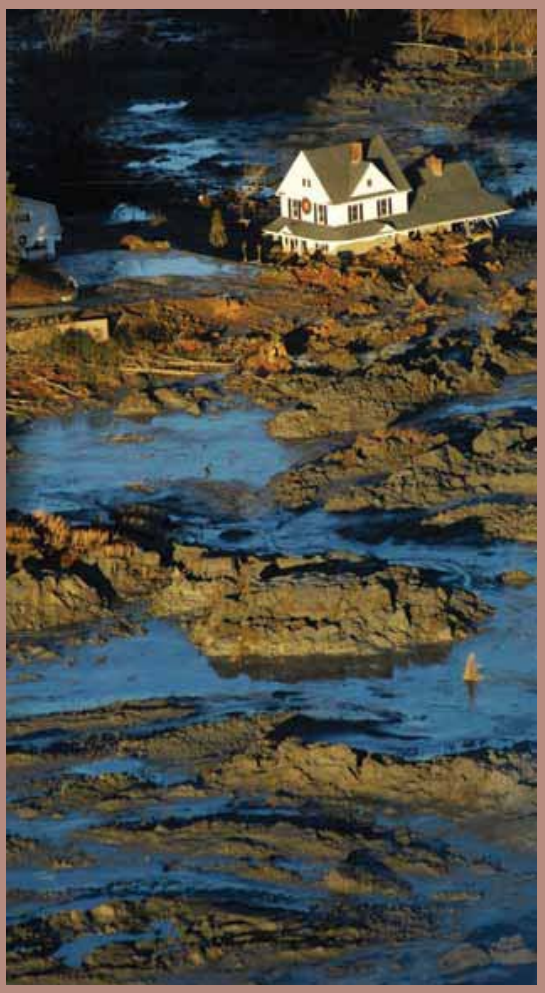
EPA's Blind Spot: Hexavalent Chromium in Coal Ash

Coal ash may be the secret source of cancer-causing chromium in your drinking water



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Author: Lisa Evans, Earthjustice
Contributing Authors: Barb Gottlieb, Physicians for Social Responsibility;
Lisa Widawsky, Jeff Stant, Abel Russ, John Dawes, Environmental Integrity Project
Environmental Consultant: J. Russell Boulding

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Introduction

Hexavalent chromium is again in the headlines. In the 1990s, Erin Brockovich achieved fame by uncovering the presence of extraordinarily high levels of industrial hexavalent chromium contamination in the drinking water of a small desert town ravaged by cancer. Today, attention to the deadly chemical is fueled by new data and extensive scientific research. In December 2010, the Environmental Working Group released a report documenting the cancer-causing chemical in tap water in 31 of 35 cities tested in the United States.[1] Days later, on December 31, 2010, the California Office of Environmental Health Hazard Assessment (OEHHA) completed a multi-year, peer-reviewed examination of the oral toxicity of the chemical, involving scientists in both the public and private sectors, and released a ground breaking proposal to establish a public health goal for hexavalent chromium in drinking water of just 0.02 parts per billion (or ug/L), 5,000 times lower than the current federal drinking water standard for total chromium.[2]

On January 11, 2011, on the heels of these announcements, the U.S. Environmental Protection Agency (EPA) issued new guidelines recommending that public water utilities nationwide test drinking water for hexavalent chromium (Cr(VI)).[3] EPA's swift reaction to the widespread presence of hexavalent chromium in American tap water is laudable. However, EPA's well-placed concern for protection of public health has a dangerous blind spot. While government regulators express concern for small quantities of the cancer-causing substance in our water, they are ignoring one of the largest sources of the hazardous chemical—coal combustion waste (or coal ash)[4] from the nation's coal burning power plants.

This report documents the connection between coal ash and hexavalent chromium. It reviews the sources, toxicity, and known coal ash dump sites where chromium has been found in groundwater. The report identifies studies of numerous power plants where testing of coal ash leachate found extremely high levels of hexavalent chromium. The report also identifies 28 coal ash disposal sites in 17 states where groundwater was documented to exceed existing federal or state standards for chromium and to exceed by many orders of magnitude the proposed California drinking water goal for hexavalent chromium. These contaminated coal ash dump sites are likely the tip of the iceberg. The threat of drinking water contamination by hexavalent chromium is present in hundreds of communities near unlined coal ash disposal sites across the United States. While the EPA doesn't need another reason to define coal ash as a hazardous waste when disposed, it certainly has one now.

Hexavalent Chromium and Coal Ash: The Deadly Connection

It has long been known that chromium readily leaches from coal ash.[5] Chromium, however, occurs primarily in two forms: trivalent chromium, which is an essential nutrient in small amounts, and hexavalent chromium, Cr(IV), which is highly toxic even in small doses. In EPA's latest report on the hazardous contaminants in coal ash, the agency made two important findings:

• Coal ash leaches chromium in amounts that can greatly exceed EPA's threshold for hazardous waste at 5000 parts per billion (ppb),[6] and

• The chromium that leaches from coal ash is "nearly 100 percent [hexavalent] Cr(VI)."[7]

Remarkably, the U.S. Department of Energy (DOE) and the energy industry have also known for years about the aggressive leaching of hexavalent chromium from coal ash. In a 2006 report co-sponsored by DOE, the Electric Power Research Institute (EPRI) found that the chromium that leaches from coal ash (including flue gas desulfurization (FGD) sludge) is typically close to 100% hexavalent chromium.[8]

These findings, buried in government reports, need to see the light of day. Hundreds – maybe thousands – of leaking and unlined coal ash dumps are situated near water supplies. EPA and DOE have demonstrated that the contaminated leachate (the liquid leaking from coal ash landfills and ponds) is often rich in this cancer-causing chemical. Therefore it is imperative that EPA Administrator Lisa Jackson act decisively to protect U.S. communities from this significant source of hexavalent chromium.

Hexavalent Chromium's Deadly Link to Cancer

In 2008, a two-year study by the U.S. Department of Health and Human Services' National Toxicology Program (NTP)[9] demonstrated that hexavalent chromium in drinking water causes cancer in laboratory animals.[10] While it has long been known that hexavalent chromium causes lung cancer when inhaled, the NTP undertook a study of Cr(VI) ingestion following a request from California's Office of Environmental Health Hazard Assessment (OEHHA). Based on a variety of cancerous oral and intestinal tumors, the NTP study definitively concluded "hexavalent chromium can also cause cancer in animals when administered orally."[11]

Furthermore, scientists believe chronic ingestion of minute amounts of Cr(VI) can be harmful. In fact, after an extensive peer-reviewed study, the California Office of Environmental Health Hazard Assessment lowered its original hexavalent chromium draft goal by 66 percent this year to account for the special sensitivity of infants and children to carcinogens. California's proposed public health goal, 0.02 parts per billion, is a mere 0.02% of the present federal drinking water standard for total chromium. If the current federal drinking water standard (100 parts per billion) is compared to a 100-yard football field, California's proposed goal for Cr(VI)would be a distance of three-quarters of an inch.

According to EPA's 2010 draft toxicological review of hexavalent chromium, EPA agrees with the estimate of cancer potency used by California's Office of Environmental Health Hazard Assessment. California's Draft Public Health Goal[12] and the U.S. EPA Draft Toxicological Review of Hexavalent Chromium[13] both use the same cancer potency value for ingested hexavalent chromium of 0.5 $(mg/kg\text{-}d)^{-1}$. Using EPA's default assumptions for body weight and drinking water ingestion rate, it is possible to

estimate the lifetime cancer risk associated with drinking water at the current federal drinking water standard for total chromium of 100 ppb (established in 1991) – the risk is 1.4 in 1,000 people.[14] This risk is 140 – 1400 times greater than EPA's range of acceptable cancer risk (between1 in 100,000 and 1 in 1,000,000 people).[15] Clearly, in view of this elevated risk recognized by both EPA and OEHHA, the 1991 federal drinking water standard of 100 ppb for total chromium is not sufficiently protective of human health from ingestion of hexavalent chromium. While a new federal drinking water standard for hexavalent chromium may be higher than California's proposed goal of 0.02 ppb, this health-protective level, as well as the current federal standard, are used as a comparison to coal ash-contaminated waters in this report.

Ingestion of Hexavalent Chromium Is Missing from EPA's Coal Ash Risk Assessment

Although the cancer risk associated with Cr(VI) in groundwater is substantial, EPA completely ignored this risk in its proposed coal ash rulemaking. While Cr(VI) was discussed in the preamble to the proposed rule, it was treated as a carcinogen by inhalation only. For purposes of calculating the human health risk by ingestion, Cr(VI) was treated as a non-carcinogen.[16] Despite the clear findings of NTP's 2008 studies, the cancer risk of ingested Cr(VI) was not mentioned once in EPA's 400-page "*Health and Ecological Risk Assessment for Coal Combustion Wastes*."

Coal Ash Dump Sites Are Significant Sources of Hexavalent Chromium

Coal ash can leach deadly quantities of Cr(VI) to drinking water.[17] For example, in the 2006 study[18] by the Electric Power Research Institute, an organization that vehemently opposes a hazardous designation for coal ash, EPRI tested leachate—liquid collected from wells, ponds or seeps at coal ash dumps—at 29 coal ash landfills and ponds and found hexavalent chromium at hundreds of times the proposed California drinking water goal at 15 coal ash disposal sites. Their findings included three landfills where leachate exceeded the proposed drinking water goal by 5,000 times, with two landfills exceeding that goal by 100,000 and 250,000 times. The location of these potentially deadly dumps is not known, but the high levels of hexavalent chromium at the sites may pose a danger to those living near the landfills. Table A lists the coal ash dump sites where leachate was found containing hexavalent chromium over 5,000 times the proposed California health goal.

Table A

Coal Ash Dump Sites Identified by the Electric Power Research Institute with Leachate containing Hexavalent Chromium (Cr(VI))

Coal ash Dump Site (Location Undisclosed)	Type of Dump Site	Type of Coal Ash Waste	Amount of Hexavalent Chromium Found in Landfill Leachate (parts per billion (ppb))	Number of Times By Which Cr(VI) Level Exceeds California Drinking Water Goal	Amount of Cr(VI) over the Federal Drinking Water Standard
EPRI Id. No. 50213	Landfill	Fly Ash	5090 ppb	254,500 times	50.9 times
EPRI Id. No. 27413	Landfill	Fly Ash	109 ppb	5,450 times	1.09 times
EPRI Id. No. 50212	Landfill	Fly Ash	2230 ppb	111,500 times	223 times

Source: Electric Power Research Institute, Characterization of Field Leachates at Coal Combustion Product Management Sites, EPRI Report 1012578 (2006).

In addition, data from **known coal ash disposal sites** obtained from EPA reports[19] and recent studies by Earthjustice, the Environmental Integrity Project (EIP) and the Sierra Club[20] make it eminently clear that the threat is widespread and serious. For example, chromium in groundwater contaminated by a coal ash landfill in Ohio reached 1.68 parts per million – a level 84,000 times California's proposed drinking water goal (if nearly all the chromium measured was hexavalent, as predicted in both EPA's and EPRI's reports). Table B lists 28 coal ash dump sites in 17 states where coal ash contaminated groundwater was found to contain chromium at levels exceeding the current federal drinking water standard (100 ppb) or an applicable state standard (50 ppb for groundwater in North Carolina). Often EPA did not provide a specific value for the chromium found in groundwater wells, but simply indicated that it was greater than the federal standard of 100 ppb. These chromium concentrations, if 100 percent hexavalent chromium, represent a level 5,000 times higher than the proposed California goal. In Table B, all chromium is assumed to be hexavalent chromium, a premise supported by the studies conducted by EPA, DOE and EPRI. In addition, most of the coal ash ponds, landfills and fill sites listed below are unlined – a factor that greatly increases the danger to neighboring communities. Lastly, while many of the sites below have undergone some form of remediation under Superfund or state authorities, in most cases the contamination has been left in place, and there may be little attempt to monitor its migration off-site to protect well users from harmful exposure to hexavalent chromium or other toxic metals commonly found in coal ash leachate.

Table B

Name and Location of Coal Ash Disposal Site	Type of Dump Site	Level of Chromium (Highest Level Reported)	Number of Times By Which Cr(VI) Level Exceeds California Drinking Water Goal	Amount of Chromium Above Federal Drinking Water Standard	Source
TVA Colbert Fossil Fuel Plant **Tuscambia, Alabama**	Unlined Pond	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA[a]
2. TVA Widows Creek Fossil Plant **Stevenson, Alabama**	Unlined Pond	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA
3. Flint Creek Power Plant **Gentry, Arkansas**	Landfill	128 ppb	6,400 times	1.28 times	EJ/EIP/ SC[b]
4. Indian River Power Station **Millsboro, Delaware**	Unlined Landfill (closed)	211 ppb	10,550 times	2.11 times	EJ/EIP[c]
5. FP&L Lansing Smith Plant **Southport, Florida**	unknown	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA
6. Rocky Acres/Grays Siding Coal Combustion Byproduct Landfill **Oakwood, Illinois**	Unlined Fill Site	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EJ/EIP
7. Merom Generating Station Coal Combustion Waste Landfill **Sullivan, Indiana**	Landfill	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA
8. Xcel Energy/Southern Minnesota Municipal Power Agency - Sherburne County (Sherco) Generating Plant **Becker, Minnesota**	unknown	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA
9. Salem Acres Site, **Salem Massachusetts**	Unlined Landfill (closed)	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA
10. Brayton Point Power Station, **Somerset, Massachusetts**	Unlined Landfill	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA
11. Duke Dan River Steam Station **Eden, North Carolina**	Unlined Ponds and Landfill	61 ppb	3,050 times	22% over NC groundwater standard	EJ/EIP/

Name and Location of Coal Ash Disposal Site	Type of Dump Site	Level of Chromium (Highest Level Reported)	Number of Times By Which Cr(VI) Level Exceeds California Drinking Water Goal	Amount of Chromium Above Federal Drinking Water Standard	Source
12. Progress Energy Asheville Steam Electric Plant **Asheville, North Carolina**	Unlined Pond	83 ppb	4,150 times	66% over NC groundwater standard	EJ/EIP
13. Progress Energy Cape Fear Steam Plant **Montcure, North Carolina**	Unlined Pond	100 ppb	5,000 times	Equal to federal maximum	EJ/EIP
14. Basin Electric Power Cooperative W.J. Neal Station Surface Impoundment **Velva, North Dakota**	Unlined Pond	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA
15. Reid Gardner Generating Facility **Moapa, Nevada**	Landfill	110 ppb	5,500 times	1.1 time	EJ/EIP
16. Conesville Fixed FGD Sludge Landfill **Coshocon County, Ohio**	Unlined Landfill	Above 100 ppb	Over 5000 times	Above standard, but degree unknown	EPA
17. Industrial Excess Landfill **Uniontown, OH**	Unlined Landfill	1680 ppb	84,000 times	1.68 times	EJ/EIP/
18. American Electric Power Northeastern Station **Oologah, Oklahoma**	Unlined Landfill and Pond	417 ppb	20,850 times	4.17 times	EJ/EIP/
19. Allegheny Energy Hatfield Ferry Power Station **Masontown, Pennsylvania**	Landfill	104 ppb	5,200 times	1.04 times	EJ/EIP/
20. Seward Generating Station **New Florence, Pennsylvania**	Unlined Pond and Landfill	330 ppb	16,500 times	3.3 times	EJ/EIP
21. PPL Martins Creek Power Plant **Martins Creek, Pennsylvania**	Unlined Pond	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA
22. TVA Johnsonville Fossil Plant **New Johnsonville, Tennessee**	Unlined Pond	620 ppb	31,000 times	6.2 times	EJ/EIP/
23. Trans-Ash, Inc CCW Landfill, **Camden, Tennessee**	Partially Unlined Landfill	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EJ/EIP

Name and Location of Coal Ash Disposal Site	Type of Dump Site	Level of Chromium (Highest Level Reported)	Number of Times By Which Cr(VI) Level Exceeds California Drinking Water Goal	Amount of Chromium Above Federal Drinking Water Standard	Source
24. TVA Kingston Fossil Plant **Harriman, Tennessee**	Unlined Pond	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA
25. Battlefield Golf Course **Chesapeake, Virginia**	Unlined Fill	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA
26. Virginia Power Yorktown Power Station Chisman Creek Disposal Site **Yorktown, Virginia**	Unlined Landfill	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA
27. Dairyland Power Cooperative E.J. Stoneman Generating Station Ash Disposal Pond **Cassville, Wisconsin**	Unlined Pond	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA
28. Lemberger Landfill, **Wisconsin**	Unlined Landfill	Above 100 ppb	Over 5,000 times	Above standard, but degree unknown	EPA

a: U.S. EPA, Damage Case Report for Coal Combustion Wastes (August 2007) and additional damage cases described in EPA's Proposed Coal Ash Rule, 75 Fed. Reg. 35128.
b: Earthjustice, Environmental Integrity Project, and Sierra Club. In Harm's Way: Lack of Federal Coal Ash Regulations Endangers Americans and their Environment (August 2010).
c: Earthjustice and Environmental Integrity Project. Out of Control: Mounting Damages from Coal Ash Waste Sites (May 2010).

Uniontown, Ohio: A Coal Ash Site Where Health May be Endangered

The **Industrial Excess Landfill**, near Uniontown, Ohio is an example of the kind of site that may be posing a threat to the surrounding community from contamination of drinking water with hexavalent chromium. The landfill is a Superfund site surrounded on three sides by residential neighborhoods. Roughly one million tons of coal ash were dumped at the landfill in the 1960s. The landfill was closed in 1980, and EPA listed it as a Superfund site in 1986. Groundwater monitoring since then has shown chromium concentrations to be increasing to very dangerous levels. Systematic groundwater monitoring began in 1987, and chromium was detected at concentrations up to 180 ppb in off-site wells. Sampling in the early 1990s found concentrations of chromium over 100 ppb in eight monitoring wells, with concentrations up to 739 ppb. Monitoring through 2001 detected chromium at up to 1,680 ppb in off-site wells located in or near residential areas- over 15 times the federal drinking water standard. Residents report many incidences of cancer in the affected neighborhoods.

Despite alarming evidence of off-site groundwater contamination with heavy metals, including chromium, metals monitoring was phased out around 2001, and remedial actions stopped in 2005. And yet the potential for human exposure to this contamination is very high—there are almost 4,000 private drinking water wells within two miles of the site, and about 90 wells within 1,500 feet. Some homes have been provided with alternative water supplies, but many have not. The cancer risk associated with drinking water having chromium concentrations over 100 ppb is greater than 1 in 1,000. The risk associated with the highest known concentration, 1,680 ppb, would be greater than 1 in 50. Furthermore, this cancer risk would be amplified by the presence of arsenic and other carcinogens in the coal ash contaminant plume.

EPA Laboratory Testing of Coal Ash Reveals Dramatic Chromium Leaching

EPA also found that leachate produced in the laboratory from coal ash at a variety of plants contained sky-high chromium. In a 2009 report, EPA tested coal ash leachate by obtaining waste from numerous operating power plants.[21] EPA found that many ashes and sludges produce leachate extremely rich in chromium. The table below provides EPA's results from five plants. These results represent the highest level of chromium in leachate determined by EPA lab tests. Unlike the EPRI data in Table A and the groundwater and surface water data in Table B, the results below were not field samples. However, EPA used a leach test that mimics field conditions in order to determine the range of chromium that would leach from coal ash disposed under real-world conditions. If this leachate were seeping or leaking into groundwater from a landfill or pond, it could threaten drinking water wells and human health. While the public is not likely to be exposed to coal ash leachate at full strength, leachate this rich in chromium, even if it is diluted as it flows through groundwater, can still pose a significant hazard when it reaches drinking water wells.

Table C

Name and Location of Power Plant	Level of Chromium In Leachate	Number of Times Cr(VI) Level Exceeds CA Drinking Water Goal	Number of Times Above Federal Drinking Water Standard
DTE Energy St. Clair Power Plant **East China, Michigan**	1140 ppb (all Cr(VI))	57,000 times	11.4 times
TVA's Widows Creek Plant **Stevenson, Alabama**	7370 ppb	368,500 times	73.7 times
Progress Energy Roxboro Plant **Semora, North Carolina**	1850 ppb	92,500 times	18.5 times
Southern Company Crist Plant **Pensacola, Florida**	1920 ppb	96,000 times	19.2 times
WE Energies Pleasant Prairie Plant **Kenosha, Wisconsin**	3443 ppb	172,150 times	34.3 times

How much chromium is released by U.S. Coal-Fired Power Plants each year?

The amount of chromium released by our nation's coal-burning power plants dwarfs all other industrial sources. According to EPA's Toxic Release Inventory, the electric power industry dumps over ten million pounds of chromium and chromium compounds in on-and off-site disposal sites each year. Between 2000 and 2009, **over 116 million pounds** of chromium and chromium compounds were released from coal-fired power plants. The overwhelming majority of this chromium ends up in unlined or inadequately lined coal ash landfills, ponds, and mines. See Table D.

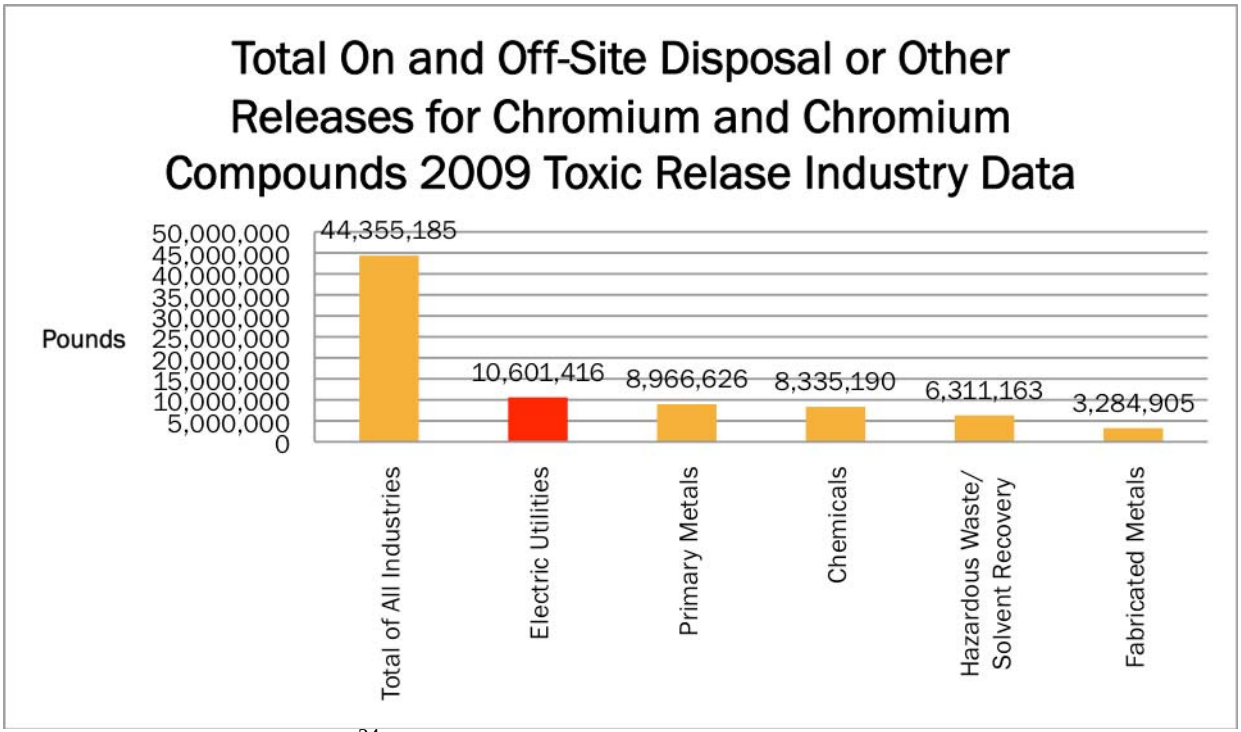
Table D

Chromium and Chromium Compound Disposal Reported to TRI By Year (pounds) 2000-2009		
YEAR	RELEASES TO DISPOSAL UNITS	TOTAL AMOUNT RELEASED
2009	10,161,172	10,601,419
2008	11,502,282	12,102,656
2007	11,459,398	11,871,535
2006	10,877,609	11,220,349
2005	11,577,014	11,960,425
2004	11,537,051	11,963,400
2003	11,607,647	12,057,221
2002	11,720,460	12,285,721
2001	10,293,621	12,202,505
2000	8,375,845	10,221,991
Total	109,112,099	116,487,222

In 2009, the electric power industry reported 10.6 million pounds of chromium and chromium compounds were released to the environment (10.1 million of which was dumped in disposal sites). These 10.6 million pounds represent **24 percent** of the total chromium and chromium compounds released by **all industries** in 2009. See Chart, below. In fact, the top ten chromium-releasing coal-fired power plants alone released almost 1.8 million pounds of chromium and chromium compounds in 2009, and each of these has at least one – if not, more than one – unlined coal ash disposal unit. Despite the obvious significance of this source of chromium, coal-fired power plants are rarely tagged as a source of hexavalent chromium.

As the Air Gets Cleaner, the Threat to Drinking Water Increases

EPA has found that as power plants reduce their emissions of nitrogen oxides (NO_X) by employing pollution controls at the power plant stacks, more hexavalent chromium is found in the flue gas desulfurization (FGD) sludge.[22] According to EPA, over half of the U.S. coal-fired capacity is projected to be equipped with SCR and/or FGD technology by 2020.[23] In fact, EPA anticipates an increase of approximately 16%



in scrubbed units by 2015.[24] Thus as the Clean Air Act requires more and more plants to install pollution controls, we may experience a much greater threat to our drinking water from hexavalent chromium if disposal of the increased volume of FGD sludge is not properly controlled.

EPA Must Determine that Coal Ash is Hazardous When Disposed

Although coal ash readily leaches hexavalent chromium, the waste is currently not federally regulated and is routinely dumped in unlined ponds and pits and used as construction fill without restriction. **EPA must keep this dangerous chemical out of our water – by regulating coal ash, when disposed, as a hazardous waste, thereby requiring its disposal in safe, secure landfills.**

In addition, EPA should immediately investigate the ponds, landfills and fill sites identified in this report to determine if public health is being threatened by exposure to hexavalent chromium, including:

- The three landfills identified in the DOE/EPRI report where Cr(VI) levels in leachate exceed proposed drinking water goals by thousands to hundreds of thousands of times (Table A);

- The 28 landfills, ponds and fill sites where groundwater has been contaminated with chromium over the current federal drinking water standard (Table B) and thousands of times over the proposed drinking water goal (Table B); and

- The disposal sites at the five plants where EPA's laboratory tests document the potential for dangerous levels of Cr(VI) to leach from ash and sludge (Table C).

EPA must conduct these investigations to ensure that highly contaminated leachate from these coal ash disposal sites is not leaking into drinking water and threatening human health. However, it is important to understand that these sites do not represent the universe of coal ash sites that have contaminated groundwater with chromium. Most coal ash disposal sites in the U.S. is are not monitored sufficiently to determine whether they are contaminating groundwater, and certainly very few coal ash sites are monitored for hexavalent chromium at all. Ultimately only the regulation of coal ash under subtitle C of the Resource Conservation and Recovery Act will ensure that these disposal sites, as well as every coal ash dump in the nation, are constructed securely and monitored sufficiently to keep hexavalent chromium out of our drinking water.

[1] Envtl. Working Group, Chromium-6 Is Widespread in U.S. Tap Water, http://static.ewg.org/reports/2010/chrome6/html/home.html.
[2] California Environmental Protection Agency, Office of Environmental Health and Hazard Assessment, Press Release: OEHHA Releases Revised Draft Public Health Goal for Hexavalent Chromium (Dec. 31, 2010), *available at* http://oehha.ca.gov/water/phg/pdf/Chrom6press123110.pdf.
[3] U.S. Envtl. Protection Agency (U.S. EPA), Press Release: EPA Issues Guidance for Enhanced Monitoring of Hexavalent Chromium in Drinking Water (Jan. 11, 2011), *available at*

http://yosemite.epa.gov/opa/admpress.nsf/a883dc3da7094f97852572a00065d7d8/93a75b03149d30b08525781500600f62!OpenDocument.

[4]Coal ash is commonly used to encompass the entire solid waste stream resulting from the combustion of coal, including fly ash, flue gas desulfurization (FGD) sludge, bottom ash and boiler slag.

[5] *Office of Solid Waste & Emergency Response, U.S. EPA, Report to Congress: Wastes from the Combustion of Fossil Fuels* (Mar. 1999).

[6] *Office of Research & Dev., U.S. EPA, Characterization of Coal Combustion Residues from Electric Utilities – Leaching and Characterization Data* (EPA-600/R-09/151) at xiv, 91 (Dec. 2009), http://www.epa.gov/nrmrl/pubs/600r09151/600r09151.pdf.

[7] *Id.* at 91.

[8] *Electric Power Research Institute, Characterization of Field Leachates at Coal Combustion Product Management Sites, Arsenic, Selenium, Chromium, and Mercury Speciation* (Nov. 2006) at 5–26.

[9] The NTP, established in 1978, is an interagency program whose mission is to evaluate agents of public health concern by developing and applying tools of modern toxicology and molecular biology. According to HHS, "The program maintains an objective, science-based approach in dealing with critical issues in toxicology and is committed to using the best science available to prioritize, design, conduct, and interpret its studies." *See* Nat'l Toxicology Program, Dep't Health & Human Serv., History of the NTPhttp://ntp.niehs.nih.gov/?objectid=720163C9-BDB7-CEBA-FE4B970B9E72BF54.

[10] Nat'l Toxicology Program, Dep't Health & Human Serv., Hexavalent Chromium, http://ntp.niehs.nih.gov/files/NTPHexaVChrmFactR5.pdf.

[11] *Id.*

[12] Cal. Envtl. Prot. Agency, Public Health Goal for Hexavalent Chromium in Drinking Water, 1, 75–77 (draft, Dec. 2010).

[13] U.S. EPA, Toxicological Review of Hexavalent Chromium, 240 (external review draft, Sept. 2010).

[14] It is standard practice when converting a cancer potency estimate to a unit risk (risk per ug/L) or a risk estimate to assume a 70 kg body weight and a drinking water ingestion rate of 2 L/d. *See, e.g., U.S. EPA, Exposure Factors Handbook* (Aug. 1997), *available at* http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=12464.

[15] U.S. EPA, Hazardous and Solid Waste Management System; Identification and Listing of Special Wastes; Disposal of Coal Combustion Residuals From Electric Utilities75 Fed. Reg. 35,128, 35,169–70 (proposed June 21, 2010).

[16] U.S. EPA, Human and Ecological Risk Assessment of Coal Combustion Wastes (draft, Apr. 2010)

[17] U.S. EPA, *Characterization of Coal Combustion Residues from Electric Utilities – Leaching and Characterization Data* (EPA-600/R-09/151), at 7 (Dec. 2009).

[18] *Electric Power Research Institute, Characterization of Field Leachates at Coal Combustion Product Management Sites, Arsenic, Selenium, Chromium, and Mercury Speciation* (Nov. 2006).

[19] *U.S. EPA, Coal Combustion waste Damage Cases* (July 9, 2007); *Office of Research & Dev., U.S. EPA, Characterization of Coal Combustion Residues from Electric Utilities – Leaching and Characterization Data* (EPA-600/R-09/151) (Dec. 2009).

[20] *The Environmental Integrity Project, Earthjustice, & Sierra Club, In Harm's Way: How Lack of Federal Coal Ash Regulations Endangers Americans and Their Environment* (Aug. 26, 2010), *available at* http://earthjustice.org/sites/default/files/files/report-in-harms-way.pdf; *The Environmental Integrity Project and Earthjustice, Out of Control: Mounting Damages from Coal Ash Waste Sites* (Feb. 24, 2010), *available at* http://www.environmentalintegrity.org/news_reports/documents/OutofControl-MountingDamagesFromCoalAshWasteSites.pdf.

[21] *Office of Research & Dev., U.S. EPA, Characterization of Coal Combustion Residues from Electric Utilities – Leaching and Characterization Data* (EPA-600/R-09/151) (Dec. 2009).

[22] *Id.* at 91.

[23] *Id.* at 7.

[24] U.S. EPA, *Steam Electric Power Generating Point Source Category: Final Detailed Study Report* 4-1-4-6 (2009).