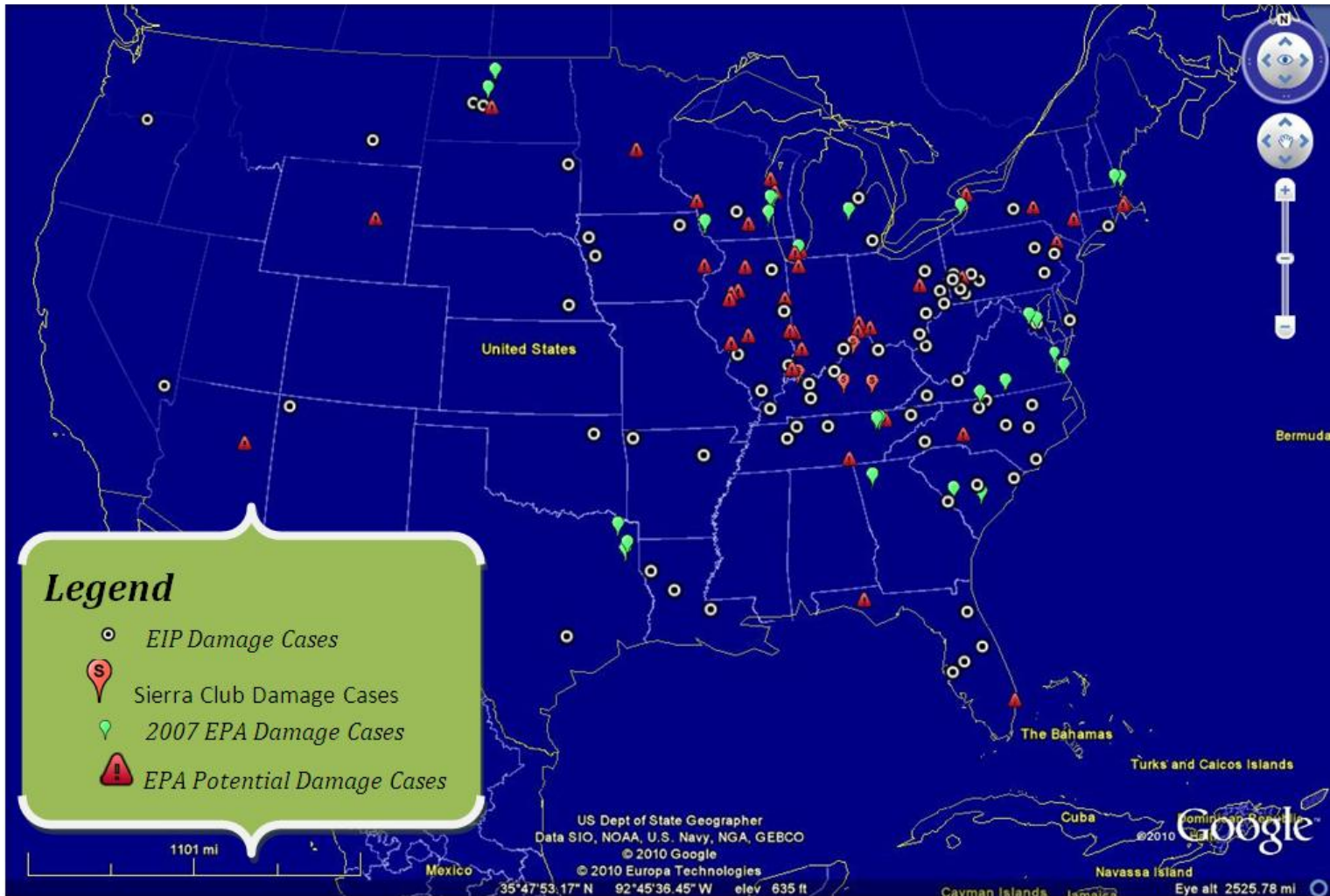


TABLE 1: SUMMARY OF DAMAGE CASES

State	Site	Owner	Wastes Present	Determination	Documented Impact	At Risk Populations
AR	Flint Creek Power Plant	American Electric Power d/b/a SWEPCO	Coal fly ash, bottom ash, wastewater sludge, storm water runoff	Demonstrated damage to groundwater moving off-site (to an intermittent stream that drains to ash ponds which discharge to an off-site reservoir)	Groundwater downgradient of a CCW landfill has been contaminated with lead up to 33 times the MCL, barium, selenium, cadmium and chromium exceeding the MCL and iron, manganese and silver exceeding Arkansas groundwater standards. 2009 assessment monitoring found selenium at 3 times the MCL, and sulfate and TDS at 8 and 5 times the SMCL respectively in a well 360 feet downgradient from the landfill. A leachate seep with high metals discharges to a stream that drains to ash ponds which discharge to an off-site recreational reservoir without limits or monitoring of ash metals.	45 private wells are within a 2-mile radius of the plant. Six public wells are within a 5-mile radius of the plant.
AR	Independence Steam Station	Entergy d/b/a Arkansas Power and Light	Coal fly ash, bottom ash, process wastewaters	Demonstrated damage to groundwater moving off-site (to northern and eastern property lines)	The network of 34 monitoring wells at Independence has documented widespread contamination of groundwater with arsenic, cadmium and lead above MCLs. From 2002-2009, SMCLs have been exceeded repeatedly for iron, manganese, sulfate, pH and TDS in two downgradient CCW landfill wells closest to the eastern property line where flow off-site is magnified by farm irrigation pumping. Iron concentrations have been as high as 131 times the SMCL and arsenic is approaching the MCL in these wells.	25 irrigation wells and one drinking well are within a mile; 3 production wells have been used for drinking water at the plant.

State	Site	Owner	Wastes Present	Determination	Documented Impact	At Risk Populations
CT	Montville Generating Station	NRG Energy / Montville Power, LLC	Coal fly ash and bottom ash	Demonstrated damage to soil and groundwater moving off-site to surface water (discharging into the Thames River)	Multiple "areas of concern" (AOCs) exist in this urban site where coal ash has contaminated groundwater and soil with iron more than 1000 times the SMCL, and arsenic up to 26 times and beryllium more than 3 times the MCL and increasing in one well despite ash disposal stopping 40 years ago. There are two groundwater zones, and arsenic has been up to 8 times the MCL and beryllium exceeding the MCL in the zone that is supposed to attain potable standards. Lead has exceeded "pollutant mobility criteria," and arsenic and beryllium exceed "direct exposure criteria" in soils and cadmium, nickel, zinc and copper have been "constituents of concern" in an AOC in this zone.	The area immediately west of the Plant is densely populated. Documents suggest over 300 private wells are likely within 2 miles and over 40 municipal wells are within 5 miles of the Plant.
FL	C.D. McIntosh, Jr. Power Plant	City of Lakeland	Coal fly ash, bottom ash and FGD waste	Demonstrated on-site damage to groundwater	Groundwater around two unlined CCW landfills and process waste water ponds is contaminated with arsenic, cadmium, lead, selenium, and nitrates above MCLs, vanadium above state std, and manganese, iron, sulfate, TDS and pH above SMCLs near property lines. FDEP Consent Order was issued in 2001 to address monitoring and cleanup. In 2010, MCL for arsenic was exceeded in 15 wells monitoring 3 water bearing zones.	Disposal areas are near Lake Parker, the shoreline of which is densely populated, and the lake is used recreationally.
IA	George Neal Station North	Berkshire Hathaway d/b/a MidAmerican Energy	Coal fly ash and bottom ash	Demonstrated damage to groundwater moving off-site, (into the Missouri River on the western perimeter of the property)	Since 2001, arsenic has exceeded the MCL in all 6 wells monitoring the shallow and deeper aquifers downgradient of the CCW monofill with maximum concentration exceeding the MCL by 22 times. High levels of iron, manganese and sulfate are also in groundwater downgradient from the monofill.	Unknown
IA	George Neal Station South	Berkshire Hathaway d/b/a MidAmerican Energy	Coal fly ash and bottom ash	Demonstrated damage to groundwater moving off-site, (as indicated by downgradient contaminant levels exceeding state standards that indicate contaminants are migrating in groundwater)	Groundwater monitoring implemented in 2000 has found arsenic up to 8.4 times the MCL in downgradient groundwater. Average iron and manganese levels surpass SMCLs by up to 32 and 75 times, respectively and the Lifetime Health Advisory for manganese by 6 times. Selenium, barium and zinc exceed "Upgradient Control Limits" set by IA DNR indicating these contaminants are migrating beyond the disposal site.	Unknown

State	Site	Owner	Wastes Present	Determination	Documented Impact	At Risk Populations
IA	Lansing Power Station	Alliant Energy d/b/a Interstate Power & Light	Coal fly ash and bottom ash	Demonstrated damage to on-site groundwater	Groundwater downgradient from the ash landfill at Lansing Station has arsenic levels at more than twice the MCL. Sampling also shows that iron, sulfate and manganese are far above SMCLs and manganese concentrations also exceed EPA's Lifetime Health Advisory level by as much as 33 times.	There are about a dozen residences within 1000 feet of the landfill and ash ponds. There are 33 drinking wells within a 2-mile radius of the Plant and 5 public water sources within a 5-mile radius.
IL	Joliet 9 Generating Station	Edison International d/b/a Midwest Generations EME LLC	Coal bottom ash and boiler slag	Demonstrated damage to off-site groundwater, drinking water and surface water moving off-site	Midwest Generation bought out or replaced 18 off-site drinking water wells contaminated with boron from CCW dumped in its unlined landfill and two unlined ponds built in a quarry 1,000 feet away. IEPA has applied relaxed groundwater standards for boron, cadmium, molybdenum and selenium since 1996, e.g. allowing groundwater moving off-site to be contaminated 52 times over the MCL for cadmium. In Aug. 2009, IEPA issued a Notice of Violation citing 50 exceedances of groundwater standards for arsenic, barium, copper and molybdenum. Arsenic has exceeded the MCL by up to 8.3 times and molybdenum had exceeded the fed. Lifetime HA by 70 times in 2 off-site monitoring wells. Yet IEPA has not required testing or replacement of off-site private wells northeast of the site even though its modeling indicates their likely contamination.	There are 94 drinking wells within a mile radius of the landfill with wells downgradient to the northeast and southeast of the disposal sites. Concerns are that pumping in other quarries to the east will pull the contamination into more private wells.
IL	Marion Plant	Southern Illinois Power Cooperative	Coal fly ash, bottom ash, FGD waste	Demonstrated damage to groundwater moving off-site to surface water (discharging into Saline Creek on the northern perimeter of the site)	Cadmium levels from unlined ponds and a landfill have reached 17.6 times the MCL and 35 times federal water quality standard for acute toxicity in groundwater discharging to Saline Creek. Cadmium and iron also exceed Illinois Class I Groundwater Standards. 2009 data show high concentrations of aluminum, boron and manganese in ash pond discharges to Saline Creek.	There are 3 wells within a mile radius of the CCW disposal areas.
IL	Venice Power Station	Ameren Energy d/b/a/ AmerenUE	Coal fly ash, bottom ash, wastewater sludge, storm water runoff	Demonstrated damage to groundwater off-site (400 feet east of ash ponds & beyond property line)	Contaminant plumes from inactive, unlined ash ponds exceed the MCL for arsenic by 21 times on-site and by 3.8 times 400 feet east of ash ponds in off-site monitoring wells and exceed boron Health Advisories and IL Class I groundwater standards 600 feet from the ponds. Groundwater Management Zone proposed to control off-site contamination.	Unknown

State	Site	Owner	Wastes Present	Determination	Documented Impact	At Risk Populations
KY	Mill Creek Station	E.ON d/b/a Louisville Gas & Electric	Coal fly ash, bottom ash, FGD waste, coal pile runoff	Demonstrated damage to groundwater moving off-site, (Ohio River).	Groundwater monitoring has measured arsenic, sulfate and TDS exceeding MCLs and SMCLs in a contaminant plume one-mile wide potentially endangering off-site use of shallow groundwater.	There are 15 private wells within a 2-mile radius and 4 public wells within a 5-mile radius of the Plant.
KY	Shawnee Fossil Plant	Tennessee Valley Authority	Coal fly ash and bottom ash	Demonstrated damage to groundwater moving off-site, (into Little Bayou Creek and Ohio River).	Groundwater in the Alluvial Aquifer is contaminated with arsenic and selenium exceeding MCLs, boron exceeding USEPA's Lifetime Health Advisory and sulfate and TDS exceeding SMCLs. Assessment documents contamination of the site since the 1980s. Reddish leachate seeps from CCW areas into Little Bayou Creek.	Unknown - Metropolis Lake in adjacent state-owned park is contaminated with mercury.
KY	Spurlock Power Station	East Kentucky Power Cooperative	Coal fly ash, bottom ash and FGD waste	Demonstrated damage to off-site groundwater, (750 feet beyond landfill boundary).	Spurlock's CCW landfill has contaminated underlying groundwater since at least 2005 with arsenic, iron, sulfate and TDS exceeding MCLs and SMCLs. Arsenic has reached 16 times the MCL in an off-site well 750 feet northeast of the landfill. The disposal site discharges to three receiving streams that flow into the Ohio River.	There are 25 private wells within a 2-mile radius and 3 public wells within a 5-mile radius of the Plant.
LA	Big Cajun 2 Power Plant	NRG Energy d/b/a Louisiana Generating	Coal fly ash, bottom ash, wastewater sludge	Demonstrated damage to groundwater moving off-site, (at property boundary).	A mile long complex of ash ponds has contaminated all five on-site monitoring wells with selenium up to 26.4 times the MCL. LDEQ has required 11 more wells be installed but also allowed approximately 11,500 tons of Big Cajun's ash to be dumped into the Mississippi River for barge mooring cells without any monitoring to assure that selenium or other ash metals are not contaminating the river.	There are 3 private drinking wells within a 2-mile radius and 11 public wells within a 5-mile radius of the Plant. Four public wells are downgradient of the Plant.
LA	Dolet Hills Power Station	Cleco Power	Coal fly ash, bottom ash, FGD waste, storm water runoff, metal cleaning waste	Demonstrated damage to groundwater moving off-site, (half mile from disposal sites).	Groundwater has been contaminated with arsenic, lead and selenium exceeding MCLs. Sulfate concentrations are up to 16 times higher than the SMCL and TDS is up to 28 times higher than the SMCL. Each is more than 4 times the SMCL a half mile downgradient of disposal sites.	There are 2 private wells within a 2-mile radius and 1 public well within a 5-mile radius of the Plant.
LA	Rodemacher Power Station	Cleco Power	Coal fly ash, bottom ash, storm water runoff, metal cleaning waste, clarifier sludge	Demonstrated damage to groundwater moving off-site, (to Lake Rodemacher, Bayou de Jean and the Red River).	Monitoring of four wells under a CCW landfill has found average arsenic 4 times and maximum arsenic up to 5.75 times the MCL and lead exceeding the MCL under other disposal units. Contamination is discharging to off-site surface water bodies 50 feet from waste disposal units with no attempt to monitor surface or groundwater off-site.	There are 36 registered water wells within a mile radius and 3 public drinking water wells within a 5-mile radius of the Plant. CLECO and the Louisiana DNR had conflicting well data. See site report.

State	Site	Owner	Wastes Present	Determination	Documented Impact	At Risk Populations
MI	J.R. Whiting Generating Plant	CMS Energy d/b/a Consumers Energy	Coal fly ash, boiler cleaning wastes, treated sewage waste	Demonstrated off-site ecological damage to aquatic life.	A 1980s study conducted by the U.S. Fish and Wildlife Service concluded that effluent discharges from the coal ash basin adjacent to Lake Erie put oligochaetes (freshwater worms) and young fish at risk. Chronic exposure to effluent could undermine fitness of populations by increased susceptibility to disease, predation and reduced reproductive capacity.	Not Examined
NC	Dan River Steam Station	Duke Energy	Coal fly ash and bottom ash	Demonstrated on-site damage to groundwater	Voluntary groundwater monitoring at Dan River's ash ponds has revealed levels of chromium, iron, lead, manganese, silver and sulfate exceeding state groundwater standards and federal MCLs.	Several dozen private residences are within two miles of the ash ponds.
ND	Antelope Valley Station	Basic Electric Power Cooperative	Coal fly ash, bottom ash, FGD waste, inert construction waste	Demonstrated damage to on-site groundwater	A closed, clay-lined CCW landfill has contaminated underlying groundwater with arsenic that has increased to more than 3 times the MCL. ND regulators have no monitoring data, only trend graphs of results provided by the power plant.	The area surrounding the Plant is primarily agricultural and there are private wells used for irrigation. There are 2 public water supplies within 5 miles of the Plant.
ND	Leland Olds Station	Basic Electric Power Cooperative	Coal fly ash, bottom ash, coal pile runoff, coal slack, boiler blowdown	Demonstrated damage to on-site groundwater	Monitoring has measured arsenic at nearly 8 times and lead at nearly 5 times MCLs as well as elevated selenium and boron in groundwater underneath clay-lined, decommissioned ash ponds.	A municipal well is within 5 miles of the plant. Fish and irrigation water from the Missouri river could be at risk.
NE	Sheldon Station	Nebraska Public Power District	Coal fly ash and bottom ash	Demonstrated damage to groundwater moving off-site (at property boundary).	Selenium and sulfate have risen to levels exceeding MCLs and SMCLs in shallow groundwater 400 feet downgradient of a closed, clay-lined ash landfill at the northern property line. State has extended monitoring period and expanded monitoring to determine extent of the contamination.	An irrigation well is located downgradient within one mile of the landfill.
NY	Cayuga Generation Plant	AES	Coal fly ash and bottom ash	Demonstrated damage to groundwater on-site and a former private residential well (now owned by AES)	Concentrations of arsenic and selenium exceed MCLs in groundwater on-site by 10 times and 1.6 times, respectively. Ash leachate pond discharges to Cayuga Lake grossly exceed surface water quality standards for arsenic, cadmium and selenium, but NYDEC does not limit or monitor for these parameters in Cayuga Lake.	Cayuga Lake is one of New York's Finger Lake, and heavily used for recreation.

State	Site	Owner	Wastes Present	Determination	Documented Impact	At Risk Populations
OH	Cardinal Plant	American Electric Power	Coal fly ash, bottom ash, FGD waste	Demonstrated damage to groundwater moving off-site (discharging into Riddles Run and Blockhouse Hollow).	A statistically significant increase in arsenic exceeding the MCL by up to 10 times and molybdenum exceeding the federal Health Advisory by more than 10 times are in groundwater underneath two unlined ash ponds. Private wells in the Tidd-Dale Subdivision are only a half mile downgradient, but have not been sampled.	The nearby Tidd-Dale subdivision is in the direct groundwater path of Fly Ash Reservoir 2. The subdivision relies on private drinking water wells. There are 16 private drinking wells with 2 miles of the Plant and 5 public drinking water sources within 5 miles.
OH	Gavin Power Plant	American Electric Power d/b/a Ohio Power Company	Coal fly ash, bottom ash, FGD waste, filter cake, lime	Demonstrated damage to groundwater off-site (in monitoring well beyond the southern property line and surface water and aquatic life in Stingy Run and Kyger Creek)	Ash landfill monitoring shows groundwater is contaminated with alpha activity, arsenic, barium, cadmium, lead and molybdenum in excess of MCLs and the federal Lifetime Health Advisory. Molybdenum has reached 2.5 times this advisory in groundwater 700 ft south of landfill. Wells exceeding alpha activity MCL have grown from 9 to 15. NPDES permit violations have occurred at the landfill and closed ash pond. Their discharges are acutely toxic to aquatic life.	There are at least 63 wells within 1.5 miles of the fly ash pond. Human exposure to contaminants may occur if fish is consumed from nearby surface waters.
OH	Muskingum River Plant	American Electric Power d/b/a Ohio Power Company	Coal fly ash and bottom ash	Demonstrated damage to groundwater moving off-site (to southern property line).	Monitoring shows exceedances of the MCL for alpha particles (up to 8.5 times the MCL), a notable increase in barium is occurring and iron and sulfate are substantially exceeding SMCLs in shallow downgradient groundwater 350 feet from an unlined ash pond. Arsenic and mercury exceed MCLs by more than 3 times in the seepage from the pond dike.	48 drinking water wells are within 1.5 miles of the plant; two wells are 0.25 miles from the plant
OH	Industrial Excess Landfill	Hyman Budoff / Merle & Charles Kittinger	Coal ash, masonry rubble, paper, scrap lumber, organic chemical liquid wastes, hospital waste, septic tank waste, other wastes	Demonstrated damage to off-site groundwater, including damage to many domestic drinking water wells	This site has been designated a Superfund Site by the EPA. MCLs for antimony, arsenic, beryllium, cadmium, chromium and lead has been exceeded often by many times and in off-site residential wells. Radionuclides and anthropogenic radioisotopes have migrated into nearby residential areas.	There are 90 private wells with 1500 feet of the site. There are documented cases of residents drinking contaminated well water.
OK	Northeastern Station	American Electric Power d/b/a Public Service Company of Oklahoma	Coal fly ash	Demonstrated damage to groundwater moving off-site (to the Verdigris river at the southern boundary).	Groundwater at this unlined ash landfill contains selenium up to 37 times, arsenic up to 6 times, lead up to 13 times, and barium up to 4 times the MCL. Chromium and thallium exceed MCLs. Vanadium is 9 times state standards. Contamination flows in 3 directions. Arsenic is 3 times the MCL 900 feet northwest of the landfill.	At least 6 private wells are downgradient within 2 miles in Oologah and 3 public wells are within 5 miles.

State	Site	Owner	Wastes Present	Determination	Documented Impact	At Risk Populations
OR	Boardman Plant	Portland General Electric	Coal fly ash, bottom ash, economizer ash	Demonstrated damage to groundwater moving off-site (at monitoring wells 750 and 1,500 feet from CCW disposal area)	Groundwater contamination has been documented at the ash landfill and Carty Reservoir where ash sluice water has been disposed at the Boardman Plant since 1981. The Oregon Numerical Groundwater Quality Reference Level (ONGQRL) for selenium has been exceeded and vanadium has reached 2.5 times state standards in shallow groundwater 1,500 feet downgradient of the ash landfill which has a liner made of hydrated coal ash. No off-site monitoring is occurring. Carty Reservoir is not sampled for vanadium or selenium.	Groundwater in the vicinity of the plant is used for irrigation and livestock. Within 5 miles of the Plant, 14 wells are used for irrigation, 19 wells are used as private water supply and 18 wells are used for livestock watering. Carty Reservoir is also used for irrigation at a neighboring farm.
PA	Bruce Mansfield Power Station	FirstEnergy	Coal fly ash, FGD Waste	Demonstrated damage to off-site groundwater and surface water (in domestic wells and in Marks Run and other surface waters).	Contamination and discharges from the unlined Little Blue Run surface impoundment have caused exceedances of groundwater and/or surface water quality standards for aluminum, antimony, arsenic, barium, boron, cadmium, chloride, chromium, fluoride, iron, lead, manganese, pH, selenium, sulfate, TDS, thallium, turbidity. Contamination has been detected in multiple off-site residential drinking wells, in Mark's Run and other off-site surface waters, and at many on-site monitoring wells moving off-site.	At least 22 private wells have been contaminated above state standards, federal MCLs, SMCLs, or health advisories
PA	Hatfield's Ferry Power Station	Allegheny Energy	Coal fly ash, bottom ash, wastewater sludge, storm water runoff	Demonstrated damage to groundwater moving off-site and to off-site surface water and aquatic life (in Little Whitely Creek and tributaries).	Arsenic, molybdenum, boron, sulfate and total dissolved solids (TDS) are far over standards in groundwater flowing from this largely unlined CCW landfill. Total arsenic has reached 342 times the MCL, boron more than 5 times the lifetime Health Advisory and molybdenum 33 times this advisory in groundwater 1,500 feet from the landfill that is flowing toward a municipal water supply intake on the Monongahela River that has had documented exceedances of the arsenic MCL. The landfill's leachate pollutes streams with boron, molybdenum, sulfate, thallium and TDS violating PA water quality criteria and harms aquatic life.	There are seven drinking water wells within 2 miles of the ash site.
SD	Big Stone Power Plant	Otter Tail Power	Coal fly ash, bottom ash, FGD waste, wastewater	Demonstrated damage to groundwater moving off-site (at northern and eastern property boundaries and south toward the Whetstone River).	21 of 25 monitoring wells report exceedances of groundwater standards downgradient of CCW disposal units in two aquifers. Arsenic has been up to 13 times and lead up to 7 times the MCL, boron up to 34 times the Lifetime Health Advisory and sulfate up to 224 times the SMCL at 56,000 mg/L. Despite mounding of groundwater at the property lines, no monitoring of nearby ponds or private wells has occurred	Groundwater is the only source of public water supply in South Dakota. There are 119 wells within a 5-mile radius of the Plant.

State	Site	Owner	Wastes Present	Determination	Documented Impact	At Risk Populations
TN	Cumberland Steam Plant	Tennessee Valley Authority	Coal fly ash and bottom ash	Demonstrated damage to on-site groundwater.	Groundwater downgradient of the gypsum storage area and ash ponds contains arsenic more than twice the MCL, selenium 3 times the MCL and boron 13 times the Child Health Advisory. Aluminum, chloride, iron, manganese, sulfate and TDS exceed the SMCL. Placement of two CCW storage-disposal areas over older unlined ash ponds that were built in a former creek channel has created conditions conducive to contamination.	There are 440 households within 3 miles. The majority of nearby drinking water sources utilize groundwater.
TN	Gallatin Fossil Plant	Tennessee Valley Authority	Coal fly ash and bottom ash	Demonstrated damage to on-site groundwater moving off-site (into the adjacent Cumberland River)	An unlined closed ash pond has contaminated groundwater with beryllium up to 6 times the MCL, cadmium exceeding the MCL, nickel exceeding the TN MCL by 2.5 times and boron consistently exceeding the federal Child Health Advisory. Concentrations of aluminum, iron, manganese, sulfate and TDS exceed Secondary MCLs. Two newer active ash impoundments are not lined or monitored.	Many public drinking water sources for communities near Gallatin use treated water from the Cumberland River. The Gallatin Water Department draws water just over 1 mile downstream of the plant's ash ponds.
TN	Johnsonville Fossil Plant	Tennessee Valley Authority	Coal fly ash and bottom ash	Demonstrated damage to on-site groundwater discharging to surface water, (Tennessee River).	An active ash disposal area resides on an unlined island in the middle of the Tennessee River. Groundwater on the island and at-on shore dumps contains arsenic, aluminum, boron, cadmium, chromium, iron, lead, manganese, molybdenum, sulfate and TDS far above federal Maximum Contaminant Levels (MCL), SMCLs, and federal health advisory levels.	Disposal areas discharge into recreational waters of Tennessee River within a mile of New Johnsonville and Camden municipal water intake pipes.
TX	Fayette Power Project	Lower Colorado River Authority	Coal fly ash, bottom ash, FGD waste, boiler slag construction wastes, other non-CCW wastes	Demonstrated damage to groundwater moving off-site (to the southeast and southwest and discharging to Cedar and Baylor Creeks).	Groundwater sampling has found arsenic, cobalt, molybdenum and selenium exceeding Texas Protective Contamination Levels, MCLs and Health Advisories by 2-4 times. Aluminum, chloride, manganese, sulfate and TDS concentrations exceed federal SMCLs. Molybdenum contamination in the middle sand water bearing unit appears to be moving off-site.	TCEQ has notified two neighboring landowners of possible molybdenum contamination. There are 42 private wells and 23 public wells within 5 miles of the Plant.
VA	Clinch River Plant	American Electric Power d/b/a Appalachian Power	Coal fly ash and bottom ash	Demonstrated off-site ecological damage to aquatic ecosystems, (fish, snails, mussels, and aquatic macroinvertebrates in the Clinch River).	In 1967 a dike from a coal ash pond at Clinch River Plant collapsed releasing a caustic ash slurry into the Clinch River. Some 217,000 fish were killed for up to 90 miles downriver and benthic macroinvertebrates, snails and mussels were also wiped out or very negatively affected. Forty years after the spill, aquatic ecosystems downstream remain degraded. High concentrations of copper and aluminum from power plant effluent also contribute to biotic impairment.	Unknown

State	Site	Owner	Wastes Present	Determination	Documented Impact	At Risk Populations
VA	Glen Lyn Plant	American Electric Power d/b/a Appalachian Power	Coal fly ash and bottom ash	Demonstrated off-site damage to surface water and aquatic ecosystems, (aquatic macroinvertebrates and bacteria in a receiving stream).	Scientific studies in the 1970s and 1980s documented acute toxicity of effluent discharges from a fly ash holding pond to aquatic insects (mayflies) and bacteria in a mountain stream that flows into the New River. High TSS, pH at 9.5 units and cadmium and selenium exceeding Virginia Water Quality Standards for acute toxicity by 30 times and 4 times, respectively in the stream were responsible for the mortality. Bioaccumulation of copper by 580 times and cadmium and nickel by 10,000 times in Duckweek, a floating plant in the pond over levels in the water or sediments posed a toxic potential to off-site life if the plant was flushed from the pond.	Unknown
WI	Columbia Energy Center	Alliant Energy d/b/a Wisconsin Power & Light	Coal fly ash and bottom ash	Demonstrated off-site damage to aquatic ecosystems (aquatic macroinvertebrates in a receiving stream).	Ecological studies in the late 1970s identified devastating impacts on aquatic life in a stream receiving discharge from ash ponds wiping out nearly all aquatic insects for 2.2 miles downstream. High conductivity and concentrations of cadmium and copper that likely exceeded federal and Wisconsin water quality criteria for acute toxicity in the stream as well as flocculent in the discharge coating the stream bottom were the culprits.	Unknown
WI	Oak Creek Power Plant (Caledonia)	Wisconsin Energy(WE Energies) d/b/a Wisconsin Electric Power Co.	Coal fly ash, bottom ash, FGD waste, wastewater solids	Demonstrated damage to off-site drinking water wells	Twelve private drinking wells within 1500 feet of the Oak Creek and Caledonia CCW landfills have been contaminated with molybdenum exceeding WI Enforcement Standard (ES) and the federal Lifetime Health Advisory by up to 3 times and boron levels exceeding WI's Preventative Action Limit by up to 3.8 times. WE Energies started providing bottled water to residences in August 2009. WIDNR has started an investigation. Molybdenum in monitoring wells at the Oak Creek landfills is up to 13.5 times higher than WI ES and federal Lifetime HA and 375 times higher than these standards in landfill leachate.	In August 2009, WE Energies informed nearby residents that their water was unsafe to drink and has been providing bottled water to about two dozen residences. There about 100 more households north of these homes and potentially in the pathway of contamination but most are on public water. Other homes are potentially effected by localized contamination further west.

TABLE 2: COAL COMBUSTION WASTE DAMAGE TO GROUNDWATER

State	Site	Pollutant	Reference	Limit	Maximum Result	Media	Location	Enforcement Action
AR	Flint Creek Power Plant	Barium	Federal Primary MCL	2 mg/L	2.4 mg/L	Groundwater	On-site	None State Required Assessment Monitoring
		Cadmium	Federal Primary MCL	0.005 mg/L	0.01 mg/L	Groundwater	On-site	
		Chromium	Federal Primary MCL	0.1 mg/L	0.128 mg/L	Groundwater	On-site	
		Lead	Federal Primary MCL	0.015 mg/L	0.5 mg/L	Groundwater	On-site	
		Selenium	Federal Primary MCL	0.05 mg/L	0.152 mg/L	Groundwater	On-site	
		Silver	Federal Secondary MCL ¹	0.1 mg/L	0.2 mg/L	Groundwater	On-site	
AR	Independence Steam Station	Arsenic	Federal Primary MCL	0.01 mg/L	0.016 mg/L (0.061 mg/L rejected due to turbidity)	Groundwater	On-site	None
		Cadmium	Federal Primary MCL	0.005 mg/L	0.006 mg/L	Groundwater	On-site	
		Lead	Federal Primary MCL	0.015 mg/L	0.023 mg/L	Groundwater	On-site	
CT	Montville Generating Station	Arsenic	Federal Primary MCL	0.01 mg/L	0.262 mg/L	Groundwater	On-site	EPA Proposed RCRA Remedial Action Plan
		Beryllium	Federal Primary MCL	0.004 mg/L	0.0138 mg/L	Groundwater	On-site	
FL	C.D. McIntosh, Jr. Power Plant	Arsenic	Federal Primary MCL	0.01 mg/L	0.0165 mg/L	Groundwater	On-site	Consent Decree issued in December 2001; State Required Assessment Monitoring
IA	George Neal Station North	Arsenic	Federal Primary MCL	0.01 mg/L	0.218 mg/L	Groundwater	On-site	Risk evaluation requested by State
IA	George Neal Station South	Arsenic	Federal Primary MCL	0.01 mg/L	0.0839 mg/L	Groundwater	On-site	None
IA	Lansing Power Station	Arsenic	Federal Primary MCL	0.01 mg/L	0.023 mg/L	Groundwater	On-site	None

State	Site	Pollutant	Reference	Limit	Maximum Result	Media	Location	Enforcement Action
IL	Joliet 9 Generating Station	Ammonia	IL Applicable Groundwater Quality Standard (IAGQS)	1.57 mg/L	5.3 mg/L	Groundwater	On-site	Illinois EPA issued a Notice of Violation in August 2009 for 50 groundwater exceedances. No cleanup required as of yet
		Arsenic	Federal Primary MCL and IAGQS	0.01 mg/L	0.1 mg/L	Groundwater	Off-site, unconfirmed	
		Barium	Federal Primary MCL ⁱⁱ	2 mg/L	0.36 mg/L	Surface Water	Discharge Point	
		Boron	Federal Child Health Advisory ⁱⁱⁱ	3.0 mg/L	10 mg/L	Groundwater	Off-site, unconfirmed	
		Cadmium	Federal Primary MCL ^{iv}	0.005 mg/L	Exceeded 0.264 mg/L	Groundwater	Unknown	
		Molybdenum	Federal Lifetime Health Advisory ^v	0.04 mg/L	2.9 mg/L	Groundwater	Off-site, unconfirmed	
		pH	Federal Secondary MCL ^{vi}	6.5 - 8.5	9.98	Groundwater	Off-site, unconfirmed	
		Selenium	Federal Primary MCL ^{vii}	0.05 mg/L	Exceeded 0.325 mg/L	Groundwater	Unknown	
		Sodium	Federal Health-based Drinking Water Advisory ^{viii}	20 mg/L	470 mg/L	Groundwater	Off-site, unconfirmed	
Sulfate	Federal Secondary MCL ^{ix}	250 mg/L	690 mg/L	Groundwater	Off-site, unconfirmed			
TDS	Federal Secondary MCL ^x	500 mg/L	1,300 mg/L	Groundwater	Off-site, unconfirmed			
IL	Marion Plant	Boron	Illinois Groundwater Standard ^{xi}	2 mg/L	2.53 mg/L	Groundwater	On-site	State Required Assessment Monitoring
		Cadmium	Federal Primary MCL	0.005 mg/L	0.088 mg/L	Groundwater	On-site	

Table 2: Coal Combustion Waste Damage to Groundwater

State	Site	Pollutant	Reference	Limit	Maximum Result	Media	Location	Enforcement Action
IL	Venice Power Station	Arsenic	Federal Primary MCL	0.01 mg/L	0.215 mg/L	Groundwater	On-site	State Required Assessment Monitoring, Groundwater Management Zone proposed.
		Boron	Federal Child Health Advisory ^{xii}	3 mg/L	27.7 mg/L	Groundwater	On-site	
		Cadmium	Federal Primary MCL	0.005 mg/L	0.006 mg/L	Groundwater	On-site	
KY	Mill Creek Station	Arsenic	Federal Primary MCL	0.01 mg/L	0.015 mg/L	Groundwater	On-site	State Required Assessment Monitoring
KY	Shawnee Fossil Plant	Arsenic	Federal Primary MCL	0.01 mg/L	0.012 mg/L	Groundwater	On-site	None
		Boron	Federal Child Health Advisory	3 mg/L	15 mg/L	Groundwater	On-site	
		Selenium	Federal Primary MCL	0.05 mg/L	0.087 mg/L	Groundwater	On-site	
KY	Spurlock Power Station	Arsenic	Federal Primary MCL	0.01 mg/L	0.16 mg/L	Groundwater	Off-site	None
LA	Big Cajun 2 Power Plant	Selenium	Federal Primary MCL	0.05 mg/L	1.32 mg/L	Groundwater	On-site	Notice of Deficiency; State Required Assessment Monitoring
LA	Dolet Hills Power Station	Arsenic	Federal Primary MCL	0.01 mg/L	0.0156 mg/L	Groundwater	On-site	State Required Assessment Monitoring
		Lead	Federal Primary MCL	0.015 mg/L	0.023 mg/L	Groundwater	On-site	
		Selenium	Federal Primary MCL	0.05 mg/L	0.173 mg/L	Groundwater	On-site	
LA	Rodemacher Power Station	Arsenic	Federal Primary MCL	0.01 mg/L	0.0575 mg/L	Groundwater	On-site	State Required Assessment Monitoring
		Lead	Federal Primary MCL	0.015 mg/L	0.0209 mg/L	Groundwater	On-site	
NC	Dan River Steam Station	Chromium	North Carolina Groundwater Standard	0.05 mg/L	0.0611 mg/L	Groundwater	On-site	None
		Lead	Federal Primary MCL	0.015 mg/L	0.0392 mg/L	Groundwater	On-site	
		Silver	North Carolina Groundwater Standard	0.0175 mg/L	0.0411 mg/L	Groundwater	On-site	

Table 2: Coal Combustion Waste Damage to Groundwater

State	Site	Pollutant	Reference	Limit	Maximum Result	Media	Location	Enforcement Action
ND	Antelope Valley Station	Arsenic	Federal Primary MCL	0.01 mg/L	0.035 mg/L ^{xiii}	Groundwater	On-site	None
ND	Leland Olds Station	Arsenic	Federal Primary MCL	0.01 mg/L	0.0789 mg/L	Groundwater	On-site	None
		Lead	Federal Primary MCL	0.015 mg/L	0.0716 mg/L	Groundwater	On-site	
NE	Sheldon Station	Selenium	Federal Primary MCL	0.05 mg/L	.0728 mg/L	Groundwater	On-site	Post-closure groundwater monitoring extended with more monitoring wells
NY	Cayuga Generation Plant ^{xiv}	Arsenic	Federal Primary MCL	0.01 mg/L	0.019 mg/L	Groundwater	On-site	None
		Selenium	New York Groundwater Standard ^{xv}	0.01 mg/L	0.076 mg/L	Groundwater	On-site	
OH	Cardinal Plant	Arsenic	Federal Primary MCL	0.01 mg/L	0.1 mg/L	Groundwater	On-site	State Required Assessment Monitoring
		Boron	Federal Child Health Advisory	3 mg/L	5.57 mg/L	Groundwater	On-site	
		Molybdenum	Federal Lifetime Health Advisory	0.04 mg/L	0.43 mg/L	Groundwater	On-site	
OH	Gavin Power Plant ^{xvi}	Alpha Particles	Federal Primary MCL	15 pCi/L	1,497 pCi/L	Groundwater	On-site	State Required Assessment Monitoring
		Arsenic	Federal Primary MCL	0.01 mg/L	0.057 mg/L	Groundwater	On-site	
		Barium	Federal Primary MCL	2 mg/L	13.8 mg/L	Groundwater	On-site	
		Boron	Daily Maximum Concentration in NPDES Discharge Permit	8.551 mg/L	9.47 mg/L	Outfall 007	Landfill Discharge to Surface Water	
		Cadmium	Federal Primary MCL	0.005 mg/L	0.007 mg/L	Groundwater	On-site	
		Lead	Federal Primary MCL	0.015 mg/L	0.051 mg/L	Groundwater	On-site	
	Molybdenum	Federal Lifetime Health Advisory	0.04 mg/L	0.409 mg/L	Groundwater	On-site		

Table 2: Coal Combustion Waste Damage to Groundwater

State	Site	Pollutant	Reference	Limit	Maximum Result	Media	Location	Enforcement Action
OH	Muskingum River Plant	Alpha Particles	Federal Primary MCL	15 pCi/L	128 pCi/L	Groundwater	On-site	Monitoring required due to increase in impoundment dam height
OH	Industrial Excess Landfill (Uniontown)	Antimony	Federal Primary MCL	0.006 mg/L	0.315 mg/L	Groundwater	Off-site (close to or within a residential area)	EPA Designated Superfund Site
		Arsenic	Federal Primary MCL	0.01 mg/L	0.132 mg/L	Groundwater	Off-site (close to or within a residential area)	
		Barium	Federal Primary MCL	2 mg/L	2.3 mg/L	Groundwater	Off-site (close to or within a residential area)	
		Beryllium	Federal Primary MCL	0.004 mg/L	0.121 mg/L	Groundwater	Off-site (close to or within a residential area)	
		Cadmium	Federal Primary MCL	0.005 mg/L	0.265 mg/L	Groundwater	Off-site (close to or within a residential area)	
		Chromium	Federal Primary MCL	0.1 mg/L	1.680 mg/L	Groundwater	Off-site (close to or within a residential area)	
		Lead	Federal Primary MCL	0.015 mg/L	0.70 mg/L	Groundwater	Off-site (close to or within a residential area)	
		Mercury	Federal Primary MCL	0.002 mg/L	0.0055 mg/L	Groundwater	Off-site (close to or within a residential area)	
		Nickel	Federal Primary MCL	0.1 mg/L	2.2 mg/L	Groundwater	Off-site (close to or within a residential area)	
		Thallium	Federal Primary MCL	0.002 mg/L	0.0129 mg/L	Groundwater	Off-site (close to or within a residential area)	

Table 2: Coal Combustion Waste Damage to Groundwater

State	Site	Pollutant	Reference	Limit	Maximum Result	Media	Location	Enforcement Action
OK	Northeastern Station	Arsenic	Federal Primary MCL	0.01 mg/L	0.094 mg/L	Groundwater	On-site ^{xvii}	State Required Investigation and possible remediation of contaminant plume moving south but no action on contamination moving north.
		Barium	Oklahoma Groundwater Standard ^{xviii}	1 mg/L	8.69 mg/L	Groundwater	On-site	
		Chromium	Federal Primary MCL	0.1 mg/L	0.225 mg/L	Groundwater	On-site moving off-site	
		Lead	Federal Primary MCL	0.015 mg/L	0.208 mg/L	Groundwater	On-site moving off-site	
		Selenium	Oklahoma Groundwater Standard ^{xix}	0.01 mg/L	1.85 mg/L	Groundwater	On-site	
		Thallium	Federal Primary MCL	0.002 mg/L	0.003 mg/L	Groundwater	On-site	
OR	Boardman Plant	Selenium	Oregon Groundwater Standard	0.01 mg/L	0.019 mg/L	Groundwater	On-site	None
		Vanadium	Florida Groundwater Standard (see site report)	0.049 mg/L	0.126 mg/L	Groundwater	On-site ^{xx}	
PA	Bruce Mansfield Power Station (Little Blue)	Aluminum	Federal Secondary MCL	0.05 - 0.2 mg/L	0.711 mg/L	Groundwater	Off-site Private Drinking Well	PADEP and FirstEnergy entered into a settlement agreement in 1994 for groundwater contamination; since then, PADEP has issued two NOVs for fugitive dust and required resampling of 10 wells with elevated arsenic levels, but no comprehensive remediation plan has been required nor penalties assessed.
		Antimony	Pennsylvania WQC Health Criteria	0.0056 mg/L	0.01 mg/L	Surface Water	Off-site (seep 1,490 feet from the impoundment)	
		Arsenic	Federal Primary MCL	0.01 mg/L	0.025 mg/L	Groundwater	Off-site Private Drinking Well	

Table 2: Coal Combustion Waste Damage to Groundwater

State	Site	Pollutant	Reference	Limit	Maximum Result	Media	Location	Enforcement Action
PA	Bruce Mansfield Power Station (Little Blue)	Arsenic	Federal Primary MCL	0.01 mg/L	0.036 mg/L	Groundwater	On-site ^{xxi}	PADEP and FirstEnergy entered into a settlement agreement in 1994 for groundwater contamination; since then, PADEP has issued two NOV's for fugitive dust and required resampling of 10 wells with elevated arsenic levels, but no comprehensive remediation plan has been required nor penalties assessed.
		Arsenic	Pennsylvania Criteria Continuous Concentration	0.01 mg/L	0.028 mg/L	Surface Water	Off-site (a spring over 2,000 feet from the impoundment)	
		Barium	Federal Primary MCL	2 mg/L	5.93 mg/L	Groundwater	Off-site Private Drinking Well	
		Boron	Pennsylvania Criteria Continuous Concentration	1.6 mg/L	15.2 mg/L	Surface Water	Off-site	
		Boron	Pennsylvania Criteria Continuous Concentration	1.6 mg/L	11.8 mg/L	Surface Water	On-site (a seep over 1,800 feet from the impoundment)	
		Cadmium	Federal Primary MCL	0.005 mg/L	0.85 mg/L (total)	Groundwater	Off-site Private Drinking Well	
		Cadmium	Pennsylvania Criteria Continuous Concentration	0.00064 mg/L	0.00074 mg/L	Surface Water	Off-site	
		Chloride	Federal Secondary MCL	250 mg/L	3,520 mg/L / 1,900 mg/L	Groundwater	Off-site Monitoring Well/Private Drinking Water Well	
		Chloride	Federal Secondary MCL	250 mg/L	589 mg/L	Surface Water	Off-site	
Fluoride	Federal Secondary MCL	2 mg/L	2.3 mg/L	Groundwater	Off-site Private Drinking Well			

Table 2: Coal Combustion Waste Damage to Groundwater

State	Site	Pollutant	Reference	Limit	Maximum Result	Media	Location	Enforcement Action
PA	Bruce Mansfield Power Station (Little Blue)	Fluoride	Federal Secondary MCL	2 mg/L	4.4 mg/L	Groundwater	On-site ^{xxi}	PADEP and FirstEnergy entered into a settlement agreement in 1994 for groundwater contamination; since then, PADEP has issued two NOV's for fugitive dust and required resampling of 10 wells with elevated arsenic levels, but no comprehensive remediation plan has been required nor penalties assessed.
		Hexavalent Chromium	Pennsylvania Criteria Continuous Concentration	0.010 mg/L	0.028 mg/L	Surface Water	Off-site	
		Iron	Federal Secondary MCL	0.3 mg/L	36 mg/L / 29 mg/L	Groundwater	Off-site Monitoring Well/Private Drinking Water Well	
		Iron	Federal Secondary MCL	0.3 mg/L	14.6 mg/L	Surface Water	Off-site	
		Lead	Federal Primary MCL	0.015 mg/L	2.69 mg/L	Groundwater	On-site ^{xxi}	
		Lead	Federal Primary MCL ^{xxii}	0.015 mg/L	1.8 mg/L (total)	Groundwater	Off-site Private Drinking Well	
		Lead	Pennsylvania Criteria Continuous Concentration	0.01094 mg/L	0.150 mg/L	Surface Water	Off-site	
		Manganese	Federal Secondary MCL	0.05 mg/L	3.27 mg/L / 2.399 mg/L	Groundwater	Off-site Monitoring Well/Private Drinking Water Well	
		Manganese	Federal Secondary MCL	0.05 mg/L	5.5 mg/L	Surface Water	Off-site	
		pH	Federal Secondary MCL	6.5 - 8.5	8.7	Groundwater	Off-site Private Drinking Well	
pH	Pennsylvania Secondary WQC Health Criteria	6.5 (minimum)	5.5 (minimum result)	Surface Water	Off-site			

Table 2: Coal Combustion Waste Damage to Groundwater

State	Site	Pollutant	Reference	Limit	Maximum Result	Media	Location	Enforcement Action
PA	Bruce Mansfield Power Station (Little Blue)	Selenium	Pennsylvania Criteria Continuous Concentration	0.0046 mg/L	0.150 mg/L	Surface Water	Off-site	PADEP and FirstEnergy entered into a settlement agreement in 1994 for groundwater contamination; since then, PADEP has issued two NOV's for fugitive dust and required resampling of 10 wells with elevated arsenic levels, but no comprehensive remediation plan has been required nor penalties assessed.
		Selenium	Pennsylvania Criteria Continuous Concentration	0.0046 mg/L	0.0939 mg/L	Surface Water	On-site (a seep just below impoundment dam)	
		Sulfate	Federal Secondary MCL	250 mg/L	1,710 mg/L	Groundwater	Off-site Private Drinking Well	
		Sulfate	Federal Secondary MCL	250 mg/L	3,480 mg/L	Surface Water	Off-site	
		TDS	Federal Secondary MCL	500 mg/L	7,310 mg/L / 2,900 mg/L	Groundwater	Off-site Monitoring Well/Private Drinking Water Well	
		TDS	Federal Secondary MCL	500 mg/L	6,460 mg/L	Surface Water	Off-site	
		Thallium	Pennsylvania WQC Health Criteria	0.00024 mg/L	0.00046 mg/L	Surface Water	Off-site	
		Turbidity	Pennsylvania Groundwater Standard	1 NTU	220 NTU / 40 NTU	Groundwater	Off-site Monitoring Well/Private Drinking Well	
PA	Hatfield's Ferry Power Station	Arsenic	Federal Primary MCL	0.01 mg/L	3.419 mg/L (total)	Groundwater	On-site ^{xxiii}	
		Boron	Federal Child Health Advisory	3 mg/L	31.7 mg/L	Groundwater	On-site ^{xxiv}	

Table 2: Coal Combustion Waste Damage to Groundwater

State	Site	Pollutant	Reference	Limit	Maximum Result	Media	Location	Enforcement Action
PA	Hatfield's Ferry Power Station	Boron	Pennsylvania Criteria Continuous Concentration	1.600 mg/L	8.428 mg/L	Surface Water	Off-site in unnamed tributary of Little Whitely Creek	2008 Consent Order and Agreement for violations of effluent limits in ash landfill discharges to the unnamed tributary to Little Whitely Creek. Required corrective action plan to address deficiencies in landfill's wetland treatment system. Steps to be implemented are unclear.
		Chromium	Federal Primary MCL	0.1 mg/L	0.104 mg/L	Groundwater	On-site ^{xxv}	
		Manganese	Federal Secondary MCL	0.050 mg/L	0.355 mg/L	Surface Water	Off-site in unnamed tributary of Little Whitely Creek	
		Molybdenum	EPA Lifetime Health Advisory	0.04 mg/L	1.31 mg/L	Groundwater	On-site ^{xxvi}	
		Molybdenum	EPA Lifetime Health Advisory	0.04 mg/L	0.49 mg/L	Surface Water	Off-site in unnamed tributary of Little Whitely Creek	
		Sulfate	Federal Secondary MCL	250 mg/L	1,256 mg/L	Surface Water	Off-site in unnamed tributary of Little Whitely Creek	
SD	Big Stone Power Plant	Arsenic	Federal Primary MCL	0.01 mg/L	0.1322 mg/L	Groundwater	On-site	Assessment required additional wells in 1990. Contamination has continued.
		Boron	Federal Child Health Advisory	3 mg/L	204 mg/L	Groundwater	On-site	

Table 2: Coal Combustion Waste Damage to Groundwater

State	Site	Pollutant	Reference	Limit	Maximum Result	Media	Location	Enforcement Action
SD	Big Stone Power Plant	Lead	Federal Primary MCL	0.015 mg/L	0.1086 mg/L	Groundwater	On-site	Assessment required additional wells in 1990. Contamination has continued.
		Strontium	Federal Lifetime Health Advisory	4 mg/L	6.03 mg/L	Groundwater	On-site	
		Sulfate	Federal Secondary MCL	250 mg/L	56,000 mg/L	Groundwater	On-site	
TN	Cumberland Steam Plant	Arsenic	Federal Primary MCL	0.01 mg/L	0.022 mg/L	Groundwater	On-site	No actions evident
		Boron	Federal Child Health Advisory	3 mg/L	38 mg/L	Groundwater	On-site	
		Selenium	Federal Primary MCL	0.05 mg/L	0.15 mg/L	Groundwater	On-site	
TN	Gallatin Fossil Plant	Beryllium	Federal Primary MCL	0.004 mg/L	0.023 mg/L	Groundwater	On-site	No actions evident. There are two active disposal units on-site that are not monitored.
		Boron	EPA Child Health Advisory	3 mg/L	5.6 mg/L	Groundwater	On-site	
		Cadmium	Federal Primary MCL	0.005 mg/L	0.0064 mg/L	Groundwater	On-site	
		Nickel	Tennessee Groundwater Standard	0.1 mg/L	0.25 mg/L	Groundwater	On-site	
TN	Johnsonville Fossil Plant	Arsenic	Federal Primary MCL	0.01 mg/L	0.570 mg/L	Groundwater	On-site	No actions evident. TDEC has allowed TVA to stop monitoring the two most contaminated areas on-site.
		Boron	Federal Child Health Advisory	3 mg/L	48 mg/L	Groundwater	On-site	
		Cadmium	Federal Primary MCL	0.005 mg/L	0.260 mg/L	Groundwater	On-site	
		Chromium	Federal Primary MCL	0.1 mg/L	0.16 mg/L	Groundwater	On-site	
		Lead	Federal Primary MCL	0.015 mg/L	0.39 mg/L	Groundwater	On-site	
		Molybdenum	EPA Lifetime Health Advisory	0.04 mg/L	1.20 mg/L	Groundwater	On-site	

Table 2: Coal Combustion Waste Damage to Groundwater

State	Site	Pollutant	Reference	Limit	Maximum Result	Media	Location	Enforcement Action
TX	Fayette Power Project (Sam Seymour)	Arsenic	Federal Primary MCL	0.01 mg/L	0.023 mg/L	Groundwater	On-site	None
		Cobalt	Texas Residential Protective Contamination Level	0.0073 mg/L	0.0303 mg/L	Groundwater	On-site	None
		Molybdenum	Federal Lifetime Health Advisory ^{xxvii}	0.04 mg/L	0.169 mg/L	Groundwater	On-site	Letter sent to neighboring landowners warning of potential molybdenum contamination
		Selenium	Federal Primary MCL	0.05 mg/L	0.212 mg/L	Groundwater	On-site	State required assessment monitoring for selenium.
WI	Oak Creek Power Plant (Caledonia)	Boron	Wisconsin Preventative Action Limit	0.19 mg/L	0.72 mg/L	Groundwater	Off-Site - Douglas and Avenue Private Wells	Utility and WDNR are sampling off-site private wells.
		Molybdenum	Wisconsin Enforcement Standard	0.04 mg/L	0.094 mg/L	Groundwater	On-site	
		Molybdenum	Federal Lifetime Health Advisory	0.04 mg/L	0.124 mg/L	Groundwater	Off-Site - Douglas and Botting Avenue Wells	

ⁱ Arkansas Groundwater Protection Standard for silver is 0.18 mg/L.

ⁱⁱ The IAGQS for barium is 0.075 mg/L. IAGQS are site specific standards approved by IL EPA for the Joliet Site.

ⁱⁱⁱ The IAGQS for boron is 5.9 mg/L.

^{iv} The IAGQS for cadmium is 0.264 mg/L, 52.8 times higher than the Federal Primary MCL.

^v The IAGQS for molybdenum is 1.38 mg/L, 34.5 times higher than the Federal Life-time Health Advisory.

^{vi} The IAGQS for pH is 6.14 to 8.56.

^{vii} The IAGQS for selenium is 0.325 mg/L, 6.5 times higher than the Federal Primary MCL.

- viii The IAGQS for sodium is 165 mg/L, more than 8 times higher than the health-based Federal Drinking Water Advisory.
- ix The IAGQS for sulfate is 493 mg/L.
- x The IAGQS for TDS is 1,112 mg/L.
- xi The federal Child Health Advisory for boron is 3.0 mg/L.
- xii The Illinois Groundwater Protection Standard for boron is 2.0 mg/L.
- xiii This is an approximate value, based on a trend graph. The state had only trend graphs of data available for public review from the operator.
- xiv Ash leachate discharges to Cayuga Lake contain arsenic up to 0.086 mg/L, 4778 times the federal human health /fish consumption water quality criteria, cadmium up to 0.052 mg/L, 26 times the federal aquatic life acute toxicity water quality criteria (a hardness dependent standard), selenium up to 0.273 mg/L, 55 times the federal aquatic life chronic toxicity water quality criteria and boron up to 75.1 mg/L, 25 times the federal Child Health Advisory. Cayuga Lake is not monitored for possible water quality criteria (standard) violations resulting from these discharges.
- xv The federal primary MCL for selenium is 0.05 mg/L.
- xvi Nickel and zinc concentrations exceeding water quality criteria in discharges from the ash pond are suspected of killing the test aquatic insect, *Ceriodaphnia dubia*, in Stingy Run.
- xvii Arsenic, chromium and lead have been measured up to 9.4 times, 2.25 times and 9.3 times higher than their federal primary MCLs respectively in groundwater 900 feet downgradient of the ash landfill to the north reflecting contamination moving off-site.
- xviii The federal primary MCL for barium is 2.0 mg/L.
- xix The federal primary MCL for selenium is 0.05 mg/L.
- xx This vanadium concentration was measured at a well 1,500 feet downgradient of the ash landfill reflecting contamination moving off-site.
- xxi Result reflects on-site contamination moving off-site.
- xxii The Pennsylvania Groundwater Standard for lead is 0.005 mg/L.
- xxiii This arsenic concentration was measured at a well approximately 1,500 feet downgradient of the ash landfill reflecting contamination moving off-site.
- xxiv This boron concentration was measured at a well approximately 1,500 feet downgradient of the ash landfill reflecting contamination moving off-site.
- xxv This chromium concentration was measured at a well approximately 1,500 feet downgradient of the ash landfill reflecting contamination moving off-site.
- xxvi This molybdenum concentration was measured at a well approximately 1,500 feet downgradient of the ash landfill reflecting movement of contamination off-site.
- xxvii The Texas Protective Contamination Level (TPCL) for molybdenum is 0.122 mg/L.