Risky Business

Coal Ash Threatens America's Groundwater Resources at 19 More Sites

The Environmental Integrity Project (EIP) has been collecting evidence of groundwater contamination near coal ash ponds and landfills for several years, and the more we look, the more we find. After EPA documented 67 proven or potential 'damage cases' in 2007, we found groundwater or surface water contamination at 70 additional sites, and submitted our analysis to EPA in two reports released in February and August of 2010.[1]

In this report, we identify an additional 19 sites where coal combustion waste appears to have contaminated groundwater with arsenic or other pollutants at levels above primary Safe Drinking Water Act Maximum Contaminant Limits (MCL) for pollutants like arsenic. All but two have also measured concentrations of other pollutants – such as boron, molybdenum, and manganese – above the limits EPA has recommended in Health Advisories for children or adults.[2] In addition, our report includes new information about 7 previously recognized damage cases, including stunning evidence of groundwater more toxic than hazardous waste leachate. Finally, we have identified soil contamination at an Indiana site where coal ash was used to fill in a rail bed. These structural fills account for most "recycling" of coal combustion waste, and are largely unregulated.

19 new sites

Table 1 identifies peak concentrations of pollutants measured in groundwater at 19 sites not previously identified, including seven in Illinois, three in South Carolina, two each in Iowa and Texas, and one each in Florida, Georgia, Kentucky, Nevada, and Tennessee. All of the data were obtained from states through Freedom of Information Act requests, and were derived from onsite monitoring wells, as virtually no offsite monitoring has been conducted.[3] Results include the following:

- Arsenic has been measured above the MCL of 10 parts per billion (ppb) at 14 sites, with groundwater concentrations more than 10 times over that threshold at Winyah Station (SC), Meredosia Station (IL), and Parish Station (TX), and the North Valmy Station (NV).

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[1] See EIP & Earthjustice, Out Of Control (Feb., 2010), available at http://www.environmentalintegrity.org/news_reports/documents/OutofControl-MountingDamagesFromCoalAshWasteSites.pdf.; EIP et al., In Harm's Way (Aug., 2010), available at http://www.environmentalintegrity.org/news_reports/documents/INHARMSWAY_FINAL3.pdf

[2] A list of the EPA Maximum Contaminant Levels and Health Advisories for pollutants identified in these reports is available at: http://water.epa.gov/action/advisories/drinking/upload/dwstandards2011.pdf.

[3] The lack of offsite data should not be seen as evidence that there is no offsite contamination—it is simply that very little offsite monitoring has been done. In fact, contaminated groundwater can and does contaminate drinking water supplies and move into adjacent rivers and lakes.

- Lead levels reached 209 parts per billion at the McMeekin site in South Carolina, almost fourteen times the MCL for lead. The Joppa and Powerton stations in Illinois, and the Coleto Creek site in Texas also reported lead concentrations well above the 15 ppb MCL.

- Maximum Contaminant Levels for antimony, barium cadmium, chromium, and selenium were also exceeded at one or more locations.

- Monitoring wells at seven Illinois sites show contamination above the MCL for arsenic or other pollutants. Illinois began monitoring groundwater downgradient of the previously unmonitored coal ash ponds at these sites in 2010; all have contaminated groundwater to some degree. Some states still do not require monitoring near ash ponds, so the extent of groundwater pollution at these locations is unknown.

- All sites showed pollutants like boron, molybdenum or sulfates at concentrations greater than the "Health Advisories" established by the EPA to protect children and adults from unsafe levels of such contaminants. These pollutants can infiltrate private wells, but are not covered by the Safe Drinking Water Act, which addresses public drinking water supplies.

- At least five sites report groundwater levels that exceed Health Advisories for three or more contaminants, including Prairie Creek in Iowa, the Joppa and Waukegan plants in Illinois, the Paradise Fossil Plant in Kentucky, and the W.A. Parish plant in Texas. Monitoring wells at the Parish plant have measured molybdenum levels as high as 856 ppb, more than 20 times the EPA Lifetime Health Advisory of 40 ppb.

- Two sites—the Prairie Creek Station in Iowa and the Meredosia plant in Illinois—have shown boron in excess of 30 parts per million (ppm), ten times the Health Advisory for drinking water consumed by children within a twenty four hour period.

- At a site where coal combustion wastes were used in rail bed construction, arsenic and lead in soil are well above state and EPA screening levels for cleanup of sites with contaminated soils.

The data we present only include results from wells that are above background levels, and in the path of groundwater flowing from coal combustion waste disposal sites. The actual groundwater monitoring reports have been provided to EPA, and are available from EIP upon request.

New evidence at known damage cases

Table 2 lists new evidence of groundwater pollution at 7 sites already identified by EPA or EIP in earlier reports. These include three South Carolina sites previously listed for surface water issues, one site previously listed for its massive structural failure and now showing dramatic

selenium contamination (Kingston Fossil Plant), and three sites where previously limited evidence of groundwater contamination has substantially increased.

Our data review found new evidence of contamination at locations previously evaluated by EPA. At the TVA Colbert site, downgradient monitoring wells recorded arsenic levels ranging from 53 to 70 ppm in October of 2010, and new downgradient well data for TVA Bull Run shows arsenic as high as 27 ppb. These values are well above the drinking water standard of 10 ppb. EPA's 2007 review rated both sites as only "potential" damage cases, due to the lack of information about arsenic or other primary pollutants. The new data indicate that arsenic has moved beyond the solid waste unit boundary, and that both of these sites are now proven damage cases based on EPA's criteria.

New information from South Carolina documents concentrations of arsenic in groundwater that are actually higher than amounts found in the leachate from hazardous waste. To provide some context, federal solid waste law uses concentrations of pollutants in a waste's leachate – the liquid passing directly out of a waste material -- to define that waste as hazardous. These "toxicity characteristics" were originally set at 100 times a pollutant's MCL. The toxicity characteristic for arsenic, for example, is 5 parts per million (ppm), 100 times the old arsenic MCL of 0.05 ppm.[4] However, the arsenic MCL has since been revised to 0.01 ppm, and the toxicity characteristic should be revised to 1 ppm. It should be emphasized that these criteria are applied to leachate— groundwater is far more dilute than pure leachate and should never approach much less exceed these toxicity characteristics. Yet we have found several such exceedances, including in groundwater under three ash ponds in South Carolina:

- Groundwater near the ash pond at Wateree Station in South Carolina has shown arsenic as high as 5.1 ppm, above even the outdated toxicity characteristic. The same site has shown cadmium, chromium, and lead above their respective MCLs. (Data from 2001-2010; maximum concentration in 2006).

- Arsenic concentrations at two other South Carolina sites, Grainger Station and Urquhart Station, have been as high as 2.1 and 1.2 ppm, respectively—higher than what should be the new arsenic toxicity characteristic, and over 100 times above the arsenic MCL. (Data from 2010 for both sites).

Further information about these existing sites is available in Appendix B to this report.

Concentrations of chromium in the groundwater at ash sites warrant particular concern in light of the fact that some forms of chromium can cause cancer. The new California Public Health Goal for the more toxic species—hexavalent chromium—is 5,000 times lower than the current MCL.[5] Research that we plan to release shortly will document our conclusion that chromium

[4] See http://www.epa.gov/osw/hazard/wastetypes/characteristic.htm; see also 40 C.F.R. § 261.24.

[5] California Environmental Protection Agency (CA EPA), 2011a. Final Public Health Goal for Hexavalent Chromium (CrVI) in Drinking Water. Office of Environmental Health Hazard Assessment (OEHHA), July, 2011. Link to download document available at: http://oehha.ca.gov/water/phg/072911Cr6PHG.html.

leaching from coal ash is dominated by hexavalent chromium, meaning that any measurements of total chromium significantly above the California standard likely indicate water that is unsafe to drink. Although we do not include the data in the tables below, it should be noted that most of the twenty new cases being presented have found levels of total chromium orders of magnitude above California's Public Health Goal for hexavalent chromium. Where chromium exceeds the current MCL—McMeekin Station in South Carolina, for example, has had concentrations up to 371 ppb—then the water is many orders of magnitude above a truly safe concentration.

Soil Contamination at Structural Fill

Our research also identified a site where coal ash used in rail bed construction contaminated soil with arsenic and lead at concentrations far above the "screening levels" that EPA and states use to determine whether cleanup is needed. Arsenic levels measured at a former CSX rail corridor in Indiana were as high as 347 milligrams per kilogram of soil (mg/kg) – almost nine hundred times the EPA screening level of 0.39 mg/kg for arsenic. Lead levels reached 1,200 mg/kg, or three times the screening level of 400 mg/kg.[6]

According to the American Coal Ash Association, nearly a million tons of coal ash was used in road beds in 2009, and another 8.8 million tons in structural fills. These and other land-based applications account for about two thirds of the "recycling" of coal combustion waste, which is subject to minimal regulation in most states.[7]

Maximum Contaminant Levels and Health Advisories

EIP's report compares data from downgradient monitoring wells to the "Maximum Concentration Levels" (MCLs) established for primary pollutants under the federal Safe Drinking Water Act. The MCLs are supposed to provide an "ample margin of safety" for public water supply systems, but the standard is subject to two important limitations. First, it must take into account the availability of treatment technology that can remove contaminants. For example, arsenic is a known carcinogen and EPA has not identified any "safe" level of exposure; the current standard of ten micrograms per liter (ten parts per billion) was set because the Agency determined that was the lowest level that could be achieved after treatment to remove this pollutant. Second, EPA estimates that fifteen percent of U.S. households draw their drinking water from private wells that are not subject to the MCL standards or the federal Safe Drinking Water Act.[8]

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[6] EPA residential soil screening levels can be found at: http://www.epa.gov/region9/superfund/prg/.

[7] American Coal Ash Association, Revised 2009 Coal Combustion Product (CCP) Production and Use Survey Report, available at http://www.acaa-usa.org/associations/8003/files/2009_Production_and_Use_Survey_Revised_100511.pdf

[8] USEPA, "Private Drinking Water Wells," at http://water.epa.gov/drink/info/well/index.cfm.

EPA has established "Health Advisories" for a number of other pollutants for which MCLs have not been determined. These standards, which are not enforceable under federal law, identify concentrations that are thought to pose no risk. Health advisories consider the potential risk based on short-term exposure of children or lifetime exposure to adults for the given contaminant. These health advisories can be especially important to citizens who drink water from their private wells. For example, EPA has declined to set an MCL for boron, which at higher doses has been linked to nausea, diarrhea and other more serious ailments, in part because it is not commonly found in public water supplies. But boron is one of the signature pollutants at coal ash sites, where groundwater monitoring has measured concentrations more than ten times the EPA Health Advisory of 3 mg/liter.

EPA has also established "secondary" MCLs for other coal ash pollutants, like chloride or iron, because these contaminants can make water too foul to drink, corrode pipes, or create other serious nuisances. These secondary limits are not addressed in our report, because they are based on so-called "aesthetic" values and have not been linked to specific health concerns at the levels used to set these secondary standards. Of course, if your water is too foul to drink at all, you are not likely to be consoled by the fact that it won't seriously harm your health if you manage to swallow it.

Notes on Methodology

FOIA requests. EIP made a series of FOIA requests in spring, 2011, in which we asked for all groundwater monitoring data from 2008-2011, groundwater quality results from the date of well installation, maps showing the locations of groundwater wells, information about compliance boundaries, hydrogeologic reports, groundwater monitoring plans, and any records of enforcement actions related to groundwater.

Point of Measurement: As far as we were able to determine, all groundwater data were obtained from monitoring wells located outside the boundary of waste management units, but virtually all wells were at or inside the perimeter of the power plant or disposal facility. We are not able to estimate actual exposure to public or private drinking water supplies due to limited data and the lack of monitoring beyond the site boundary. Contaminants like arsenic do not degrade easily in groundwater, may move slowly through aquifers and, according to EPA, may not reach peak levels until decades after they are first detected.

In some cases, groundwater can be intercepted by a stream or other surface water body, which may move contaminants away from drinking water wells. The discharge of contaminants to surface water from an adjacent aquifer can load a stream with pollutants that threaten aquatic life, or raise treatment costs for downstream public water supply systems. Some federal courts have found that these hydrological discharges violate the Clean Water Act.[9]

[9] See, e.g., Hernandez v. Esso Standard Oil Co., 599 F.Supp.2d 175, 181 (D. Puerto Rico 2009) (noting that "whether pollution is introduced by a visible, above-ground conduit or enters the surface water through the aquifer matters little to the fish, waterfowl, and recreational users which are affected.").

Sampling dates. The report emphasizes data from 2008-2011 because we wanted to focus on recent and ongoing contamination issues. On the other hand, concentrations of pollutants in groundwater at a fixed location can fluctuate over time due to variations in the surrounding hydrogeology. The solubility and mobility of some metals, for example, can be affected by subtle variations in pH and redox potential. The direction in which a contaminant plume is moving may also change due to seasonal changes in groundwater flow and/or nearby surface water levels. For these reasons it should not be assumed that a drop in the concentration of a pollutant from one sampling date to the next is indicative of a trend—it could go up again in the next round. There were a few instances where we recently acquired data from prior years and chose to include it: Allen Fossil Plant, TN (the two most recent reports were from 2006 and 2008); Colbert Fossil Plant, AL (2007-2010); Fair Station, IA (1995-2008); Prairie Creek Generating Station, IA (1994-2009); and Wateree Station, SC (2001-2010).

Anomalous data and upgradient wells. We attempted to exclude anomalous data—very high readings of an individual pollutant that were more likely due to methodological or typographic errors than to reflect actual groundwater conditions. We also tried to exclude results from upgradient wells when listing exceedances. In some cases wells that were identified as upgradient in groundwater monitoring reports were very likely affected by coal ash pollutants (see, for example, the discussion of the Allen Fossil Plant below). Where we do include putatively upgradient results we include an explanation of our rationale in the text or appendices.

Note on Illinois sites. The seven Illinois cases in this report resulted from a request to the Illinois Environmental Protection Agency in the spring of 2011, when we became aware of new (2010) monitoring around 12 Illinois surface impoundments. Monitoring had not been required at these ash ponds prior to the TVA Kingston ash spill in Tennessee. Cases involving MCL exceedances are presented here, but every site exceeded EPA Health Advisories for manganese, sulfates, and other pollutants. The five sites not discussed below are Baldwin, Crawford, Edwards, Newton, and Will County Power Stations.

Table 1: Exceedances of Maximum Contaminant Levels (MCLs—in bold type) and other health advisories at 19 new damage cases.

State	Site (Owner)	Pollutant	Maximum concentration	MCL (bold) or health advisory[10]
FL	Plant Crist (Southern Company)	**Arsenic**	**35 ppb**	**10 ppb**
		Cadmium	**16 ppb**	**5 ppb**
		Manganese	1.3 ppm	0.3 ppm
		Sulfate	930 ppm	500 ppm
GA	Plant Yates (Southern Company)	**Chromium**	**220 ppb**	**100 ppb**
		Selenium	**110 ppb**	**50 ppb**
		Nickel	280 ppb	100 ppb
IA	Fair Station (Central Iowa Power Cooperative)	**Selenium**	**713 ppb**	**50 ppb**
		Manganese	7.8 ppm	0.3 ppm
		Sulfate	2,600 ppm	500 ppm
IA	Prairie Creek Generating Station (Alliant Energy)	**Arsenic**	**28.9 ppb**	**10 ppb**
		Boron	37.1 ppm	3 ppm
		Manganese	5.7 ppm	0.3 ppm
		Sulfate	5,300 ppm	500 ppm
IL	Dallman Power Station (City Water, Light & Power)	**Arsenic**	**93.6 ppb**	**10 ppb**
		Boron	11.9 ppm	3 ppm
		Manganese	9.25 ppm	0.3 ppm
IL	Joliet 29 (Edison International)	**Antimony**	**12 ppb**	**6 ppb**
		Manganese	1.1 ppm	0.3 ppm
		Sulfate	1,660 ppm	500 ppm
IL	Joppa plant (Ameren and others)	**Lead**	**27.4 ppb**	**15 ppb**
		Boron	11.8 ppm	3 ppm
		Manganese	4.25 ppm	0.3 ppm
		Sulfate	768 ppm	500 ppm
IL	Meredosia Power Station (Ameren)	**Arsenic**	**148 ppb**	**10 ppb**
		Boron	30.2 ppm	3 ppm
		Manganese	3.1 ppm	0.3 ppm
IL	Pearl Station (Prairie Power)	**Arsenic**	**48 ppb**	**10 ppb**
		Boron	16 ppm	3 ppm
IL	Powerton Station (Edison International)	**Arsenic**	**26 ppb**	**10 ppb**
		Lead	**39 ppb**	**15 ppb**
		Manganese	3.5 ppm	0.3 ppm
IL	Waukegan Station (Edison International)	**Antimony**	**15 ppb**	**6 ppb**
		Arsenic	**54 ppb**	**10 ppb**
		Boron	28 ppm	3 ppm
		Manganese	0.71 ppm	0.3 ppm
		Sulfate	920 ppm	500 ppm

[10] Health-based guidelines used here include EPA Lifetime Health Advisories for manganese (300 ppb), molybdenum (40 ppb), and nickel (100 ppb), the EPA Child Health Advisory for boron (3 ppm), and the EPA health-based drinking water advisory for sulfate (500 ppm).

Table 1 (cont.): Exceedances of Maximum Contaminant Levels (MCLs—in bold type) and other health advisories at 19 new damage cases.

State	Site (Owner)	Pollutant	Maximum concentration	MCL (bold) or health advisory[11]
KY	Paradise Fossil Plant (TVA)	**Arsenic**	**18 ppb**	**10 ppb**
		Boron	24 ppm	3 ppm
		Manganese	61 ppm	0.3 ppm
		Nickel	200 ppb	100 ppb
		Sulfate	1,900 ppm	500 ppm
NV	North Valmy Generating Station (NV Energy/Idaho Power)	**Arsenic**	**260 ppb**	**10 ppb**
		Fluoride	**7.7 ppm**	**4 ppm**
		Manganese	0.41 ppm	0.3 ppm
SC	Cross Station (Santee Cooper)	**Arsenic**	**16.4 ppb**	**10 ppb**
		Cadmium	**16.8 ppb**	**5 ppb**
		Sulfate	1,982 ppm	500 ppm
SC	McMeekin Station (SCANA corporation)	**Chromium**	**371 ppb**	**100 ppb**
		Lead	**209 ppb**	**15 ppb**
		Sulfate	729 ppb	500 ppm
SC	Winyah Station (Santee Cooper)	**Arsenic**	**180 ppb**	**10 ppb**
		Sulfate	1,163 ppm	500 ppm
TN	Allen Fossil Plant (TVA)	**Arsenic**	**14 ppb**	**10 ppb**
		Manganese	1.4 ppm	0.3 ppm
TX	Coleto Creek Power Station (International Power)	**Arsenic**	**19 ppb**	**10 ppb**
		Lead	**73 ppb**	**15 ppb**
		Boron	4.12 ppm	3 ppm
		Nickel	140 ppb	100 ppb
TX	W.A. Parish Station (NRG Energy)	**Arsenic**	**125 ppb**	**10 ppb**
		Barium	**2.15 ppm**	**2 ppm**
		Selenium	**242 ppb**	**50 ppb**
		Boron	8.3 ppm	3 ppm
		Manganese	4.62 ppm	0.3 ppm
		Molybdenum	856 ppb	40 ppb
		Sulfate	3,870 ppm	500 ppm

[11] Health-based guidelines used here include EPA Lifetime Health Advisories for manganese (300 ppb), molybdenum (40 ppb), and nickel (100 ppb), the EPA Child Health Advisory for boron (3 ppm), and the EPA health-based drinking water advisory for sulfate (500 ppm).

Table 2: New evidence of groundwater contamination at previously identified sites.

State	Site (Owner)	Pollutant	Maximum concentration	MCL (bold) or health advisory[12]
SC	Grainger Generating Station (Santee Cooper)	**Arsenic**	**2,112 ppb**	**10 ppb**
SC	Urquhart Station (SCANA corporation)	**Arsenic**	**1,209 ppb**	**10 ppb**
SC	Wateree (SCANA corporation)	**Arsenic** **Cadmium** **Chromium** **Lead** Sulfate	**5,100 ppb** **8.8 ppb** **187 ppb** **67.5 ppb** 9,330 ppm	**10 ppb** **5 ppb** **100 ppb** **15 ppb** 500 ppm
AL	Colbert Fossil Plant (TVA)	**Antimony** **Arsenic** **Chromium** **Lead** **Nitrate** Boron Manganese Molybdenum Sulfate	**14 ppb** **70 ppb** **110 ppb** **160 ppb** **36 ppm** 12 ppm 1.2 ppm 200 ppb 540 ppm	**6 ppb** **10 ppb** **100 ppb** **15 ppb** **10 ppm** 3 ppm 0.3 ppm 40 ppb 500 ppm
KY	Shawnee Fossil Plant (TVA)	**Arsenic** **Beryllium** **Chromium** **Lead** Boron Manganese Molybdenum Nickel Sulfate	**22 ppb** **5.8 ppb** **150 ppb** **120 ppb** 21 ppm 67 ppm 710 ppb 120 ppb 1,500 ppm	**10 ppb** **4 ppb** **100 ppb** **15 ppb** 3 ppm 0.3 ppm 40 ppb 100 ppb 500 ppm
TN	Bull Run Fossil Plant (TVA)	**Arsenic** Boron Manganese Molybdenum Sulfate	**27 ppb** 17 ppm 24.7 ppm 700 ppb 2,100 ppm	**10 ppb** 3 ppm 0.3 ppm 40 ppb 500 ppm
TN	Kingston Fossil Plant (TVA)	**Selenium** Manganese	**412 ppb** 26.9 ppm	**50 ppb** 0.3 ppm

[12] Health-based guidelines used here include EPA Lifetime Health Advisories for manganese (300 ppb), molybdenum (40 ppb), and nickel (100 ppb), the EPA Child Health Advisory for boron (3 ppm), and the EPA health-based drinking water advisory for sulfate (500 ppm).

SUMMARIES OF NEW DAMAGE CASES

1. **Crist Plant:** Pensacola, FL; GPS Coordinates 30.565167, -87.225944. This landfill is 78 acres and includes fly ash and bottom ash storage areas southwest of the plant and Gypsum Storage Areas 1 and 2 northwest of the plant. The 1,135 MW plant has been generating CCW from four units built from 1959 to 1973.

Summary: Groundwater monitoring data from five sampling events from May 2008 to November 2010 show contamination from a coal ash landfill and gypsum storage areas at the Crist Power Plant in the Florida panhandle. Maximum Contaminant Levels (MCLs) for arsenic and cadmium were exceeded multiple times in one compliance monitoring well, MWC-4, near the landfill. Arsenic exceedances ranged from 29 to 35 ppb, (3.5 times the MCL), while cadmium was measured at 16 ppb (3.2 times the MCL). Health advisories were exceeded for manganese and sulfate. The worst sulfate concentrations were downgradient of gypsum storage areas.

2. **Yates Generating Plant:** Newnan, GA; GPS Coordinates 33.462389, -84.89861. Eight ash ponds covering 219 acres, with additional ash and FGD disposal areas. Only the FGD landfill has monitoring available for public inspection. The 1,487 MW plant has been generating CCW from seven units that went online from 1950 to 1974.

Summary: Groundwater monitoring data from 2008 to 2010 in eight wells shows exceedances of MCLs for total chromium in two wells (maximum 220 ppb, 2.2 times the MCL) and selenium in one well (maximum 110 ppb, 2.2 times the MCL). Southern Company information indicates that this concentration of selenium has been measured previously in downgradient wells, which have also shown lead at up to 34 ppb, 2.3 times higher than the MCL. The nickel health advisory was also exceeded in one downgradient well (280 ppb, 2.8 times the Lifetime Health Advisory.

3. **Fair Station**: Montpelier, IA; GPS Coordinates 41.457406, -90.822663. This coal ash monofill is located on alluvial sands, silts and clays next to Pine Creek, a tributary of the Mississippi River, and has received coal ash from Fair Station since 1974. The 62.5-MW plant has been generating CCW from two units that came online in 1960 and 1967.

Summary: Groundwater monitoring data from 1995 to 2008 show an average concentration of selenium above the MCL in a downgradient well. The highest concentration, 713 ppb, was more than 14 times above the MCL. Average concentrations of manganese and sulfate have exceeded Health Advisories in five downgradient wells. The maximum manganese concentration, 7.8 ppm, was more than 20 times above the LHA.

4. **Prairie Creek Generating Station/Stoney Point Coal Ash Landfill:** Cedar Rapids, IA; GPS Coordinates 41.944291, 91.63799. Located in a former limestone quarry, this landfill received ash from the Prairie Creek Station until 1987. A final cover was installed in 1992. The 245-MW station's four units went online in 1951, 1958, 1967, and 1997.

Summary: Groundwater monitoring data from 1994 to 2009 shows that arsenic concentrations have steadily increased in two downgradient wells, exceeding the MCL in 2008 and 2009 with concentrations up to 28.9 ppb in one well and 18.3 ppb in the other. The EPA Child Health Advisory of 3 ppm for boron has been exceeded in ten wells, with a maximum concentration of 37.1 ppm. Other health advisories have been exceeded for sulfate, in ten downgradient wells (maximum of 5,300 ppm), and for manganese, in five downgradient wells (maximum of 5.2 ppm).

5. **Former CSX Rail Corridor:** Bloomington, IN; GPS Coordinates 39°09'40.0"N, 86°32'10.5"W.

Summary: In the course of environmental investigations undertaken as part of a rails-to-trails project in Bloomington, Indiana, extensive arsenic and lead contamination was found in a railroad right-of-way as a result of coal ash and cinders used for ballast for the rail bed. Sampling along the 2.5-mile section of the former CSX railroad right of way found the following:

- *Arsenic:* 97.8% of 46 samples taken from cinders and ballast and soil samples to a depth of one foot in the northwest section of the trail exceeded the Indiana Department of Environmental Management's default closure levels (DCL) for residential (3.9 mg/kg) and industrial (5.8 mg/kg) arsenic-contaminated soil. The highest concentration of arsenic in a sample, 347 mg/kg, was 88 times higher than the DCL for residential use and 60 times higher than the DCL for industrial use of soils. It was also almost nine hundred times the EPA screening level of 0.39 mg/kg for arsenic.[13]
- *Lead:* Lead also exceeded the residential use DCL of 81 mg/kg in a majority of samples (62.5%). The highest lead concentration, 1,200 mg/kg, was 14.8 times higher than the DCL for residential use, 5.2 times higher than the DCL for industrial use of soils, and three times the EPA screening level of 400 mg/kg.[13]

6. **Dallman Station (City, Water, Light and Power):** Springfield, IL; GPS Coordinates 39.753899, -89.6036 . Two active unlined ponds receive CCW from this plant, one an ash pond and the other for FGD waste. The 388-MW plant's three units went online from 1968 to 1978.

[13] EPA residential soil screening levels can be found at: http://www.epa.gov/region9/superfund/prg/.

Summary: The first round of groundwater sampling measured five downgradient wells at the ash pond, and three downgradient wells at the FGD pond. Results showed exceedances of the arsenic MCL at three ash pond wells (maximum 93.6 ppb, 9.4 times the MCL) and one FGD well (14.8 ppb). The Child Health Advisory for boron was exceeded in one ash well (11.9 ppm, 3.9 times the Child Health Advisory).

7. **Joliet 29 Generating Station:** Joliet, IL; GPS Coordinates 41.495703, -88.130534. There are three active ponds at this 1,320-MW plant that are reportedly lined. The plant's two units went online in 1965 and 1966.

Summary: Eleven downgradient wells at the three ash ponds were first monitored in 2010. The antimony MCL was exceeded in one well with a concentration of 12 ppb (twice the MCL). Health Advisories were also exceeded for manganese in two wells (maximum of 3.7 times the LHA) and sulfate in one well (3.2 times the DWA).

8. **Joppa Steam Plant:** Joppa, IL; GPS Coordinates 37.21693, -88.866096. Joppa has two unlined ash ponds, one active and the other inactive. The 1,100-MW plant's six units went online in the early 1950s.

Summary: The first round of groundwater sampling measured seven monitoring wells at the two ash ponds in August 2010. The lead MCL was exceeded in two wells with concentrations of 27.4 ppb and 19.1 ppb. Boron, manganese and sulfate all exceeded Health Advisories: Boron exceeded the CHA in three wells (by up to 3.9 times), manganese exceeded the LHA in two wells (by up to 14.2 times), and sulfate exceeded the DWA in one well (by 1.5 times).

9. **Meredosia Power Station:** Meredosia, IL; GPS Coordinates 39.823269, -90.5672. There are five unlined ash ponds at this plant, two active and three inactive. The active ponds include a 186-acre fly ash pond built in 1968 and a 34-acre bottom ash pond built in 1972. The 354-MW plant's three units went online from 1948 to 1960.

Summary: Five downgradient wells were first sampled in December 2010. Arsenic exceeded the MCL in two wells, at 148 ppb (14.8 times the MCL) and 53.2 ppb (5.3 times the MCL). . Health advisories were also exceeded for boron in one well (30.2 ppm, 10.1 times the CHA), and manganese in two wells (up to 3.1 ppm, 10.3 times the LHA).

10. **Pearl Station:** Pearl, IL 62361; GPS Coordinates 39.4489, -90.6142. One active, unlined pond receives ash from this 22-MW plant whose sole unit went online in 1967.

Summary: The first round of groundwater sampling measured twelve downgradient wells at the ash pond in May 2010. The arsenic MCL was exceeded in five wells, with a maximum

concentration of 48 ppb, 4.8 times the MCL. The CHA for boron was exceeded in seven wells (with a maximum of 16 ppm, 5.3 times the CHA). Sulfate was above the DWA in five wells, at up to 1,400 ppm. Manganese was above the LHA in all wells, with a maximum of 18 ppm, 60 times the LHA.

11. **Powerton Generating Station:** Pekin, IL; GPS Coordinates 40.542091, -89.680487. This plant has three active, reportedly lined ash ponds: an Ash Basin (holding 31 million gallons), a Secondary Basin (holding 7.5 million gallons), and a Bypass Basin (holding 2.2 million gallons). The 1,786-MW plant's two units went online in 1972 and 1975.

Summary: Ten downgradient wells were first sampled in December, 2010. Arsenic exceeded the MCL in one well (26 ppb). Lead exceeded the MCL in the same well, with a concentration of 39 ppb, 2.6 times the MCL. The LHA for manganese was exceeded in five wells at up to 3.5 ppm, 11.7 times LHA.

12. **Waukegan Generating Station:** Waukegan, IL; GPS Coordinates 42.382778, -87.820274. This 803-MW plant has two lined ash ponds, with a 52-million gallon capacity, and an ash landfill. The plant's three units came online from 1952 to 1962.

Summary: There are five wells at this site. One well is designated as upgradient, yet has higher concentrations of boron, sulfate, manganese and total dissolved solids than the other four wells, suggesting that it has been affected by coal ash. We have not seen a map of well locations or potentiometric contours, but we are presuming that all wells are effectively downgradient. The first round of sampling in October, 2010 found arsenic above the MCL in two wells, at up to 54 ppb, more than five times the MCL (both wells were designated as downgradient). Antimony exceeded the MCL in one well (15 ppb, 2.5 times the MCL). The one purportedly upgradient well exceeded Health Advisories for boron (28 ppm, 9.3 times the CHA), manganese (0.71 ppm, 2.4 times LHA), and sulfate (920 ppm, 1.8 times DWA).

13. **Paradise Fossil Plant:** Paradise, KY; GPS Coordinates 37.259722, -86.978056. Paradise is a 2,558-MW, three-unit power plant completed in 1970. Disposal units include three ash ponds and an FGD disposal area.

Summary: Monitoring in the 1980s revealed contamination at this site that included beryllium, cadmium, and lead above MCLs (see Appendix A). There was apparently no groundwater monitoring throughout the 1990s and 2000s. Nine wells were finally installed in 2010. The first round of sampling, done in June, 2011, detected arsenic above the MCL in one well near the plant's bottom ash ponds. Boron, manganese, nickel, and sulfate all exceeded Health Advisories, with a maximum manganese concentration of 61,000 ppm—over 200 times the LHA.

14. **North Valmy Generating Station**: Valmy, NV; GPS Coordinates 40.8831, -117.1542. North Valmy is a 522-MW, two-unit power plant completed in 1985. Disposal units include five lined ponds and a landfill.

Summary: Although there are technically four groundwater wells at the North Valmy plant, two of these are chronically dry, and so only two are actively measured. These two wells are located northwest and northeast of the five evaporation ponds. The ponds have had a long history of tears, leaks, and repairs. Arsenic has been consistently above 100 ppb in both wells over the past three years, with a maximum concentration of 260 ppb. The fluoride MCL has been exceeded in one well. Manganese has been detected at up to 410 ppb, above the LHA. It is possible that the high arsenic and fluoride levels are naturally occurring due to the unique geology of the area; without upgradient or background monitoring this is only speculation.

15. **Cross Generating Station:** Pineville, SC. GPS Coordinates 33°22'20", 80°06'35". An ash pond and an ash landfill receive CCW from this 2,390 MW plant. Its four units began operation in 1984, 1995, 2007, and 2008.

Summary: Monitoring data for 1 upgradient and 17 downgradient wells from 2009 and 2010 found exceedances of MCLs for arsenic in two downgradient wells (maximum of 16.4 ppb, 1.6 times the MCL) and cadmium in one downgradient well (maximum of 16.8 ppb, 3.4 times the MCL). The sulfate DWA was exceeded in six wells (maximum of 1,982 ppm, 4 times DWA). Contamination may be worse than we are able to document, because the groundwater monitoring program did not analyze for a number of toxic metals, including antimony, barium, beryllium, lead, mercury, selenium, and thallium.

16. **McMeekin Station:** Columbia, SC; GPS Coordinates 34.0533, - 81.2178. An ash landfill and three ponds receive waste from this 294-MW plant whose 2 units went online in 1958.

Summary: Groundwater monitoring data from 2005 to 2010 show that MCLs were exceeded for chromium (maximum of 371 ppb, 3.7 times the MCL) and lead (maximum of 209 ppb, 13.9 times the MCL) in one well. This well also had high turbidity, suggesting that a significant fraction of these metals may have been suspended and not dissolved. The sulfate DWA was exceeded in one well (maximum of 729 ppm, 1.5 times DWA). The groundwater monitoring program did not analyze for a number of toxic metals, including antimony, beryllium, lead, mercury, selenium, and thallium. Furthermore, although ten wells are identified in the monitoring program, results of only one round sampling could be found for three of these wells, and no results were found for two others.

17. **Winyah Generating Station**: Georgetown, SC; GPS Coordinates 33.330278, -79.3575. There are four ash ponds covering 274 acres, and two "slurry ponds" covering 134 acres, that receive waste from this 1,260-MW plant. Its four units went online between 1975 and 1981.

Summary: Monitoring data for twelve wells from 2009 to 2010 found arsenic exceeding the MCL in three downgradient wells (by more than ten times in two of them). The sulfate DWA was exceeded in four wells (up to 1,163 ppm, 2.3 times the DWA). The groundwater monitoring program did not include a number of toxic metals, including antimony, beryllium, mercury, and thallium.

18. **Allen Fossil Plant**: Memphis, TN; GPS Coordinates 35.073611, -90.148889. Two ash ponds covering 93 acres receive wastes from this 990-MW plant. Its three units went online in 1959.

Summary: There are five wells at Allen, all of which should be considered downgradient because groundwater flow reverses from time to time. According to groundwater monitoring reports there is a strong "communication" between the alluvial aquifer beneath Allen and the adjacent Lake McKellar, and "[t]he predominant flow of groundwater is towards Lake McKellar." Yet lake levels sometimes rise above the local groundwater table and reverse the direction of flow. The groundwater levels measured for the February 2008 sample collection, for example, showed groundwater movement away from the lake. The authors of the 2008 report note that "[t]he ash ponds and other impoundments likely produce radial groundwater flow away from there [sic] impoundments that cannot be adequately characterized with the existing well network."

Groundwater monitoring data from 2006 and 2008 found arsenic exceeding the MCL in in two wells (maximum 14 ppb, 1.4 times the MCL). The LHA for manganese, 300 ppb, was exceeded in all five wells (by up to 4.7 times above the advisory). Tennessee regulations do not require groundwater monitoring for ash ponds, and the Tennessee Department of Environment and Conservation was apparently not aware of this voluntary monitoring until it was revealed in a June, 2011 report by TVAs Office of Inspector General.

19. **Coleto Creek Power Station**: Fannin, TX; GPS Coordinates 28.713333, -97.213333. Two ash ponds built in 1976-77 and covering 200 acres receive fly ash and bottom ash from this 600-MW plant. A map of the site also indicates that a "Dry Product Storage Area" of 130 acres exists on the western side of the ponds.

Summary: Monitoring from 10 wells sampled in May and October of 2010 found lead nearly five times higher than the MCL in one well and arsenic above the MCL in six wells, with a maximum arsenic concentration of 19 ppb. The boron CHA was exceeded in one well, and nickel exceeded the LHA in two wells.

20. **Parish Generating Station**: Thompsons, TX; GPS Coordinates 29.475722, -95.636167. A dry landfill receives fly ash and bottom ash from this 2,697-MW plant. Its four units went online in 1977-1982. There is also a clay-lined "FGD Emergency Pond" onsite.

Summary: There are 27 wells at this site. Monitoring results from four sampling events in 2009 and 2010 showed arsenic, barium, and selenium above MCLs. Arsenic exceeded the MCL in 10 wells, at up to 125 ppb, 12.5 times the MCL. Selenium exceeded the MCL in two wells with a maximum concentration of 242 ppb, 4.8 times the MCL, and barium exceeded the MCL in one well. Boron, manganese, molybdenum, and sulfate all exceeded Health Advisories—boron in 5 wells, manganese in 21 wells (at up to 4.62 ppm, more than 15 times the LHA), molybdenum in 3 wells at up to 20 times the LHA, and sulfate in 15 wells.

Appendix A: Detailed Information on New Damage Cases.

Compiled by J. Russell Boulding, Boulding Soil and Water Consulting, Bloomington, IN, October 31, 2011

The Damage Cases:

1) **Crist Plant,** Gulf Power--Pensacola, FL
2) **Yates Generating Plant,** Georgia Power—Newnan, GA
3) **Fair Station,** Central Iowa Power Cooperative—Montpelier, IA
4) **Prairie Creek Generating Station,** Interstate Power and Light—Cedar Rapids, IA
5) **Former CSX Rail Corridor,** CSX Railroad - Bloomington, IN
6) **Dallman Station,** City Water, Light and Power--Springfield, IL
7) **Joliet 29 Generating Station,** Midwest Generation--Joliet, IL
8) **Joppa Steam Plant,** Electric Energy/Ameren--Joppa, IL
9) **Meredosia Power Station,** Ameren Energy Generating--Meredosia, IL
10) **Pearl Station,** Prairie Power--Pearl, IL
11) **Powerton Generating Station,** Midwest Generation--Pekin, IL
12) **Waukegan Generating Station,** Midwest Generation--Waukegan, IL
13) **Paradise Fossil Plant**, TVA--Paradise, KY
14) **North Valmy Generating Station**, NV Energy/Idaho Power--Valmy, NV
15) **Cross Generating Station,** South Carolina Public Service Authority--Pineville, SC
16) **McMeekin Station,** South Carolina Electric & Gas Company--Columbia, SC
17) **Winyah Generating Station,** South Caroline Public Service Company--Georgetown, SC
18) **Allen Fossil Plant,** Tennessee Valley Authority—Memphis, TN
19) **Coleto Creek Station,** International Power, Fannin, TX
20) **Parish Generating Station,** NRG Energy, Thompsons, TX

Methodology:

The format for providing information for the new damage cases in this report has been abbreviated from that used for the 70 damage cases that we reported previously.[1] The current report focuses on results of recent analyses of groundwater data at coal combustion waste (CCW) sites obtained via Freedom of Information Act (FOIA) requests. In all damage cases presented in this report the cause of contamination is presumed to be the CCW disposal site, and exceedances of drinking water or other relevant standards were identified at downgradient monitoring points. State regulatory action, or lack of it, has not been documented in this report, but merits further examination.

The format for documenting the 18 damage cases presented in this report is as follows:

- *Plant Name/Capacity/Location*: Information on the power plant generally comes from the Sourcewatch[2] website for the station.
- *Owner/Parent Company*: Also from Sourcewatch.
- *Summary*: Identifies highest exceedances of standards found.
- *Constituents Involved*: Identifies the parameters with exceedances of Maximum Contaminant Levels (MCLs), other federal and state health-based guidelines, and Secondary Maximum Contaminant Levels (SMCLs). Table A identifies the concentrations used to define exceedances.
- *CCW Disposal Site Characteristics*: Information on surface impoundments in Illinois comes from IEPA's initial assessment of Illinois ash impoundments in response to the Kingston TN ash impoundment failure (Wilhite, 2009). For sites in other states, information is from EPA's 2009 surface impoundment survey and data compiled for the recently released report *State of Failure* (EarthJustice and Appalachian Mountain Advocates, 2011). Landfills were identified from monitoring well location maps, satellite photos and other permit materials provided by states.
- *Hydrogeologic Conditions*: Though requested, none of the FOIA responses for damage cases in this report included substantive hydrogeologic reports, so detailed hydrogeologic information was not readily available for most of the sites. Hydrogeologic vulnerability ratings for the Illinois sites come from Wilhite (2009). Groundwater flow directions were identified from site maps and potentiometric maps, when available, or estimated from interpretation of satellite photos.

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[1] See EIP & Earthjustice, Out Of Control (Feb., 2010), available at http://www.environmentalintegrity.org/news_reports/documents/OutofControl-MountingDamagesFromCoalAshWasteSites.pdf.; EIP et al., In Harm's Way (Aug., 2010), available at http://www.environmentalintegrity.org/news_reports/documents/INHARMSWAY_FINAL3.pdf

[2] http://www.sourcewatch.org.

- *Groundwater Data Analysis*: This section identifies the number of monitoring wells and dates of sampling that were analyzed. Exceedances for individual parameters are summarized by well number and concentration. Monitoring wells are located on the satellite photo of the site when location maps were available (none were received for the Illinois sites).
- *At Risk Population*: For Illinois the number of private wells within a mile and potable well contamination potential comes from Wilhite (2009). At other sites, satellite photos or other information provided by states were assessed to identify residences or water uses in the vicinity of the ash disposal sites that might rely on wells.
- *Other Information*: As noted.
- *Sources*: At most sites the FOIA requests yielded groundwater monitoring but no full reports related to the monitoring programs. Where specific documents were used in preparing the damage case, these are cited.

Measures of Groundwater Contamination

Groundwater data were compared to health-based standards and guidelines in the following order (see Table A):

- Federal Maximum Contaminant Levels (MCLs) were used where available because many state agencies use MCLs to evaluate groundwater quality. Since many states treat the EPA Action Level for lead like an MCL, this report does the same. It should be noted that MCLs are not always ideal comparison values. MCLs are enforceable standards for public water supplies and can take the feasibility of treating water into account. This means that they are sometimes less health-protective than pure risk-based guidelines. Arsenic, for example, has an MCL of 10 ppb, even though this concentration in drinking water is expected to carry a lifetime cancer risk of 5 in 10,000, outside of the typical range of acceptable risk.
- Other federal health-based guidelines where MCLs are not available. These are estimates of drinking water concentrations that are not expected to create a risk of non-cancer health effects, and include EPA Lifetime Health Advisories (LHAs), Child Health Advisories (CHAs) and Drinking Water Advisories (DWAs). Where neither MCLs nor EPA health advisories were available, groundwater data were compared to EPA Regional Screening Levels (RSLs) for tapwater. RSLs are health-based screening values used to determine whether further investigation of a site is warranted.
- State groundwater standards. Illinois sites were also compared with Illinois Class I Groundwater Standards (discussed further below). Where states have established health-based standards for groundwater protection that are more conservative than federal MCLs and guidelines these are noted in Table A. Exceedances of these values would only be considered violations in the state to which they apply, but are useful benchmarks for evaluating contamination levels for parameters where federal MCLs

and guidelines have not been established or may show that the federal levels are less protective than certain state levels for the parameter in question.

- Secondary Drinking Water Standards (SMCLs) are not health-based, but when exceeded impair the use of groundwater. Exceedances of SMCLs can have significant adverse economic impacts by increased costs for treatment and, in the case of total dissolved solids (TDS), more frequent replacement of water heaters.

Groundwater quality at Illinois surface impoundments were compared with the Class I Groundwater Standards established by the Illinois Environmental Protection Agency. These standards can be higher or lower than federally established levels, as noted below:

- Arsenic (50 ppb, five times higher than EPA's MCL of 10 ppb).
- Boron (2 ppm, lower than EPA's CHA of 3 ppm).
- Lead (7.5 ppb, one-half EPA's Action Level of 15 ppb).
- Manganese (150 ppb, one-half EPA's LHA of 300 ppb and three times higher than the SMCL of 50 ppb).
- Iron (5 ppm, 16.7 times higher than the SMCL of 0.3 ppm).
- Chloride (200 ppm, lower than the SMCL of 250 ppm).
- Sulfate (400 ppm, lower than the EPA DWA of 500 ppm but higher than the SMCL of 250 ppm)
- Total Dissolved Solids (1200 ppm, higher than the SMCL of 500 ppm).

Groundwater sampling results were reviewed to identify exceedances of MCLs, health-based guidelines, and SMCLs. The well numbers, dates and concentrations exceeding standards were summarized in the individual damage cases. Concentrations exceeding standards in wells identified as "upgradient" were also discussed when this information could be discerned from material provided by states.

References

EarthJustice and Appalachian Mountain Advocates. 2011. *State of Failure: How States Fail to Protect Our Health and Drinking Water from Toxic Coal Ash*. August, 2011.

Environmental Integrity Project and Earthjustice (EIP&EJ). 2010. *Out of Control: Mounting Damage from Coal Ash Waste Sites*. February 24, 2010.

Environmental Integrity Project, Earthjustice, and Sierra Club (EIP et al.). 2010. *In Harm's Way: Lack of Federal Coal Ash Regulations Endangers Americans and Their Environment*. August 26, 2010.

Wilhite. 2009. Assessment of Ash Impoundments Permitted Within the State of Illinois. Draft Memorandum from Marcia Wilhite, Chief, Bureau of Water to Douglas Scott, Director Illinois EPA, February 3, 2009.

Table A. Comparison Values for Contaminants Discussed in This Report.

	MCL	Other health-based guidelines	State Standards	SMCL
Alpha particles (pCi/L)	15	-	-	-
Aluminum (ppm)	-	37 (RSL)	-	005 to 0.2
Antimony (ppb)	6	-	-	-
Arsenic (ppb)	10	0.045 (RSL)	-	
Barium (ppb)	2,000	-	-	-
Beryllium (ppb)	4	-	-	-
Boron (ppm)	-	3 (CHA)	2 (IL); 1 (IA)	
Cadmium (ppb)	5	-	-	-
Chloride (ppm)	-	-	200 (IL)	250
Chromium, total (ppb)	100	-	-	-
Chromium, hexavalent (ppb)			0.02 (CA)	
Cobalt (ppb)	-	11 (RSL)	22 (TX); 40 (WI)	-
Iron (ppm)	-	26 (RSL)	-	0.3
Lead (ppb)	15	-	7.5 (IL)	
Manganese (ppb)	-	300 (LHA)	150 (IL)	50
Mercury (ppb)	2	0.63 (RSL)	-	-
Molybdenum (ppb)	-	40 (LHA)	-	-
Nickel (ppb)	-	100 (LHA)	-	-
Selenium (ppb)	50	-	-	-
Silver (ppb)	-	100 (LHA)	50 (IL)	
Sodium (ppm)	-	20 (DWA)	-	-
Strontium (ppm)	-	4 (LHA)	-	-
Sulfate (ppm)	-	500 (DWA)	400 (IL)	250
Thallium (ppb)	2	-	-	-
Total Dissolved Solids (ppm)	-	-	-	500
Vanadium (ppm)	-	180 (RSL)	49 (FL); 50 (MN)	-
Zinc (ppm)	-	2 (LHA)	-	-

MCL = Maximum Contaminant Level (the Action Level for lead is also included in this column); CHA = Child Health Advisory; DWA = Drinking Water Advisory; LHA = Lifetime Health Advisory; RSL = Regional Screening Level for tapwater.; SMCL = Secondary Drinking Water Standards.

State standards identified include the California Public Health Goal for hexavalent chromium in in drinking water, Illinois Class I Groundwater Standards, the Texas Residential Protective Contamination Level (PCL) for cobalt, and the Florida Groundwater Cleanup Target Level and Minnesota Groundwater Health Risk Limit for vanadium.

1. Crist Plant, Ash Landfill: 1,135 MW (four units online 1959 to 1973). 55 North Q Street, Pensacola, FL 32520; GPS Coordinates 30.565167, -87.225944.

Owner/Parent Company: Gulf Power, owned by Southern Company.

Summary: Groundwater monitoring data from five sampling events from May 2008 to November 2010 show that contamination from a coal ash landfill and gypsum storage areas at the Crist Power Plant in the Florida panhandle have caused multiple exceedances of Maximum Contaminant Levels (MCLs) for arsenic and cadmium in a compliance monitoring well. An expanded monitoring program that began in 2010 added testing for thallium. The first round of monitoring found concentrations that are 85% of the thallium MCL in a detection monitoring well. Other health-based guidelines were exceeded for manganese (in two compliance wells, maximum of 0.76 ppm), sodium (in two compliance and six detection wells, maximum of 230 ppm), sulfate (in three detection wells, maximum of 930 ppm), and chromium (in ten wells, (maximum of 9.3 ppb in a landfill detection well). The highest value of chromium in the detection well is probably all or mostly hexavalent chromium, but detects for chromium in background wells suggest the possibility that some of the chromium may be from natural sources, and an average pH of less than 5.5 in half the wells may mean that trivalent chromium is also present.

Constituents Involved: MCL exceedances: arsenic and cadmium (thallium close to MCL in several wells); Health-based guideline exceedances: chromium, manganese, iron, sodium and sulfate; SMCL exceedances: aluminum, chloride, manganese, iron, sulfate, TDS and pH.

CCW Waste Disposal Characteristics: Ash landfills cover 78 acres and include fly ash and bottom ash storage areas southwest of power plant and two gypsum storage areas northwest of power plant.

Hydrogeologic Conditions: No information about hydrogeology was included in the response to our FOIA request. The power plant is located in quaternary alluvium of the Escambia River. Groundwater appears to have a naturally low pH. Some interpretations are possible from three November 2010 potentiometric maps included with the monitoring data:

- In the ash landfill in the southwest part of site, groundwater ranges in elevation from 98 feet in the south part of the landfill to 52 feet in the north part of the landfill with the potentiometric contours (lines of equal hydraulic head) indicating groundwater flow to the northwest and northeast. This hydrogeologic unit appears to have formed as a result of mounding of groundwater in the area of the ash landfill.

- The intermediate/shallow network of monitoring wells shows groundwater levels ranging in elevation from a little less than 14 feet in the west (13.93 feet) and southwest (13.83 feet) parts of the site to a little more than one foot in the northeast part of the site near the Escambia River. These groundwater elevations indicate a

general east-northeast flow toward the Escambia River. The hydraulic head difference of about 85 feet between groundwater associated with the landfill and the intermediate/shallow aquifer indicates a steep downward gradient that would allow contaminants to migrate from the landfill to the shallow water table.

- The "deep" network of monitoring wells shows elevations of groundwater that are slightly lower in the southwest part of the site (13.52 feet) and slightly higher near the Escambia River (2.29 feet), indicating flow in the same east-northeast direction as the "shallow" well network. The minor differences in elevation between the paired shallow and deep wells suggest a largely horizontal flow for the regional aquifer, with a bit of an upward gradient near the area of discharge to the river to the northeast.

Groundwater Data Analysis: The Industrial Wastewater Facility Permit for the Crist Plant (FDEP, 2011) designates three types of monitoring wells ("background", "detection" and "compliance"), with most wells designated for monitoring either the Ash Landfill or the Gypsum Storage Areas, though a few wells are designated for both areas. The locations of selected wells are shown on the attached satellite photo of the power plant and disposal areas. The designated wells for each area are as follows:

- The Ash Landfill: Background (MWB-1, MWB-2, GW-1S), Detection (GE-5S--formerly named MWI-3, GE-5D, MWI-1, MWI-2, MWI-4), Compliance (MWC-3, 4, 8, 9, 10, 11, and 12 - note that 9 is not located on the available maps).

- Gypsum Storage Area 1 and Area 2: Background (GW-1S—this well is also in the landfill network), Detection (shallow: GE-1S to 6S, including 5S which is in the Ash Landfill network, and deep: GE-1D to 6D). Note that "S" designates wells in the "shallow" aquifer and "D" designates wells in the "deep" aquifer. S and D wells with the same number represent paired or nested wells. The Escambia River is designated as the compliance boundary with one upgradient (SW-1) and seven downgradient (SW-2 to 8) surface water sampling locations.

- Background Wells MWB-1 and MWB-2 are not obviously impacted by coal ash parameters, but Background Well GW-1S may be impacted by the hydraulic gradient created by mounding in the ash landfill.

Data for five groundwater sampling events were analyzed (May and September 2008, May 2009, June and November 2010).[3] Although titled "Groundwater Reports" (Gulf Power, 2008-2010) these documents included analytical results for each well without any significant text, discussion of results, or tables that summarize the sampling data, making analysis difficult. The summary here is not a complete analysis, but focuses on key aspects of the data:

[3] If there was a second sampling event in 2009 it was not provided in the response to the FOIA request.

- All data sheets were reviewed to identify any MCL exceedances or notably high concentration of parameters for which MCLs have been established. Where MCL exceedances were identified, the results of all five sampling events were examined.

- As part of a separate project that analyzed for chromium and the potential for hexavalent chromium at ash-contaminated sites, chromium data was analyzed for all five sampling events. Hexavalent chromium is not monitored for at the Crist ash disposal sites, but pH, a parameter that decisively affects the solubility of different chromium species, was noted. Although total chromium values for each well were compiled, only the maximum value is reported here. Assessment of the potential for hexavalent or trivalent chromium to comprise most of the chromium detected in groundwater sampling results is complicated by the fact that pH shows considerable variation in the same wells, and falls within a range that tends to favor both hexavalent chromium (>5.5) and trivalent chromium (<5.5). Out of 22 chromium detects, 7 (31.8% had a pH of 5.5 or greater. Only these high-pH detects are reported as potential exceedances of the CA PHG for hexavalent chromium. The maximum chromium values measured at selected wells are shown in parentheses on the satellite photo of the disposal areas.

- Due to time limitations other than noted above, not all data produced at some wells were analyzed.

MCL Exceedances: Compliance well MWC-4 had several MCL exceedances for both arsenic and cadmium between 2008 and 2010:

- Arsenic ranged from 20 to 35 ppb in the May and September 2008 sampling events, up to 3.5 times the MCL. It was not detected in the three most recent sampling events, though one of those sampling events had a detection limit of 10 ppb, which is at the MCL.

- Cadmium was detected in all five sampling events in MWC-4 and exceeded the MCL in both sampling events in 2010. The concentration of cadmium was 16 ppb in June 2010, (3.2 times the MCL) and 6.5 ppb in the November 2010 sampling event. When the most recent sample exceeded the MCL, it was reanalyzed and the second test result rounded down and reported as 5 ppb to make it appear that the MCL was not exceeded, when in fact that actual value was 5.4 ppb.

- Thallium, which has an MCL of 2 ppb, was not analyzed in the compliance wells (MC series) for the ash landfill, but was included for the GE well series. The first sampling for thallium in the detection well for both the landfill and gypsum storage areas, GE-5S, showed a concentration of 1.7 ppb, close to the MCL for thallium. The first sampling for thallium in the "background" well for both the landfill and gypsum storage areas, GW-1S, had 1.4 ppb thallium, suggesting that this well may have been impacted by mounding of groundwater at the ash landfill.

Health-based guidelines:

- Manganese at 0.45 ppm in landfill detection well MWI-2, and 1.3 ppm in landfill compliance well MWC-4 (LHA is 0.30 ppm).
- Sodium at 230 ppm in landfill detection well MWI-2, and 110 ppm in gypsum detection well GE-4S (DWA is 20 ppm).
- Sulfate at 930 ppm in gypsum detection well GE-6S, and 820 ppm in landfill detection well MWI-2 (DWA is 500 ppm).
- The highest value for chromium was in landfill detection well MWI-2—9.3 ppb at a pH of 6.82. Four out of five samples from this well had pH greater than 5.5. Two compliance wells appeared to indicate the presence of hexavalent chromium (MWC-3, 2.5 ppb chromium and a pH of 5.7; and MWC-4 1.1 ppb chromium and a pH of 6.13). However, most samples in these wells had pH < 5.5. All three "background" wells for the landfill also had chromium detects (MWB-1 at 6.9 ppb, pH 5.5; MWB-2 at 3.8 ppb, pH 5.3; and GW-1S at 2.2 ppb, pH 5.63). As discussed above, the presence of elevated thallium levels in GW-1S indicates that it has been impacted by the ash landfill, although some of this chromium may also represent natural background levels.

SMCL Exceedances: Seven Secondary Maximum Contaminant Level parameters were commonly exceeded at multiple monitoring wells, further showing how extensively groundwater has been impacted by CCW disposal:

- Aluminum exceeded the SMCL in seven wells, with the highest concentration being 4.1 ppm in landfill detection well MWI-2 (SMCL is 0.05 to 0.2 ppm).
- Chloride was at 2,900 ppm in in gypsum detection well GE-6S (SMCL is 250 ppm).
- Iron was at 26 ppm in detection well GE-5S (SMCL is 0.3 ppm).
- pH had measurements below the SMCL (between 6.5 and 8.5 units) in nineteen wells, with the lowest being 4.06 units at gypsum detection well GE-1S.
- TDS exceeded the SMCL in five wells, with the highest being 8,000 ppm in gypsum detection well GE-6S and 1,500 ppm in landfill detection well MWI-2. The data from GE-6S indicates gypsum has been substantially degrading shallow groundwater at the site.

At Risk Population: Although the regional direction of groundwater flow is to the northeast, toward the Escambia River, a perched water table in the vicinity of the ash landfill creates a hydraulic gradient toward wells GW1S and MWC-12 at the western compliance boundary. A residential area exists about 500 feet farther to the west.

Sources:

Florida Department of Environmental Protection (FDEP). 2011 Crist Electric Generating Plant Industrial Wastewater Facility Permit FL0002275. January 28, 2011.

Gulf Power. 2008-2010. Groundwater Monitoring Reports for Sampling on May, 2008, September 2008, May, 2009, June, 2010, and November, 2010.

Crist Plant Ash Landfill (LF), Gypsum Storage Areas (GS) and monitoring well locations with maximum chromium concentrations in parentheses (ppb).

2. Yates Generating Plant, FGD Landfill: 1,487 MW (seven units online 1950 to 1974). 708 Dyer Rd., Newnan, GA 30263; GPS Coordinates 33.462389, -84.89861.

Owner/Parent Company: Georgia Power, owned by Southern Company.

Summary: Groundwater monitoring data from 2008 to 2010 show that MCLs were exceeded for total chromium in two wells (maximum 220 ppb, 2.2 times the MCL), and selenium in one well (maximum 110 ppb, 2.2 times the MCL). A maximum historic concentration of lead was 2.3 times higher than the MCL in an undisclosed well. Health-based guidelines were also exceeded for nickel in one well (maximum of 430 ppb, 4.3 times the LHA), and a maximum historic cobalt concentration cobalt of 32 ppb exceeded the tapwater RSL by 2.9 times. Chromium was detected in three other wells at concentrations which, depending on pH levels, may be 130 to 550 times the California Public Health Goal for hexavalent chromium.

Constituents Involved: MCL exceedances: chromium, nickel and selenium; health-based guideline exceedances: chromium (limited number of other parameters monitored); SMCL exceedances: not monitored.

CCW Waste Disposal Characteristics: Yates has 8 ponds covering a total of 219 acres, but apparently no groundwater monitoring is required for these surface impoundments. Groundwater monitoring is required at an FGD gypsum storage area, although a satellite photo indicates that a large area covered by gypsum and possibly coal ash is west of the area where monitoring takes place.

Hydrogeologic Conditions: The Yates Plant is located in Coweta County in the west-central part of Georgia's Piedmont crystalline rock aquifers. Groundwater flow direction is to the southeast.

Groundwater Data Analysis: Eight monitoring wells (GWA2, GWC1 to 5, and GWC6R, which replaced GWC6 in 2008). Sampling data for 2008 to 2010 were reviewed and Table 6 in Southern Generation Company (2010) identifies maximum historical concentrations from wells.

GWA2 is designated as an upgradient monitoring well, but had detects for barium, cobalt, nickel and zinc, which suggests possible contamination from coal ash. However, these concentrations were still low enough for barium and nickel to be identified as statistically elevated in a downgradient well, GWC2.

Monitoring parameters include the ten metals for which MCLs have been established and six other metals for which health-based guidelines have been established. Other significant CCW

indicator parameters, such as sulfate, boron, molybdenum, manganese, and sodium, are not monitored for.

MCL Exceedances:

- Chromium exceeded the MCL in two wells (GWC1, at 220 ppb, and GWC2, at 160 ppb).
- Selenium exceeded the MCL by in one well (GWC4, at 110 ppb). This is the maximum historical concentration in any well.
- Lead was not exceeded in the sample reviewed, but a reported maximum historical concentration was 34 ppb, 2.3 times the MCL.

Health-based guidelines:

- Nickel exceeded the LHA by 2.8 times in one well (GWC2, 280 ppb) and its maximum historical concentration of 430 ppb exceeded the LHA by 4.3 times.
- Cobalt's maximum historical concentration, 32 ppb, exceeded the Tapwater RSL by 2.9 times.
- Maximum chromium concentrations exceeded the CA PHG for hexavalent chromium by 130 to 550 times in three other wells (GWC3, 11 ppb; GWC4, 2.6 ppb; GWC5, 7.5 ppb). Whether the chromium is likely to be all or mostly hexavalent chromium depends on the pH of these wells, which was not reported.

SMCL Exceedances: Parameters not monitored or reported.

At Risk Population: The satellite photo indicates that there are about a dozen residences southeast and east of the landfill, some which may be downgradient in groundwater flow.

Other Information: Southern Company Generation (2010) offers the following reasons to argue that the MCL exceedances are not coming from the gypsum:

- TCLP leaching concentrations from gypsum are lower than those in groundwater (maximum TCLP vs. maximum historical groundwater concentrations are as follows: barium 200 ppb vs. 180 ppb in groundwater, chromium 20 ppb vs. 220, nickel <20 ppb vs. 430 ppb, and selenium, 30 ppb vs. 110 ppb).
- The settling pond and gypsum stacks are underlain by a clay and polyethylene liner.
- "Naturally occurring soils are one possible source of these metals. The well screens are within soils derived from weathering of the Waresville Schist which contains abundant nickel, chromium and cobalt (Stow, et al., 1984)."

While the third point may be true, the weight of evidence suggests that all or most of the contamination is coming from CCW residuals. The following lines of evidence support this conclusion:

- TCLP tests are known to not provide an accurate assessment of leaching potential from CCW. For example, the variable-pH leach test developed Vanderbilt University and EPA measured maximum concentrations of FGD gypsums as follows: barium, 560 ppb (and at this particular site maximum historical barium concentration were *lower* than the TCLP concentrations); chromium, 240 ppb; and selenium, 16,000 ppb (Kosson et al., 2010). Nickel was not measured in this study.
- Stow et al. (1984) present data on geochemistry of unweathered Waresville Amphibolite in Alabama, which is interlayered with schists and quartzites. Using USGS data on mean element concentrations in soils in the eastern U.S. for comparison, data presented by Stow et al. (1984) on the Waresville Amphibolite does not show any enrichment in barium, but some enrichment of chromium (248 vs. 52 ppm in soil) and nickel (77 vs. 18 ppm in soil). However, selenium was not measured by Stow et al. (1984) and is not an element that is normally associated with Amphibolites. A literature search on enrichment of minor elements in saprolite (a highly weathered soil that retains the structure of the bedrock it weathers from) identified a paper by Lesure (1971) on a saprolite mica schist in the Piedmont of Georgia. Of the elements exceeding standards in groundwater at the landfill, only nickel was identified by Lesure (1971) as having some residual enrichment in saprolite. He found that arsenic, which was not detected at the landfill, showed the greatest residual enrichment and lead, which was also not detected in the latest sampling, showed some enrichment. Lesure (1971) did not identify chromium as enriched in saprolite.
- Furthermore, even if saprolite is enriched in metals, the high degree of weathering and leaching means that they are not necessarily elevated in groundwater. A literature search to identify scientific papers on concentrations of metals in groundwater in saprolites of the Piedmont did not identify any scientific papers identifying metals contamination as a concern in this geologic setting. Vendrell (2003), in a survey of metals in Georgia groundwater, found that the MCL for lead is infrequently exceeded (4.4% of samples), and that average lead concentrations in Coweta County, where the Yates Plant is located, ranges from 1 to 1.9 ppb. Chromium was listed as a parameter in the study, but not identified as a metal of concern in Georgia groundwater.

In conclusion, the various lines of evidence discussed above suggest that the likely source of contamination at the landfill is the FGD gypsum and coal ash.

Sources:

Lesure, F.G. 1971. Residual Enrichment and Supergene Transports of Gold, Calhoun Mine, Lumpkin County, Georgia. *Economic Geology 66(1):178-186.*

Kosson, D. et al. 2009. *Characterization of Coal Combustion Residues from Electric Utilities—Leaching and Characterization Data.* USEPA Office of Research and Development, EPA-600/R-09/151, December 2009.

Southern Company Generation. 2010. Georgia Power Company Plant Yates Groundwater Monitoring Report ES1919. December, 2010. [2008 and 2009 monitoring reports also reviewed]

Stow, S.H., M.J. Nielson and T.L. Neathery. 1984. Petrography, Geochemistry and Tectonic Significance of the Amphibolites of the Alabama Piedmont. *American Journal of Science 284:416-436.*

Vendrell, P.F. 2003. Water Quality of Private Drinking Water Wells in Georgia. University of Geogia Cooperative Extension Service.

Yates Generating Plant FGD Landfill and Monitoring Wells.

3. Fair Station, Ash Landfill: 62.5 MW (two units online 1960 to 1967). 3800 Hwy. 22 West, Montpelier, IA 52759; GPS Coordinates 41.457406, -90.822663.

Owner/Parent Company: Central Iowa Power Cooperative.

Summary: Groundwater monitoring data from 1995 to 2008 indicate that a coal ash monofill located on alluvial sands, silts and clays on a tributary to the Mississippi River has contaminated underlying groundwater. The landfill has one downgradient well where the *average* concentration of selenium has exceeded the MCL with the highest concentration being 713 ppb, 14 times higher than the MCL. Health-based guidelines have been exceeded in five downgradient wells for manganese (maximum of 7.8 ppm; averages ranging from 0.47 ppm to 5.87 ppm) and for sulfate (maximum of 2,600 ppm; averages ranging from 514 to 1,408 ppm).

Constituents Involved: MCL exceedances: selenium; health-based guideline exceedances: manganese and sulfate; SMCL exceedances: manganese, sulfate and iron.

CCW Waste Disposal Characteristics: An ash monofill located about two miles west of the power plant which has received ash since 1974.

Hydrogeologic Conditions: The monofill is located on alluvial sand, silts and clays adjacent to the flood plain of Pine Creek, which enters the Mississippi River one-half mile southwest of the monofill. Over most of the site shale is found at depths of 15 feet below the original ground surface or less.

Groundwater Data Analysis: Sampling data from 1995 to 2008 for ten monitoring wells were reviewed. Two are upgradient (MW9 and MW11), four are downgradient in the water table (MW2, MW4, MW6, MW12), and four are downgradient in the uppermost aquifer (MW1, MW3, MW5, MW15). Most parameters have not been monitored continuously during this time period. Upgradient wells do not show any exceedances and are not included in the well count.

MCL Exceedances:

The maximum concentration for selenium in downgradient well MW2 was 713 ppb (14 times the MCL) and the average concentration since 1995 has been 71.3 ppb (1.4 time MCL).

Health-based guidelines:

- Manganese exceeded the LHA in five downgradient wells, with the highest concentration being 7.8 ppm in downgradient well MW6. Average concentrations in all five wells exceeded the LHA, ranging from 0.47 ppm to 5.87 ppm (the LHA is 0.3 ppm).
- Sulfate exceeded the DWA in five downgradient wells, with the highest concentration being 2,600 ppm in well MW12. Average concentrations exceeded the DWA in all five

wells, ranging from 514 to 1,408 ppm (the DWA is 500 ppm).

SMCL Exceedances:

- Average concentration of manganese exceeded the SMCL (0.050 ppm) in all downgradient wells.
- Average concentration of sulfate exceeded the SMCL (250 ppm) in six downgradient wells.
- Iron exceeded the SMCL (0.30 ppm) in three wells with a maximum concentration of 2.7 ppm in well MW12. Average concentrations in the three wells also exceeded the SMCL, ranging from 0.573 ppm to 1.55 ppm.

At Risk Population: Satellite photo indicates that there are about a dozen residences on the Mississippi River within 1,000 feet south and potentially downgradient of the monofill.

Sources:

MWH. 2008. 2008 Annual Water Quality Report for the CIPCO Coal Combustion Residue Monofill, Muscatine, Iowa. Prepared for Central Iowa Power Cooperative, December 2008.

Fair Station Ash Monofill Downgradient Monitoring Well Locations, Montpelier, IA

4. Prairie Creek Generating Station, Ash Landfill: 245 MW (four units online in 1951, 1958, 1967 and 1997). 3300 C St. Southwest, Cedar Rapids, IA 52404; GPS Coordinates 41.944291, -91.63799.

Owner/Parent Company: Interstate Power and Light, owned by Alliant.

Summary: The Stoney Point coal ash landfill, located in a former limestone quarry, received ash from the Prairie Creek Station until 1987. Groundwater monitoring data from 1994 to 2009 show that arsenic concentrations in two downgradient wells have steadily increased, exceeding the MCL in 2008 and 2009 with maximum concentrations of 18.3 and 28.9 ppb. The Iowa groundwater standard of 1.0 ppm for boron has been exceeded in ten wells, with a maximum concentration of 37.1 ppm—this is also more than 12 times higher than the EPA Child Health Advisory (CHA). Other health-based guidelines have been exceeded for sulfate, in ten downgradient wells (maximum of 5,300 ppm), and for manganese, in five downgradient wells (maximum of 5.7 ppm).

Constituents Involved: MCL exceedances: arsenic; health-based guideline exceedances: boron, manganese and sulfate; SMCL exceedances: iron, manganese and sulfate.

CCW Waste Disposal Characteristics: The closed Stoney Point landfill is located in a former limestone quarry about 4.5 miles northwest of the power plant. Ash disposal stopped in 1987, and the final cover was placed in 1992.

Hydrogeologic Conditions: The shallow groundwater flow system includes shallow bedrock in the southern part of the site, the saturated portion of the fill, and shallow unconsolidated deposits near a creek at the northern edge of the landfill. Shallow groundwater flows to the north in the northern two-thirds of the site, toward the creek, and shallow groundwater in the southern third flows to the west and northwest. An intermediate flow system includes wells completed in the Spring Grove limestone (south) and alluvium, and the contact between these layers near the creek in the northern perimeter of the landfill. Groundwater flow direction in deep wells located in the Kenwood member of the Pinicon Ridge Formation appears to be influenced by dewatering in an active quarry about 1,500 feet west of the site.

Groundwater Data Analysis: There are eighteen monitoring wells at the landfill, not all active. Data summarized here cover the period 1994-2009. Only wells with arsenic exceedances (MW12 and MW21) are located on the satellite photo of the site.

MCL Exceedances: Arsenic concentrations in two wells have had an upward trend since monitoring began in 1994, with exceedances of the MCL in both wells in 2008 and 2009. In MW12 the average concentration is 8.3 ppb, with a maximum in 2009 of 18.3 ppb, 1.8 times the MCL. In MW21 the average concentration is 8.7 ppb, with a maximum in 2008 of 28.9 ppb, 2.9 the times MCL.

Health-based guidelines:

- Average boron concentrations from 2006 to 2009 exceeded the Iowa standard of 1.0 ppm in ten wells, with the highest average being 25.8 ppm in MW16. The highest single concentration, 37.1 ppm in well MW16, is 12.4 times above the EPA CHA of 3 ppm.
- Average manganese concentrations (1999-2009) exceeded the LHA (0.3 ppm) in five wells, with a maximum concentration of 5.7 ppm.
- Average sulfate concentrations exceeded EPA's DWA in ten wells with upward trends (maximum concentration of 5,300 ppm).

SMCL Exceedances: Iron exceeded the SMCL in several wells in the mid-1990s, but exceedances have since increased to 8 wells. The maximum concentration of 5.28 ppm exceedes the SMCL by 17,600 times, and it exceeds the health-based tapwater Regional Screening Level by 203 times. SCML exceedances are widespread for manganese (14 wells) and sulfate (11 wells).

At Risk Population: There are number of private wells within 1,000 feet downgradient and one public water supply well within 2,000 feet (less than a half mile) downgradient of the landfill.

Sources:

RMT. 2009. 2009 Annual Water Quality Report, Stoney Point Closed Landfill, Cedar Rapids, Iowa. Prepared for Interstate Power and Light Company, November, 2009.

Stoney Point Landfill: Locations of monitoring well with arsenic exceedances.

5. Former CSX Rail Corridor: Bloomington, IN; GPS Coordinates 39°09'40.0" N, 86°32'10.5" W.

Owner/Parent Company: Formerly owned by CSX Railroad.

Summary: Environmental investigations conducted as part of a rails-to-trails project in Bloomington, Indiana, found extensive contamination of arsenic and lead in the railroad right-of-way soils, the result of coal ash cinders being used as ballast for the rail bed. More than 5,000 cubic yards of contaminated soil were removed to minimize the potential for exposure to those who use the trail.

Constituents Involved: Arsenic and lead, both of which exceeded Indiana Department of Environmental Management Risk-Based Soil Default Closure Levels (DCLs) for residential and industrial uses.

CCW Waste Disposal Characteristics: Coal ash and clinkers from train engine boilers used for ballast for railroad tracks.

Soil Data Analysis: In the course of developing a Rails-to-Trails project in the City of Bloomington, Indiana, a Phase II Environmental Site Assessment found elevated levels of arsenic and lead, mainly where coal ash and cinders had been used as ballast and base for the rail bed of the former CSX railroad (BCA, 2003). Subsequent sampling along the 2.5-mile section of the right of way confirmed extensive contamination by arsenic and lead (see Table below):

- Arsenic: 97.8% of 46 samples taken from cinders and ballast and soil samples to a depth of one foot in the northwest section exceeded the Indiana Department of Environmental Management's Default Closure Levels (DCL) for residential and industrial soil (3.9 and 5.8 mg/kg, respectively). The highest concentration of arsenic in a sample, 347 mg/kg, was 88 times the DCL for residential use and 60 times the DCL for industrial use. This was also almost nine hundred times the EPA screening level of 0.39 mg/kg for arsenic.[4]

- Lead: Lead exceeded the DCL of 81 mg/kg for residential use in a majority of samples (62.5%). The highest lead concentration, 1,200 mg/kg, was 14.8 times the DCL for residential use and 5.2 times the DCL for industrial use. It was also three times higher than the EPA soil screening level.[4]

[4] EPA residential soil screening levels can be found at: http://www.epa.gov/region9/superfund/prg/.

Arsenic and lead in railroad right-of-way contaminated by coal ash and cinders in Bloomington, Indiana

Area/Type of Sample	No. of Samples	Average mg/kg	Max. mg/kg	#	%	#	%
Arsenic				> IDEM Res. DCL (3.9)**		> IDEM Ind. DCL (5.8)**	
South and Central Sections (BCA, 2003)							
RoW Cinders	11	62.2	329.0	10	90.9%	10	90.9%
South and Central Sections (ATC, 2008)							
RoW Ballast	3	15.1	26.1	3	100.0%	3	100.0%
Northwest Section (ATC, 2010)							
RoW Soil 0-1'	32*	96.7	347.0	32	100.0%	32	100.0%
All RoW Samples	46			45	97.8%	45	97.8%
Lead				> IDEM Res. DCL (81)**		> IDEM Ind. DCL (230)**	
South and Central Sections (BCA, 2003)							
RoW Cinders	11	130.4	257.0	6	54.5%	1	9.1%
South and Central Sections (ATC, 2008)							
RoW Ballast	3	43.2	65.4	0	0.0%	0	0.0%
Northwest Section (ATC, 2010)							
RoW Soil 0-1'	32*	150.4	1200.0	20	62.5%	5	15.6%
All RoW Samples	46			26	56.5%	6	13.0%

* Where duplicate samples were taken for an interval, the value used was the average of the two samples.
** Indiana Department of Environmental Management (IDEM) Risk-Based Residential and Industrial Default Closure Levels (DCL) for contaminated sites.

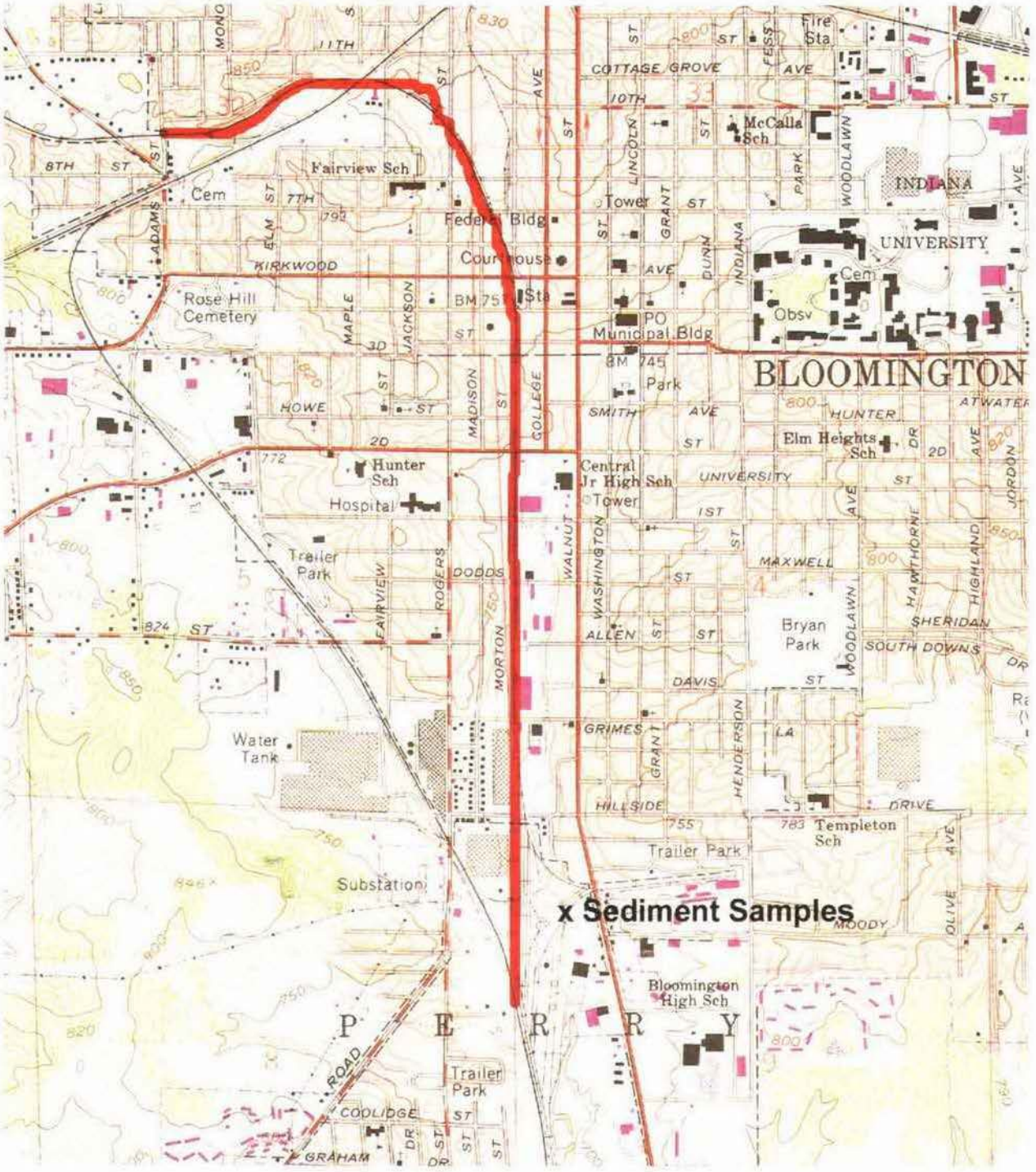
At Risk Population: B-Line Rail Trail is currently used by hundreds to thousands of people every day. More than 5,000 cubic yards of contaminated soil was removed to minimize the potential for exposure to those who use the trail.

Sources:

ATC Associates. 2008. Additional Phase II Subsurface Investigation Former CSX Rail Corridor, Bloomington, Indiana. Prepared for Indiana Brownfields Program, Indianapolis, IN, October 28, 2008.

ATC Associates. 2010. Additional Phase II Subsurface Investigation Former CSX Rail Corridor, Bloomington, Indiana. Prepared for Indiana Brownfields Program, Indianapolis, IN, February 9, 2010.

Bruce Carter Associates (BCA). 2003. Phase II Environmental Site Assessment Former McDoel Yard and CSX Railroad, Bloomington, Indiana. Prepared for City of Bloomington, November 25, 2003.



Former CSX Rail Corridor, Bloomington, Indiana. Location of soil sampling along rail corridor (red line).

6. Dallman Station, Ash and FGD Ponds: 388 MW (three units online from 1968 to 1978) 3100 Stevenson Drive, Springfield, IL 62707; GPS Coordinates 39.753899, -89.6036.

Owner/Parent Company: City Water, Light and Power/City of Springfield.

Summary: Dallman Station is one of more than a dozen power plants in Illinois with coal ash ponds where groundwater monitoring was not required by Illinois EPA prior to the TVA Kingston ash spill in Tennessee. The first round of groundwater sampling at Dallman, of five downgradient wells at the ash pond and three downgradient wells at the FGD pond in 2010, showed exceedances of the arsenic MCL at three ash pond wells (maximum 93.6 ppb, 9.4 times the MCL) and one FGD well (14.8 ppb). Illinois Class I Groundwater Standards were exceeded for arsenic in one ash well, boron in two ash wells, manganese in seven ash and FGD wells, and iron in six ash and FGD wells. EPA health-based guidelines were also exceeded for boron in one ash well (11.6 ppm, 3.9 times the CHA); sodium in one ash well (62.1 ppm, 3.1 times the DWA) and one FGD well (30.6 ppm); and iron in one FGD well (28.6 ppm, 1.1 times the Tapwater Risk Screening Level). Chromium exceeded the CA PHG for hexavalent chromium in one ash well by 910 times (18.2 ppb), and exceeded this standard by 580 times (11.6 ppb) to 1,325 times (26.5 ppb) in two FGD wells.

Constituents Involved: MCL exceedances: arsenic; health-based guideline exceedances: chromium, sodium, and manganese; IL Groundwater Standard exceedances: arsenic, boron, manganese, and iron; SMCL exceedances: iron, manganese, sulfate, and TDS.

CCW Surface Impoundment Characteristics: Two active unlined ponds. Based on monitoring well information one is an ash pond and the other currently receives FGD residuals. The satellite photograph shows these ponds to be located northeast of the plant, with the stream below the dam for the reservoir that is east and south of the plant running along the east and north sides of the ash ponds.

Hydrogeologic Conditions: Illinois rated hydrogeologic vulnerability as low (Wilhite, 2009). The location of the ponds in satellite images suggests the potential for discharge of contaminated water to the stream that flows along the west and north sides of the two ponds.

Groundwater Data Analysis: Illinois EPA's Ash Impoundment Strategy, developed in response to the TVA Kingston ash spill, identified the ash pond at Dallman as a Priority 2 site for hydrogeologic assessment (IEPA, 2010). In response to this program, four temporary piezometers were installed at the periphery of the ash pond area (AP1 to AP4, groundwater roughly 4-6 feet below ground surface) and another well, AW3, was installed at a further distance downgradient from the ash pond. There are also three wells identified as FGD monitoring wells (G110, G120, and R101). A well location map was not available for review. We presume that all wells are downgradient because all wells indicated the presence of coal ash constituents. All 8 wells were sampled in May or June of 2010.

MCL exceedances: Arsenic in three ash pond wells (AP3, 14.4 ppb; AP4, 22.5 ppb; AW3, 93.6 ppb) and one FGD well (G120, 14.8 ppb).

Health-based guidelines:

- Boron in one well (AP3, 11.9 ppm) at 3.9 times the CHA.
- Manganese in six wells, up to 9.25 ppm (the LHA is 0.3 ppm).
- Sodium (analyzed for in only two wells) exceeded the DWA of 20 ppm in one ash well (AW-3, 62.1 ppm) and one FGD well (R101, 30.6 ppm).
- Iron exceeded the tapwater RSL of 26 ppm in one FGD well (G120, 28.6 ppm).
- Chromium exceeded the CA PHG in one ash well (AW-3, 18.2 ppb) and two FGD wells (G110, 26.5 ppb and R101, 11.6 ppb). A detection limit of 70 ppb used for samples from four other ash wells is 3,500 times higher than the CA PHG, the relevant health standard for hexavalent chromium, so results for these four wells are of very little value. pH data were also not available for review, but groundwater pH in Illinois is typically >5.5, and in such water, all or most of the measured chromium is probably hexavalent.

IL Groundwater Standard exceedances:

- Arsenic in one ash well (AW3, 93.6 ppb)
- Boron in two ash wells (AP2, 2.63 ppm and AP3, 11.9 ppm)
- Manganese in seven wells (up to 9.25 ppm)
- Iron in six wells (5.68 to 28.6 ppm).

SMCL exceedances:

- Manganese in all eight wells.
- Iron in all eight wells (up to 28.6 ppm).
- Sulfate in two wells (AP3, 319 ppm and R101, 306 ppm).
- TDS in 3 ash pond wells (AP2, 620 ppm; AP3 1,090 ppm; AP4, 522 ppm) and 3 FGD pond wells (G110, 525 ppm; G120, 872 ppm; and R101, 894 ppm).

At Risk Population: There is one well within one mile rated as having very low potable well contamination potential (Wilhite, 2009). Satellite images indicate a large number of residences in the vicinity, which presumably are on municipal water.

Other Information: Facility operates under IEPA Permit IL0024767.

Sources:

Illinois Environmental Protection Agency (IEPA). 2010. Illinois EPA's Ash Impoundment Strategy Progress Report, August 4, 2010.

Illinois Environmental Protection Agency (IEPA). 2011. Response to Freedom of Information Act Request. [Reports of laboratory analyses from four groundwater monitoring wells and four temporarily piezometers sampled on May and June, 2010]

Wilhite, M. 2009. Assessment of Ash Impoundments Permitted Within the State of Illinois. Draft Memorandum from Marcia Wilhite, Chief, Bureau of Water to Douglas Scott, Director Illinois EPA, February 3, 2009.

Dallman Station Ash and FGD Ponds, Springfield, IL.

7. Joliet 29 Generating Station, Ash Ponds: 1,320 MW (two units online in 1965 and 1966). 1800 Channahon Road, Joliet, IL 60436; GPS Coordinates 41.495703, -88.130534.

Owner/Parent Company: Midwest Generation owned by Edison International.

Summary: Joliet Station is one of more than a dozen power plants in Illinois with coal ash ponds where groundwater monitoring was not required by Illinois EPA prior to the TVA Kingston ash spill in Tennessee. In 2010 the eleven downgradient wells at the three ash ponds at Joliet 29 were sampled for the first time. The antimony MCL was exceeded in one well (12 ppb, twice the MCL). Five parameters exceeded Illinois Class I Groundwater Standards, including antimony (one well), chloride (four wells), manganese (three wells), sulfate (one well), and TDS (two wells). EPA health-based guidelines were also exceeded for manganese in two wells (up to 3.7 times the LHA) and sulfate in one well (3.2 times DWA).

Constituents Involved: MCL exceedances: antimony; health-based guideline exceedances: manganese and sulfate; IL Groundwater Standard exceedances: antimony, manganese, sulfate, chloride and TDS; SMCL exceedances: manganese, sulfate, chloride and TDS.

CCW Surface Impoundment Characteristics: Three active ponds that are reported to be lined.

Hydrogeologic Conditions: Hydrogeologic vulnerability rated as very high (Wilhite, 2009).

Groundwater Data Analysis: Illinois EPA's Ash Impoundment Strategy, developed in response to the TVA Kingston ash spill, identified the ash ponds at Joliet 29 as a Priority 1 site for hydrogeologic assessment (IEPA, 2010). In response to this program, eleven wells (MW1 to MW11) were sampled on December, 6-7, 2010. A well location map was not available for review. Based on ash constituents being detected in all wells, all are presumed to be downgradient.

MCL Exceedances: Antimony at 12 ppb, twice the MCL.

Health-based guidelines:

- Manganese exceeded the LHA in two wells (MW4 and MW9) at up to 1.1 ppm.
- Sulfate exceeded the DWA in one well (MW9) at 1,600 ppm.

IL Groundwater Standard exceedances:

- Antimony exceeded the standard in one well (MW1, 12 ppb) and was detected in two other wells (MW1, 4.3 ppb and MW3, 4 ppb).
- Manganese in three wells (MW4, 0.33 ppm; MW7, 0.29 ppm; and MW9, 1.1 ppm)
- Sulfate in one well (MW9, 1,600 ppm).

- Chloride in four wells (MW3, 260 ppm; MW4, 270 ppm; MW7, 430 ppm; and MW10, 200 ppm).
- TDS in two wells (MW7, 1,200 ppm and MW9, 2,600 ppm).

SMCL Exceedances:

- Manganese in four additional wells (MW3, 0.1 ppm; MW6, 0.14 ppm; MW10, 0.12 ppm; and MW11, 0.052 ppm)
- Sulfate in two additional wells (MW4, 300 ppm and MW7, 250 ppm)
- Chloride in three wells (MW3, MW4 and MW7 as noted above).
- TDS in all 11 wells (590 ppm to 2,600 ppm).

At Risk Population: Ninety four wells are within one mile, and potential for groundwater contamination at the site is high, yet the site is rated as having low potable well contamination potential (Wilhite, 2009). The rationale for this rating was not disclosed in information provided by IEPA. Many of the wells may be screened in deeper aquifers or on the other side of the Des Plaines River from the ash ponds.

Other Information: Facility operates under IEPA Permit IL0064254.

Sources:

Illinois Environmental Protection Agency (IEPA). 2010. Illinois EPA's Ash Impoundment Strategy Progress Report, August 4, 2010.

Illinois Environmental Protection Agency (IEPA). 2011. Response to Freedom of Information Act Request. [Summary tables for sample results from eleven groundwater monitoring wells sampled on December 6-7, 2010]

Wilhite, M. 2009. Assessment of Ash Impoundments Permitted Within the State of Illinois. Draft Memorandum from Marcia Wilhite, Chief, Bureau of Water to Douglas Scott, Director Illinois EPA, February 3, 2009.

Joliet 29 Generating Station Ash Ponds, Joliet, IL.

8. Joppa Steam Plant, Ash Ponds: 1,100 MW (six units online from 1953 to 1955). 2100 Portland Road, Joppa, IL 62953; GPS Coordinates 37.21693, -88.866096.

Owner/Parent Company: Electric Energy, owned by Ameren.

Summary: Joppa Steam Plant is one of more than a dozen power plants in Illinois with coal ash ponds where groundwater monitoring was not required by Illinois EPA prior to the TVA Kingston ash spill in Tennessee. The first round of groundwater sampling of monitoring wells at two ash ponds was in 2010. The lead MCL was exceeded in two wells (up to 27.4 ppb, 1.8 times the MCL). Arsenic concentrations may be above the MCL, but his cannot be confirmed as the detection limit for arsenic was 2.5 times higher than the MCL. EPA health-based guidelines were also exceeded for boron in three wells (up to 3.9 times the CHA), manganese in two wells (up to 14.2 times the LHA), sulfate in one well (1.5 times the DWA), and cobalt in three wells (maximum of 5.9 times the tapwater RSL). Five parameters exceeded Illinois Class I Groundwater Standards, including lead in two wells, boron in three wells, manganese in four wells, iron in three wells and sulfate in one well. Total chromium was detected in two wells at pH levels where all or most is likely to be hexavalent chromium; maximum concentrations ranged up to 25.4 ppb, 1,270 times the CA PHG for hexavalent chromium.

Constituents Involved: MCL exceedances: lead and possibly arsenic; health-based guideline exceedances: chromium, boron, cobalt, manganese, and sulfate; IL Groundwater Standard exceedances: lead, boron, manganese, sulfate, and iron; SMCL exceedances: manganese, iron, sulfate, and TDS.

CCW Surface Impoundment Characteristics: Two unlined ash ponds, one active and the other inactive.

Hydrogeologic Conditions: Hydrogeologic vulnerability rated as moderately low (Wilhite, 2009).

Groundwater Data Analysis: Illinois EPA's Ash Impoundment Strategy, developed in response to the TVA Kingston ash spill, identified the ash pond at Joppa as a Priority 1 site for hydrogeologic assessment (IEPA, 2010). In response to this program seven wells (G101, G111, G112b, G113, G151, G152 and G153) were sampled on August 17, 2010. A well location map was not available for review. None of the wells are specifically identified as upgradient.

MCL Exceedances:

- Lead in two wells (19.1 and 27.4 ppb).
- Possibly arsenic; the detection limit (25 ppb) was 2.5 times higher than the MCL.

Health-based guidelines:

- Chromium in two wells exceeded the CA PHG for hexavalent chromium by more than three orders of magnitude (G151, 23.3 ppb at a pH of 6.7, and G153, 25.4 ppb at a pH of 6.9) and may have exceeded the CA PHG in other wells where the detection limit was 10 ppb. In all wells, pH ranged from 6.05 to 7.3, a range at which all or most total chromium is hexavalent.
- Cobalt exceeded the tapwater RSL of 11 ppb in three wells (G112b, 65.3 ppb; G152, 33.1 ppb; and G153, 25.4 ppb).
- Boron exceeded the CHA in three wells at up to 11.8 ppm.
- Manganese exceeded the LHA in two wells (G112b and G151) at up to 4.25 ppm.
- Sulfate exceeded the DWA in one well (G152) at 768 ppm.

IL Groundwater Standard exceedances:

- Lead in two wells (G151, 27.4 ppb and G153 19.1 ppb).
- Boron in three wells (G112b, 3.45 ppm; G151, 8.57 ppm; and G152, 11.8 ppm)
- Manganese in four wells (G112b, 4.25 ppm; G151, 0.471 ppm; G152, 0.185 ppm; and G153, 0.215 ppm).
- Sulfate in one well (G152, 768 ppm).
- Iron in three wells (G112b, 3.45 ppm; G151, 8.27 ppm; and G152, 11.8 ppm).

SMCL Exceedances:

- Manganese in all wells.
- Sulfate in one additional well (G112b, 298 ppm).
- Iron in two additional wells (G101, 1.34 ppm and G111, 0.453 ppm).
- TDS in three wells (maximum 1,110 ppm).

At Risk Population: There are twenty three wells within one mile rated as having high potable well contamination potential (Wilhite, 2009).

Other Information: Facility operates under IEPA Permit IL0004171.

Sources:

Illinois Environmental Protection Agency (IEPA). 2010. Illinois EPA's Ash Impoundment Strategy Progress Report, August 4, 2010.

Illinois Environmental Protection Agency (IEPA). 2011. Response to Freedom of Information Act Request. [Summary tables and laboratory analyses from seven groundwater monitoring wells sampled on June 1-25, 2010]

Wilhite, M. 2009. Assessment of Ash Impoundments Permitted Within the State of Illinois. Draft Memorandum from Marcia Wilhite, Chief, Bureau of Water to Douglas Scott, Director Illinois EPA, February 3, 2009.

Joppa Steam Plant Ash Ponds, Joppa, IL.

9. Meredosia Power Station, Ash Ponds: 354 MW (three units online from 1948 to 1960). 800 South Washington Street, Meredosia, IL 62665; GPS Coordinates 39.823269, -90.5672.

Owner/Parent Company: Ameren Energy Generating Company, owned by Ameren.

Summary: Meredosia Station is one of more than a dozen power plants in Illinois with coal ash ponds where groundwater monitoring was not required by Illinois EPA prior to the TVA Kingston ash spill in Tennessee. The first round of groundwater sampling of five downgradient wells at Meredosia's ash ponds occurred in 2010. Arsenic exceeded the MCL in two wells (maximum of 148 ppb, 14.8 times the MCL). EPA health-based guidelines were exceeded for boron in one well (30.2 ppm, 10.1 times the CHA), and manganese in two wells (maximum of 3.1 ppm, 10.3 times the LHA). Three parameters exceeded Illinois Class I Groundwater Standards: arsenic in two wells, boron in two wells, and manganese in three wells. The detection limit for total chromium was 500 times the CA PHG for hexavalent chromium so it is possible that chromium was present at toxic levels but not detected.

Constituents Involved: MCL exceedances: arsenic; health-based guideline exceedances: boron, manganese and possibly chromium; IL Groundwater Standard exceedances: arsenic, boron and manganese; SMCL exceedances: manganese, sulfate and TDS.

CCW Surface Impoundment Characteristics: Five unlined ash ponds, including three inactive ponds, one active 186-acre fly ash pond commissioned in 1968, and one active 34-acre bottom ash pond commissioned in 1972.

Hydrogeologic Conditions: Hydrogeologic vulnerability rated as very high (Wilhite, 2009).

Groundwater Data Analysis: Illinois EPA's Ash Impoundment Strategy, developed in response to the TVA Kingston ash spill, identified the ash ponds at Meredosia as a Priority 1 site for hydrogeologic assessment (IEPA, 2010). In response to this program five wells (APW1 to APW5) were sampled on December 13, 2010. A well location map was not available for review. Although no exceedances were found in APW1 and APW5, the presence of boron at 0.117 ppm and 0.118 ppm in these two wells suggests that all wells have been impacted by ash ponds.

MCL Exceedances: Arsenic in two wells (APW3 at 148 ppb and APW4 at 53.2 ppb)

Health-based guidelines:

- Boron exceeded the CHA in one well by 10.1 times (APW3, 30.2 ppm).
- Manganese exceeded the LHA in two wells by 3 to 10 times (APW2 at 0.931 ppm and APW4 at 3.1 ppm).
- Chromium may exceed the CA PHG—all samples were below a detection limit of 10 ppb, which is 500 times the CA PHG.

IL Groundwater Standard exceedances:

- Arsenic in two wells (APW3 at 148 ppb and APW4 at 53.2 ppb)
- Boron in two wells (APW2 at 2.11 ppm and APW3 at 30.2 ppm).
- Manganese in three wells (APW2 at 0.931 ppm, APW3 at 0.169 ppm, and APW4 at 3.1 ppm).

SMCL Exceedances:

- Manganese in three wells (as noted above).
- Sulfate in one well (APW3, 284 ppm).
- TDS is one well (APW3, 660 ppm).

At Risk Population: There are sixty-eight wells within one mile of the plant; the area is rated as having high potable well contamination potential (Wilhite, 2009).

Other Information: Facility operates under IEPA Permit IL0000116.

Sources:

Illinois Environmental Protection Agency (IEPA). 2010. Illinois EPA's Ash Impoundment Strategy Progress Report, August 4, 2010.

Illinois Environmental Protection Agency (IEPA). 2011. Response to Freedom of Information Act Request. [Reports of analyses for sample results from five groundwater monitoring wells sampled on December 13, 2010]

Wilhite, M. 2009. Assessment of Ash Impoundments Permitted Within the State of Illinois. Draft Memorandum from Marcia Wilhite, Chief, Bureau of Water to Douglas Scott, Director Illinois EPA, February 3, 2009.

Meredosia Power Station Ash Ponds, Meredosia, IL. P1 = Active Fly Ash Pond, P2 = Active Bottom Ash Pond.

10. Pearl Station, Ash Pond: 22 MW (one unit online in 1967). Route 100 South, Pearl, IL 62361; GPS Coordinates 39.4489, -90.6142

Owner/Parent Company: Prairie Power, owned by Soyland Power Cooperative.

Summary: Pearl Station is one of more than a dozen power plants in Illinois with coal ash ponds where groundwater monitoring was not required by Illinois EPA prior to the TVA Kingston ash spill in Tennessee. The first round of sampling of twelve downgradient wells at the ash pond was conducted in 2010. The arsenic MCL was exceeded in five wells at up to 48 ppb, 4.8 times the MCL. EPA health-based guidelines were exceeded for boron in seven wells (maximum 16 pm, 5.3 times the CHA), manganese in all wells (maximum of 18 ppm, 60 times LHA), and sulfate in five wells (maximum of 1,400 ppm, 2.8 times DWA). Seven parameters exceeded Illinois Class I Groundwater Standards, including lead in one well (11 ppb), boron in nine wells, chloride in two wells, manganese in all twelve wells, iron in six wells, sulfate in six wells and TDS in five wells. Total chromium was detected in two wells at 5.2 and 5.5 ppb, 260 to 275 times the CA PHG for hexavalent chromium.

Constituents Involved: MCL exceedances: arsenic; EPA health-based guideline exceedances: chromium, boron, manganese and sulfate; IL Groundwater Standard exceedances: lead, boron, manganese, sulfate, chloride, iron, TDS; SMCL exceedances: manganese, chloride, iron, sulfate, TDS

CCW Surface Impoundment Characteristics: One active unlined ash pond.

Hydrogeologic Conditions: Hydrogeologic vulnerability rated as very high (Wilhite, 2009).

Groundwater Data Analysis: Illinois EPA's Ash Impoundment Strategy, developed in response to the TVA Kingston ash spill, identified the ash pond at Pearl Station as a Priority 1 site for hydrogeologic assessment (IEPA, 2010). In response to this program, twelve wells (MW1 to MW12) were sampled on May 27, 2010. A well location map was not available for review. Based on ash constituents being detected in all wells, they are all presumed to be downgradient.

MCL Exceedances:

Arsenic exceeded the MCL in five wells by 1.1 to 4.8 times (MW1 at 24 ppb, MW2 at 11 ppb, MW5 at 32 ppb, MW9 at 13 ppb and MW12 at 48 ppb).

Health-based guidelines:

- Chromium exceeded the CA PHG for hexavalent chromium by 260 to 275 times in two wells (MW4, 5.2 ppb and MW9, 5.5 ppb). Although pH data were not available for

review, groundwater pH in Illinois is typically >5.5, so all or most of the measured chromium is probably hexavalent.

- Boron exceeded the CHA by up to 5.3 times in seven wells (3.1 to 16 ppm).
- Manganese exceeded the LHA by up to 60 times in all wells (2.5 to 18 ppm).
- Sulfate exceeded the DWA by up to 2.8 times in five wells (590 to 1,400 ppm).
- Iron exceeded the tapwater RSL in at least one well (38 ppm).

IL GW Exceedances:

- Lead in one well (MW9, 11 ppb).
- Boron in nine wells (2.2 to 16 ppm).
- Manganese in all twelve wells (2.5 to 18 ppm).
- Sulfate in six wells (460 to 1,400 ppm).
- Chloride in two wells (MW8, 370 ppm and MW9, 270 ppm).
- Iron in six wells (6.9 to 38 ppm).
- TDS in five wells (1,200 to 2,400 ppm).

SMCL Exceedances:

- Manganese in all wells, as noted above.
- Sulfate in two additional wells.
- Iron in ten wells (0.6 ppm to 38 ppm).
- Chloride in two wells as noted in IL GW exceedances.
- TDS in all wells as noted in IL GW exceedances.

At Risk Population: There are eight wells within one mile, and site has high potential to contaminate groundwater yet is also rated as having low potable well contamination potential (Wilhite, 2009). The rationale for this rating was not provided by IEPA.

Other Information: Facility operates under IEPA Permit IL0036765.

Sources:

Illinois Environmental Protection Agency (IEPA). 2010. Illinois EPA's Ash Impoundment Strategy Progress Report, August 4, 2010.

Illinois Environmental Protection Agency (IEPA). 2011. Response to Freedom of Information Act Request. [Summary table for sample results from twelve groundwater monitoring wells sampled on May 27, 2010]

Wilhite, M. 2009. Assessment of Ash Impoundments Permitted Within the State of Illinois. Draft Mernorandum from Marcia Wilhite, Chief, Bureau of Water to Douglas Scott, Director Illinois EPA, February 3, 2009.

Pearl Station Ash Pond (P), Pearl IL

11. Powerton Generating Station, Ash Ponds: 1,786 MW (two units online in 1972 and 1975). 13082 East Manito Rd., Pekin, IL 61554; GPS Coordinates 40.542091, -89.680487

Owner/Parent Company: Midwest Generation, owned by Edison International.

Summary: Powerton Station is one of more than a dozen power plants in Illinois with coal ash ponds where groundwater monitoring was not required by Illinois EPA prior to the TVA Kingston ash spill in Tennessee. The first round of groundwater sampling of ten downgradient wells at Powerton's ash ponds occurred in 2010. Arsenic and lead were above their respective MCLs in one well (arsenic at 26 ppb, 2.6 times the MCL, and lead at 39 ppb, 2.6 times the MCL). The EPA LHA for manganese was exceeded in five wells. Three parameters exceeded Illinois Class I Groundwater Standards, including lead in one well, boron in one well, and manganese in seven wells. Total chromium was detected in four wells at pH levels where all or most is likely in the form of hexavalent chromium at concentrations up to 6.0 ppb, 300 times the CA PHG for hexavalent chromium.

Constituents Involved: MCL exceedances: arsenic and lead; health-based guideline exceedances: chromium in four wells and manganese in five wells; IL Groundwater Standard exceedances: lead, boron and manganese; SMCL exceedances: manganese, iron and TDS.

CCW Surface Impoundment Characteristics: Three active ash ponds reported as lined: Ash Basin (31 million gallons), Secondary Basin (7.5 million gallons) and Bypass Basin (2.2 million gallons).

Hydrogeologic Conditions: Hydrogeologic vulnerability rated as very high (Wilhite, 2009).

Groundwater Data Analysis: Illinois EPA's Ash Impoundment Strategy, developed in response to the TVA Kingston ash spill, identified the ash ponds at Powerton as a Priority 1 site for hydrogeologic assessment (IEPA, 2010). In response to this program ten wells (MW1 to MW10) were sampled on December 15, 2010. A well location map was not available for review. Based on ash constituents being detected in all wells, they are all presumed to be downgradient.

MCL Exceedances:

- Arsenic in one well (MW7, 26 ppb), 2.6 times the MCL, and detected in five other wells at concentrations ranging from 1.1 to 5.2 ppb.
- Lead in one well (MW7, 39 ppb—2.6 times the MCL).

Health-based guidelines:

- Manganese exceeded the LHA in five wells (0.51 to 3.5 ppm).
- Chromium in exceeded the CA PHG for hexavalent chromium in four wells (MW4, 4.5 ppb at pH 7.27, MW5, 4.4 ppb at pH 7.68, MW6, 6 ppb at pH 7.68 and MW7, 8.8 ppb at

unknown pH). At this range of pH, all or most total chromium is presumed to be hexavalent.

IL Groundwater Standard Exceedances:

- Lead in one well (MW7, 39 ppb).
- Boron in one well (MW9, 2.1 ppm).
- Manganese in seven wells (0.15 to 3.5 ppm).

SMCL Exceedances:

- Manganese in seven wells.
- Iron in one well (MW8, 0.56 ppm).
- TDS in seven wells (500 to 950 ppm).

At Risk Population: There are twenty five wells are within one mile and the site has high potential to contaminate groundwater, yet is rated as having very low potable well contamination potential (Wilhite, 2009). The rationale for this rating was not provided by IEPA.

Other Information: Facility operates under IEPA Permit IL0002232. The Mahoney Landfill, which received coal ash from Powerton and was identified by the US EPA as a potential damage case (US EPA, 2007), is located off-site, so the new data from the ash ponds qualifies Powerton as a new damage case.

Sources:

Illinois Environmental Protection Agency (IEPA). 2010. Illinois EPA's Ash Impoundment Strategy Progress Report, August 4, 2010.

Illinois Environmental Protection Agency (IEPA). 2011. Response to Freedom of Information Act Request. [Summary tables for sample results from ten groundwater monitoring wells sampled on February 13, 2010]

Wilhite, M. 2009. Assessment of Ash Impoundments Permitted Within the State of Illinois. Draft Memorandum from Marcia Wilhite, Chief, Bureau of Water to Douglas Scott, Director Illinois EPA, February 3, 2009.

Powerton Generating Station Ash Ponds (P), Pekin IL.

12. Waukegan Generating Station, Ash Ponds: 803 MW (three units online from 1952 to 1962). 401 East Greenwood Ave., Waukegan, IL 60087; GPS Coordinates 42.382778, -87.820274

Owner/Parent Company: Midwest Generation, owned by Edison International

Summary: Waukegan Station is one of more than a dozen power plants in Illinois with coal ash ponds where groundwater monitoring was not required by Illinois EPA prior to the TVA Kingston ash spill in Tennessee. The first round of groundwater sampling of five downgradient wells at Waukegan's ash ponds occurred in 2010.

Constituents Involved: MCL exceedances: arsenic and antimony; health-based guideline exceedances: boron, manganese and sulfate; IL Groundwater Standard exceedances: arsenic, antimony, boron, manganese sulfate and TDS; SMCL exceedances: manganese, iron, sulfate and TDS.

CCW Surface Impoundment Characteristics: Two ash ponds with 52 million gallon capacity (east and west) reported as lined. There also appears to be an ash landfill.

Hydrogeologic Conditions: Wilhite (2010) describes ponds as being on disturbed land. Satellite images indicate that they are located on shore sediments of Lake Michigan.

Groundwater Data Analysis: Illinois EPA's Ash Impoundment Strategy, developed in response to the TVA Kingston ash spill, identified the ash ponds at Waukegan as a Priority 2 site for hydrogeologic assessment (IEPA, 2010). Five wells (MW1 to MW5) were sampled on October 25, 2010. A well location map was not available for review. MW5 is identified as an upgradient well, but very high concentrations of boron (28 ppm), sulfate, and TDS, in addition to arsenic and selenium detections, indicate that it is in fact contaminated by coal ash.

MCL Exceedances:

- Arsenic exceeded the MCL in two wells (MW1, 54 ppb and MW2, 25 ppb).
- Antimony exceeded the MCL in one well (MW2, 15 ppb).

Health-based guidelines:

- Boron exceeded the CHA in MW5, with a concentration of 28 ppm.
- Manganese exceeded the LHA in MW5 (0.71 ppm).
- Sulfate exceeded the DWA in MW5 (920 ppm).

IL Groundwater Standard exceedances:

- Arsenic in one well (MW1, 54 ppb).
- Antimony in one well (MW2, 15 ppb).
- Boron in four wells (MW1, 2.6 ppm; MW2, 2.2 ppm; MW4, 2.0 ppm; and MW5, 28 ppm).
- Manganese in one well (MW5, 0.71 ppm).
- Sulfate in one well (MW5, 920 ppm).
- TDS (MW5, 1,500 ppm).

SMCL Exceedances:

- Manganese in one additional well (MW4, 0.058 ppm).
- Sulfate in two additional wells (MW1, 350 ppm and MW4, 250 ppm).
- Iron in one well (MW5, 3.5 ppm).
- TDS in one well (MW5, 1,500 ppm).

At Risk Population: There are eleven wells within one mile, but the site is rated as having very low potable well contamination potential (Wilhite, 2009). This rating appears to be based on the assumption that any groundwater contamination will flow into Lake Michigan.

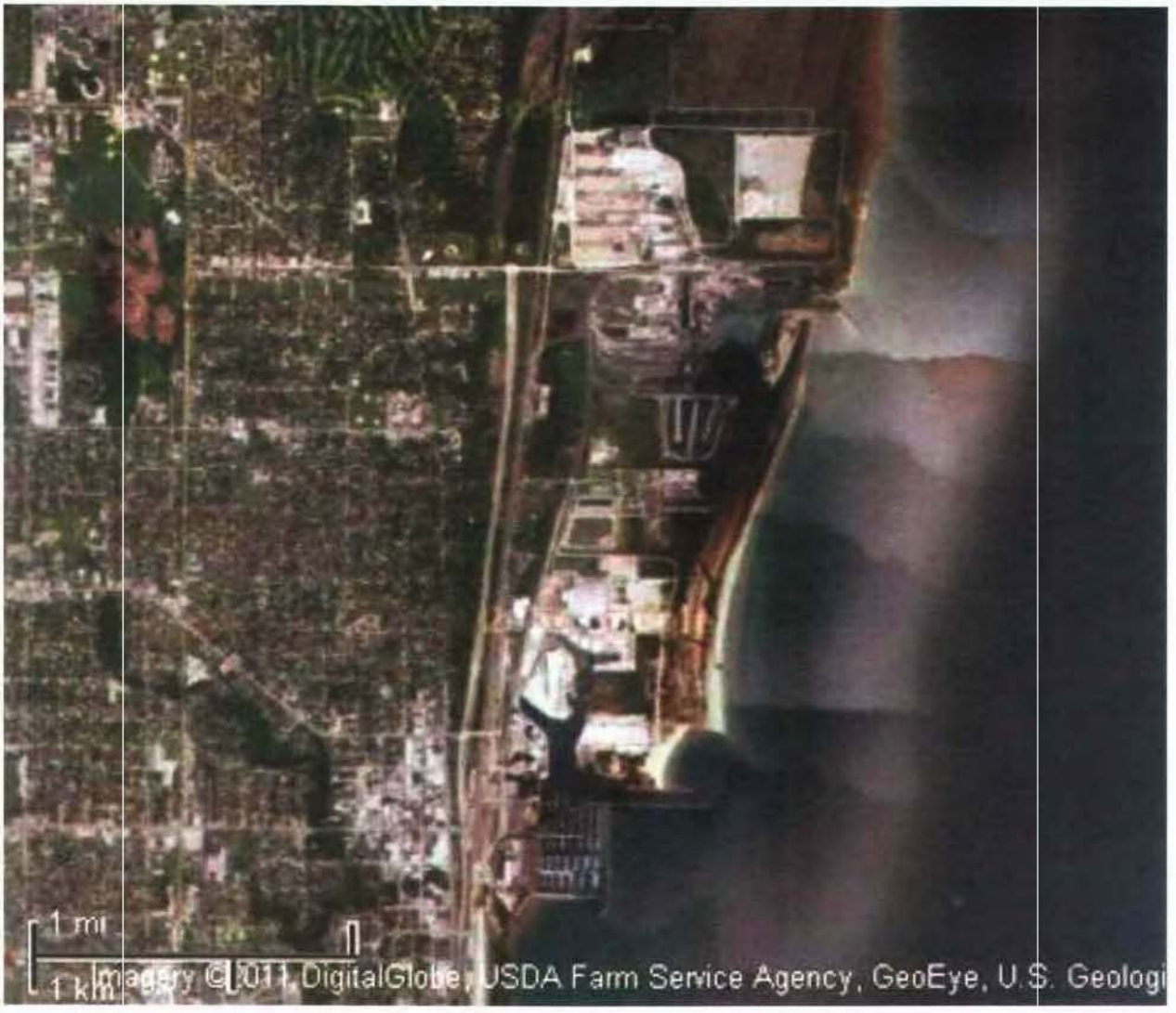
Other Information: Facility operates under IEPA Permit IL0002259.

Sources:

Illinois Environmental Protection Agency (IEPA). 2010. Illinois EPA's Ash Impoundment Strategy Progress Report, August 4, 2010.

Illinois Environmental Protection Agency (IEPA). 2011. Response to Freedom of Information Act Request. [Summary tables for sample results from five groundwater monitoring wells sampled on October 25, 2010]

Wilhite, M. 2009. Assessment of Ash Impoundments Permitted Within the State of Illinois. Draft Memorandum from Marcia Wilhite, Chief, Bureau of Water to Douglas Scott, Director Illinois EPA, February 3, 2009.



Waukegan Generating Station Ash Ponds, Waukegan, IL

13. Paradise Fossil Plant Ash Ponds: 2,558 MW; three units completed in 1963 and 1970. Paradise, KY. GPS Coordinates 37.259722, -86.978056.

Owner/Parent Company: Tennessee Valley Authority.

Summary: Monitoring in the 1980s, reported in a 1989 Draft Environmental Assessment for development of a dredged coal ash disposal area, revealed contamination at this site that included beryllium, cadmium, and lead above MCLs (TVA 1989). There was apparently no groundwater monitoring throughout the 1990s and 2000s. Nine wells were finally installed in 2010. The first round of sampling, done in June, 2011, detected arsenic above the MCL in one well near the plant's bottom ash ponds. Other wells showed that boron, manganese, nickel, and sulfate all exceeded EPA health advisories, with a maximum manganese concentration of 61,000 ppm—over 200 times the LHA.

Constituents Involved: MCL exceedances: arsenic; other health-based guideline exceedances: boron, chromium, cobalt, and manganese.

CCW Disposal Site Characteristics: There are three ash disposal areas at Paradise, including a pair of bottom ash ponds in an abandoned strip mine pit adjacent to the Green River, Jacob's Creek Ash Pond south of the plant, and an FGD disposal area southwest of the plant.

Hydrogeologic Conditions: The area around the Paradise plant has been severely disturbed by strip mining. A Lisman Formation aquifer 6 to 22 feet beneath the surface has been substantially removed by mining, and where it remains it is in direct contact with ash disposal areas. A 1989 environmental assessment in preparation for selecting a new ash disposal area noted that "[p]roposed sites 1 and 3 [site 1 was apparently selected] would offer no potential for attenuation if wastes were discharged directly into the existing ponds because the fly ash would be in direct contact with the groundwater" (TVA 1989). Groundwater movement in the area is expected to be generally toward the river and the Jacob's Creek drainage basin.

Groundwater Data Analysis: There are two wells between the bottom ash ponds and the Green River (10-8 and 10-9), four wells around Jacob's Creek Ash Pond (10-3 to 10-6), two wells along the eastern edge of the FGD disposal area (10-1 and 10-2) and one well, presumably intended to be upgradient, west of the plant (10-7).

MCL exceedances: Arsenic in well 10-8 was measured at 18 ppb. Arsenic in nearby well 10-9 was 1.2 ppb. Well 10-4, east of Jacob's Creek Ash Pond, was measured twice and showed roughly 8 ppb of arsenic.

Health-based guidelines: Boron exceeded the 3-ppm CHA in 4 onsite wells, including the two FGD disposal area wells (10-1 and 10-2, at up to 24 ppm, 8 times above the CHA), one well near Jacob's Creek Ash Pond (10-6, 3.2 ppm), and one well near the bottom ash ponds (10-9, 15 ppm). Chromium was detected in seven wells at concentration of up to 23 ppb. Although we

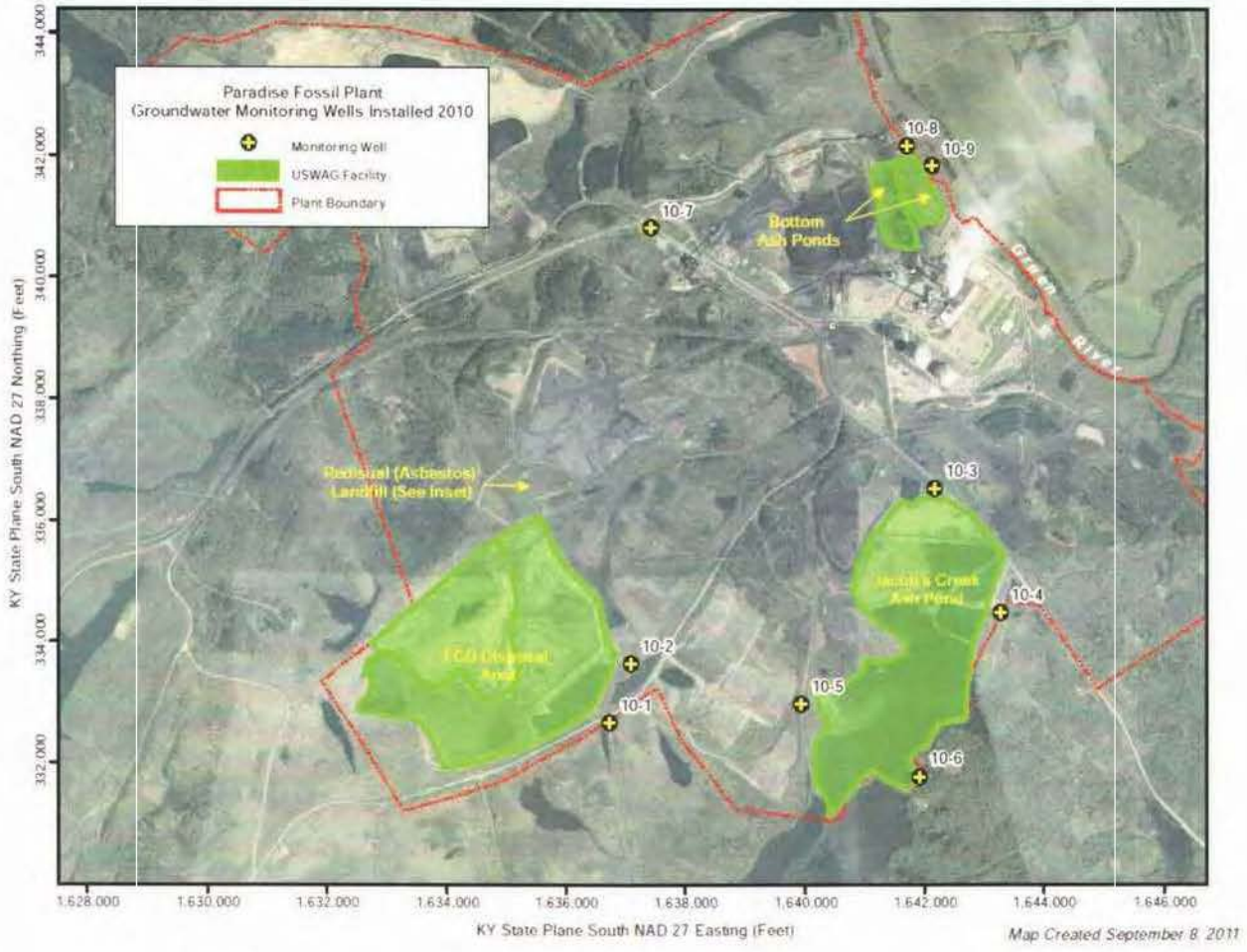
do not know how much of this was hexavalent chromium (we have no pH or conductivity information), 23 ppb is roughly 1,000 times higher than the CA Public Health Goal for hexavalent chromium. Cobalt exceeded the tapwater RSL in five wells. Although one of these wells was 10-7, an apparently upgradient well, the maximum downgradient concentration (370 ppb in well 10-9) was almost three times higher than the amount found in well 10-7. This concentration was also more than 30 times higher than the 11-ppb RSL. Manganese exceeded the LHA in all wells, and was measured at up to 61 ppm, more than 200 times above the LHA.

At Risk Population: There are roughly 200 households within 3 miles of the plant, but there are likely few, if any, domestic wells currently affected. Of greater concern is the long-term impact on groundwater and possible ecological impacts to local surface water (see, e.g., TVA, 1989: "Any impacts to groundwater will be localized, with increased fluxes to the Green River and/or Jacob's Creek.").

Sources:

TVA, 1989. Memorandum from W.G. Ruffner, Manager of Environmental Affairs, to M. Paul Schmierbach, Manager of Environmental Quality, re: Jacobs Creek Ash Pond, Dredge Pond Environmental Assessment (Mar. 1, 1989).

TVA, 2011. Letter from Denise Smith, TVA FOIA Officer, to Abel Russ, Environmental Integrity Project (Oct. 27, 2011) (including locations of and initial monitoring results from 29 newly-installed wells throughout the TVA coal fleet).



Paradise Fossil Plant, Paradise, TN (TVA, 2011).

14. North Valmy Generating Station Ash Ponds. 522 MW. 2 units completed in 1985. Valmy, NV; GPS Coordinates 40.8831, -117.1542.

Owner/Parent Company: NV Energy and Idaho Power.

Summary: Although there are technically four groundwater wells at the North Valmy plant, two of these are chronically dry, and so only two are actively measured. These two wells are located northwest and northeast of the five evaporation ponds. The ponds are lined, but have had a long history of tears, leaks, and repairs. Arsenic has been consistently above 100 ppb in both wells over the past three years, with a maximum concentration of 260 ppb. The fluoride MCL has been exceeded in one well. Manganese has been detected at up to 410 ppb, above the LHA. It is possible that the high arsenic and fluoride levels are naturally occurring due to the unique geology of the area, but upgradient or background monitoring would be required to confirm this possibility.

Constituents Involved: MCLs: arsenic and fluoride; health-based guidelines: manganese.

CCW Disposal Site Characteristics: Disposal units include five lined ponds and a landfill.

Hydrogeologic Conditions: We have only received limited information regarding underlying geology and hydrology. One of the two actively monitored wells, LF-4, is screened from 64.5 to 84.5 feet below the surface in "sandy clay lake deposits and basaltic bedrock." The second, MW-3, is screened in a shallow perched groundwater system from 24 to 44 feet below the surface, in "sand and gravel paleochannel deposits" (Water Management Consultants 2005).

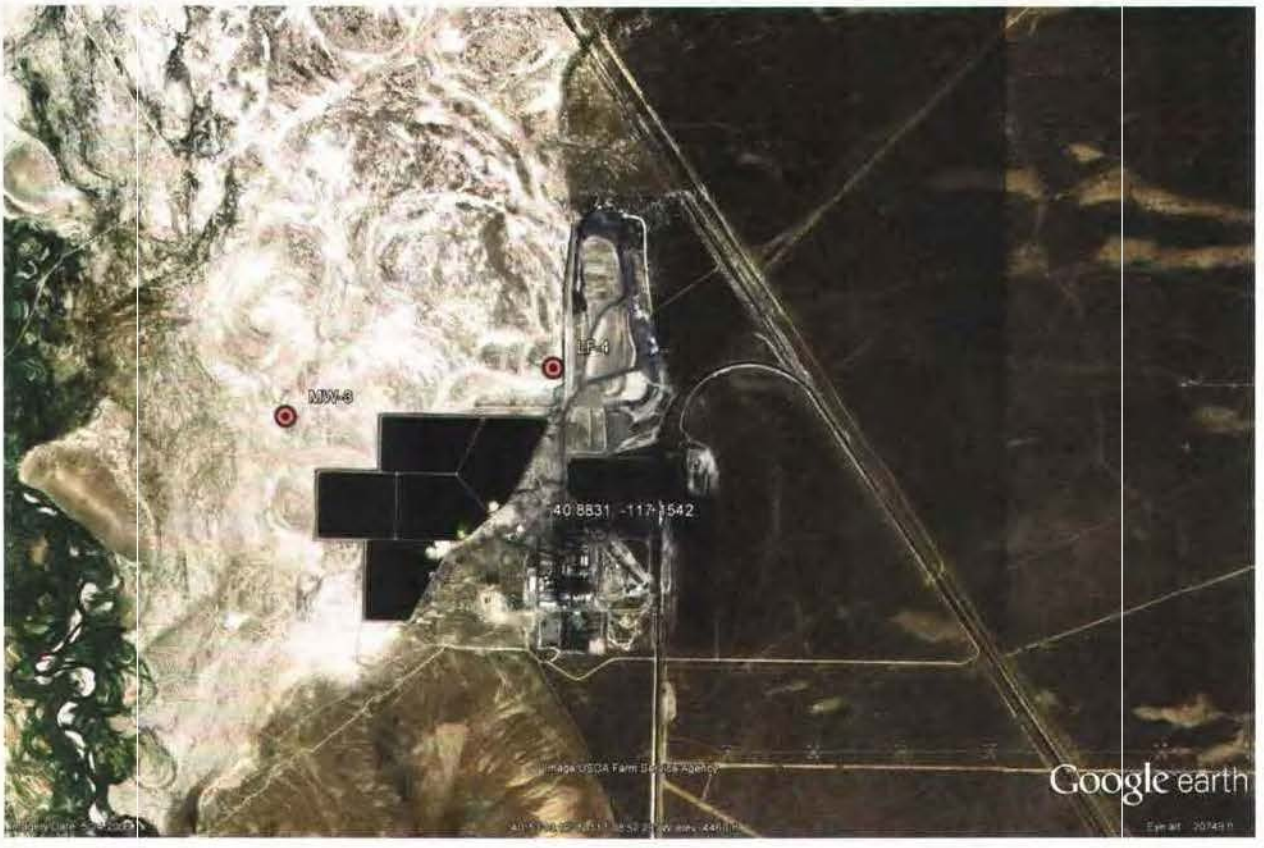
Groundwater Data Analysis: We looked at quarterly results for wells LF-4 and MW-3 from the fourth quarter of 2007 through the fourth quarter of 2010. Not all parameters were measured in all monitoring events. Boron, fluoride, and manganese, for example, were only measured in the fourth quarter of 2010.

At Risk Population: No information has been collected. This is a very sparsely populated area.

Sources:

NV Energy, 2011. Fourth Quarter/Annual 2010 Discharge Monitoring Report Permit Number NEV96015 – NV Energy – North Valmy Generating Station (Jan. 21, 2011) (and earlier quarterly and annual reports).

Water Management Consultants, Inc. 2005. Memorandum to Arnold D. Luther, Sierra Pacific Power Company, re: Sampling results from monitoring wells near the North Valmy evaporation ponds (Nov. 18, 2005).



North Valmy Generating Station, Valmy, NV.

15. Cross Generating Station Ash Landfill and Ponds: 2,390 MW; four units built between 1984 and 2008. 553 Cross Station Road, Pineville, SC 29468. GPS Coordinates 33°22'20", 80°06'35".

Owner/Parent Company: South Carolina Public Service Authority (SCPSA), owned by Santee Cooper.

Summary: Groundwater monitoring data from 2009 and 2010 show that MCLs were exceeded for arsenic in two wells (maximum of 16.4 ppb) and cadmium in one well (16.8 ppb). EPA health advisories or screening levels were also exceeded for sodium in eleven wells (maximum of 213.4 ppm), sulfate in six wells (maximum of 1,982 ppm, 4 times the DWA), and iron in four wells (maximum of 123.4 ppm, 4.7 times the tapwater RSL). Total chromium was detected in two wells at pH levels where all or most is likely to be in the form of hexavalent chromium. The maximum concentration, 12 ppb, is 600 times the CA PHG for hexavalent chromium.

Constituents Involved: MCL exceedances: arsenic and cadmium; health-based guideline exceedances: chromium, sodium, sulfate and iron; SMCL exceedances: aluminum, chloride, iron, sulfate and TDS.

CCW Disposal Site Characteristics: An ash landfill appears to be located northwest of the power plant and an ash pond north of the power plant.

Hydrogeologic Conditions: The most recent map available does not correctly show potentiometric contours, but examination of groundwater elevation indicates flow from the ash pond to the northeast toward Lake Moultrie, which lies about a half mile away.

Groundwater Data Analysis: One apparent upgradient well (PM1), and seventeen downgradient monitoring wells (CAP1 to 14, PM2, PM4, and PM6), were sampled in January and July of 2009 and 2010. Concentrations given are maximums for the four sampling events. Locations of CAP6, CAP7 and CAP8, downgradient from ash ponds, and CAP13, downgradient of a possible CCW landfill, are shown on the satellite image below. Well PM1 does not appear to be affected by ash and provides a good basis for comparison. The only coal ash constituent that appears to be naturally high in PM1 is iron (16 ppm). PM1 had nondetects for heavy metals and the following concentrations for other parameters: aluminum <0.05 ppm, chloride 15.8 ppm, sodium 5.99 ppm, sulfate 6.86 ppm, and TDS 270 ppm. It should also be noted that a number of significant parameters are not included in the monitoring program, including the MCL parameters of antimony, barium, beryllium, lead, mercury, selenium, and thallium.

<u>MCL Exceedances</u>:

- Arsenic exceeded the MCL in two wells (CAP7, 16.4 ppb and CAP8, 11.9 ppb).
- Cadmium exceeded the MCL in well CAP2 in both January (16.8 ppb) and May (7.35 ppb) of 2010.

Health-based guidelines:

- Sodium exceeded the DWA by up to 10.7 times in 11 wells (38.5 to 213.4 ppm).
- Sulfate exceeded the DWA by up to 4 times in 6 wells (642 to 1,982 ppm).
- Although iron levels appeared to be naturally high in groundwater (16.0 ppm in upgradient well PM1), there were some exceptionally high iron values exceeding the EPA tapwater RSL in four wells (34.9 to 123.4 ppm).
- Chromium in two wells with pH > 5.5 (levels at which all or most chromium is hexavalent) exceeded the CA PHG for hexavalent chromium by up to 600 times (CAP6, 12.0 ppb at a pH of 6.71, and CAP8, 4.8 ppb at a pH of 6.61).

SMCL Exceedances:

- Aluminum was greater than 0.2 ppm in 9 wells (0.26 to 27.4 ppm) and greater than 0.05 ppm in five more wells.
- Chloride in 9 wells (292 to 8,252 ppm).
- Iron in 14 wells.
- Sulfate in 2 additional wells (317 to 481 ppm).
- TDS in 12 wells (507 to 30,280 ppm).

At Risk Population: Satellite images show more than 100 houses on the shore of Lake Moultrie, about 2,000 feet downgradient from the ash pond.

Sources:

Santee Cooper. 2009-2010. Groundwater Monitoring Data Summary Tables and Laboratory Analysis Sheets for January and July 2009 and 2010. [FOIA request to SCDHEC also included a monitoring well map that apparently dates from 2010]

Cross Generation Station Ash Pond (P), possible landfill (LF?) and Selected Monitoring Well Locations in Pineville SC (top), and potential downgradient receptors (bottom).

16. McMeekin Station Ash Landfill and Ponds: 294 MW (2 units online in 1958), 2000 North Lake Drive, Columbia, SC 29212; GPS Coordinates 34.0533, -81.2178.

Owner/Parent Company: South Carolina Electric & Gas Company, owned by SCANA.

Summary: Groundwater monitoring data from 2005 to 2010 show MCL exceedances for chromium (maximum 371 ppb, 3.7 times the MCL) and lead (maximum 209 ppb, 13.9 times the MCL) in one well, although these exceedances were associated with high turbidity. The EPA Drinking Water Advisory for sulfate was exceeded in one well (up to 729 ppm). Total chromium was detected in three wells at pH levels where all or most is likely to be hexavalent chromium, with maximum concentrations up to 42.7 ppb, more than 2,000 times above the CA PHG for hexavalent chromium.

Constituents Involved: MCL exceedances: chromium and lead (in turbid samples); health advisory exceedances: chromium and sulfate; SMCL exceedances: sulfate, iron and TDS.

CCW Disposal Site Characteristics: Ash landfill and three ponds.

Hydrogeologic Conditions: The site is located in the eastern edge of the Piedmont Physiographic Province on the Carolinas. Bedrock is overlain by varying thicknesses of saprolite. Most of the site is underlain by quartz microcline gneiss and associated pelitic and semi-pelitic schists (metamorphic rock derived by metamorphism of an argillaceous or a fine-grained aluminous sediment).

Groundwater Data Analysis: The current groundwater monitoring program was established in 2005 and was supposed to have seven monitoring wells in the vicinity of the ash landfill south of the Saluda River (MW3B, MW13, MW14, MW15R, MW16R, MW17, and MW18), and three monitoring wells north of the Saluda River (MW30, MW31 and MW32). Review of monitoring data from 2005 to 2010 indicates that MW13, MW14 and MW15 were only sampled in May, 2005, and no data were found for MW15R and MW18.

Bi-annual sampling data from 2005 to 2010 were analyzed for MW30, MW31, MW32, MW3B, and MW16R, and maximum concentrations reported in the analysis below. MW3B and MW32 are designated as upgradient wells, but both show evidence of contamination by coal ash and so are included as contaminated wells in this analysis. An undated aerial photograph showing monitoring well locations also indicates the possible placement of coal ash in the area surrounding MW32.

It should also be noted that the monitoring programs omits many parameters known to be a potential concern at CCW disposal sites including antimony, beryllium, lead, mercury, selenium and thallium.

Interpretation of chromium in groundwater sampling results is complicated by the fact that pH shows considerable variation in the same wells, and falls within a range that tends to favor both hexavalent chromium (>5.5) and trivalent chromium (<5.5). Ranges of field pH for the wells are: 5.50 to 6.71 (MW30), 4.71 to 6.62 (MW31), 4.89 to 6.97 (MW32), 4.26 to 7.11 (MW3B), and 6.42 to 7.08 (MW16R). As explained below, only chromium results with pH >5.5 are compared with the CA PHG for hexavalent chromium. This is a site where consistent testing for hexavalent chromium would be essential to evaluate risks from chromium contamination. Specific chromium results for each well, with field pH and notations of high turbidity, are as follows:

- MW30: Three detects (13.5 ppb at pH 6.54 and 17 ppb at pH 6.71). The lower detects were associated with high turbidity (>200 NTU).
- MW31: Five detects, three with high pH (34-371 ppb at pH 6.35-6.62). The two highest results were associated with high turbidity (>200 NTU). One high result occurred at a low pH (110 ppb at pH 4.8, associated with high turbidity), and additional detect of 24.7 ppb occurred with an unknown pH.
- MW32: Five detects, all with high pH (6.97-42.7 ppb at pH 6.58-6.97). The sample with the highest chromium had high turbidity, >200 NTU. The other three samples had a low turbidity, ranging from 4.17 to 36.5 NTU.
- MW16R: One detect with high pH (17.5 ppb at pH 6.84) associated with high turbidity (188.6 NTU).
- MW3B: One detect with low pH (47.0 ppb at pH 4.84) associated with high turbidity (>200 NTU).

The above chromium data suggest the following:

- The highest chromium values (greater than 100 ppb) are associated with high turbidity meaning that some portion of the chromium may have been in suspension but not dissolved in the water, but pH of turbid samples can favor either hexavalent chromium (pH>5.5) or trivalent chromium (pH<5.5).
- High turbidity does not necessarily result in the highest chromium concentrations—in MW30 the highest concentration was in a non-turbid sample.
- Twelve out of fifteen chromium detects where pH was measured (80%) had pH >5.5, which suggests that all or most chromium detected at this site is toxic hexavalent chromium.

MCL Exceedances: Chromium and lead exceeded their respective MCLs in one well (MW31). The exceedances were associated with high field turbidity (>200 NTU) suggesting that some portion of these metal concentrations may not be dissolved in the water.

- Chromium exceedances in MW31 ranged from 190 to 371 ppb with pH levels that favor hexavalent chromium as the dominant form.

- Lead exceedances in MW31 ranged from 45 to 209 ppb. Lead was also detected three times in this well in non-turbid samples at concentrations from 8 to 13.8 ppb.

Health-based guidelines:

- Total chromium in non-turbid samples with pH >5.5 exceeded the CA PHG for hexavalent chromium in three wells: MW30 (up to17 ppb), MW31 (34 ppb), and MW32 (42.7 ppb).
- Sulfate exceeded the DWA in one well (MW31, up to 729 ppm).

SMCL Exceedances:

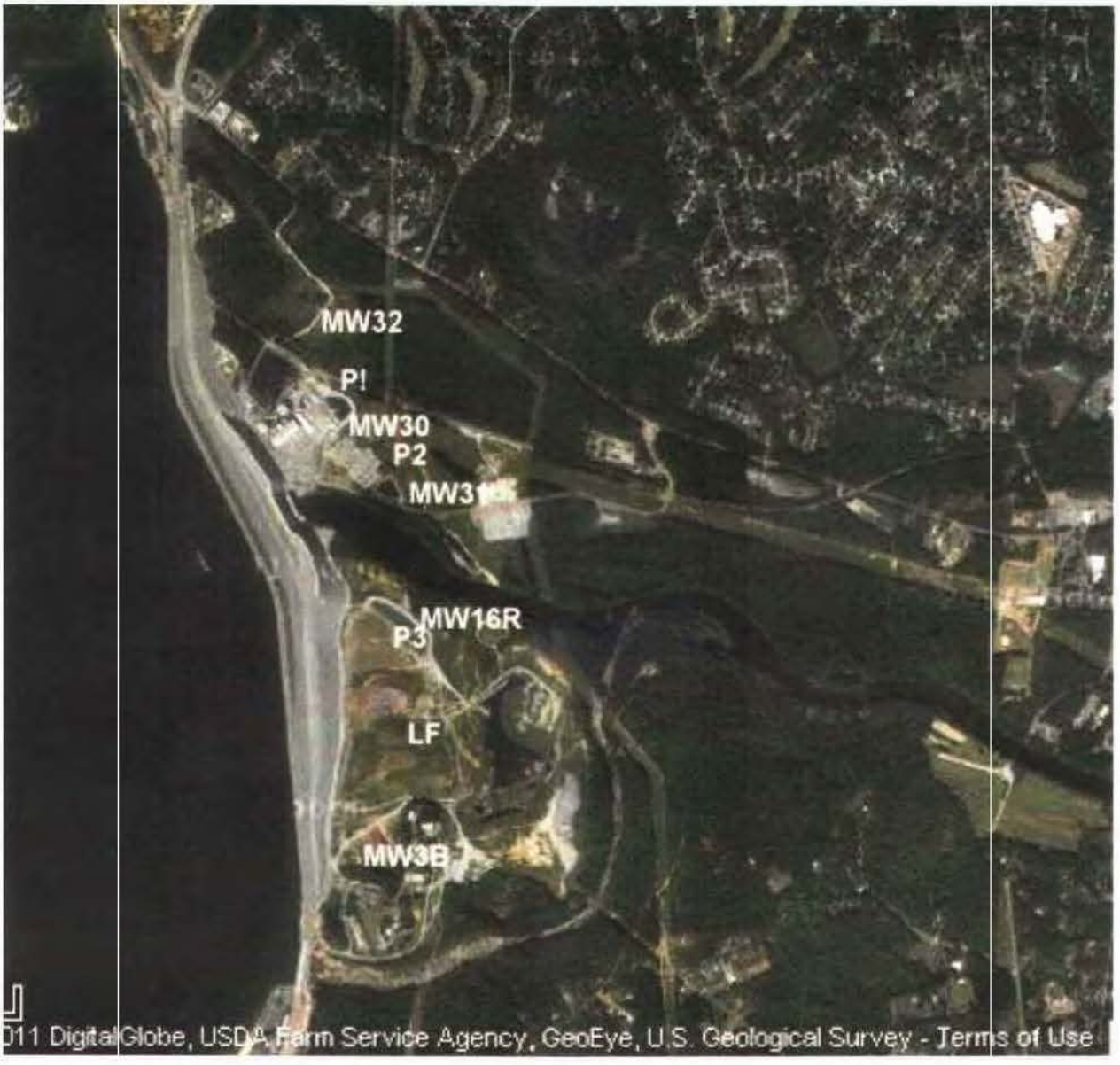
- Sulfate in MW31 (up to 729 ppm).
- TDS in MW31 (up to 982 ppm).
- Iron was high in virtually all samples and all wells (20.5 to 309.5 ppm in samples with turbidity >200 NTU, and up to 18.6 ppm in other samples).
- The pH was less than 6.5 in many samples.

At Risk Population: An urban area is nearby, northeast of power plant and ash disposal areas. Groundwater flow is towards the Saluda River below the dam for Lake Murray.

Sources:

SCE&G. 2005 to 2010. Groundwater Monitoring Reports.

Withers & Ravenel. 2005. Groundwater Monitoring Plan for the McMeekin Station, Industrial Solid Waste Facility, Coal Pile Runoff Pond and Low Volume Waste Pond. Prepared for South Caroline Electric & Gas Company, November 17, 2005.



McMeekin Station Active Landfill (LF), Pond P1 (Coal Pile Runoff), Pond P2 (Low Volume Waste), Pond P3 (Wastewater), and Monitoring Well Locations.

17. Winyah Generating Station Ash and FGD Ponds: 1,260 MW (four units online 1975 to 1981), 661 Steam Plant Dr., Georgetown, SC 29440; GPS Coordinates 33.330278, -79.3575.

Owner/Parent Company: South Caroline Public Service Company, owned by Santee Cooper.

Summary: Groundwater monitoring data from 2009 and 2010 show arsenic above the MCL in three wells at up to 180 ppb, 18 times the MCL. Health-based guidelines were also exceeded for sulfate in four wells (maximum of 1,163 ppm) and iron in two wells (up to 88.7 ppm, 3.4 times the tapwater RSL. Total chromium was detected in one well at pH levels where all or most is likely to be in the form of hexavalent chromium.

Constituents Involved: MCL exceedances: arsenic; health-based guideline exceedances: chromium, sulfate and iron; SMCL exceedances: sulfate, chloride and iron.

CCW Disposal Site Characteristics:

- Ash Pond A was constructed in 1975 and is used for fly ash, bottom ash and boiler slag. The 24.5-foot dam contains a pond with a surface area of 88 acres;
- Ash Pond B was constructed in 1975 and is used for fly ash, bottom ash and boiler slag. The 31-foot dam contains a pond with a surface area of 63 acres;
- The South Ash Pond was constructed in 1980 and is used for fly ash, bottom ash and boiler slag. The 22-foot dam contains a pond with a surface area of 61 acres;
- The West Ash Pond was constructed in 1980 and is used for fly ash, bottom ash and boiler slag. The 32-foot dam contains a pond with a surface area of 62 acres;
- The Units 1 & 2 Slurry Pond was constructed in 1977 and is used for "fuel gas emission control residuals." The 12-foot dam contains a pond with a surface area of 34 acres;
- Units 3 & 4 Slurry Pond was constructed in 1980 and is used for "fuel gas emission control residuals." The 30-foot dam contains a pond with a surface area of 100 acres.

Hydrogeologic Conditions: The general direction of groundwater flow is to the northwest.

Groundwater Data Analysis: Groundwater monitoring data are available back to 1995. Data for twelve monitoring wells (WAP1 to WAP12—a few have "R" designations) were analyzed for four sampling events (February, August, December, 2009 and February, 2010). WAP1 is upgradient and far enough from Ash Pond B to be largely unaffected and so provides a reasonable baseline for comparing monitoring well results to the following parameters and concentrations: TDS (17-29 ppm), sulfate (10.6 to 18.9 ppm), chloride (4.9 to 5.9 ppm), and pH (4.24 to 5.35). However, the most recent sampling event for this well detected lead (9.44 ppb), barium (12.5 ppb), and a significantly higher iron concentration compared to earlier samples, indicating that the well may have recently been affected by ash pond contaminants.

It should also be noted that the monitoring programs omits many parameters known to be of potential concern at CCW disposal sites including the MCL parameters antimony, beryllium,

mercury, and thallium, and many other parameters for which health-based standards have been set. Lead appears to have been added as a parameter in the most recent sampling event and was detected in six wells at concentrations ranging from 2.98 to 10.2 ppb.

MCL Exceedances: Arsenic exceeded the MCL by up to 18 times in three wells (WAP4, <5 to 32.4 ppb with a possible upward trend; WAP8, 144 to 161 ppb; and WAP10, 94.1 to 180 ppb).

Health-based guidelines:

- Maximum sulfate concentrations exceeded the DWA in four wells (WAP4, 549 to 560 ppm; WAP7R, 720 to 1,163 ppm; WAP8, 593 to 1,115 ppm and WAP10, 514 to 813 ppm).
- Although iron levels appear to be naturally high in the groundwater (up to 3.28 ppm and possibly higher), there are some exceptionally high iron values in downgradient wells. The EPA tapwater RSL for iron, 26 ppm, was exceeded in two of these wells (WAP3 at 31.3 to 88.7 ppm, and WAP4 at 40.1 to 60.9 ppm).
- Chromium in one well exceeded the CA PHG by up to 430 times (WAP7R, <3 to 8.6 ppb with an upward trend). The pH of the highest concentration was 6.33, a level at which all or most of the chromium is likely to be hexavalent. The pH of all downgradient monitoring wells other than WAP6 is >5.5.

SMCL Exceedances:

- Sulfate in seven wells (WAP3, WAP4, WAP5, WAP6, WAP7R, WAP8 and WAP10).
- Chloride in five wells (WAP3, up to 353 ppm; WAP4, up to 921 ppm; WAP5, up to 407 ppm; WAP8, up to 1,053 ppm, and WAP10, up to 854 ppm).
- Iron was high in all wells.

At Risk Population: Satellite imagery indicates a number of possible private residences east (upgradient) of Slurry Ponds 1 & 2 and a few residences may be northwest (downgradient) of Slurry Ponds 3 & 4.

Sources:

Santee Cooper. 2010. Winyah Generating Station NPDES Groundwater Monitoring Potentiometric Map, July 2010.

South Carolina Department of Health and Environmental Control (SCDHEC). 2011. Response to Freedom of Information Act Request. [Summary table for sample results from eleven groundwater monitoring wells sampled on February, August, December, 2009 and February, 2010].

Winyah Generating Station Ash and FGD Ponds and Monitoring Well Locations. Ash Pond A (APA), Ash Pond B (APB), West Ash Pond (WAP), South Ash Pond (SAP), Slurry Ponds (SP1&2 and SP3&4); Monitoring Wells WAP1 to WAP11.

18. Allen Fossil Plant, Ash Ponds: 990 MW (three units online in 1959). 2574 Plant Rd., Memphis, TN 38109; *GPS Coordinates*: 35.073611, -90.148889.

Owner/Parent Company: Tennessee Valley Authority.

Summary: Groundwater monitoring data from 2006 and 2008 show arsenic above the MCL in two wells (maximum 14 ppb). The LHA for manganese was exceeded in all five wells at up to 1.4 ppm. Chromium was detected in three wells at concentrations, which, depending on pH levels, may be up to 90 times the CA PHG for hexavalent chromium.

Constituents Involved: MCL exceedances: arsenic; health-based guideline exceedances: manganese; SMCL exceedances: TDS.

CCW Waste Disposal Characteristics: Two ash ponds covering 93 acres.

Hydrogeologic Conditions: Ash ponds are located on alluvium of the Mississippi River, adjacent to Lake McKellar, which appears to be a partially cut off meander of the river. There are five wells at Allen, all of which should be considered downgradient because groundwater flow reverses from time to time. According to groundwater monitoring reports there is a strong "communication" between the alluvial aquifer beneath Allen and the adjacent Lake McKellar, and "[t]he predominant flow of groundwater is towards Lake McKellar" (TVA, 2008). Yet lake levels sometimes rise above the local groundwater table and reverse the direction of flow. The groundwater levels measured for the February 2008 sample collection, for example, showed groundwater movement away from the lake. The authors of the 2008 report note that "[t]he ash ponds and other impoundments likely produce radial groundwater flow away from there [sic] impoundments that cannot be adequately characterized with the existing well network" (TVA, 2008).

Groundwater Data Analysis: Five wells (P1 to P5) were sampled in February 2006 and February 2008 (the most recent date sampled).

MCL Exceedances: Arsenic in two wells (P2, 14 ppb in 2006 and 10 ppb in 2008; and P3, 13 ppb in 2008).

Health-based guidelines:

- Manganese in all five wells exceeded the Lifetime Health Advisory of 0.3 ppm, with the maximum concentration, 1,400 ppb, exceeding the LHA by 4.7 times.
- Chromium was detected at concentrations above the CA PHG for hexavalent chromium in three wells (P1, P2, and P5). All samples had high pH (>7), a condition that favors the presence of hexavalent chromium.

SMCL Exceedances:

- TDS in two wells (P1, 560 to 600 ppm; and P2, 620 ppm in 2006).
- Manganese in all five wells.

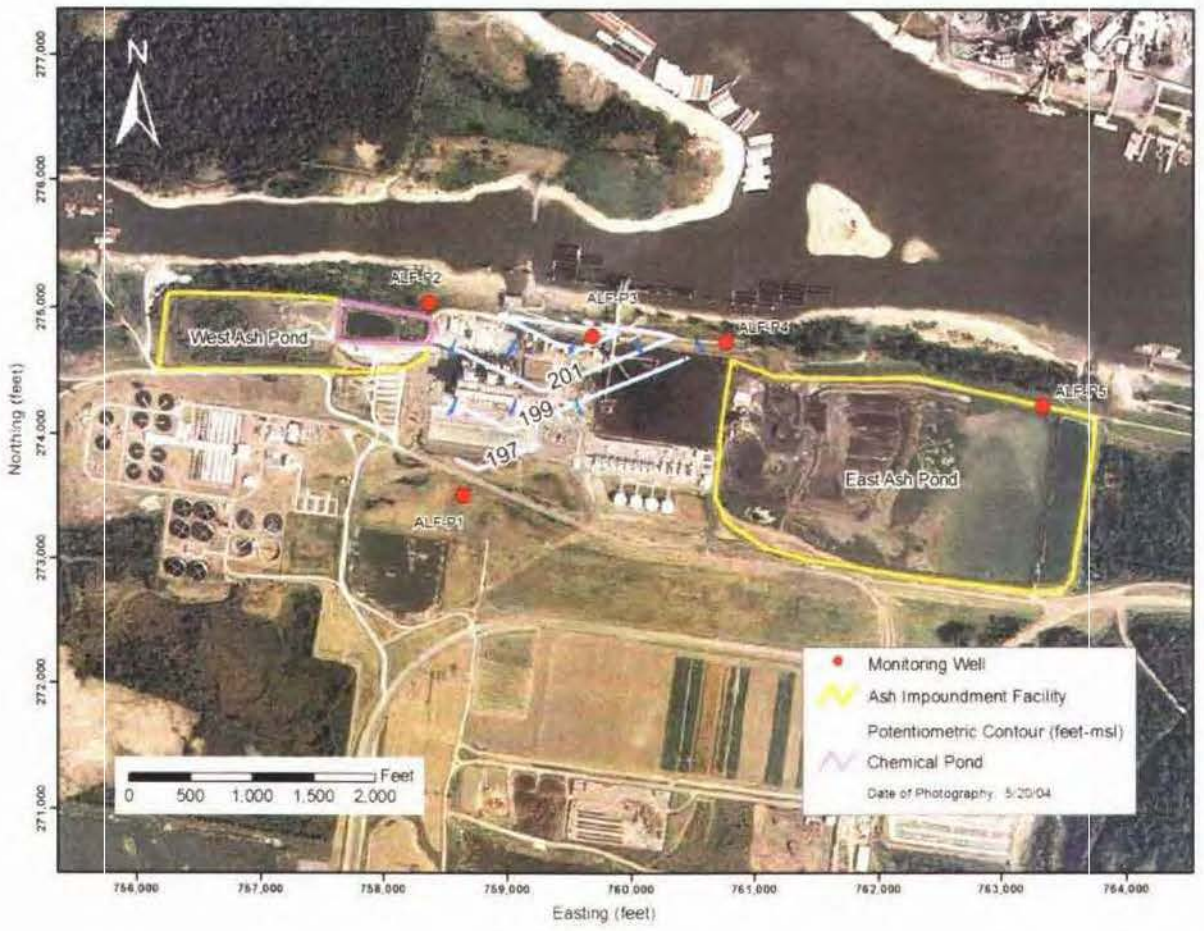
At Risk Population: TVA (2011) notes that the aquifer supplying drinking water to Memphis "runs under Allen."

Other Information: This plant does not have any permitted landfills, so the Tennessee Department of Environment and Conservation (TNDEC) does not require groundwater monitoring of its ash disposal sites. Voluntary monitoring took place from 2004 to 2008 (FOIA requests did not yield data for 2004). TDEC was not aware of the arsenic exceedances at the ash ponds prior to a 2011 TVA Office of Inspector General Report (TVA, 2011).

Sources:

Tennessee Valley Authority. 2011. TVA's Groundwater Monitoring at Coal Combustion Products Disposal Areas. Office of the Inspector General Inspection 2009-12991, June 21, 2011.

Tennessee Valley Authority. 2008. Groundwater Monitoring Report, February 2008 (Aug. 22, 2008).



Allen Fossil Plant, Memphis, TN.

19. Coleto Creek Power Station: 600 MW (online 1980) F.M. 2987, Fannin, TX 77960; GPS Coordinates 28.713333, -97.213333.

Owner/Parent Company: International Power.

Summary: The response to the Freedom of Information Act request for data from Coleto Creek Station was received too late to develop a detailed description of contamination at this site, but MCL and health advisory exceedances are summarized briefly below.

Constituents Involved: MCL exceedances: arsenic and lead; health-based guideline exceedances: boron, cobalt, nickel and vanadium.

CCW Waste Disposal Characteristics: Two ash ponds ("primary" and "secondary"), built in 1976-77 and covering 200 acres, receive fly ash and bottom ash from this plant. A third pond receives coal pile runoff, and a fourth is an evaporation pond. A map of the site provided by TCEQ in response to our FOIA request (source is undisclosed) also indicates that a "Dry Product Storage Area" of 130 acres exists north of the ponds.

Hydrogeologic Conditions: Groundwater flows to the east, southeast, and south from waste ponds toward Coleto Creek Reservoir, in a water-bearing seam of sand and silty sand that is approximately 10 to 25 below the ground surface and 40 to 54 feet thick (Aecom, 2010).

Groundwater Data Analysis: Eight wells and 5 piezometers sampled in May, 2010 for coal ash metals for the first time found the following:

MCL Exceedances:

- Arsenic above the MCL in three downgradient wells and one piezometer, up to 19 ppb.
- Lead above the 15 ppb Action Level in one downgradient well at (73 ppb) and equal to the Action Level in another well.
- Selenium at 800 ppb in seepage from the primary ash pond and 400 ppb in seepage from the secondary ash pond in June 1985 (Central Power & Light Company, 1986). Although it is not clear whether these samples were of groundwater or surface water, these concentrations were 8-16 times higher than the MCL and 80-160 times higher than the federal surface water quality standard (Criteria Continuous Concentration for chronic toxicity to aquatic life). No monitoring results were available for selenium from 1987 until the May 2010 sampling, which found selenium at lower levels (maximum of 12 ppb in a downgradient well).

Health-based guidelines:

- Boron above the 3-ppm CHA in 1 downgradient well (4.12 ppm).
- Cobalt above the 11-ppb tapwater RSL in 4 downgradient wells at up to 272 ppb.

- Nickel above the 100-ppb LHA in 2 downgradient wells at up to 140 ppb.

At Risk Population: Information received from TCEQ indicates that there are 19 wells within a mile of the plant and its ash ponds (Aecom, 2009). The utility claims that these wells are either uprgradient or isolated from plant groundwater by the plant's cooling water supply, Coleto Creek Reservoir, which flanks the southern and eastern boundaries of the site (Aecom, 2010). According to the TCEQ, "multiple aquifer levels are accessed in the region," and "numerous private water wells are located around and adjacent to the facility with reported uses such as irrigation, household, and private drinking water." (TCEQ, 2009).

Sources:

AECOM ENVIRONMENT, 2009, "*Groundwater Wells Within One Mile of the Facility Coleto Creek Power Station, Goliad County, Texas,*" 11-17-09.

AECOM ENVIRONMENT, 2010, "*Groundwater Quality Assessment Plan, Coleto Creek Power Plant, Goliad County, Fannin, Texas,*" prepared for Coleto Creek Power, LP/International Power, Nov. 2009, for submittal to Texas Commission on Environmental Quality, Ms. April Hoh, P.G., Water Quality Assessment Team on March 2, 2010.

Central Power & Light Company, Coleto Creek Power Station – TDWR Permit No. 2159, Quarterly Ash Pond Seepage Analysis, 2/03/86.

Texas Commission on Environmental Quality, 2009, TCEQ Groundwater Impact Evaluation "*Groundwater Data Review, Coleto Creek Power Plant, Amendment to permit 02159-000, Goliad County,*" Hoh, April, P.G., Water Quality Assessment Team, September 1, 2009.

International Power Coleto Creek, 2010, "*Coleto Creek Power Station, Fannin, TX, Groundwater Monitoring Annual Report, September 2010, In Compliance with TCEQ permit 2159, Other Requirement No. 13-IV,*" Crysup, Ross., Environmental Health and Safety Coordinator, International Power, L.P., 45 FM 2987, Fannin, TX 77960, September 30, 2010.

TCEQ, Coleto Creek Facility Map, Entitled, "Satellite Locations Map" by hand, Provided September, 2011, Source undisclosed.

Coleto Creek Power Station. Direction of groundwater flow from coal pile runoff and ash ponds (Aecom, 2010, page 30 of 134).

20. Parish Generating Station: 2,697 MW (four units online 1977-1982). 2500 Y.U. Jones Rd., Thompsons, TX 77481; GPS Coordinates 29.475722, -95.636167.

Owner/Parent Company: Texas Genco II, owned by NRG Energy.

Summary: The response to our Freedom of Information Act request for data from Parish Station was received too late to develop a detailed description of contamination at this site, but MCL and HBL exceedances are briefly summarized below.

Constituents Involved: MCL exceedances: arsenic, selenium and barium; health-based guideline exceedances: boron, chromium, cobalt, manganese, molybdenum, and sulfate.

CCW Waste Disposal Characteristics: A dry landfill receives fly ash and bottom ash from this plant. There is also a clay-lined FGD Emergency Pond that receives flue gas desulfurization liquids and sludge on a temporary basis during emergency conditions.

Groundwater Data Analysis: 27 wells sampled in 2009 and 2010 (two sampling events each year/four total):

MCL Exceedances:

- Arsenic: 10 wells above the MCL, up to 125 ppb.
- Barium: 1 well above the MCL, at 2.15 ppm.
- Selenium: 2 wells above the MCL, up to 242 ppb.

Health-based guidelines:

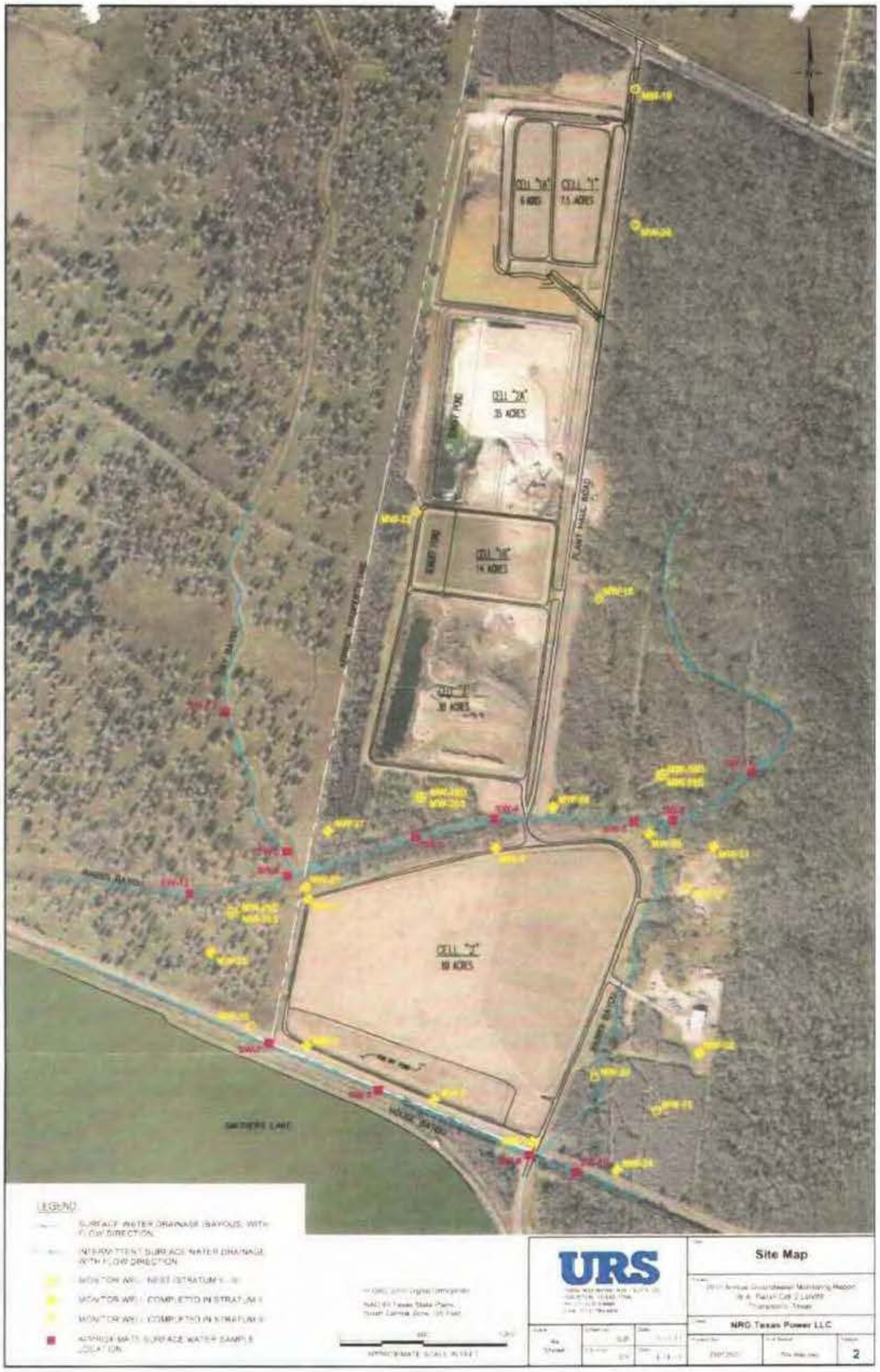
- Boron: 5 wells above the 3-ppm CHA, up to 8.3 ppm.
- Chromium: 15 wells with detectable total chromium at up to 85.7 ppb, under the MCL but more than 4,000 times higher than the CA PHG for hexavalent chromium. One well, MW18, was measured for hexavalent chromium and not detected, but it was measured at a higher detection limit (10 ppb) than the total chromium measurement (5 ppb). Total chromium measured between 5 and 10 ppb in two sampling events in 2009. These results are consistent with the possibility that all of the chromium detected at the Parish plant is hexavalent.
- Cobalt: 1 well above the 11-ppb tapwater RSL, at 13.2 ppb.
- Manganese: 21 wells above the 300-ppb LHA at up to 4.62 ppm, more than 10 times above the advisory.
- Molybdenum: 3 wells above the 40-ppb LHA at up to 856 ppb.
- Sulfate: 15 wells above the 500-ppm DWA at up to 3,870 ppm.

At Risk Population: Although we have not been able to determine how many nearby residences have private wells, there are approximately 4,000 people living within three miles of the Parish Generating Station, including scattered residential areas roughly one mile north and northeast of the landfill. Limited groundwater flow information suggests that groundwater in a shallow stratum is migrating radially away from the landfill, and groundwater in a slightly deeper stratum is moving northeast (URS, 2011). Fishing is prohibited in 2,140 acre Smithers Lake, immediately north of the power plant which is owned and operated by NRG as a cooling water lake for the plant.

Sources:

URS, 2011. 2010 Annual Groundwater Monitoring Report: W.A. Parish Electric Generating Station, Thompsons, Texas (Mar. 2011).

URS, 2010. 2009 Annual Groundwater Monitoring Report [for the W.A. Parish Electric Generating Station] (Feb. 2010).



Parish Generating Station landfill, Thompsons, TX.

Appendix B: More Data Reveals Worse Contamination at Known Damage Sites

Compiled by J. Russell Boulding, Boulding Soil and Water Consulting, Bloomington, IN,
October 31, 2011

As monitoring continues at coal ash sites where groundwater contamination has already been identified, levels of arsenic, selenium and other contaminants are often found to be increasing. Furthermore, new contaminants, usually unmonitored for in the past, such as cobalt, molybdenum, and beryllium, are being found in the groundwater at dangerously high levels.

South Carolina sites

We previously presented three sites in South Carolina (Grainger, Urquhart and Wateree) as damage cases based on evidence of groundwater and surface water contamination, but did not, at that time, have access to groundwater monitoring reports. We have since obtained monitoring reports, and have discovered that the contamination is worse than we originally thought:

- Ash ponds at the Grainger plant were previously reported, based on sampling done in 2000, to have contaminated the underlying groundwater with concentrations of arsenic as high as 917 ppb. The most recent sampling at the Grainger ash ponds (April 2010, October 2010, and April 2011) shows arsenic above the MCL in seven of ten wells, with a maximum value of 2,112 ppb—more than 200 times over the MCL.
- Groundwater Ash ponds and the CCW landfill at the Urquhart plant were previously reported in state documents to have concentrations exceeding the arsenic MCL, but actual concentrations were not available to EIP for inclusion in the 2010 report. Sampling at Urquhart Station in 2010-2011 shows arsenic above the MCL in four of nine ash pond wells (up to 1,209 ppb, 121 times the MCL), and in five of six wells at the coal ash landfill (up to 287 ppb).
- The ash pond at Wateree plant was reported to have had concentrations of arsenic as high as 180 ppb in underlying groundwater in the 1990s. Review of 2001-2010 groundwater monitoring data obtained by EIP, as well as data from the most recent round of sampling in April 2011, show that arsenic has been exceeding the MCL by orders of magnitude in five of six wells. The highest concentration was recorded in 2006, a staggering 5,100 ppb, 510 times the MCL and higher than the toxicity characteristic for hazardous waste leachate. Exceedances continued in two of eight wells in the most recent sampling, with a maximum of 1,100 ppb (110 times the MCL). MCLs were also exceeded from 2001 to 2011 for chromium (in one well, 187 ppb), cadmium (in two wells, maximum of 8.8 ppb), and lead (in three wells, maximum of 67.5 ppb).

These results are presented in the Tables 1 through 4:

Table 1. Recent Groundwater Data from the Grainger Ash Ponds, South Carolina

	Report Dates	# Wells	Type of Exceedance	Maximum Concentration
Arsenic	April 2010	6 of 10	MCL (10 ppb)	1,620 ppb
	October 2010	7 of 10		1,729 ppb
	April 2011	7 of10		2,112 ppb
Chromium	April 2010	4 of 10	CA PHG for Cr(VI) (0.02 ppb)	49.1 ppb
	October 2010	4 of 10		36.0 ppb
	April 2011	3 of 10		29.2 ppb
Iron	April 2010	5 of 10	RSL (26 ppm)	72.2 ppm
	October 2010	5 of 10		59.6 ppm
	April 2011	5 of 10		62.7 ppm
TDS	April 2010	6 of 10	SMCL (500 ppm)	767 ppm
	October 2010	4 of 10		860 ppm
	April 2011	3 of 10		726 ppm

Table 2. Recent Groundwater Data from the Urquhart Ash Ponds, South Carolina

	Report Dates	# Wells	Type of Exceedance	Maximum Concentration
Arsenic	October 2010	4 of 9	MCL (10 ppb)	1,209 ppb
	December 2010	4 of 9		1,088 ppb
	May 2011	4 of 9		1,169 ppb
Iron	October 2010	5 of 9	RSL (26 ppm)	56.0 ppm
	December 2010	5 of 9		40.0 ppm
	May 2011	5 of 9		66.2 ppm

Table 3. Recent Groundwater Data from the Urquhart Ash Landfill, South Carolina

	Report Dates	# Wells	Type of exceedance	Maximum concentration
Arsenic	October 2010	5 of 6	MCL (10 ppb)	251 ppb
	December 20100	5 of 6		287 ppb
	May 2011	4 or 6		284 ppb
Chromium	May 2011	1 of 6	CA PHG for Cr(VI) (0.02 ppb)	22.2 ppb
Iron	October 2010	0 of 6	RSL (26 ppm)	-
	December 20100	1 of 6		28.6 ppm
	May 2011	1 of 6		31.3 ppm

Table 4. Recent Groundwater Data from the Wateree Ash Pond, South Carolina

	Report Dates	# Wells	Type of exceedance	Maximum concentration
Arsenic	2001-2010	6 of 8	MCL (10 ppb)	5,100 ppb
	April 2011	2 of 8		1,100 ppb
Cadmium	2001-2011	2 of 8	MCL (5 ppb)	8.8 ppb
Chromium	2001-2011	1 of 8	MCL (100 ppb)	187 ppb
	2001-2010	2 of 7	CA PHG for Cr(VI)	93.0 ppb
	April 2011	2 of 8	(0.02 ppb)	8.7 ppb
Lead	2001-2011	3 of 8	MCL (15 ppb)	67.5 ppb
Iron	April 2011	5 or 8	RSL (26 ppm)	300.5 ppm
Sulfate	April 2011	1 of 8	DWA (500 ppm)	900 ppm
TDS	April 2011	1 of 3	SMCL (500 ppm)	1,506 ppm

* Well with Chromium MCL exceedances not include in count

TVA sites

Additional evidence of damage is emerging at the following TVA sites, previously identified as potential or proven damage cases by EPA or environmental groups.

- **Colbert Fossil Plant**. Colbert was listed by the US EPA as a potential damage case based on incomplete data suggesting contamination with cadmium and other pollutants. More recent groundwater monitoring at Colbert has identified five pollutants above MCLs since 2007: antimony in three wells (up to 14 ppb), arsenic in three wells (up to 70 ppb), chromium in one well (up to 110 ppb), lead in four wells (up to 160 ppb), and nitrate in two wells (up to 36 ppm). Boron, manganese, and molybdenum have all exceeded Health Advisories in at least four wells, and sulfate exceeded the DWA in one newly installed well. Table 5 summarizes the most recent data.

Table 5. Recent Groundwater Data from Colbert Site-wide Monitoring, Alabama

	Report Dates	# Wells	Type of exceedance	Maximum concentration
Antimony	2010-2011	3	MCL (6 ppb)	14 ppb
Arsenic	2010-2011	3	MCL (10 ppb)	70 ppb
Lead	2010-2011	3	MCL (15 ppb)	160 ppb
Boron	2010-2011	4	CHA (3 ppm)	9.3 ppm
Manganese	2010-2011	8	LHA (300 ppb)	2,100 ppb

- **Kingston Fossil Plant**. The collapsed impoundment at Kingston was identified as a proven damage case by the US EPA's based solely on the ash spill. Recent monitoring of groundwater under Kingston's coal ash disposal area, ash processing area, and gypsum disposal facility shows exceedances of the MCL for selenium in three wells (maximum 412 ppb, 8.2 times the MCL) and of federal health-based guidelines for cobalt (maximum 104 ppb) and manganese (maximum 26,900 ppb, 90 times the LHA).

Table 6. Recent Groundwater Data from Kingston Ash Landfills, Tennessee

	Report Dates	# Wells	Type of exceedance	Maximum concentration
Cobalt	March 2010	1 of 14	RSL (11 ppb)	87.1 ppb
	December 2010	1 of 14		104 ppb
Selenium	December 2010	3 of 14	MCL (50 ppb)	412 ppb
Manganese	January 2010	2 of 3	LHA (300 ppb)	5,640 ppb
	February 2010	2 of 3		5,130 ppb
	March 2010	5 of 7		26,900 ppb

- **Shawnee Fossil Plant**. EIP and others submitted Shawnee as a damage case based on 2008 evidence of groundwater contamination. More evidence of groundwater contamination has been found in 2009/2010 monitoring at TVA Shawnee Plant's surface impoundment in Kentucky, The number of parameters analyzed for has been expanded, and newly-discovered MCL exceedances include beryllium in one well (5.8 ppb), chromium in one well (150 ppb), and lead in one well (120 ppb, eight times the MCL). Exceedances of other health-based guidelines were also identified for cobalt, nickel, molybdenum and vanadium.

Table 7. Recent Groundwater Data from Shawnee Ash Pond, Kentucky.

	Report Dates	# Wells	Type of exceedance	Maximum concentration
Arsenic	September 2010	2 of 14	MCL (10 ppb)	22 ppb
Beryllium	September 2010	1 of 14	MCL (4 ppb)	5.8 ppb
Chromium	September 2010	1 of 14	MCL (100 ppb)	150 ppb
Cobalt	September 2010	1 of 14	RSL (11 ppb)	74 ppb
Lead	September 2010	1 of 14	MCL/AL (15 ppb)	120 ppb
Nickel	September 2010	1 of 14	LHA (100 ppb)	120 ppb
Selenium	September 2010	1 of 14	MCL (50 ppb)	24 ppb
Vanadium	September 2010	1 of 14	RSL (180 ppb)	200 ppb
Boron	June 2009	7 of 13	CHA (3 ppm)	19 ppm
	November 2009	6 of 14		19 ppm
	June 2010	7 of 14		18 ppm
	September 2010	6 of 14		20 ppm
Manganese	September 2010	12 of 14	LHA (300 ppb)	67,000 ppb
Molybdenum	June 2009	1 of 13	RSL (180 ppb) LHA (40 ppb)	530 ppb
	November 2009	1 of 14		560 ppb
	June 2010	1 of 14		670 ppb
	September 2010	1 of 14		600 ppb
Sulfate	June 2009	2 of 13	DWA (500 ppm)	1,200 ppm
	November 2009	2 of 14		1,200 ppm
	June 2010	2 of 14		1,500 ppm
	September 2010	2 of 14		1,100 ppm

- The US EPA identified the Bull Run Fossil Plant in Tennessee as a potential damage case based on exceedances of Secondary MCLs and some evidence of ecological impacts. Groundwater monitoring data around landfills and impoundments at this plant indicate an exceedance of the arsenic MCL and exceedances of health-based guidelines for boron, manganese, molybdenum, and sulfate.
- The Gallatin Fossil Plant in Tennessee was originally identified by EIP as a damage case based on concentrations of beryllium and cadmium above MCLs. More recent data have revealed additional exceedances of the MCLs for beryllium and cadmium, as well as exceedances of the MCL for mercury (up to 2.9 ppb) and exceedances of federal health-based guidelines for boron (up to 5.7 ppm), cobalt (maximum of 300 ppb, 27 times the Tapwater Regional Screening Level) and nickel (up to 170 ppb).
- The Johnsonville Fossil Plant was identified by EIP as a damage case based on past MCL exceedances for arsenic, cadmium, and lead, and exceedances of health-based guidelines for boron and molybdenum. More recent data show exceedances of the regional screening level for cobalt (maximum 65 ppb) in addition to levels of boron, manganese, and sulfate that continue to exceed health advisories.